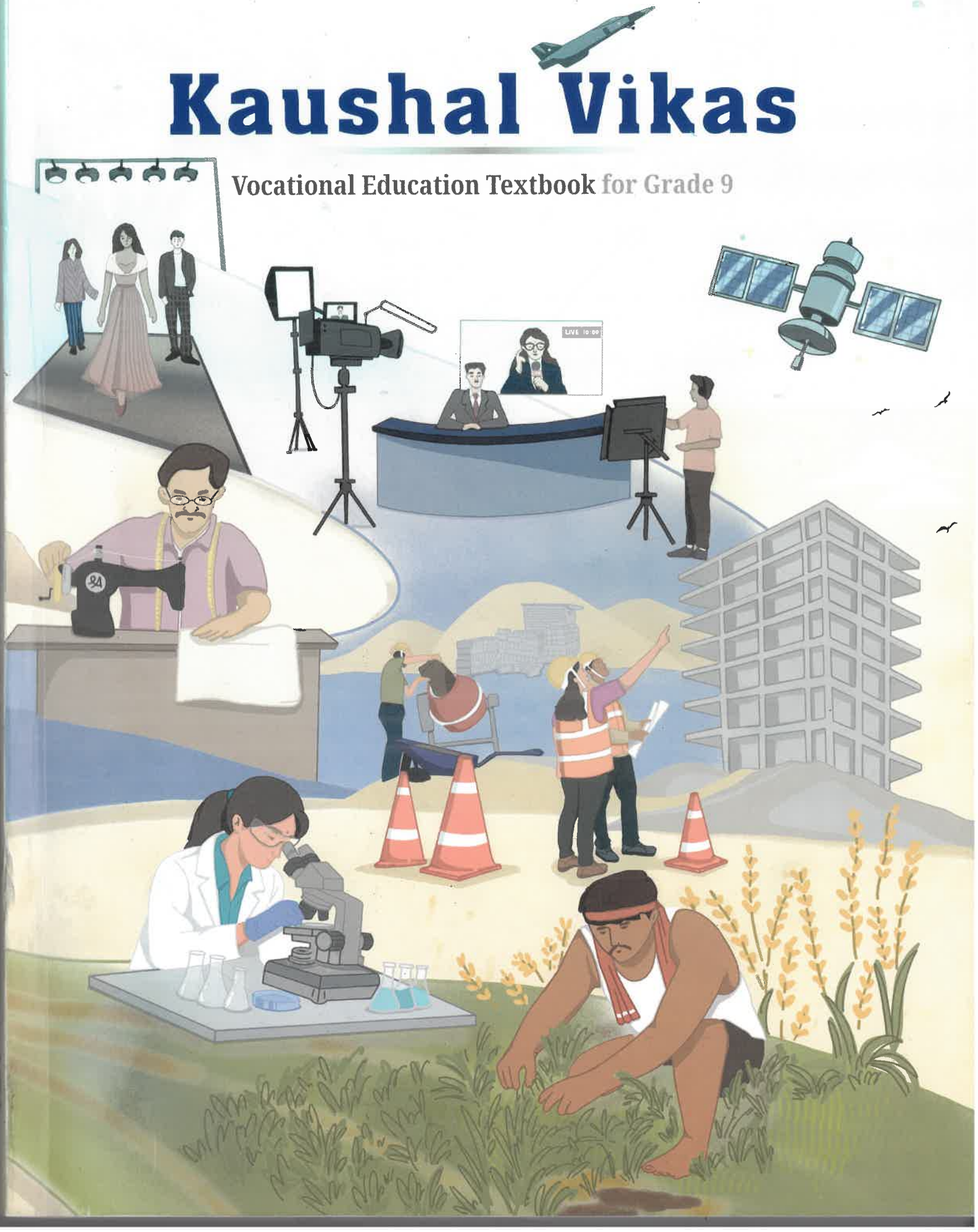
Kaushal Vikas

Vocational Education Textbook for Grade 9



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Kaushal Vikas

Vocational Education Textbook for Grade 9

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NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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Foreword

The National Education Policy 2020 envisions an education system that is firmly rooted in India's civilisational wisdom, values and ethical traditions. The rich intellectual heritage simultaneously enables learners to engage meaningfully with the complexities and possibilities of a rapidly changing world. The National Curriculum Framework for School Education (NCF-SE) 2023 provides concrete expression to this vision by laying out a coherent curricular pathway across stages of schooling, that nurtures critical thinking, creativity, sensitivity, along with the values and dispositions that are needed for responsible citizenship in an interconnected global society.

Learners have progressed through the Foundational, Preparatory and Middle Stages, where their inherent potential has been nurtured holistically. Now, they enter the Secondary Stage with enhanced capacity for reflection, reasoning, inquiry and self-expression. Spanning across Grades 9 to 12, also known as the adolescent stage, it marks a crucial period in the intellectual and personal growth of the students. It prepares them to engage with abstract ideas, complex social realities, ethical dilemmas and the expanding universe of knowledge, while deepening their understanding of the self and the world around them.

The NCF-SE 2023 recommends that the curriculum in Grades 9–10 should equip students with the skills that are needed to grow as they advance in their lives. Students can use these skills for reasoning, argumentation and effective communication. It endeavours to enhance their analytical and descriptive capabilities to prepare them for the challenges and opportunities that await them. A diverse curriculum, covering ten subjects: three languages—including at least two languages native to India—Science, Mathematics, Social Sciences, Art Education, Physical Education and Well-being, Individuals in Society/Environmental Education and Vocational Education promotes their holistic development.

As per the NCF-SE 2023, at this stage, Vocational Education assumes significance not merely as a means of developing competencies related to a specific vocation but also as a vital space for developing broad transferable competencies that are applicable across a range of vocations. The NCF-SE 2023 emphasises that Vocational Education must cultivate values and dispositions related to work, capacities that prepare learners for the world of work in the future and an understanding of concepts, protocols, safety precautions and processes. *Kaushal Vikas* seeks to promote sensitivity towards the environment and inclusivity, and to enable learners to participate with confidence not only in the space of work but also in academic and social domains. It is in this spirit that *Kaushal Vikas*, the Vocational Education textbook for the Secondary Stage, has been conceptualised and developed.

A range of vocations have been covered in *Kaushal Vikas* that reflects the socio-cultural and geographical landscapes through which students are sure to contextualise their lived experiences. The content has been selected to engage learners with different forms of work through selected common competencies applicable across vocations as well as vocation-specific competencies that can be transferred across a range of vocations. This will further encourage learners to inculcate the value of the dignity of labour, while developing competencies that are of use not only in workspaces but also in homes. At the same time, the textbook draws upon India's traditions, weaving into it elements of Indian Knowledge Systems and our cultural heritage, and seamlessly connecting them with our contemporary experiences.

While *Kaushal Vikas* serves as a central learning resource, it also invites students to engage with a broader world of books, media, digital archives, libraries and community knowledge. The role of teachers, parents and school libraries is, therefore, pivotal in nurturing a rich culture of integration of local knowledge and context through a range of vocations and independent exploration at this stage. The textbook integrates technology through the use of QR Codes in each unit, which provide additional reading material and resources.

The National Council of Educational Research and Training acknowledges with deep appreciation the contributions of the Textbook Development Team, subject experts, pedagogues, practising teachers, reviewers and all others who have supported the development of this textbook. We hope that *Kaushal Vikas* will inspire learners to think deeply, communicate confidently, and participate thoughtfully in the intellectual and social life of our nation and the world. We also warmly welcome suggestions and feedback from all its users for further improvement in the subsequent editions.

March 2026
New Delhi

DINESH PRASAD SAKLANI
Director
National Council of Educational Research and Training

About the Book

Kaushal Vikas, the textbook for Vocational Education for Grade 9 has been developed in alignment with the vision of the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCF-SE) 2023. This textbook progresses from the broad exposure-based approach of *Kaushal Bodh* in the Middle Stage to providing in-depth exposure with the intent of developing competencies that can be used to do a variety of work.

In the NCF-SE 2023, work has been categorised under three broad forms: Work with Life Forms, Work with Machines and Materials, and Work in Human Services. Students are required to do work related to one vocation from each form of work in Grade 9. The textbook has been designed to achieve this purpose, keeping in mind the principles of choice and flexibility in the NCF-SE 2023.

The structure of the book is as follows (please see Tables 1 and 2):

1. The textbook has been designed so as to help students develop competencies that are (i) common across all forms of work, for example, planning and costing; and (ii) common across a form of work, for example, soil/water testing in Work with Life Forms, making prototypes in Work with Machines and Materials, and creating service environment in Work in Human Services.
2. There are three units, one each for Work with Life Forms, Work with Machines and Materials, and Work in Human Services. Each unit must be covered to ensure students engage with at least one vocation from each form of work.
3. Within each unit, the first chapter, that is, Chapter 1 in Unit I, 5 in Unit II, and 9 in Unit III, is mandatory.
   a. They build a foundation of common processes, for example, using essential conditions for growth to make decisions related to agricultural practices, making technical drawings, developing a service orientation and creating a service environment that apply across multiple vocations within the form of work.
   b. These chapters serve as a bridge between the project-based approach in the Middle Stage and a deeper engagement with vocations in the Secondary Stage.
   c. The focus is on one or two key concepts related to Vocational Education and common processes that apply across a range of vocations.
4. The remaining chapters are intended to develop competencies that are transferable across a range of vocations. Seven vocations are included in each unit. Schools are encouraged to choose any one of these seven vocations.

a. The second and third chapters in each unit are illustrative. They are designed to guide students through a sequence of tasks leading to a productive outcome, along with applying the procedural and conceptual knowledge learnt in the first chapter.
b. The fourth chapter in each unit contains broad guidelines for five other vocations.

5. The inclusion of 21 vocations in the book (seven for each form of work) has been planned to provide schools with flexibility.
6. Please note that schools could choose to select a vocation, that is, completely different from those in the textbook, while ensuring the competencies in the NCF-SE 2023 are met.
7. This approach ensures in-depth exposure to one vocation in each form of work.

Kaushal Vikas is designed to ensure that students are aware of what they are learning. Each chapter begins with a map of what students will be able to do. It also has call-outs in the margins of the textbook to highlight what is being learnt. Tasks, caselets, additional information and safety precautions are indicated, along with references to Technology and Artificial Intelligence. Finally, guidance around what can be added to portfolios is also provided in the textbook.

Table 1: Overview of structure of book

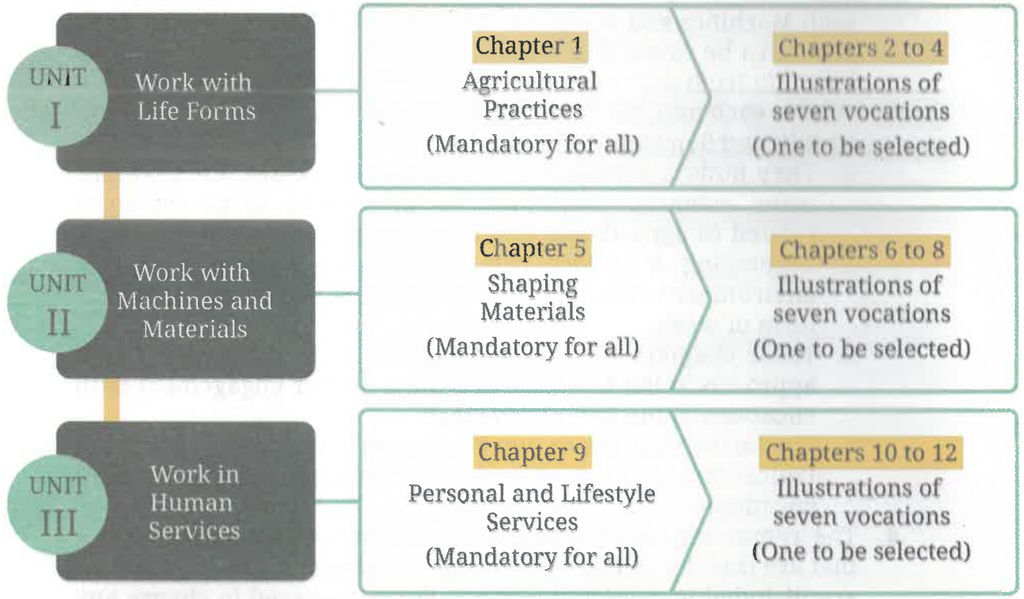

Table 2: Details of chapters

Chapter Type	Unit I – Work with Life Forms	Unit II – Work with Machines and Materials	Unit III – Work in Human Services
Mandatory Developing common competencies across a form of work – key concepts and processes related to broad vocational area	Chapter 1 – Agricultural Practices	Chapter 5 – Shaping Materials	Chapter 9 – Personal and Lifestyle Services
Choice Developing vocation-specific transferable competencies Choice of seven vocations – one to be selected from each form of work based on the local context and availability of **experts**	Chapter 2 – Rooftop Gardening (Illustration) Chapter 3 – Precision Farming (Illustration) Chapter 4 – Guidelines for five more vocations (Mushroom cultivation, Aquaponics, Pisciculture, Backyard poultry and Non-timber forest produce)	Chapter 6 – Construction (Illustration) Chapter 7 – Apparel (Illustration) Chapter 8 – Guidelines for five more vocations (Sheet metal work, Plumbing, Food processing, Furniture making and Pottery)	Chapter 10 – Healthcare (Illustration) Chapter 11 – Tourism (Illustration) Chapter 12 – Guidelines for five more vocations (Hospitality, Event management, Data-based services, Interior design and Public information services)

Cross-cutting themes, such as Indian Knowledge Systems, values, heritage, gender sensitivity and inclusion have been integrated wherever possible. Clear illustrations of stepwise processes, safety notes, assessments during and at the end of the chapter, as well as opportunities for authentic work are meant to motivate students through achievement. Each chapter ends with a summary of key learnings and questions for students to evaluate their learning.

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Note for Teachers and School Heads

After three years of broad exposure to work using a project-based approach during the Middle Stage, the focus in Grades 9 and 10 is on developing transferable vocational competencies through an in-depth exposure to different vocations. These competencies are a blend of procedural knowledge, conceptual knowledge, and values and dispositions. As mentioned in 'About the Book', like the Middle Stage, the framework for Vocational Education in Grades 9 and 10 comprises three forms of work:

1. **Work with Life Forms:** Work with Life Forms involves developing competencies for doing productive work that involves plants and animals.
2. **Work with Machines and Materials:** Work with Machines and Materials involves developing competencies for designing, making or modifying products using materials (including waste) and machines.
3. **Work in Human Services:** Work in Human Services involves developing competencies for interaction with people to understand their needs and requirements. It also develops competencies to communicate well, and an understanding of the processes and resources involved in providing a service.

Approach

The principles informing the approach of the textbook are as follows:

1. Given the diversity of our country and schools, it is not possible to prescribe a single vocation. Hence, choice and flexibility must be inbuilt in the textbooks.
2. Some competencies are common across vocations, for example, documentation, costing and planning, while others are common across a form of work, for example, providing essential conditions for growth, measurement and estimation, needs identification and communication. The focus in Grades 9 and 10 is the development of these transferable competencies.
3. Content for the textbook has been selected keeping the focus on transferable competencies.
4. Choice and flexibility are also necessary within vocations keeping in mind the diversity in schools.

Figure 1 summarises how the textbook operationalises these principles.

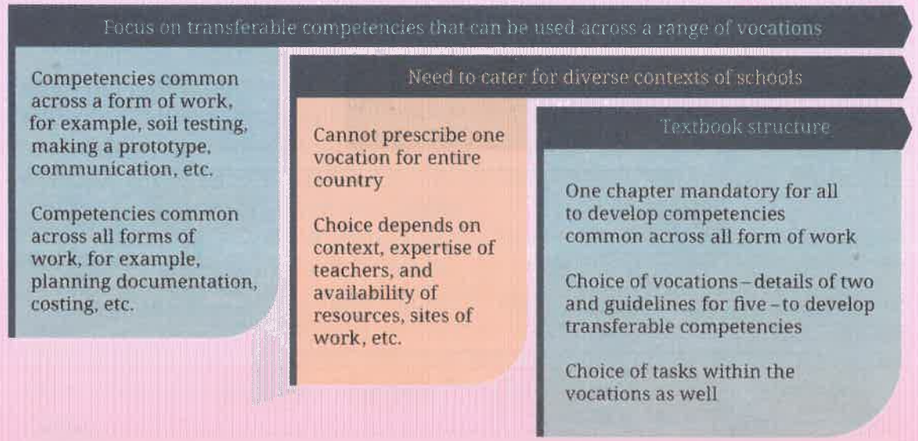


Figure 1: *Operationalising principles informing textbook development*

It is important for you to understand that the **vocations contained in the textbook are not prescriptive. Schools must choose a vocation based on local relevance and availability of resources.** The chosen vocations may be selected from the two provided in each unit or from any of the five additional illustrative examples, or from other relevant vocations developed by the school in accordance with the local context. It must be ensured that one vocation from each form of work is transacted within the stipulated time. For additional resources, teachers are advised to visit the PSSCIVE website, which offers a range of materials on different vocations aimed at developing the required skills and capacities. What remains common across the country is the set of competencies that students will develop (Figure 2).

Competencies required for setting up an irrigation system developed in school can be applied to installing a plumbing system in a residential or commercial building, process piping in industrial facilities required to transport materials, and installing water and sewer systems, storm drainage as well as water transmission mains. There will be differences, for example, materials and dimensions of pipes, but the core competencies will be the same. To some extent, vocational knowledge will also be common (for example, relationship between diameter of pipe and water pressure, selection of material of pipes, etc.), while values related to work are common across all vocations. Thus, learning related to a specific vocation is transferable across a set of other vocations.

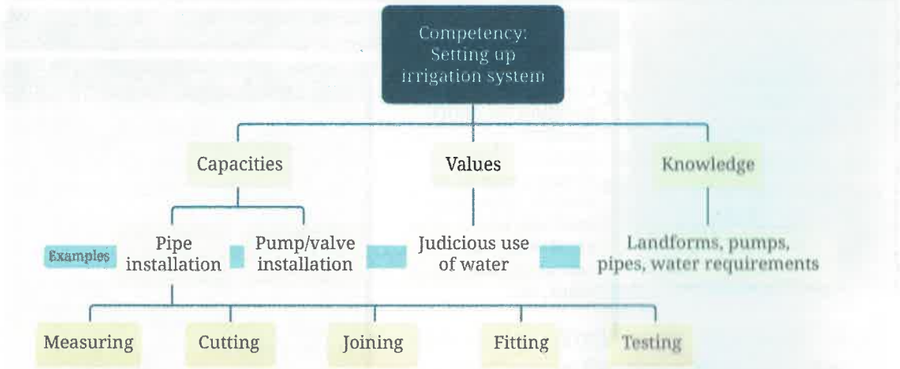


Figure 2: *Illustration of transferability in Vocational Education*

Thus, any vocation can be chosen since the same transferable competencies can be developed independent of the choice of vocations. Vocations are simply a medium for developing these competencies. This approach will prepare students for different kinds of jobs, including those that may emerge in the future as opposed to focusing on a single job role.

Vocational Education in Grades 9 and 10 is, therefore, not job-specific training. It is an educational process that helps students understand the world of work, practise real tasks, engage with the community and industry, and develop confidence in their ability to learn by doing so.

Using the textbook

The textbook provides a structure for schools to ensure that the competencies related to Vocational Education outlined in the NCF-SE 2023 are met. Please refer to 'About the Book' to understand the structure of the book.

Choice is inbuilt in the textbook through options of seven vocations in each vocational area, and the option to choose any vocation other than what is given in the textbook (Figure 3). Choice is also incorporated to some extent through giving flexibility in the work to be done, for example, plants to be grown, structure to be made and service to be provided. Choice can also be exercised in the kind of tasks to be done, depending on the resources available in school. For example, a low-tunnel can be built instead of shade-net; students can make a deeper foundation and use RCC

to make a construction if materials and experts are available; sensors are not mandatory but can be made in the school if resources are available, students can set up a health camp or simply develop awareness materials and conduct an awareness march in the community. At the same time, to illustrate the entire work from end to end, caselets of students in the fictional Government High School have been interspersed with the text to ensure details of tasks are available.

Students must work in groups, while maintaining individual portfolios – the textbook offers hints on what can be added to student portfolios.

Students can take up different kinds of work within the same vocation. Depending on the resources available, different groups of students can work on different vocations, offering them opportunities for acquiring the same competencies while learning from each other.

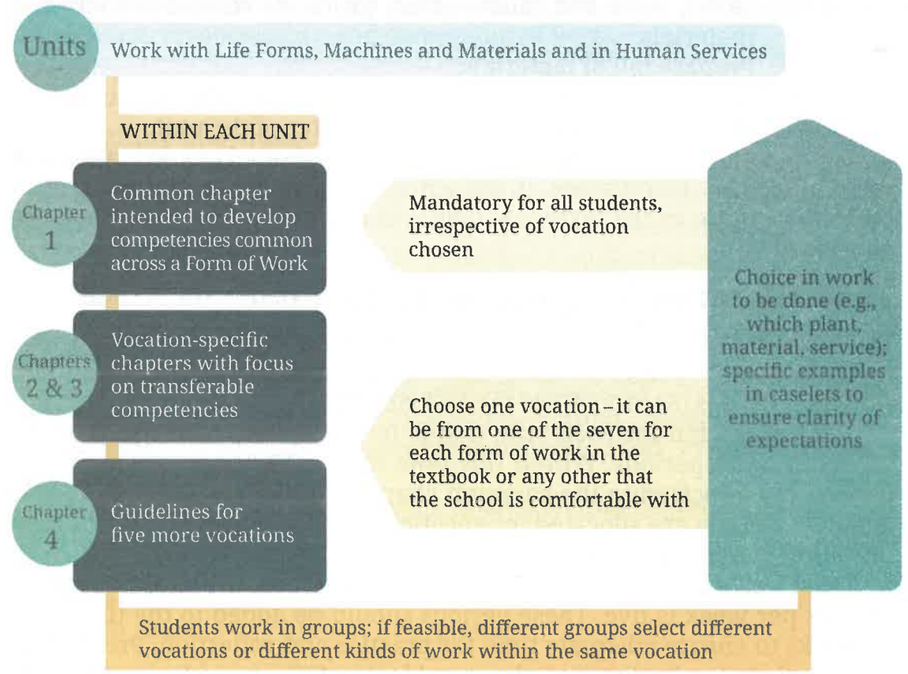


Figure 3: *Using the textbook*

Whichever vocation the school chooses, the following must be ensured:

1. Values and dispositions related to work are foundational and must be integrated into the learning experiences. These include– attention to detail, persistence and focus, curiosity and creativity, empathy and sensitivity, collaboration and teamwork, and willingness to do physical work.

2. The first chapter in each unit (Chapters 1, 5 and 9) must be taken up by all students. These chapters are intended to attain the following outcomes:
   a. Understand the importance of the vocational area,
   b. Apply key concepts related to the vocational area,
   c. Develop competencies to complete key common processes,
   d. Explore different sources of information about a vocation, and map resources required to take up work in the vocational area,
   e. Identify criteria for quality.
3. Regarding vocation-specific learning, whichever vocation the school chooses, the following outcomes must be attained:
   a. Identify the work to be done within the vocational area,
   b. Visit a worksite and develop a process chart,
   c. Select, store and follow safety protocols related to tools and materials,
   d. Prepare bill of materials,
   e. Do work that will allow them to practice the key common processes discussed in the first chapter of the unit.

The chapters in each unit of the textbook are oriented towards attaining these outcomes. To reiterate, if the school chooses to take up a vocation other than those in the textbook, they will have to ensure the above are addressed.

Time Allocation for Vocational Education

The total time allotted to Vocational Education is 110 hours or 132 periods in one academic year, excluding time for assessment, school events, and similar activities (Section 4.3 of the NCF-SE 2023).

Time allocation for each unit, that is for each form of work, is about 36 hours or 44 periods. Within this time frame, 10 hours or roughly 12 periods are allocated to the common chapters (Chapters 1, 5 and 9), and about 32 periods are allocated for vocation-specific learning. Lessons may be planned accordingly.

These periods may be distributed across the week; the total number of periods per week is five. These periods should be added to the timetable as blocks to ensure adequate time for practise and reflection. Preferably, these periods can be distributed as two blocks of two periods on weekdays and one period on Saturday.

Pedagogy

Experiential Learning through Authentic Work

Vocational Education must be rooted in real work. Students learn best when they engage directly with materials, tools, environments and people in authentic situations. Teachers should create conditions where students carry out tasks that lead to productive and visible outcomes, such as cultivating a crop, producing an item, providing a service, repairing an appliance or completing a community-related activity. Students must be given opportunities for on-site exposure to industrial or agricultural spaces.

To maintain authenticity, tasks must be end-to-end rather than fragmented. For example, students should experience the full cycle of plants: from seed to harvest, or technical drawing and prototype to completed product. These complete cycles help them understand sequencing, responsibility and ownership of work.

Use of Technology

Technology adds value across all forms of work and should be integrated meaningfully into students' tasks. Students will require support in using mobile applications for monitoring or recording data or employ digital drawing tools and CAD software. Where feasible, AI-based tools can also support accuracy, efficiency and safety. However, technology must enable students to work better, not replace hands-on engagement.

Inclusion, Equity and Safety

A foundational expectation of Vocational Education is that all students have equal access to learning experiences. It must be ensured that no discrimination occurs based on gender, disability or socio-economic background. Students with disabilities should receive appropriate accommodation, assistive devices and learning support, so they can engage meaningfully in the work.

Safety is essential across all vocational activities. Safety practices must be reinforced related to tool use, electrical work, chemical handling, hygiene, cyber safety and confidentiality. Students must access online resources only under supervision and be made aware of precautions related to sharing any kind of information.

Incorporating Lok Vidya

Finally, learning deepens when students connect classroom experiences to real-world practices. Integrating indigenous and local knowledge systems enriches students' understanding and situates learning within their own cultural and geographical context. These experiences help students recognise the diversity of work and see its relevance in everyday life.

Assessment

The NCF-SE 2023 recommends for Vocational Education that '75 percentage of weightage in overall certification be given to the demonstration-based assessment, and only 25 percentage to any written examination'. Further, the NCF-SE 2023 recommends school-based assessment with an external examiner.

Given the nature of knowledge of Vocational Education, assessment should be done through demonstrated performance, using tools like observation based on checklists and rubrics, portfolio, and viva voce related to the process of 'doing'. Self–and peer–assessment will also play an important role in Vocational Education, based on suitable rubrics and evidence.

In Vocational Education, the primary focus of assessment should be:

1. What and how the students demonstrate their capacity to perform tasks safely, correctly, and in proper sequence, demonstrating their strong procedural knowledge.
2. Students' understanding of why tasks are performed in specific ways, reflecting their vocational knowledge, should also be assessed.
3. Values and dispositions are equally important, such as attention to detail, persistence, teamwork, empathy, curiosity, and willingness to engage in work.

Assessment must be continuous, supportive, and aligned with competencies. Assessment of demonstration of processes is as important as the assessment of the end product. It must recognise effort, improvement, and the processes students follow to reach outcomes. Values and dispositions that students demonstrate during their work should also be observed throughout by teachers; self-assessment should be encouraged.

A variety of evidence-based tools should be used to capture learning comprehensively. Observation checklists and rubrics help document performance over time. Portfolios can contain process charts, sketches, notes, photos, bills of materials, reflections, and feedback, giving a rich picture of student growth. Self- and peer-assessment help students reflect on their learning progression. Viva voce provides insight into students' reasoning, choices, challenges, and improvements, while written tasks such as case-based questions, diagrams, flowcharts, or problem-solving scenarios help assess their understanding in applied contexts. Table 1 tries to capture the criteria for assessment, and tools and sources of evidence against the key outcomes rooted in the NCF-SE 2023.

The textbook lends itself to formative assessments through tasks that students do through applying conceptual and procedural knowledge, while demonstrating values and dispositions. It also contains assessments at different points through Check your understanding. Assessment as learning is embedded where relevant through questions and activities intended to strengthen understanding while learning. Questions at the end of each chapter are intended as a summative assessment, while the Portfolio builds evidence of learning progression through the school year.

Table 1: Criteria, tools and sources of evidence for assessment

What is to be assessed?	Criteria for assessment	Examples of tools and sources of evidence
Values and dispositions related to work	• Observation and questioning during demonstration and while doing work • Respect for the dignity of labour • Collaboration with peers • Efficiency in doing work • Pursuit of quality • Creativity and problem solving • Willingness and motivation • Optimal use of all resources	• Teachers' observations • Oral Presentation/ Viva Voce • Self-assessment
Selection, use and maintenance of tools and equipment	• Appropriate tools selected for task • Correct use of tools • Keeping materials and equipment ready for use • Following safety protocols • Proper storage of tools and materials post usage	• Teachers' Observations • Demonstration and Oral Presentation/ Viva Voce • Paper–pencil test • Portfolio
Knowledge to perform tasks/ activities	• Vocational knowledge necessary to do work • Context and relevance of work • Sustainable and/or indigenous practices • Knowledge of procedures and protocols (including safety, documentation) • Planning templates/ Creating process charts • Mapping and budgeting of resources	• Oral Presentation/ Viva Voce • Paper–pencil test • Portfolio
Performance of tasks	• Sequencing of tasks • Creating appropriate conditions/ gathering tools and materials • Estimation of materials/needs identification • Carrying out tasks using tools and materials as per protocol and safely • Improvements basis testing/feedback • Monitoring progress against plan • Workplace organisation • Waste management	• Teachers' Observations • Portfolio • Demonstration and Oral presentation of the task performance

Place of vocation in the world of work	• Importance of vocation • Livelihood ecosystem	• Oral Presentation/ Viva Voce • Paper–pencil test • Site visit reports/ observation notes
Quality	• Identifying criteria for evaluating quality of products • Reflection on processes	• Oral Presentation/ Viva Voce • Paper–pencil test • Portfolio • Self-assessment
Application of vocational competencies at home	• Use of vocational skills and knowledge at home	• Paper–pencil test • Oral Presentation/ Viva Voce • Portfolio

A suggested weightage for assessment is given in Table 2.

Table 2: Weightage to different modes of assessment

Mode of Assessment	Weightage
Paper–pencil test	25%
Demonstration and Oral Presentation/Viva Voce	20%
Site visit report/observation notes	5%
Portfolio	30%
Teachers' observations	20%

Who will teach?

Since the purpose of Vocational Education in the secondary stage is to engage students deeply in one vocation in each form of work, that is, three vocations every year, a Vocational Teacher would ideally be required. But it might not be feasible to immediately appoint multiple teachers with different specialisation. Hence, existing teachers or a vocational trainer can conduct vocational training with the support of resource persons/master instructors from the community. Thus, to reiterate, the choice of vocation must be dictated by the resources and experts available close to the school.

Till every school has at least one Vocational Teacher, the Head of the School may nominate a Teacher Coordinator among the existing teachers to coordinate for different vocations and conduct the activities of different vocations with external resource persons.

The QR code placed on the first page of the textbook is linked to a document that contains tables mapping the competencies and learning outcomes to content, and to the time allocation for the different tasks related to vocations included in the book. These will be helpful for any school that selects a vocation other than those in the illustrative chapters.

Note for Students

Dear students,

The purpose of this textbook is to help you learn about three vocations related to life forms, machines and materials, and human services, respectively. You will do this by reading the textbook and following instructions to complete tasks that will lead you to the completion of work in each of the forms.

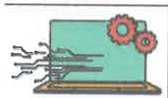
Vocational Education prepares you to deal with practical things related to daily life and understand the world of work. You will understand linkages between different vocations. You will examine how value is added to the raw material in farms (Life form), and to product in factories (Machines and Materials). You will also learn, how the same material is delivered as a 'Service' (Human Services) and adds value.

Vocational Education gives you an opportunity to work with your hands, work in groups with your peers, and learn the basic skills. These skills are applicable across multiple vocations. Your schools can select any Vocation depending on the various factors. But the generic competencies learned by you through the vocations are the same. They will be useful to prepare you for deciding your preference for future vocation.

How to use the Book?

You can read the section on 'About the Book' to understand the structure of the book. In addition, Table 1 shows some common elements of the textbook.

Table 1: Common elements across the textbook

Element	Description
  	**Transferable learning** These icons indicate that you are learning something that is applicable across a range of vocations. These icons are different across the units, but some learnings are common across units. For example, creating a process chart is common across all units but testing growing media is common across Work with Life Forms, making technical drawings is common across Work with Machines and Materials and creating service environment is common across Work in Human Services.
	**Portfolio** This icon indicates guidance on what to add to your portfolio – this does not mean you cannot add anything else. These are merely hints to guide you.
	**Caselet** This icon indicates examples of work done by students of the fictional Government High School related to the vocations that have been included in the textbook. These are intended to help you understand the details of specific tasks.
	**Safety** While safety precautions are included where relevant, this icon highlights some measures.
	**Task** This icon indicates a specific task that you need to do in order to apply something you have read about in the textbook.
	**Technology and Artificial Intelligence** This icon indicates either a task or information related to technology and artificial intelligence. Do remember to take due precautions related to cyber safety.

Learning by Doing

The textbook is designed for 'hands on activities'. Try to apply learning in real life work. It can be small tasks in school/community or at home. Practice will make you perfect.

Safety

Safety is the first priority. Accidents can happen any time. You must find out any potential danger while starting any work. You will be using tools and working outside the classroom. Be alert while using tools. Follow all safety protocols. Do not overlook any instruction. Holding tools and handling materials as per protocol, using safety gadgets including shoes, goggles and gloves are essential. Maintain workplace hygiene before and after work.

Ask for Help

If you are unsure about any part of an activity, do not hesitate to ask a teacher, parent or peers for help. Ask as many questions as needed if something is unclear. Collaboration and discussion can make learning more fun and effective.

Reflect

Think about different career opportunities related to work. Try to find out what you liked most and appreciated in that vocation. Think if you like to take up certain task as your career.

Internet Safety

If you use Internet searches or AI tools or both, please do so under supervision of an adult. You need to be careful of what you are accessing on the Internet. Just as there are places in and around your school and home where you will not go without an adult, there are places on the Internet that are not safe for anyone, neither you, nor adults. You must take care, and whenever in doubt, ask someone you trust.

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THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

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CONSTITUTION OF INDIA

Part III (Articles 12 – 35)
(Subject to certain conditions, some exceptions and reasonable restrictions)

guarantees these

Fundamental Rights

Right to Equality

- before law and equal protection of laws;
- irrespective of religion, race, caste, sex or place of birth;
- of opportunity in public employment;
- by abolition of untouchability and titles.

Right to Freedom

- of expression, assembly, association, movement, residence and profession;
- of certain protections in respect of conviction for offences;
- of protection of life and personal liberty;
- of free and compulsory education for children between the age of six and fourteen years;
- of protection against arrest and detention in certain cases.

Right against Exploitation

- for prohibition of traffic in human beings and forced labour;
- for prohibition of employment of children in hazardous jobs.

Right to Freedom of Religion

- freedom of conscience and free profession, practice and propagation of religion;
- freedom to manage religious affairs;
- freedom as to payment of taxes for promotion of any particular religion;
- freedom as to attendance at religious instruction or religious worship in certain educational institutions.

Cultural and Educational Rights

- for protection of interests of minorities;
- for minorities to establish and administer educational institutions;
- saving of certain Laws 31A–31D.

Right to Constitutional Remedies

- by issuance of directions or orders or writs by the Supreme Court and High Courts for enforcement of these Fundamental Rights.

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Constitution of India

Part IV A (Article 51 A)

Fundamental Duties

It shall be the duty of every citizen of India —

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

(g) to protect and improve the natural environment including forests, lakes, rivers, and wildlife, and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement;

*(k) who is a parent or guardian, to provide opportunities for education to his child or, as the case may be, ward between the age of six and fourteen years.

Note: The Article 51A containing Fundamental Duties was inserted by the Constitution (42nd Amendment) Act, 1976 S.11 (with effect from 3 January 1977).

*(k) was inserted by the Constitution (86th Amendment) Act, 2002 S.4 (with effect from 1 April 2010).

Contents

Gandhiji's Talisman

I will give you a talisman. Whenever you are in doubt or when the self becomes too much with you, apply the following test:

Recall the face of the poorest and the weakest man whom you may have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he gain anything by it? Will it restore him to a control over his own life and destiny? In other words, will it lead to Swaraj for the hungry and spiritually starving millions?

Then you will find your doubts and your self melting away.

M.K. Gandhi

Unit I

Work with Life Forms

Work with Life Forms involves working with plants and animals. Humans have always depended on plants and animals, from early hunting and gathering to the cultivation of different crops and animal husbandry, not only to survive but also to create surplus for a better life. *Work with Life Forms* is, therefore, fundamental to human survival and growth.

Work in this form is mostly related to the food production and the supply of raw materials. It involves the cultivation of crops (pulses, wheat, cotton, spices, etc.), rearing livestock, harvesting produce from forests and other natural habitats, seaweed cultivation, and so on. In addition, raw materials are supplied to various industries, for example, cotton, jute, leather, wood, rubber, oil, tea, coffee and so on. The agricultural sector is often referred to as the 'mother of all production', since it is not only the primary source for the sustenance of human civilisation but also the provider of raw materials for almost all human activities.

Food security means that all people, at all times, have reliable access to a sufficient quantity of affordable and healthy food.

In modern times, the world of work is undergoing a lot of changes. However, agriculture remains far ahead of all other sectors as a provider of employment and will continue to remain so in the future. It will undergo transformation to ensure food security for all in the face of challenges, like depletion of natural resources, reduction of land for farming and climate change. Already, various technologies are being used in farming to address these challenges, for example, precision farming technologies to deliver exact amounts of water and fertiliser, sensors to alert farmers to any requirements, solar pumps for irrigation, mobile apps for weather forecasting, market prices and government schemes. At the same time, traditional practices like natural farming are also being used more frequently, combining traditional wisdom with modern technology.

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Agricultural tool and equipment manufacture,
Research, Training, Transportation, Packing,
Trading, Branding and Export-Import

Agricultur Practices

Soil Science

Soil health,
Soil conservation

Soil scientist,
Crop consultant,
Soil conservationist

Horticulture

Fruits, Vegetables,
Ornamentals

Gardener, Nursery worker, Landscape designer

Forestry

Trees, Non-Timber Forest produce (NTFP), Agroforestry

Forest officer, Conservationist, NTFP harvester, Agroforester

Animal Husbandry

Livestock rea
Health and veterinary care, Feed production

Livestock farmer/herder, Veterinarian

Crop Production

Cereals, Pulses,
Oilseeds, Vegetables

Farmer, Agronomist, Scientist

Precision Farming

Protected cultivation,
Hydroponics, Drip irrigation, Fertigation

Precision farmer, Agricultural engineer, Drone operator, Data analyst

Sustainable Farming

Natural farming,
Organic farming

Soil and water conservationist, Scientist, Organic farmer

Aquaculture

Inland and Marine fisheries, Seaweed farming

Aquaculturist, Seaweed cultivator, Fish farmer

The figure overleaf depicts the agricultural livelihood ecosystem. A livelihood ecosystem is an interconnected network of resources, people, institutions, activities and environmental factors that enable individuals to earn a living, while contributing to society and the nation. For instance, the livelihood ecosystem in different geographies will vary depending on resources (for example, type of soil, and availability of water, materials and tools), support (for example, agricultural experts), access to markets (for example, transportation), and demand at local, national and global levels. Further, this implies that no work is done in isolation—different kinds of work are deeply connected. For example, if demand for a particular kind of produce reduces, then the farmer will not be the only one affected. Slowly, the requirement for transport, production of agricultural equipment and experts will also decrease. As you can see in the figure, there are many opportunities in agriculture. Besides crop cultivation and animal rearing, the area includes research, storage, transport, trade and so on; the list is long. Each level in the figure provides details of the kind of work that can be done in this area. The last level indicates the interlinkages between the work of the farmer or livestock owner, and various other allied work that enable agricultural practices and ensure that society benefits from them.

This unit will give you the opportunity to do work related to agricultural practices. You can choose the work you will do either from options in the unit or you can identify some other kind of work related to agricultural practices. This unit offers illustrations of seven vocations, as explained in the paragraphs below.

Chapter 1 introduces key concepts and processes that are common across a range of work related to agriculture. This chapter is mandatory for you.

Chapters 2 to 4 use common concepts and processes to help you understand how to do specific work. At the same time, they also introduce additional concepts and processes that you can learn while doing. Chapters 2 and 3 detail work related to rooftop gardening and precision farming, respectively. Chapter 4 contains guidelines for mushroom cultivation, aquaponics, pisciculture, backyard poultry and non-timber forest produce.

To reiterate, you can choose to do work related to any of these seven vocations or you can select something related to agricultural practices that is entirely different. Remember to consult your teacher and/or an expert for guidance at all points. Work is to be done in groups. Remember—a big part of work is doing it together.

CHAPTER 1

Introduction to Agricultural Practices

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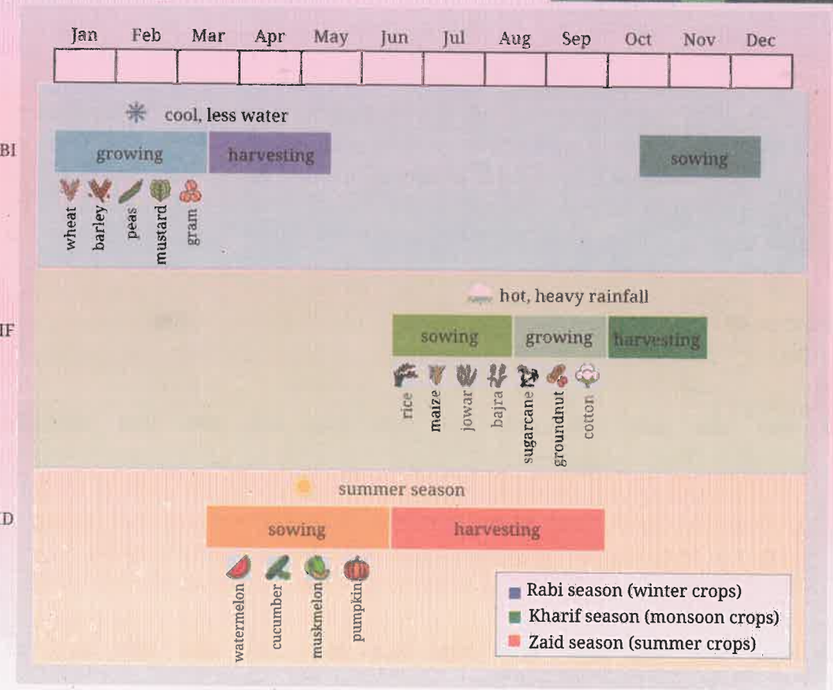


Figure 1.1: *Example of a crop calendar*

Figure 1.1 is an example of a crop calendar that provides a structured schedule for farming activities, so that farmers can make decisions related to planting, maintenance and harvesting based on local weather and soil conditions. You may have studied this calendar in your Grade 9 Social Science textbook. These calendars are created by agricultural organisations, researchers and sometimes by the farmers themselves.

In this chapter, you will

- Understand the importance of agricultural practices
- Understand agro-climate relationship
- Set up a meteorological observatory
- Test and improve soil quality
- Test and treat seeds
- Identify key processes related to agricultural practices
- Explore vocations related to agricultural practices
- Identify quality criteria related to agricultural practices

Importance of work

1.1 Introduction

We are one of the oldest agricultural civilisations in the world and among the world leaders in overall farm outputs. India leads in production of vegetables, fruits, milk, eggs and fish. Growing plants and caring for animals not only help us with a better understanding of agriculture but also help in acquiring many life skills. The agriculture sector also has opportunities for different jobs and entrepreneurship opportunities with new technology applications, like drones, robotics, biotechnology and Artificial Intelligence (AI).

The *Kṛiṣhi-parāśhara* provides a detailed account of traditional agricultural techniques, including soil preparation, crop selection, irrigation techniques, seasonal planning and pest management. It blends scientific observations and ecology to present natural methods that are relevant today to address issues, like soil degradation, climate unpredictability and the overuse of chemical fertilisers.

Agriculture has shaped India's socio-cultural life over centuries by influencing its traditions and rural lifestyles, and strengthened communities with practices like farming festivals. This sector has played an important role in strengthening the nation. According to the Economic Survey of India 2024–25, published by the Ministry of Finance, the agriculture sector contributed 16 per cent to India's Gross Domestic Product (GDP) and employed 46.1 per cent of the workforce.

Value chain

Have you ever thought why the price of vegetables changes depending on where you buy them from? Did you know that the cost of vegetables bought in a supermarket can be 300–400 per cent higher than that of vegetables bought in a mandi? The cost of any agricultural produce increases as it travels further or is processed further, or even packaged differently.

Value increases at each step due to costs of additional processes, like storage (for example, refrigeration, rent or maintenance of warehouses) and processing (for example, grinding wheat, rice, etc., to make flour or extract oil), cleaning, pasteurisation, etc. Profits, cost of transport and so on must also be factored in (Figure 1.2). Additionally, in cases where hybrid seeds are used, the price increases further for the consumer.

It is important to understand the value chain, since this knowledge helps us make informed choices, for example, comparing cost of travelling to farms or mandis instead of buying produce from supermarkets.

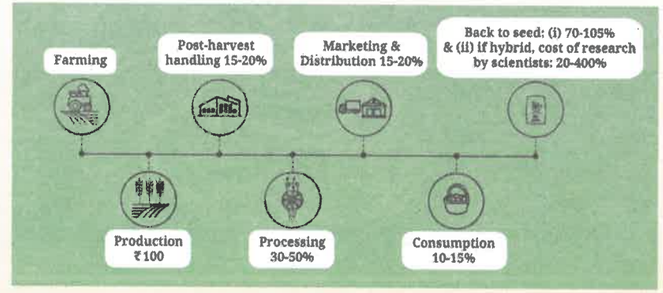


Figure 1.2: *Value chain in agriculture*

Figure 1.2 shows the percentage increase in the cost of produce from a farm as it moves up the chain value. If the cost of producing harvest is ₹100, then value keeps getting added. Post-harvest handling adds 15–20 per cent to the initial investment of ₹100. Next, processing adds 30–50 per cent to the additional value and so on. In case hybrid seeds are used, the initial cost also increases. Cost of research also needs to be factored in.

PORTFOLIO

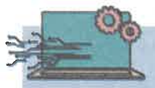
Select any product that you can trace back to agricultural practices. Find out (you can do an Internet search or ask different stakeholders, including vegetable sellers) the price of the raw product/produce sold by a farmer and the cost at which it is sold. What is the price difference? Find out why the value of the raw product/produce has increased.

Essential conditions for growth

1.2 Agro-climatic relationship

One critical factor related to agricultural practices is the climate. As you have studied in Social Science, India is a country with diverse agro-climatic regions. From the Himalayas to the coast of Kerala, the cropping patterns change from region to region. On the basis of climatic conditions, some parts of the country grow rice, some parts are known for wheat, cotton, soyabean, sugarcane, millets, etc., and yet others for fruits.

The India Meteorological Department (IMD) plays a vital role in recording meteorological observations and providing Agrotechnological Advisory Services (AAS). The weather forecast and advisories help farmers in planning their crops in *kharif*, *rabi* and summer seasons. Besides warning about rainfall or snow, IMD meteorological data and forecasts also help other agencies predict outbreaks of livestock diseases, allowing for timely action for prevention or treatment.



TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

India has one of the most extensive public weather information systems. IMD provides district- and block-level weather forecasts through SMS alerts, All India Radio, Doordarshan, community radio, mobile apps, Kisan Portal and Krishi Vikas Kendra (KVK). Apps like Bharat-VISTAAR, developed by the Government of India, offer a range of services to farmers, including agro-climatic data.

Panchayat-level meteorological data, including temperature, rainfall, soil moisture and wind direction are available on digital platforms/apps like the Gramin Krishi Mausam Sewa (GKMS).

CASELET

Weather keepers of Ladakh

Students of Government High School decided to do a project on agriculture in Ladakh. Extracts from their report are given below.

Ladakh is a cold desert and receives very little rainfall; most precipitation is in the form of snow. Irrigation is mostly dependent on glacial meltwater. Temperatures range from 25 to 30°C in summer and –25 to –8°C in winter. There is a very small period when farmers can sow barley and potatoes, and harvest apricots from trees. However, weather here is unpredictable–icy winds, sudden frost or unexpected rains can spoil a crop without warning, destroying weeks of hard labour.

Livestock rearing is also impacted by the climate of Ladakh—goats, double-humped camels, yaks and horses, though hardy, get affected by the weather.

Use of meteorological data

Searches on the Internet and a video call with a scientist at the Regional Research Centre of the Indian Council of Agricultural Research at Leh led to the following conclusions (Table 1.1).

Table 1.1: Relevance of meteorological parameters in agricultural practices

Meteorological parameter	Relevance for farmers and livestock owners
Duration of summer/winter	As Ladakh is a cold desert, a very short period is available for farming (May to September). Thus, any change in weather negatively affects agricultural activities.
Precipitation (rainfall and snowfall)	Ladakh receives maximum rainfall from July to September. This period is when most of the crops are grown. If it rains very heavily, crops may be lost due to floods, while if it rains poorly there will be water scarcity.
Temperature	From June to August, temperatures are highest during the day (20 to 30°C) and above freezing (0 to 5°C) during the night. This temperature range is best for farming activities.
Humidity	The average humidity in Ladakh ranges from 70 to 74 per cent between May and September. Very low humidity leads to higher evaporation losses from leaves and dryness of soil.
Wind direction and speed	Strong winds, especially in open fields, can cause physical damage to crops and lead to soil erosion.

CHECK YOUR UNDERSTANDING

Find out what kind of data farmers use in the region your school is located in. Why is this useful for them?

TASK

Make your own Meteorological Lab

Build a simple meteorology observatory in your school with a (i) simple rain gauge, (ii) dry-wet bulb thermometer and (iii) wind vane. Follow the steps in Figures 1.3–1.5 using the materials suggested. You can always substitute the materials if you wish; please consult your teacher/an expert before doing so.

Use your observatory to track rainfall, temperature (including the average and range of temperature) and wind direction. You should collect and analyse the data over three months, that is, the duration of the time you are doing this work. You can also create a weather bulletin board for farmers in your region.

Making a rain gauge

	
1. Take an empty plastic bottle (transparent) with a flat and stable bottom (so it does not fall over in the wind).	2. With the help of a scissors, cut off 1/3rd part of the top of the bottle (this part can now be used as a funnel).

		
3. Put the funnel upside down inside the bottle. Remember, the funnel should cover the entire mouth of the bottle, so rain can only enter through the funnel.	4. Then place a ruler outside the bottle using a tape.	5. Now place the entire setup in an open area where rain can fall directly into it. It should be placed at a height.

	
6. After it rains, check the water level against the scale.	7. Note the rainfall and compare it to the one measured by an app.

Figure 1.3: *Rain gauge is used to measure rainfall by collecting rainwater in a container and measuring its depth over a specific period using a measuring scale (in cm or mm).*

Measuring temperature and humidity of air

		
1. Take two thermometers, a plastic bottle, scissors, thread, tape, cotton gauze and water.	2. Wet the cotton gauze pad using water and cover the bulb of one of the thermometers with it (wet bulb thermometer).	3. Then, attach the thermometers to the plastic bottle with the wet bulb thermometer on one side and the dry bulb thermometer on the other.

	
4. Tie a thread at the top of the bottle and spin it.	5. Record the temperature of both the dry bulb and the wet bulb thermometer.

Figure 1.4: *Dry-wet bulb thermometer measures temperature and humidity*

The dry bulb thermometer shows the actual air temperature, while the wet bulb thermometer shows a lower temperature because water evaporates from the wet cotton and cause it to cool.

The difference between the dry bulb and wet bulb readings helps us find the humidity in the air. If the difference is small, it means the air is humid, and if the difference is high then the air is dry. Please note that to get an accurate reading, a psychrometric chart for humidity is used. You can ask your teacher or an expert to help you use the chart.

Identifying the direction of the wind

		
1. Cut a circular disc from a cardboard or a paper plate.	2. Mark the centre of the disc.	3. From there, draw and write the four directions (North, East, West and South) on the disc.

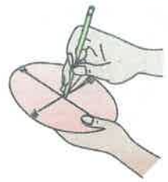
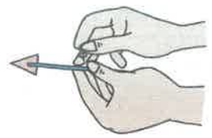
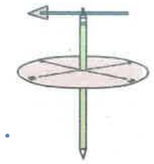
		
4. Draw and cut a stick (tail) from another piece of cardboard.	5. Draw and cut an arrow from the cardboard.	6. Join the arrow with the tail.
		
7. Push the sharp end of the pencil through the centre of the disc.	8. Place the arrow through the eraser using a pin; should move freely.	9. Keep the wind vane in an open area and observe the direction in which the arrow points.

Figure 1.5: *Wind vane identifies the direction of the wind*

PORTFOLIO

Keep a record of data you have collected over a period of time with your DIY meteorological laboratory and share it with a farmer/gardener. Record their feedback.

Quality

QUALITY

Two key processes in ensuring the quality of inputs while working with plants are detailed in the section below. The first is to ensure the quality of the soil, while the other is to ensure the quality of the seeds.

1.3 Processes related to agricultural practices

1.3.1 Soil testing and amendment

Test and amend growing media

Testing of soil health is important for maintaining soil fertility. Soil testing helps in understanding of soil health parameters–physical (soil texture, water holding capacity, etc.), chemical (pH, nutrients, organic matter, etc.), and biological (presence of microbes).

TASK

Soil sample collection

To carry out these tests, soil can be collected from your own garden or nearby fields. The process of sample collection is very important to get good results. Take soil from different spots, for example, from a sandy area, organic pit and water channel, and mix the samples, as soil quality can vary even within a small area. Avoid shady areas (like under trees) and places, where fertilisers are stored in the field.

Remove stones, leaves and other debris. Dry the soil in sunlight for a few hours. Crush clumps and sieve the mixture to get fine soil suitable for testing. Label each sample carefully, for example, date of collection, whether the previous crop was grown, and use it for both mason jar texture tests and pH testing. Figure 1.6 will help you collect the soil samples.

		
1. Divide the field in a zig-zag manner.	2. Scrape away any stones, pebbles, leaves or other litter from that area.	3. Using a trowel, dig a 'V' shaped hole, 15–20 cm deep.
		
4. Cut a thick slice of the soil from both the faces of 'V', top to bottom.	5. Mix the soil sample well and make a heap.	6. Divide the sample into four quarters.

		
7. Discard any two opposing quarters and mix the remaining two quarters.	8. Again, divide the remaining sample into four quarters.	9. Repeat Steps 7 and 8 till you get a small, clean soil sample ready for testing–collect it in a bag.

Figure 1.6: *Process of collecting soil sample*

DID YOU KNOW?

Soil composition is a dynamic mix of four main parts: about 45 per cent minerals (sand, silt and clay), 5 per cent organic matter (humus and living organisms), 20–30 per cent water and 20–30 per cent air, filling the pore spaces.

TASK

Testing soil for its clay and sand percentage (mason jar test)

Understanding soil texture and pH is another crucial step in evaluating soil health. Soil texture is determined by the amount of sand (largest particles), silt (medium–sized particles) and clay (smallest particles). Soil texture affects how well the soil holds water, nutrients and how easily roots can grow in it. You can assess soil texture through a mason jar test. Figure 1.7 shows the process for the mason jar test.

		
1. Fill a transparent jar halfway with soil.	2. Add water and a little dish soap.	3. Shake the container well.

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4. Let soil settle for 24–48 hours.	5. Sand settles at the bottom, silt in the middle and clay on the top. Measure each layer's thickness and calculate soil composition.
Result	**Action to be taken**
Clay percentage is more than 20 per cent — this will create water logging conditions leading to suffocation of roots.	Add river sand or red-garden soil to correct it. It will improve water drainage.
Sand percentage is more than 80 per cent – this will hold very little water leading to wilting of plant.	Add compost or garden soil. It will increase water-holding capacity of soil and add necessary nutrients for plants.

Figure 1.7: *Process for mason jar test*

pH test and amendment

Soil pH testing helps determine whether the soil is acidic, neutral or alkaline. Most plants grow in slightly acidic to neutral soils (pH 6–7). Acidic soil can make it difficult for plants to absorb certain nutrients, while alkaline soils may prevent other nutrients from reaching the plant, leading to deficiencies. Figure 1.8 shows the process of pH testing.

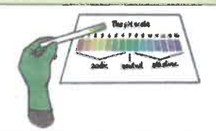
		
1. Add a little distilled water to the soil sample, making it a paste/slurry.	2. Dip pH strip/pH metre into the slurry.	3. Compare strip colour or metre reading with pH scale to identify soil as acidic, neutral or alkaline.
Result	**Action to be taken**	
Soil pH is acidic, i.e., below 6	• Adding compost (organic matter) • Adding wood ash • Adding lime or dolomite	
Soil pH is basic, i.e., above 8.5	• Adding extra water and draining it (soil wash) • Adding compost (organic matter) • Adding gypsum or sulphur containing fertiliser	

Figure 1.8: *Process for pH testing*

SAFETY

Follow the steps carefully while performing tests. Do not taste chemicals and handle glass containers carefully.

CHECK YOUR UNDERSTANDING

- Which test did you do?
- What were the results of the test?
- What steps did you take to improve the quality of the soil?

Seed selection

1.3.2 Seed selection

Once you have ensured that the soil selected is of good quality, you need to focus on the seeds you will be using. If the seed is weak or unhealthy, the plant that grows from it will also be weak, no matter how fertile the soil is. The germination test that you may have done in Grade 7 *Kaushal Bodh* book will help you estimate the percentage of seeds that will actually sprout, thereby giving you an idea of how many seeds to plant.

Before sowing, seeds are treated to increase their germination rate, and to protect them from insects and diseases. Let us learn a simple seed treatment, using common salt (NaCl). This method of treatment is commonly used for cereal crops, like wheat and rice. The addition of salt in water increases the density of water (thereby making water heavier), so that damaged or hollow seeds float. Through this process, we can easily identify non-germinating seeds. Salt water also helps in removing any microbial infections on the seed coat. (Figure 1.9).

Seed dormancy

Seed dormancy is a natural condition where seeds remain alive but do not germinate. This adaptation prevents seeds from sprouting in unsuitable conditions, increasing their chances of survival in adverse environments. Sometimes we need to treat seeds to break their dormancy (for example, soaking rice seeds in hot water for few hours), while in some seeds, dormancy is induced through specific processes to prevent germination during storage.

TASK

Floating method

 1. Take 1 L water in bucket.	 2. Add 100 g salt to water.	 3. Add 250 g of wheat seeds.
 4. Wait for 3–5 minutes.	 5. Damaged, infected or hollow seeds float on water.	 6. Discard floating seeds, wash remaining seeds in fresh water and dry in shade.

Figure 1.9: *Floating method to identify germinating and non-germinating seeds*

1.3.3 Preparing organic fertilisers and pesticides

You may have prepared organic fertilisers and pesticides in the Middle Stage. Refer to *Kaushal Bodh* of Grade 6 for preparation of vermicompost and *Kaushal Bodh* of Grade 7 for preparation of liquid compost. The Grade 6 book also contains directions for preparation of pesticide. The caselet shows how students of Government High School did the work.

CASELET

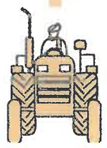
Students making vermicompost

Students of Government High School collected 50 kg of agro waste and 50 kg of cow dung. They filled the agro waste and cow dung in the composting bed, layer by layer, in a pit dug under a green shade-net. Worms were introduced and the pit was watered to keep it moist. They covered the pit with a gunny bag to maintain the moisture within it. After six days, the vermicompost was ready to harvest. After harvesting, the students sieved it and packed it into 1 kg bags for use (Figure 1.10).

Figure 1.10: *Making vermicompost*

Students also learnt to make an organic pesticide, *Daśhaparṇī arka*. As the name suggests it is an organic pesticide made with ten different materials–plant leaves, cow-dung and cow-urine. They also used locally available plant leaves like *neem, karanj*, custard apple, papaya, castor, marigold, lantana, *bael, tulsi* and hibiscus. They first removed the leaves from their stem and carefully weighed 200 g of leaves. These were added to a bucket of 20 L capacity along with 220 g cow-dung and 500 ml cow-urine. After adding 15 L water to the bucket, they stirred it and kept it aside for fermentation (30–40 days). Once it was ready, they used it for spraying in a ratio of 15 mL per 1 L of water (Figure 1.11).

Figure 1.11: *Making organic pesticide*



Explore different sources of information

Mapping resources

1.4 Selection of vocation

This section will help you decide the vocation that you will take up related to working with life forms. The textbook provides details of rooftop gardening and precision farming, as well as guidelines for mushroom cultivation, aquaponics, pisciculture, backyard poultry and non-timber forest produce. But before that, you need to explore vocations around yourself.

TASK

Exploring vocations around us

Look around you and answer the following questions:

1. What kind of work related to agricultural practices do you observe around yourself? You can use different sources of information, for example, experts, site visits, libraries, online resources, specific government sites or reports.

2. Briefly describe what the work involves–what are the inputs, what are the key processes and what are the outcomes.

Mapping resources

Do you think it is possible for you to do the work in school? Discuss in a group why/why not. Table 1.2 will help you decide.

Table 1.2: Mapping resources to select vocation

Work related to agricultural practices around us	Will you be able to complete the work in three months?	Do you have adequate space to build necessary structures?	Have you identified an expert to help?	Will you be able to manage resources needed to complete the work?	Will you be able to do 'real' hands-on work?

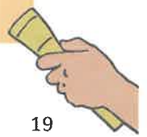
Mapping resources

PORTFOLIO

Which vocation have you chosen and why?

1.5 While doing work related to agriculture

1. Always handle tools and materials as per the instructions of the teacher/expert, or as specified on packet labels or in manuals.
2. Using tools like a rain gauge, dry-wet bulb thermometer and wind vane to monitor local weather help take decisions related to the selection of plants, sowing, harvesting and irrigation.
3. Testing soil health helps assess vital parameters, such as soil texture and pH, and take simple steps to improve soil quality.
4. Healthy seeds can be identified using the 'floating method' in salt water. Damaged or hollow seeds float, while healthy seeds benefit from coating with salt.
5. Agro waste and cow dung can be used for vermicompost, while organic pesticides such as *Daśhaparṇī arka* made from local leaves, like neem and papaya, can be used for pest management.



1.6 Assess your learning

1. A farmer has sandy soil with high acidity. Suggest two amendments and explain how they will improve soil quality.
2. Non-timber Forest Produce (NTFP) refers to all useful products from forests (except timber), including resin, medicinal plants, fruits, nuts, etc. Lac is an important NTFP that is produced by a tiny insect, *Kerria lacca,* which secretes a resinous substance as a protective coating on the branches of host trees. Lac production is dependent on insect population. Insect growth in turn depends on suitable host plants and a warm and humid climate, among other factors like growth of plant, etc. If you were part of a team building a meteorological observatory to help monitor conditions for the growth of *Kerria lacca,* which two instruments would you prioritise and why?
3. Table 1.3 shows the rainfall in a region and the rainfall requirements of some crops. On the basis of the rainfall data, suggest which among the following crops can be safely planted in the region and when. Justify your choice.

Table 1.3: Rainfall chart and rainfall requirement of crops

Rainfall chart—Annual rainfall per year			Rainfall requirements of some crops		
S.No.	Year	Rainfall (mm)	SN	Crop	Rainfall (mm)
1	2015	480	1	Rice	1500–3000
2	2016	333	2	Wheat	750–1000
3	2017	882	3	Jawar	500–1000
4	2018	350	4	Pulses	400–500
5	2019	974	5	Groundnut	500–1250
6	2020	693	6	Soyabean	500–1000
7	2021	494	7	Maize	500–1000
8	2022	917	8	Sugarcane	750–1500
9	2023	549	9	Jute	1250–2000
10	2024	596	10	Cotton	500–1000

4. Create a farm-to-plate journey map for any farming produce. Indicate the value chain as the produce travels from where it was grown to the table in the form of food.
5. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
6. Give examples of how you can apply your learning in a real-life situation.

CHAPTER 2

Rooftop Gardening

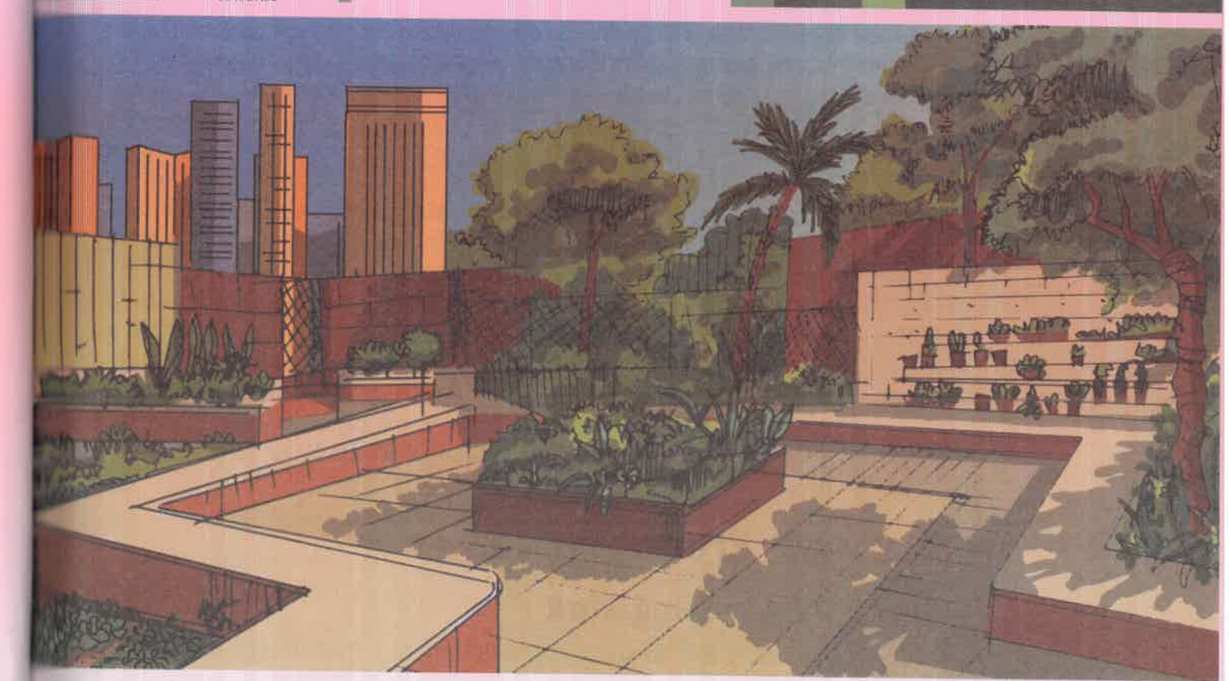


Figure 2.1: *A rooftop garden with shade provided by trees, heavy containers placed at the edge of the roof, a pathway for walking and a rack for pots*

Apart from production of healthy vegetables, rooftop gardening also cools down the temperature, reduces air pollution and creates green spaces that make people feel happy and relaxed. Most importantly, rooftop gardens help people connect with nature and provide a habitat for diverse animals (Figure 2.1).

In this chapter, you will

- Design the layout of a rooftop garden
- Select materials and tools
- Prepare potting mixture
- Conduct a germination test
- Harvest, store and package produce
- Sow, maintain and protect plants

2.1 Introduction

Rooftop gardening involves growing plants on the roof of a house, school or building. Instead of leaving rooftops unused, they can be turned into green spaces, where vegetables, fruits, herbs and flowers are grown in pots, grow bags or specially-prepared beds. This practice is especially useful in cities and towns, where open land for farming is limited. Rooftop gardens reduce dependence on market produce, improve air quality and keep buildings cooler during summers, while making the surroundings beautiful.

This chapter discusses the processes of growing plants in pots, on rooftops, balconies and terraces. The yield of such a garden varies based on the type of plant (leafy greens, fruits or flowers), gardening method used (soil, pots or water-based systems) and care. However, even a small space of just 1 square metre on a rooftop can yield about 10 kg of vegetables in a year.

2.2 Process chart

2.2.1 Scoping work

Defining scope of work

Deciding the scope of the work means that decisions need to be taken regarding the following:

1. Which plants should be grown? Refer to the discussion on agro-climatic relationship in Chapter 1 to identify what you can grow. Ensure that the life cycle of the selected plants is 2–3 months.
2. Other considerations include the amount of sunlight required, the amount of water required (you should select plants that require little water), investment in pots/containers, soil or any other growing media to be used, weight of pots, and any other specific point brought up by the teacher or expert.
3. What is useful? You need to decide, for example, vegetables for the midday meal or flowers during the festival or wedding season.
4. Where should they be grown? You will also need to decide where to create the garden and how many pots can be placed in the available space.

PORTFOLIO

Which plants will you grow? Justify your choice.

2.2.2 Making the process chart

A process chart lists all the tasks you will do along with estimated dates of completion and responsibility (Table 2.1).

Making a process chart

Table 2.1: Template for process chart

Tasks for rooftop gardening	Dates	Responsibility
Layout of rooftop garden		
Soil testing and potting mixture preparation		
Germination test		
Sowing		
Maintenance (irrigation and weeding)		
Protection from pests		
Monitoring growth and providing nutrients		
Harvesting		
Packaging and transport		

2.3 Site visit

To learn from experienced practitioners, visit rooftop gardens with your teacher. Possible site visits can include residences, offices, hospitals, hotels or educational institutes that have developed rooftop gardens.

PORTFOLIO

Note your observations with reference to Table 2.2.

Table 2.2: Guidelines for observation during site visit

Points of observation/ discussions	Description
Process followed	Key steps and their importance
Tools and materials used	Materials used and their storage Tools used and their maintenance
Safety protocols	Using tools correctly, safety precautions, etc.
Schedules	Frequency and timing of key tasks
Quality criteria	Criteria of quality for inputs, process and output
Technology use	Digital tools/apps used

Think of any other points for observation, while visiting the site. For example:

1. What does the gardener value the most about their work (for example, quality of produce, connect with nature, opportunity for employment, earnings, etc.)?
2. Possible challenges and how to overcome them

Create a process chart for the work you will do.

Essential conditions for growth

2.4 Designing the layout

When designing the layout for rooftop gardening, you must keep the following in mind:

1. **Space:** Adequate space must be left between pots or containers for watering and general maintenance.
2. **Sunlight requirement:** Select the part of the rooftop that receives at least 5–6 hours of direct sunlight every day. Different plants have different needs, so areas with partial shade can be used for herbs and leafy vegetables, while sun-loving plants, like tomatoes and cucurbits can be placed in open areas.
3. **Weight and safety considerations:** The weight of pots/ containers, growing media, and other materials can overload a roof and damage the building. Therefore, heavier containers, such as large pots or cement planters should be placed close to the edges of the roof or above the beams, where the roof can support more load. This requires an understanding of the structure of the roof (Figure 2.2) and the standardised maximum weight load limit for rooftops.
4. **Water management:** Pots should be placed on trays, tiles or stands, so that excess water is collected and the roof surface is protected from seepage. Proper drainage arrangements prevent waterlogging and extend the life of the roof.

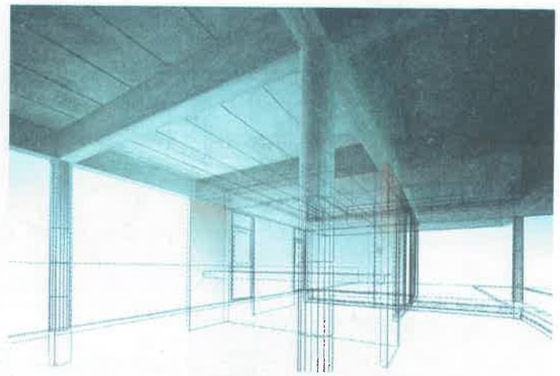


Figure 2.2: *Beams support the roof; more weight can be placed over beams compared to the rest of the roof.*

5. **Provision for shade:** Certain plants cannot tolerate strong, direct sunlight. For these, shaded areas can be created using shade nets, bamboo screens or vertical trellises. This helps in balancing light exposure across the rooftop.
6. **Protection from wind:** In rooftop gardening, plants will need protection from strong winds, which can damage plants or even throw entire pots off-balance. Use instruments from the meteorological observatory that you developed as part of Chapter 1 to record the direction of wind for about a week before finalising the layout.

Essential conditions for growth

TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

You can use 3D modelling software like Computer Aided Design (CAD) to design the layout of the roof. You can also determine the intensity of sunlight on different parts of the roof using Lux Meter mobile app.

PORTFOLIO

Draw and label a detailed sketch of the layout of your rooftop garden. Give reasons for your decisions related to the placement of pots.

CHECK YOUR UNDERSTANDING

On the basis of Figures 2.3 and 2.4, answer the following questions:

1. Why do you think some pots are placed in area B? Can you give examples of such plants from your geographic region?
2. Do you think the pots placed in area C can be placed in area E? Why or why not?
3. If the number of plants is increased, which area of the rooftop garden should be expanded first and why?
4. Do you think the layout has enough space to accommodate all the plants? Can you imagine any other layout?

Figure 2.3: *Representation of a rooftop garden*

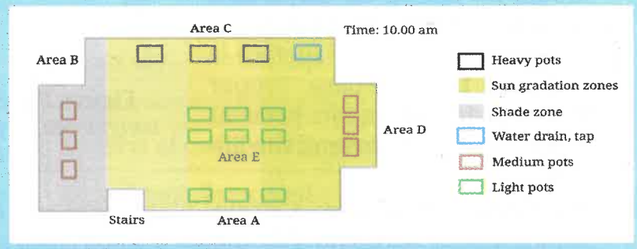


Figure 2.4: *Sketch of layout of rooftop garden*

CASELET

Structural Safety and Waterproofing

Students of Grade 9 in Government High School formed the 'Go-Green' team to develop a rooftop garden (Figure 2.5). To ensure safety, they first ensured the parapet wall was strong. Next, they consulted the contractor, who had built the school building. He informed them that the roof could safely support a maximum load of 150 kg per square meter.

Figure 2.5: *Setting up a rooftop garden*

The students selected an area of 4 m × 3 m (12 m^2) for their garden, which meant the total permissible load on that section of the roof was 1,800 kg. After consultation with their teacher and experts, they estimated that the combined weight of around 50 pots, the potting mixture and other components of the rooftop garden would be about 1,200 kg – well within the safe limit.

With this confirmation, they waterproofed the roof with tarpaulin liner and installed support of bamboo to support climbers.

2.5 Selecting materials

After the layout has been planned, the next step is to select materials. The table below (Table 2.3) will help you make decisions for gathering materials for the rooftop garden. You may recall some of these from Grades 6 to 8 *Kaushal Bodh*.

Table 2.3: Selection of materials

Materials	Options	Safety note
Pots/ containers	Terracotta pots (allow air and moisture to pass, preventing waterlogging around roots), plastic pots (lightweight), grow bags (flexible and easy to move), cement pots (limited use since heavy and retain heat), wooden containers (allow air to pass, preventing temperature fluctuations and waterlogging) and recycled material (for example, old buckets with holes drilled in bottom, old sinks)	Place heavy pots/containers only near beams or roof edges. Distribute weight evenly across the roof
Potting mixture	Soil, compost mixtures and cocopeat/ perlite/vermiculite	Avoid using only soil, as it retains excess water and increases the load on the roof
For watering	Watering cans, small sprinklers and hose pipe attached to taps, and trays/ saucers to prevent seepage	Always place trays/saucers under pots to collect extra water and prevent seepage
Shade and support structures	Shade net, bamboo screens and lightweight movable trellises	For providing shade and for climbers
Gloves	-	Always wear gloves while handling soil and organic matter
Other components	Compost bin and storage area	Care to be taken to avoid infestation by rats and/or pests, and proper storage with lock arrangements

SAFETY

Safety protocols/instructions to be followed while lifting and carrying load, and handling tools and materials. Protective gear to be used as required.

Select tools and materials

2.6 Selecting tools for doing work

Table 2.4 provides a list of tools necessary for developing the rooftop garden, along with their use and safe handling. You may recall some of these from the Grades 6–8 *Kaushal Bodh*.

Table 2.4: Selection of tools

Tools	Use	Safety note
Hand trowel	Digging soil, planting seeds and transplanting seedlings	Do not leave sharp tools lying around; store them safely after use
Pruning scissors	Cutting stems, removing dried leaves and shaping plants	Handle carefully; keep blades closed when not in use
Watering can/ spray bottle	Watering plants gently, especially seedlings	Avoid spilling water on the floor; keep a firm grip to prevent slipping
Buckets/trays	Carrying soil mix and collecting water drainage from pots	Do not overload buckets; lift small quantities to avoid strain
Pots/grow bags/ grow beds and nursery trays	Growing seedlings and plants	Choose plant container as per need and convenience in handling; avoid large pots as they will be difficult to handle

Cost estimation and documentation

2.7 Making Bill of Materials

The Bill of Materials (BoM) helps in estimating costs in advance, avoiding wastage by buying only what is necessary and organising the work step by step. You can use the template in Table 2.5 or modify it to list your estimated materials and tools. Cost of labour should also include the estimated time spent in doing the work.

CASELET

The 'Go-Green' team was almost ready to begin developing their rooftop garden, but felt a bit unsure about the quantity and cost of various materials required. Their teacher advised them to prepare a Bill of Materials for the project. To understand the concept better, the students sought guidance from a parent, who is an entrepreneur. Table 2.5 shows the Bill of Materials they prepared.

Table 2.5: Bill of Materials

Items	Quantity	Estimated cost (in ₹)	Remarks (if any)
Terracotta pots	15	500	As per the space available on roof/ convenience of use.
Hose pipe	10 m	600	Length calculated as per distance between tap and most distant pot
Bamboo for safety railing and trellis	3 pieces	250	Length of each pole is 5 m
Potting mix	100 kg	-	Donated by the local nursery

Cost of labour	Value (Time in hours × hourly estimate × frequency per week)	Estimated cost (in ₹)	Remarks (if any)
Watering plants	0.5 × ₹ 25 × 4	50	
Care and maintenance	0.5 × ₹ 25 × 2	25	
Total		**1425**	

PORTFOLIO

Prepare a Bill of Materials for your rooftop garden.

2.8 Pot preparation and sowing

Preparing growing media

You may have learned the basics of soil preparation and sowing in Grade 6 *Kaushal Bodh*. This section contains guidelines specifically for rooftop gardening.

You will need to prepare a potting mixture, for the rooftop garden as shown in Figure 2.6. For preparing a potting mixture, follow the steps below:

1. Collect material for the potting mix, keeping in mind the weight (lightweight is better) and nutrient supply (manure/compost).
2. Mix cocopeat/ vermiculite/ perlite with compost/ vermicompost and soil in 1:1:1 proportion.
3. Test for pH as described in Chapter 1.

DID YOU KNOW?

Low weight but nutrient rich potting mixture

Potting mix (please refer to Grade 6 *Kaushal Bodh*) is used, because ordinary garden soil is too dense and heavy for pots. When watered, soil particles get packed together tightly, which prevents air from reaching the plant roots. This causes poor drainage, leading to waterlogging and rotting of the root.

Potting mix is specifically designed to remain loose and airy. This ensures better aeration (oxygen for roots) and allows excess water to drain out easily, creating an ideal environment for healthy plant growth in a pot or container, while reducing the weight on the roof.

For example, a potting mixture of cocopeat + compost + perlite in 1:1:1 proportion will weigh around 290 g for a pot of 1 L capacity. If you replace perlite with soil, the same mixture will weigh around 700 g because soil is much heavier than perlite. So, just by replacing or reducing the amount of soil, you can reduce the weight of pots.

Figure 2.6: *Potting mixture weight distribution*

TASK

Testing pH of potting mixture and adjusting pH for 20 pots/ containers of 1 L volume

1. Follow the pH testing process given in Chapter 1.
2. If pH is acidic (below 6.0), add garden lime (calcium carbonate) and if pH is alkaline (above 8.5), add sulphur or organic manure. Quantity of lime or sulphur can be determined through trial and error, for example, adding one tablespoon of garden lime or sulphur/organic manure and testing pH again till it is satisfactory.
3. Test pH again and adjust it to 6.5 to 7.0 for the potting mix.

PORTFOLIO

Note the details of your work so far; you can use the template in Table 2.6.

Table 2.6: Preparation of growing media

Plants you are growing	Method of sowing	Materials for potting mix, and proportion used	Result of pH testing of potting mixture and amendments

DID YOU KNOW?

Hybrid seeds are specially produced for higher yield. These seeds are costly and can be used only once. Farmers preserve indigenous knowledge related to harvesting and storage of local seeds. This is very important for 'seed security' and biodiversity conservation. Seeds are harvested carefully and preserved for the next season.

Seed selection

TASK

Testing seed germination rate

You can check the quality of seeds by testing their germination rate. Seed germination rate is also printed on seed packets, but it may vary in the field as per sowing conditions (for example, soil moisture and temperature).

You may have done a seed germination test in Grade 7 *Kaushal Bodh*. Now, you can test the seeds in a potting mix to verify germination rate following the steps in Figure 2.7.

1. Count the seeds (you may recall that Grade 6 *Kaushal Bodh* recommends reading seed packets or asking experts about planting depth and spacing instructions; you can estimate the number of seeds required based on the size of the pots/ containers).

2. Plant them in a seedling tray, pot or container.

3. Water regularly.

4. After 2–3 weeks, count the number of germinated seeds and compare them to the number of seeds planted.

5. Calculate germination percentage and compare it with the 'seed packet' claim, if possible.

6. You can use these seedlings for your rooftop garden by carefully transplanting them to pots or containers.

Figure 2.7: *Process to test seed germination rate*

You have learned the basics of seed sowing in Grades 6–8 *Kaushal Bodh*. In case of a rooftop garden, do remember to protect young seedlings from strong winds, using small covers or nets, or by placing pots against a wall.

2.9 Maintenance and recording growth of plants

Maintenance and monitoring

2.9.1 Irrigation

If you provide less water, plants will not grow properly, due to water stress (when demand for water exceeds available supply), while heavy watering may lead to suffocation of roots. In soil-based farming, roots can grow deep in the soil in search of water. Furthermore, excess water can percolate down without harming the roots. As both these advantages are not available in pots/containers, you must irrigate with care.

TASK

Estimating water requirement

To estimate the approximate amount of water required by your garden, you will need to calculate the Water Holding Capacity (WHC) of the potting mixture. WHC is the maximum amount of water that soil can hold; in this case, soil has been replaced by potting mixture (Figure 2.8).

 1. Add 500 g potting mixture to the container/pot.	 2. Note the weight of the potting mixture, along with the container/pot (dry weight).
 3. Slowly add water until the potting mixture gets saturated (does not absorb any more water).	 4. Let the water drain out (this will take 10–15 minutes).
 5. Once the water stops draining out, note the weight of the pot again (wet weight).	 6. Calculate WHC = (Wet weight − Dry weight)/(Dry weight) × 100

For example, WHC = $\frac{130-105}{105} \times 100 \approx 24\%$

Figure 2.8: *Process to calculate water holding capacity*

On the basis of the WHC of the potting mixture, you can calculate the approximate water requirement of your garden. For example, if you have used 400 kg of potting mix and your WHC is 25 per cent then you need 100 L water to irrigate your garden. But do remember that this is an approximate calculation. Also, this does not mean that you need to use 100 L of water per day. This is the maximum water required by plants for growth.

Maintenance and monitoring

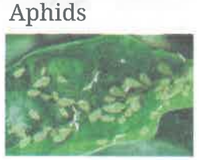
2.9.2 Plant protection

2.9.2.1 Protection from diseases and pests

Plants need protection from diseases and pests. You cannot eliminate all diseases and pests, as they are part of our ecology. However, you can limit damage to crops. The integrated disease or pest management approach involves physical (for example, removal of diseased leaves and insect larvae), chemical (for example, spraying organic pesticide) and biological (for example, rearing beneficial insects) methods.

To protect your crop, you will need to observe each plant carefully for symptoms of disease or pest infection (for example, presence of spots or insect bites). You can identify the disease or pest, using a mobile app or by sending photographs to experts. Refer to Table 2.7 to identify the actions to be taken.

Table 2.7: Examples of common pest infestation and remedies

Symptoms/damage	Pest	Plants likely to be infested	Remedy
Chewed leaf 	Caterpillar 	Cabbage, cauliflower, broccoli, tomato, brinjal and chilli	*Neem* spray and turmeric to repel
Discoloured leaves 	Spider mites 	Rose, hibiscus, beans, brinjal, cucumber, watermelon and indoor plants	Spray with water to dislodge pests
Deformed leaves 	Aphids 	Mustard, cabbage, cauliflower, tomato, brinjal, chilli, rose, hibiscus and marigold	*Neem* spray, chilli garlic spray and manual removal at early stage

Large holes and shiny trails 	Slug/Snail 	Cabbage, lettuce, spinach and seedlings of all vegetables	Manual removal and salt lines
Wilted and chewed leaves 	Chafers (beetles) 	Rose, hibiscus, jasmine, potato, groundnut, maize and sugarcane	Digging to expose larvae, neem spray and hand picking beetles
Black mould and weak sticky leaves 	White fly 	Tomato, brinjal, chilli, cotton, okra (bhindi), cucumber and hibiscus	*Neem* spray and soap water spray

2.9.2.2 Protection from weeds

In simple terms, weeds are unwanted plants in your garden. Farmers remove weeds by physical means (for example, hand-weeding, using power or mechanised weeders), through mulching (for example, organic mulching using materials, like bark, wood chips, straw, hay, grass clippings and shredded leaves or plastic paper) (Figure 2.9) and also through spray chemical weedicides. Refer to Figure 2.10 to manually remove weeds from your pots/containers.

Maintenance and monitoring

(a)

(b)

Figure 2.9: *(a) Mulching using plastic sheets and (b) organic mulching*

 1. Identify the weeds, growing near the main plant.	 2. Loosen the soil around the weed gently, using your fingers, so that the roots can come out easily.	 3. Hold the weed firmly at the base (near the soil surface).
 4. Pull the weed out slowly and steadily, making sure the complete root comes out.		 5. Level the soil around the main plant, after removing the weed.

Figure 2.10: *Manual weeding*

2.10 Harvesting and storage

The timely collection of produce is very important, because it ensures both quality and a longer shelf life. If harvesting is delayed, the produce may become overripe, lose taste or spoil quickly (Figure 2.11).

You have already learnt the basics of harvesting in Grade 6 and 8 *Kaushal Bodh*. Some important points to keep in mind for rooftop gardening are:

1. **Gentle handling:** Since rooftop gardens usually produce small quantities, every fruit, leaf or flower is valuable. Handle them carefully to avoid bruising or crushing.
2. **Right time:** Harvesting in the early morning or late evening keeps the produce fresh and reduces wilting. In the heat of the day, plants lose more water and become limp.
3. **Use of tools:** Simple tools, like scissors, pruning shears or small knives, can make harvesting easier and cleaner. Pulling the produce by hand may damage the plant.
4. **Stage of maturity:** Different crops have different maturity indicators. For example, spinach leaves should be picked when tender, tomatoes when they turn red and coriander before flowering.

Harvesting, packaging and storing

Storage of produce

Storage is just as important as harvesting, because it determines how long the produce will stay usable.

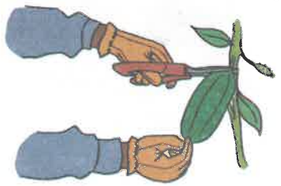


Figure 2.11: *Harvesting vegetables*

1. **Cleaning:** Wash vegetables and herbs gently to remove soil and dust. Dry them before storing.
2. **Containers:** Use baskets or perforated containers, that allow air to circulate.
3. **Temperature:** Leafy vegetables, like spinach and coriander stay fresh longer if kept in a cool, moist place or wrapped in damp cloth. Fruits like tomatoes should be stored at room temperature until fully ripe.

TASK

Observe how long the produce stays fresh in different storage conditions (for example, room temperature, refrigerator or wrapped in cloth).

Table 2.8 lists the time from sowing to harvest and appropriate storage methods for common rooftop crops.

Table 2.8: Harvest time and storage method of crops

Crop	Harvest time (in days)	Storage method
Lettuce	45–55	Store in a plastic bag in the refrigerator for up to 1 week
Spinach	30–60	Wash, dry thoroughly and store in an airtight container in the refrigerator for less than 1 week
Radish	25–45	Remove the leaves and refrigerate
Okra (Bhindi)	45–55	Store in a container and refrigerate
Capsicum	60–80	Refrigerate for 1–2 weeks
Basil, mint, coriander	25–30	Place stems in a jar of water on the counter or loosely wrap in a damp paper towel
Tomato	55–70	Keep at room temperature
Brinjal	60–70	Store in a cool place.

2.11 Packaging and transport

Packaging is important to keep the produce fresh for a longer duration. Common processes for packaging produce include (Figure 2.12) the following:

Figure 2.12: *Types of packaging*

1. **Leafy vegetables (like spinach, coriander, mint):** Wrap in a clean, damp cloth or newspaper to prevent wilting. Refrigerate soon after.
2. **Fruits like tomatoes and chillies:** Store in baskets, trays or ventilated corrugated cardboard boxes. Do not pack in tight plastic bags with no aeration, as these trap moisture and cause rotting. Many fruits naturally emit ethylene gas. Corrugated boxes with holes or baskets that allow air to circulate are used for fruit. They help to remove ethylene gas, which causes fruit to ripen faster. By removing this gas, fruits can be stored for a longer period, especially during transportation.
3. **Herbs:** Tie small bunches neatly with jute string or paper bands. Label them with names for easy identification.
4. **Flowers:** Place in baskets lined with damp cloth or corrugated sheets. The moisture keeps the flowers fresh for a longer time.

2.12 While developing the rooftop garden

1. Follow safety protocols related to lifting, and handling of tools and materials. Ensure safety of all, while working on rooftops.
2. Plants must be selected considering local agro-climatic conditions (rainfall, temperature, humidity, snowfall, etc). Locally-available varieties grow well, help in improving air quality and cool building, along with greater chances of a good harvest.
3. Consider design factors, like availability of sunlight, space, structural safety, water management and shade provision, while planning the rooftop garden.
4. Use lightweight pots and potting mixture test the potting mixture and make amendments as needed.
5. Test seed germination rate to try and ensure growth of all planted seeds.
6. Set watering schedules, regularly monitor plants for pest and diseases, and use organic pesticides for healthy plant growth.
7. Harvest at the right time, using simple methods to preserve and package produce for distribution.

2.13 Assess your learning

1. During a site visit, students notice that one rooftop garden uses grow bags, while another uses clay pots.
   i. List one advantage and one disadvantage of each container.
   ii. Which one would you recommend for your school rooftop garden and why?
2. You have prepared two potting mixes as follows:
   i. Mix A: Soil + Compost + Cocopeat
   ii. Mix B: Soil only

   After one month, plants grown in the Mix A potting mix look healthier and are lighter to carry, while plants in Mix B pot are heavy and waterlogged.

   Explain why Mix A is better for rooftop gardening.
3. A group of students noticed their tomato plants turning yellow despite regular watering. Later, they found out that the pots were waterlogged due to blocked drainage holes.
   i. What went wrong?
   ii. Suggest two preventive measures for the future.
4. A group of students harvests 5 kg of spinach, packs half in plastic bags and half in damp cloth. After two days, the spinach in a damp cloth is fresher.
   i. Why did the spinach in a damp cloth stay fresh longer?
   ii. What lesson does this give about packaging?
5. Your school has received a donation of 15 (6 inch) pots for rooftop gardening as well as spinach, tomatoes and marigold seeds.
   i. Which plants will you select?
   ii. Justify your choice based on agro-climatic conditions, usefulness (food/decoration), life cycle and water requirement.
6. A family wants to try rooftop gardening, but is worried about the cost.
   i. Suggest two recycled materials they can use as containers.
   ii. How does recycling support the environment?
7. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
8. Give examples of how you can apply your learning in a real-life situation.

CHAPTER 3

Precision Farming

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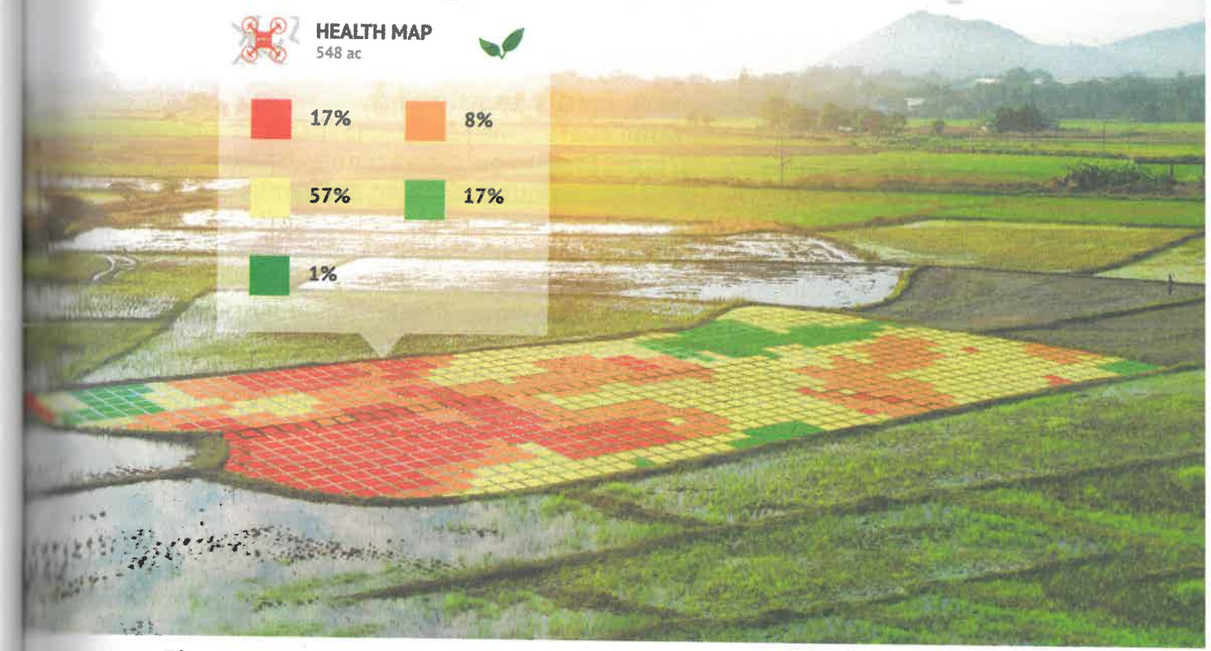

Figure 3.1: *'Health map' used for monitoring crop conditions in a field using remote sensing (satellite or drone imagery)*

Different colours on the map in Figure 3.1 indicate crops health, with red indicating the worst and green indicating the best. In the figure, 17 per cent of crops are in poor health and only 1 per cent are in good health. Farmers use these data to make decisions related to irrigation, fertilisation and pest management for small areas of land.

In this chapter, you will

- Learn about the use of technology in farming
- Use agro-climatic data for deciding the mode of crop protection
- Set up a humidity chamber for production of healthy seedlings
- Estimate the quantity of compost for healthy growth of plants
- Build a low-tunnel
- Prepare a bio-fertiliser (LAB culture)
- Harvest and label produce for distribution

3.1 Introduction

Precision farming uses science and technology to improve agricultural yield, while caring for the environment. The word 'precision' means 'exactly as required and consistent, that is, the same every time'. In keeping with this meaning, precision farming focuses on giving plants exactly what they need, i.e., the right amount of water, nutrients, and care at the right time and in the right amount (Table 3.1).

Precision farming is especially useful in small nurseries, since space and resources are limited. By using techniques like drip irrigation and sensors, and making data-based decisions, you can save water and avoid wastage, reduce excess use of fertilisers and pesticides, and grow healthier plants.

Greenhouses and shade-net (please refer to Grade 7 *Kaushal Bodh*) are examples of precision farming, since plants are provided with essential conditions for growth as per their need.

Table 3.1: Comparison of traditional and precision farming

Farming practice	Traditional farming	Precision farming
Agro-climatic impact	No control on climatic parameters	Precise control on temperature, humidity, light intensity, etc., through use of greenhouse, shade-net and also forecast using meteorological data.
Seed sowing	Seed broadcasting or sowing with manual tools	Sowing seeds with the help of machinery at proper spacing and depth; plant nursery management using modern techniques.
Irrigation	Flood irrigation (watering entire field)	Targeted watering using micro-irrigation (drip, sprinkler, etc.) guided by soil–moisture sensor and automated systems.
Fertiliser and pest management	Estimation of doses of fertilisers and pesticides by experience	Need-based application based on soil analysis and information from drones, satellites and apps, and experts.
Harvesting and packaging	Higher losses due to poor handling and packaging	Lower losses due to automated harvesters, using sensors and advanced packaging using digital labels.

3.2 Process chart

Defining scope of work

3.2.1 Scoping work

In order to proceed with the work, you need to make decisions about the following:

1. You can choose to work with farmers, who are already using precision farming techniques. You can request them to allow you to assist them in small groups of 5–10.
2. You can establish a precision farming unit in your school, including a small plant nursery.
3. You can convert your school garden into a precision farming unit by using technology-based inputs for decision making.

The following questions will help refine your decision-making process further:

1. Which plants should be grown? Refer to the discussion on agro-climate relationship in Chapter 1 to choose what you can grow. Ensure that the life cycle of the selected plants is 2–3 months.
2. What is useful? You need to decide what will be useful for the school or the community (for example, vegetables for the midday meal or flowers during the festival and wedding seasons).
3. Where to set up the precision farming unit? You will need a level area with good ventilation and scope for building structural support like a greenhouse. You will also need access to a reliable water source for irrigation and a separate area for storage. The entire set-up should be located, so that there is ventilation and penetration of sunlight.

4. Which technology to use? For example, use of a humidity chamber, low-tunnel, shade-net or greenhouse structure, drip irrigation system, and sensors (for example, moisture sensors and climate sensors).

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1. Where will you use the precision techniques – in a farmer's field or in school?
2. Which plants will you grow? Justify your choice.

Making a process chart

3.2.2 Making a process chart

A process chart lists all the tasks you will do, along with estimated dates of completion and responsibility (Table 3.2).

Table 3.2: Template for process chart

Tasks for precision farming	Dates for task	Responsibility
Site selection and layout		
Deciding crop protection method based on agro-climatic data		
Testing for organic carbon and adding required compost		
Setting up humidity chamber for raising seedlings		
Building a low-tunnel or shade-net		
Installation of drip irrigation system		
Preparing biofertiliser		
Identifying and managing pests using apps		
Harvesting		
Packaging and transport/labelling with QR code		

3.3 Site visit

To understand how precision farming works in practice, you can interact with farmers, agricultural scientists or even urban gardeners. Possible sites for visit can be Krishi Vigyan Kendra (KVK), agricultural universities or greenhouses in a community, in the presence of a teacher.

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Table 3.3 lists some points of observation, while visiting the site.

Table 3.3: Guidelines for observation during site visit

Points of observation/ discussion	Description
Tools and materials used	Materials used and their storage Tools used and their storage
Key processes	Key steps and their importance
Safety protocols	Using appropriate tools, safety precautions, etc.
Schedules	Frequency and timing of key tasks, if any
Quality criteria	Criteria for quality inputs, process and output
Technology use	Types of digital tools/apps used

You can ask the expert, what they value most about their work (for example, quality of produce, connect with nature, opportunity for employment, earnings, etc.), and how they face any specific challenges.

Create a process chart for the work you will do.

CASELET

A group of students from Grade 9 in Government High School visited farmers in their vicinity to learn about precision farming techniques such as low-tunnel farming (Figure 3.2) and drip irrigation. Using these modes farmers cultivate vegetables that usually grow in the summer and rainy season (like tomatoes and cucumbers) in harsh winter months. They learnt the process of low-tunnel farming, which involves creating tunnel-like structures made

up with hoops and polythene covers. These low-tunnels create a 'greenhouse effect' to protect the crops from cold weather and provide conditions necessary for their growth. Farmers also use humidity chambers, which are designed to maintain high humidity. This supports the growth of young plants that are yet to develop a root system.

Figure 3.2: *Low-tunnels used in precision farming to create necessary conditions for growth*

Essential conditions for growth

3.4 Setting up a precision farming unit in school

3.4.1 Collecting weather data

In precision farming, you can modify climatic conditions for better plant growth by providing shade, increasing humidity, and protecting them from rain and wind. Use Table 3.4 to decide the crop protection method you will use.

TASK

Collecting weather data and deciding which crop protection method to use.

Collect data from the school meteorological observatory (Chapter 1) and identify the crop protection method for your area (Table 3.4). You can also collect data from the Indian Meteorological Department (IMD) website, local Krishi Vigyan Kendra (KVK) or an agricultural university in your locality.

Table 3.4: Deciding crop protection method

Mode of protection	Advantages
Greenhouse	Lowering temperature, protection from rainfall and frost
Low-tunnel	Increasing temperature, protection from intense sunlight
Humidity chamber	Increasing humidity, especially for nursery seedlings
Shade-net	Protection from high temperatures and scorching heat

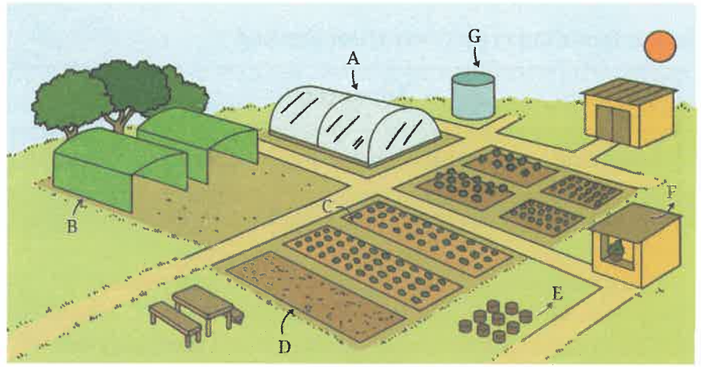
CHECK YOUR UNDERSTANDING

Students of Government High School collected data from the school meteorological observatory and the meteorological department website. They observed that the temperature usually ranges between 22°C and 34°C (the hottest months are April and May, while December is the coolest with 22°C). The area experiences heavy monsoon rainfall, mainly from June to September (average annual precipitation of around 3,000 to 3,350 mm). Humidity remains high, between 70 and 90 per cent, especially during the monsoon season. Which crop protection method should they use? Justify your selection.

3.4.2 Layout

As you design the layout of the precision farming unit, you can refer to the project on Plant Nursery in Grade 7 *Kaushal Bodh*. Figure 3.3 shows a layout that includes raised beds, low-tunnel and an area for pots.

1. On the basis of weather data and the selected plant protection mode, you can build a small greenhouse, low-tunnel or a shade-net.
2. You will also need a small space to create a humidity chamber–this provides special protection to seedlings.
3. You will need to mark areas for plant beds or to place pots for plant cultivation.
4. You will also need to indicate the placement of water tank, water pump, storage of raw material, pathways, etc.
5. You may like to keep space for composting and any other aspect you feel is important.



A - Low tunnel
B - Shade net (plant nursery)
C - Raised beds
D - Composting bed
E - Area for pots
F - Storage
G - Water tank

Figure 3.3: *Layout of a small precision farming unit*

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Make a sketch of the layout of the precision farming unit you plan to set up. Mark the dimensions accurately.

Select tools and materials

3.5 Selecting materials

After the layout has been planned, the next step is to select materials. Table 3.5 will help you make decisions for gathering materials for the rooftop garden. You may recall some of these from Grades 6–8 *Kaushal Bodh* textbooks.

Table 3.5: Selection of materials

Materials	Use	Safety note
Seeds/saplings	For plant cultivation	Ensure viability (healthy, disease-free); handle gently to avoid crushing; store in a dry and cool place
Growing media (soil, cocopeat, vermicompost, sand and pot mix)	For seed germination and plant growth	Wear gloves, while handling to prevent skin irritation; wash hands thoroughly after handling organic media
Bamboo poles/metal frame	Framework for low-tunnel/humidity chamber/shade-net	Ensure bamboo or metal frames are securely fixed and free of sharp edges
Polyethylene sheet/ shade-net	Covering for tunnel/ humidity chamber/ shade-net	
Trays, pots and containers	Sowing of seeds and saplings	
Water hose pipe, drippers, micro-sprinkler, etc.	Irrigation	Ensure minimal wastage of water

3.6 Selecting tools

Table 3.6 below provides a list of tools necessary for developing the rooftop garden, along with their use and safe handling. You may recall some of these from the Grades 6–8 *Kaushal Bodh* textbook.

Table 3.6: Selection of tools

Tools	Use	Safety note
Hand trowel	Digging soil, planting seeds, transplanting seedlings	Do not leave sharp tools lying around; store safely after use.
Measuring tape	Marking systematic grid layout for beds and spacing	Use flexible tape to avoid sharp metal edges; store properly to prevent injury.
Hygrometer (humidity meter)	Measuring humidity in chamber	Handle carefully, as cover can break; do not expose to excess water.
Pruning scissors	Cutting stems, removing dried leaves, shaping plants	Handle carefully; keep blades closed when not in use.
Watering can/Spray bottle	Watering plants gently, especially seedlings	Avoid spilling water on the roof floor; keep a firm grip to prevent slipping.
Gloves	Protecting hands from soil, compost, and cuts	Always wear gloves, while handling soil or organic manure.
Measuring scale	Measure precise amounts	
Pipes	For drip irrigation system	
Hand tools	For making structures	As per protocols for using tools

Cost estimation and documentation

3.7 Making Bill of Materials

The Bill of Materials helps in estimating costs in advance, avoiding waste by buying only what is necessary and organising the work step by step. You can use the template in Table 3.7 or modify it to list your estimated materials and tools.

CASELET

Students of Government High School calculated the Bill of Materials for their work on 30 square metres of land. They planned to set up four plant beds, two for low-tunnel chambers (Figure 3.4) and two for open farming. They also planned to set up a humidity chamber, and leave space for a water tank and material storage.

With the help of the expert, they estimated the cost of tools, materials, technologies used, and the duration of the hands-on activity.

Figure 3.4: *Setting up a low-tunnel for precision farming*

Table 3.7: Bill of Materials

Items	Quantity	Estimated cost (in ₹)	Remarks (if any)
Trays	10	100	As per the space available on the roof
Bamboo sticks for low–tunnel frame	20 poles (about 2 m long)	200	Alternatives–wooden sticks, PVC pipes, iron rod
Mulching material	20 sq m	500	Alternatives–newspaper, used paper
Spinach seeds	250 g	150	Other alternative–seeds of any leafy vegetable
Total		**950**	

Cost of labour	Value (time spent in hours × hourly estimate × frequency per week)	Estimated cost (in ₹)	Remarks (if any)
Watering beds	0.25 × ₹10 × 12	30	
Marking of land and cleaning	0.5 hr × ₹25 (1 time activity)	12.50	
Making raised beds	2.0 × ₹25 × 2	100	
Making low-tunnel	1 hr × ₹25 (1 time activity)	25	
Total		**167.50**	

PORTFOLIO

Create a Bill of Materials for the work you will do.

3.8 Building a precision farming unit in school

Modes of crop protection

Besides protection, a humidity chamber or low-tunnel provides a warm and humid environment, and soil moisture, thereby supporting germination and reducing need for daily watering. You can use a humidity chamber for growing seedlings and then transfer them to a low-tunnel for controlled growth of healthier plants.

3.8.1 Humidity chamber for plant nursery

A humidity chamber is a small, specialised structure that provides extremely high, precise levels of moisture and temperature, making it ideal for the rapid growth of cuttings and seed germination.

TASK

Figure 3.5 shows three different ways to make a humidity chamber to grow saplings in a controlled environment.

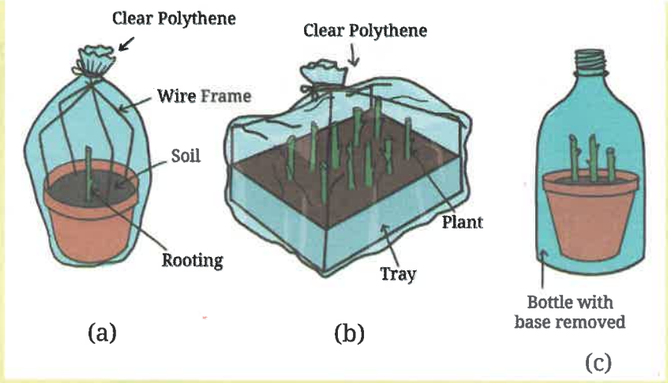

Figure 3.5: *Making a humidity chamber — (a) place a clear polythene bag over a pot, (b) over a tray or (c) place a pot inside a clear bottle whose bottom has been cut off*

3.8.2 Low-tunnel

Compared to a humidity chamber, a low-tunnel is a larger, less controlled structure. It primarily serves to extend the growing season by trapping solar heat and providing a protective barrier against harsh weather. This results in better crop quality and higher yields. Figure 3.6 shows how to make a simple low-tunnel.

Steps to Create a Simple Low-Tunnel

Step 1: Build a tunnel structure (frame) using bamboo, wood, or metal rods.

Step 2: Cover the frame with transparent polyethylene sheets to trap heat and moisture.

Step 3: At the base, spread a layer of sand and compost (1:1 proportion), which can be sprinkled with water to increase humidity.

(a) (b)

Step 4: Provide (a) small openings or (b) roll-up sides for airflow to prevent overheating, as required.

Figure 3.6: *Steps to create a low-tunnel*

You can place trays of water or use misting bottles inside the tunnel to maintain moisture levels. You can also place a DIY dry bulb-wet bulb thermometer or use a basic hygrometer (humidity meter) to regularly check and regulate humidity.

TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

Do-It-Yourself (DIY) weather monitor

To record temperature and humidity inside a humidity chamber, you can build a 'DIY weather monitor' with simple sensors and programming boards (Figure 3.7). Please refer to Project on Home Automation in Grade 8 *Kaushal Bodh*. You can also look for videos on assembling the circuit online.

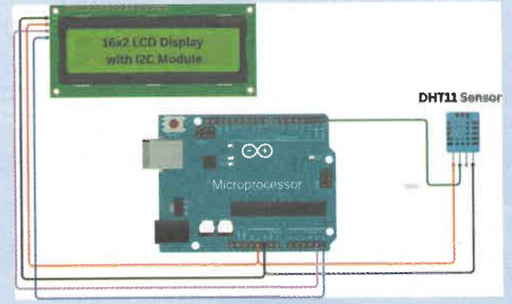

Figure 3.7: *DIY weather monitor*

TASK

You may have prepared plant seedlings by using plug or seedling trays and the stem cutting method (*Kaushal Bodh*, Grade 7). Now, observe the germination and growth of seedlings in a humidity chamber. Follow the simple steps for this activity:

1. Observe plants on a daily basis for germination (sprouting), growth, number of leaves, etc., and prepare an observation record.
2. Keep a record of the temperature and humidity in the humidity chamber.
3. Note any analysis or reflections, based on your observations.

3.8.3 Installation of drip irrigation system

Drip irrigation systems are used to deliver water drop by drop, directly to the root zone through drippers. Soil moisture sensors can be added to the system to ensure that water is given as per the need and when required.

Maintenance and monitoring

TASK

Setting up drip irrigation system

Figure 3.8 provides details related to setting up a drip irrigation system.

Step 1: Laying out pipes – Arrange main pipes and smaller lateral pipes, along the plant beds.
Step 2: Attach drippers – Fix small nozzles or emitters at intervals, close to the roots of each plant.
Step 3: Connect to water source – Attach the system to a tank or pump that supplies water.
Step 4: Add filter unit – Place a simple filter to prevent clogging of pipes and drippers.
Step 5: Control flow – Use valves to adjust how much water each part of the field/garden/nursery receives.
Step 6: Integrate 'fertigation' – Dissolve nutrients (fertilisers) in the irrigation tank, so that water and nutrients are delivered together in a measured amount.

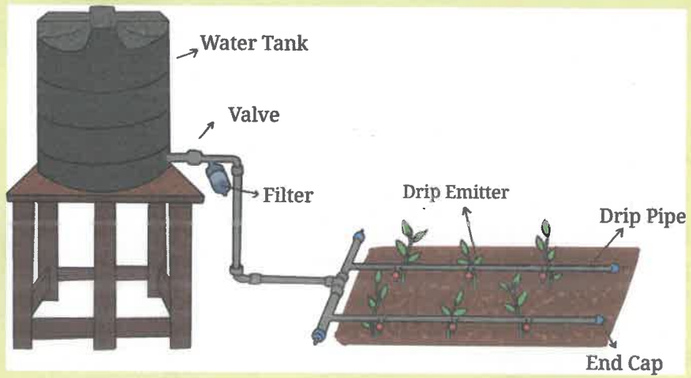

Figure 3.8: *Drip irrigation system*

TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

Do-It-Yourself (DIY) drip irrigation system with soil–moisture sensor

In precision farming, water is provided to plants through drip irrigation (micro-irrigation). The drip system can be automated with the help of soil–moisture sensors for precise water management (Figure 3.9).

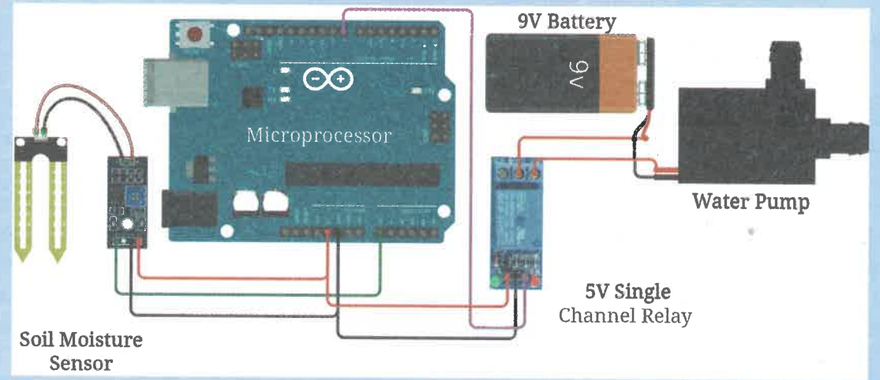

Figure 3.9: *Soil–moisture sensor*

3.8.4 Deciding quantity of organic fertiliser

You have learnt about testing soil for its texture (mason-jar test), and acidity or alkalinity of soil (soil pH test) in Chapter 1. In precision farming, soil nutrient management is achieved through precise measurement and supply of essential plant nutrients using a soil-sensor-based 'fertigation' (fertiliser supply through drip irrigation) system.

In this section, you will learn how fertiliser requirement can be estimated using a simple test.

Preparation of growing media

TASK

Rough estimation of organic carbon in soil

Take two soil samples in two small clear containers:

1. **Sample A (Control):** Soil without addition of compost
2. **Sample B (Test):** Soil enriched with compost. You will also need 3 per cent Hydrogen Peroxide (H_2O_2)

Step 1: Prepare the Samples – Place small and equal amounts of debris-free soil samples A and B in two separate containers.
Step 2: Add Hydrogen Peroxide – Pour hydrogen peroxide in both containers, such that both samples are saturated (wear safety gear during this step).
Step 3: Observe the Reaction – Observe both samples for immediate fizzing, bubbling or foaming as hydrogen peroxide reacts with the Organic Carbon (OC) in the soil (an oxidation reaction), releasing oxygen gas (O_2) (Table 3.8).

Table 3.8: Organic carbon content based on observation

Observation	Conclusion
No bubbling	Indicates poor or very low organic carbon
Light bubbling	Indicates moderate organic carbon
Intense effervescence and/or foam	Indicates good or high organic carbon

Calculating compost for maintaining from 1.5 per cent to 2 per cent organic carbon in soil

Soil must contain from 1.5 per cent to 2.0 per cent organic carbon for healthy plant growth. Organic carbon makes soil more porous for healthy root growth, enhances water-holding capacity of soil, increases nutrient availability and provides energy to beneficial microorganisms that support plant growth. Organic fertiliser is added to soil to maintain the desired amount of organic carbon.

To calculate the amount of compost required for maintaining from 1.5 per cent to 2.0 per cent organic carbon in soil, follow the steps in Figure 3.10.

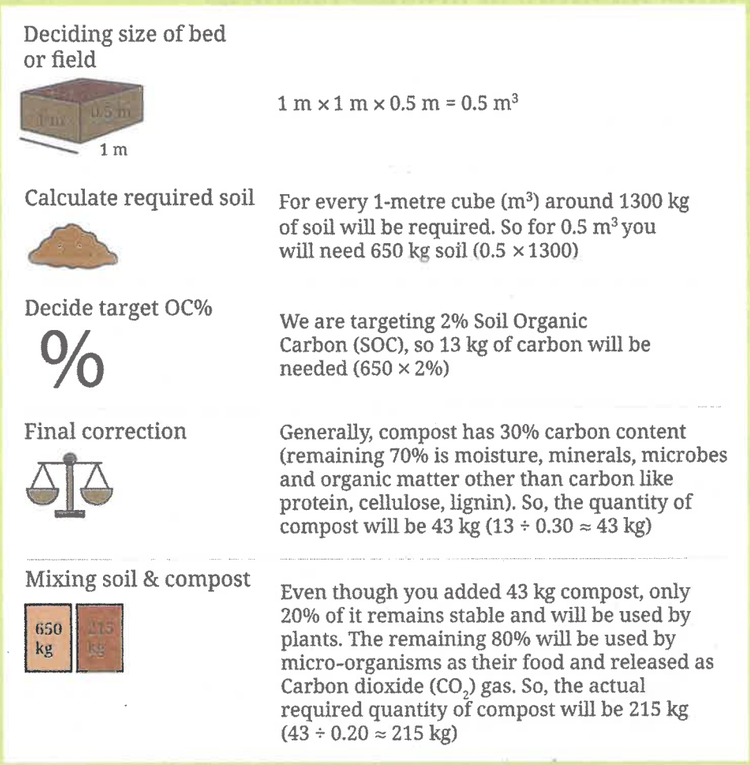

Figure 3.10: *Organic carbon in soil*

Once your soil and compost mix is ready with the known amount of organic carbon, you can use it for planting seedlings grown in the nursery.

3.9 Preparing an organic biofertiliser for nutrients

Maintenance and monitoring

Plants need essential nutrients during the growth stage. These nutrients can be supplied through organic fertilisers, liquid organic manure (*jīvāmṛita*, vermiwash, *pañchagavya*, compost tea, etc.) and compost (farmyard manure, vermicompost and kitchen waste compost).

In addition to these, synthetic (chemical) fertilisers and biofertilisers are also available. Biofertilisers are made from beneficial micro-organisms, like bacterial fungi and algae. These micro-organisms help plants absorb nutrients from the soil and also improve soil fertility. You will learn how to make a biofertiliser in this section.

TASK

Preparing a Lactic Acid Bacteria (LAB) culture

Lactic Acid Bacteria (LAB) culture is a useful biofertiliser containing beneficial lactic acid producing bacteria (Figure 3.11). You will need – Rice grains (500 g), clean water, milk (100 ml of any type of milk), glass jars, muslin cloth, rubber band and labels

1. Wash uncooked rice and collect the rinse water from the first two washes. Use only this water.

2. Pour the rinse water into a clean glass jar, filling it about two-thirds full. Cover the jar with a muslin cloth and secure it with a rubber band. Keep the jar at room temperature, away from direct sunlight, for 3 to 5 days; do not move it during this period.

	
3. After fermentation, a floating 'mat' will form on top. Pour out only the cloudy liquid beneath the mat. This liquid contains wild Lactic Acid Bacteria (LAB).	4. Mix one part of the fermented rice rinsed water with ten parts of milk. Pour this mixture into another clean jar, filling it, about two-thirds of the glass, and cover as before. Keep it in a dark place at room temperature for 3 to 5 days.
	
5. The jar contents will separate into solids (curds) and a yellowish liquid. Pour off the yellow liquid carefully as this is the active LAB culture. Store it in a clean bottle for use as biofertiliser.	6. Mix 1 L LAB culture in 9 L water and apply to plants through drip irrigation or direct application.

Figure 3.11: *Preparing Lactic Acid Bacteria (LAB) Culture.*

Remember–LAB culture has living micro-organisms (bacteria), so always use clean containers and utensils to avoid contamination. Do not shake or move the jars during fermentation, and keep the jars away from direct sunlight.

CASELET

Students of Government High School visited a nearby Krishi Vigyan Kendra (KVK) to understand different types of organic fertilisers and pesticides. They learnt that many bacteria and fungi are useful in farming. KVK's Subject Matter Expert (SME) gifted a packet of Trichoderma, a type of fungus (*Trichoderma viride*) to use as a biofertiliser. Students learnt that it is a very useful biopesticide, that lives on the surface of roots and helps the plant absorb nutrients like phosphorus. It releases lytic enzymes that dissolve the cell walls (outer skin) of harmful fungi, thereby protecting the plant. It also releases natural toxins, strong chemicals that kill harmful fungi and other pathogens.

3.10 Identification and management of pests

Maintenance and monitoring

You will need to protect your plants from harmful insect pests. As insects are part of the ecosystem, we must not eliminate them completely. Therefore, it is important to manage pest population in a way that balances crop protection with environmental health. Identification of harmful insect pests is the first step towards sustainable pest management.

You can build a simple light trap to identify various insects. A light trap is an eco-friendly pest management tool used by farmers. It uses a light source to attract and trap harmful insect pests in crop fields. Apart from identification of pests, a light trap can also help reduce the pest population.

TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

Do-It-Yourself (DIY)

Light Dependent Resistor (LDR) sensor for an insect trap

You can automatically switch on and switch off your insect trap during night and day, using an LDR sensor (Figure 3.12).

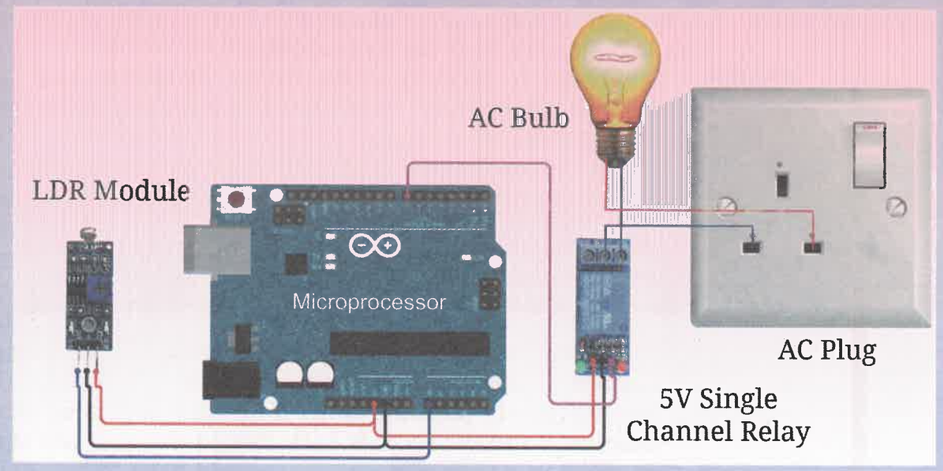

Figure 3.12: *Light Dependent Resistant (LDR) sensor*

TASK

Indian Council of Agricultural Research (ICAR) has launched a mobile-based pest identification and surveillance application named National Pest Surveillance System (NPSS). It uses Artificial Intelligence (AI) and Machine Learning (ML) technology for identification of insect pests in farming.

Identify the insects on the plants or those collected in the light trap using the mobile app.

1. What is their role in the ecosystem?
2. What value do they add to the ecosystem?
3. How many of them are pests (harmful for your plants)?

Harvesting, packaging and storage

3.11 Harvesting, packaging and storage of produce

Harvesting is the stage, where all the care and effort put into rooftop gardening yield results. The timely collection of produce is very important, because it ensures both quality and a longer shelf life of fruits, vegetables and herbs. If harvesting is delayed, the produce may become overripe, lose taste or spoil quickly. You have already learnt the basics of harvesting in Grade 6 *Kaushal Bodh* for nursery plants and Grade 8 *Kaushal Bodh* for hydroponics.

In precision farming, data-driven decisions and use of sensors help reduce crop losses, maintain quality and therefore fetch better prices.

1. **Using data to determine time for harvesting:** Harvesting should be done when the temperature and humidity are the lowest. Use data (for example, temperature and humidity trends) from the DIY school meteorological observatory or the website of the meteorological department to decide the best time of day for harvesting.
2. **Climate-controlled storage:** Imagine you have just harvested a batch of fresh spinach. If the air is too dry, the leaves will wilt (become limp). If the air is too damp (high humidity) and the room is dark, mould (fungus) will start to grow. In a normal room, you would have to manually open windows or turn on fans. In precision farming, sensors do this automatically. A humidity sensor can send a signal to the drip irrigation system or a fan. Similarly, some produce stays fresh longer in the dark since the area remains cooler – a Light Dependent Resistor can detect if a door was left open or if the sun is too bright, and automatically pull down shades or turn off the lights.
3. **Smart packaging:** Sensors to track humidity and temperature can be placed within packaging for monitoring during transport, ensuring lower losses compared to traditional methods. You can also create a QR code for the label of your package with information related to the origin of the produce, the date of harvest and the specific precision techniques (like drip irrigation) used during growth.
4. **Using data for other decisions:** Apps like Fasal and Kisan Suvidha can be used for weather updates as well as for monitoring market prices, which will help make decisions related to how long produce can be stored before selling it for the best price.

3.12 While setting up your precision farming unit

1. Use data related to agro-climatic conditions in your region for plant selection as well as making the decision–whether to use shade-net, a low-tunnel or greenhouse structure.
2. Prepare a precision nursery (humidity chamber, shade-net) for growing healthy plant seedlings.
3. Test soil and use right quantity of organic fertilisers for adjusting Soil Organic Carbon (SOC).
4. Use sensors for monitoring weather parameters (for example, temperature, humidity) and use micro-irrigation (for example, drip) for healthy plant growth.
5. Identify insect pests and diseases harming your plants and manage them by using organic pesticides.
6. Use compost and biofertiliser for healthy plants growth and yield.

3.13 Assess your learning

1. Describe the role of digital tools in precision farming. How do they change the way decisions are made on farms?
2. Create a safety checklist for the tools you used, including digital tools.
3. During a visit to a precision farming unit, list the key aspects you would observe to understand how precision techniques are applied.

4. A farmer is using random compost application in one nursery bed and measured compost in another.
5. You are asked to design a nursery layout. How would you ensure uniform growth and optimal use of resources?
6. 'With the help of technology, you can grow anything, anywhere, anytime.' Do you agree with this statement? Give two examples to support your answer. If a farmer has limited water resources, how can precision farming techniques help them use water more efficiently?
7. Suggest one low-cost innovation that could help small farmers adopt precision farming practices.
8. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
9. Give examples of how you can apply your learning in a real-life situation.

CHAPTER 4

Additional Vocations

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Mushroom Cultivation

Mushrooms grow from spores, not seeds and develop through a network called mycelium (which acts as 'roots' to absorb nutrients). The essential conditions for mushroom cultivation include proper temperature, humidity, ventilation and hygiene; these conditions can be recreated in moist, dark and cool environments.

Keywords

- **Sterilisation:** cleaning and removing germs or other organisms from the growth medium (substrate)
- **Mycelium:** root-like network that spreads in the substrate (similar to the mould that develops on the bread)
- **Spawn:** a substrate that has growing mycelium in it (acts like a growth initiator for mushroom growth)
- **Inoculation:** adding spawn into a larger sterilised substrate
- **Incubation:** providing conditions where the inoculated substrate grows (mycelium growing to the entire substrate)

Item/Material name	Description/Use
Spawn	Seed material for mushroom growth
Substrate (Straw/Sawdust/Compost)	Base medium for mushroom growth
Gypsum/Bran/Nutrient Additives	To enrich the substrate
Poly Bags/Trays	For holding the growth medium
Pressure Cooker/Drum	For sterilising substrate
Sprayer/Mist Bottle	To maintain moisture
Thermometer/Hygrometer	For monitoring temperature and humidity
Gloves and Masks	For hygiene during inoculation
Knife/Scissors	For cutting straw and harvesting

Quality parameters

Substrate: Clean, pasteurised straw/sawdust (no odour or mould)

Spawn: White, fresh, uncontaminated mycelium

Environment: Tempeture should be 25–30°C

Humidity: 80–90 per cent; good air flow

Moisture: Substrate damp, not soggy

Harvest: Firm white caps (not flattened or brown)

Storage: Cool at 4–8°C; use ventilated packs

Safety parameters

Hygiene: Clean area, pest-free, no stagnant water

Personal: Gloves, mask, apron; wash hands before handling

Tools: Keep electrical tools dry; handle heaters safely

Chemicals: Use mild disinfectants only.

Waste: Compost spent substrate; clean trays regularly

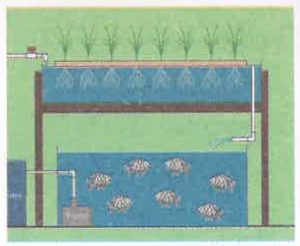
Edibility: Grow only known edible varieties

Key steps in the process

1. **Selection and site design:** Selection of mushrooms as per agro-climatic conditions; design layout for growing area (For example, polybags/trays in shaded area with ventilation and humidity control).
2. **Growth medium preparation:** Testing of growth medium (pH, soil solution, organic carbon, squeeze and mycelium growth) and amendment; sterilisation.
3. **Initiating growth and management:** Preparation and inoculation of spawn; incubation; arrangement in containers.
4. **Management:** Determining irrigation requirements (squeeze test); setting up methods (drip, humidity container); troubleshooting (gaps in sterilisation, maintaining conditions), pest identification and using organic pesticides.
5. **Monitoring growth (physical observation):** Tracking conditions (humidity, temperature, sunlight), observing growth of mushroom (height, colour, change in smell, structure, etc.).
6. **Harvesting, storage and packing:** Identifying when mushrooms are ready for harvesting (caps fully grown, gills visible, firm, etc.); harvesting between flush intervals; different storage methods (paper bags/refrigeration/avoiding plastic bag).

Aquaponics

Aquaponics is a sustainable system that naturally integrates fish (aquaculture) and plant cultivation (hydroponics), making it an efficient method for growing vegetables and raising fish at the same time. In an aquaponics system, plants grow without soil, supported in media beds or floating rafts and thrive in conditions with proper water quality, oxygen, temperature and light.



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Keywords

Nitrogen cycle: The process where bacteria convert fish waste into nutrients for plants

Biofilter: Consists of beneficial bacteria, which purify water

Flow rate: Rate at which water moves through the system

Item/Material name	Description/Use
Fish tank	Holds fish and nutrient water
Grow beds	Area where plants grow
Tubing	Moves water through the system
Grow media (gravel/clay pellets)	Supports roots and filters water
Pump	Circulates water to grow beds
Aerator	Adds oxygen for fish
Timer switch	Automates pump cycles
Seeds/Seedlings	Plants for cultivation
Fish feed	Nourishes fish to create nutrients
Water testing kit	Checks pH, ammonia, oxygen and temperature

Safety parameters

Handle with care: Keep electric parts dry

Hygiene: Wash hands before and after work

Protection: Use gloves during cleaning

Dry workspace: Avoid slips and falls

Chemical safety: Be cautious while testing water

Heavy items: Lift tanks or beds safely

Clear labeling: Mark feed and test kits properly

Fish ethics: Avoid overcrowding, handle gently

Quality parameters

Water clarity: Clean and odour-free

pH balance: Slightly acidic to neutral

Plant health: New leaf growth

Fish activity: Active movement, feeding regularly

System flow: Smooth circulation, no blockages

Sustainability check: Minimal water use, no chemicals

Key steps in the process

1. **Designing aquaponics system:** Selection of space; measurement, preparation and assembling materials as per specifications; fabrication of systems (fish tanks, hydroponics system, water pump, timer switch installation and selection of compatible fish–plant pair).
2. **Preparation of grow beds:** Filling with media, that is, gravel or clay pellet, creating bell siphon for filling and draining water to fish tank, testing water quality (pH, nitrate, nitrite, dissolved oxygen)—making amendments.

3. **Initiate growth:** Initiate nitrogen cycle before full fish load (add few fish or ammonia additive), introduce beneficial bacteria (natural colonisation or biofilter media, that is, the gravel or clay pellets); transplant seedlings into grow beds with correct spacing.
4. **Managing the system:** Track water levels and flow rate, recirculation of water, fish feeding based on weight, ensuring proper drainage and overflow control.
5. **Monitoring growth:** Observing and recording plant growth, observing fish behaviour for any disease or stress.
6. **Harvesting, storage and packing:** Harvesting plants as per maturity parameters (change in colour/shape/maturity of leafy vegetables, fruit vegetables and recording yield).

Pisciculture

Fish grow in water systems and their health depends on maintaining the right environmental conditions, such as clean water, appropriate temperature, dissolved oxygen and regular feeding. While fish are naturally farmed in rivers and ponds across many states, suitable growing conditions can also be created in controlled environments.

Key words

Aeration: Adding air or oxygen to the water to help fish stay healthy

Plankton: Tiny plants and animals floating in water that serve as natural food for fish

Spawn: Newly hatched baby fish

Juveniles: Young fish that are older and stronger than spawn

Item/Material name	Description/Use
Pond/tank	Holds fish and nutrient water
Nets	Sampling, catching, and harvesting fish
Feeding trays	Helps monitor feeding and reduces wastage
Buckets	For transporting seed, feed, or harvested fish
Lime and organic manure	Improve pond's soil and water quality
Aerator	Adds oxygen for fish.
Pipes	Manage clean water entry and drainage
Water testing kit	Checks pH, ammonia, oxygen and temperature
Fish feed	Nourishes fish

Quality parameters	Safety parameters
Site prep: Cleaned pond base, apply lime/manure correctly	**Protection:** Use gloves, non-slippery footwear
Pond: Clear, no foul odour	**Chemical safety:** Be cautious while testing water, apply lime/manure in correct dose
Ethical practices: No injuries to fingerlings.	**Fish ethics:** Avoid overcrowding, handle gently
Water clarity: Clean and odour-free	**Equipment safety:** Maintain aerators and electrical lines to prevent shocks or accidents
Fish activity: Active movement, feeding regularly	
Harvest: No deformity or signs of disease	
Storage: Kept cool, handles hygienically	

Key steps in the process

1. **Layout:** Selection of site, measuring and assembling materials, removal of weeds, ensuring proper inlet/outlet.
2. **Preparation of fish pond:** Filling clean water, testing water quality (pH, dissolved oxygen, temperature, ammonia, nitrite), making amendments.
3. **Initiate growth:** Add cow dung slurry/manure before introducing fish to stimulate natural plankton (starter food), introducing spawn or older juveniles into the pond based on size.
4. **Managing the system:** Feed rice bran, vegetables like kale, spinach, feed twice daily, install feeding trays for observation, avoid overfeeding (leads to ammonia), remove debris/fallen litter.
5. **Monitoring growth:** Take samples using nets every 2 weeks for observation, measure average weight, adjust feed accordingly; observe fish behaviour, feeding response, and signs of stress or disease.
6. **Harvesting, storage and packing:** Observing matured fish (size of fish as per marketable size), harvesting using net or draining of water, storage in refrigerator, sorting as per size and quality.

Backyard Poultry

Poultry farming does not necessarily need large spaces, instead it can be managed in small spaces like home courtyards, verandas or simple sheds made from locally-available materials. Well-being of poultry depends on suitable housing, balanced feed, clean drinking water and protection from predators. The essential conditions for successful poultry rearing include proper ventilation, warmth for young chicks, hygiene of the coop and regular health checks.

Keywords

Coop A small shelter or house where chickens are kept safe and protected

Brooder Special warm house for very young chicks

Feeding response How actively and eagerly chicks eat their food, showing their health

E. coli Bacteria found in contaminated water and causes sickness in humans and chickens

Wet bedding Damp litter on the floor that must be removed to prevent disease

Item/Material name	Description/Use
Nesting boxes	Space for hens to lay clean, protected eggs
Bedding material	Keeps the coop dry and comfortable
Fencing/Mesh	Prevents predators and keeps birds contained
Feed (grains, mash, kitchen greens)	Nutrition for growth and egg production
Cleaning tools	Maintain hygiene inside the coop
Health kit	For cleaning, parasite control and minor illnesses
Lighting bulb/Solar lamp	Provides light for safety and improves laying of eggs in winter

Quality parameters

Bird health: Active behaviour, clean eyes, good appetite, normal droppings

Egg quality: Clean shells, good shape, consistent size

Feed quality: Fresh, dry, balanced feed; no mould

Water quality: Clean, changed daily

Housing quality: Dry, ventilated, predator-proof coop

Hygiene: Regular cleaning, dry bedding, low ammonia smell

Security: Limited outsider entry, separate sick birds

Safety parameters

Coop safety: Strong fencing, secure doors, raised floor

Bird safety: Gentle handling, separation of aggressive or sick birds

Feed safety: Store feed in closed containers; avoid spoiled or contaminated feed

Cleanliness: Regular coop cleaning to prevent parasites and infections

Water safety: Provide clean water; prevent contamination from droppings

Environmental safety: Safe disposal of waste and dead birds; maintain good ventilation

Key steps in the process

1. **Layout:** Selection of site (clean, dry, removal of debris), for coop-elevation (if possible) to avoid water logging, using jute sac to build walls, litter layer with rice husk/sawdust on the floor as bedding, for brooder-cardboard or wooden box, electric bulb, bowl for water, sawdust, etc.
2. **Preparing the coop:** Access to fresh water and feed, set up of poultry shed (proper ventilation, sunlight, barriers from predators), water testing (for E.coli infection).
3. **Initiate growth:** Introducing clean and disinfected chicks in the coop, maintain temperature conditions.
4. **Managing the coup:** Regular cleaning, replacing drinking water, remove wet bedding, feeding the chicks as per requirement.
5. **Monitoring growth:** Observing chick activity, feeding response, signs of illness, egg laying per bird, etc.
6. **Harvesting, storage and packing:** Collecting eggs gently and storing in cool place, handling mature chickens safely for transport who have reached the desired height, etc.

Non-Timber Forest Produce

Non-Timber Forest Produce (NTFP) includes a wide variety of natural products, such as honey, medicinal plants, resins, gums, fruits, seeds, leaves and bamboo–items that support nutrition, health and livelihoods without cutting down trees. While most NTFP collection happens in natural forest conditions, processing steps, such as drying, sorting or extraction can easily be carried out in community spaces.

Keywords

Sustainable: Using natural resources in a careful way so they can continue to grow and be available for future use

Lac: A natural resin produced by a tiny insect that lives on certain trees (ber, kusum). It hardens on the branches and is collected to make products like varnish, toys, dyes and polishes.

Mulching: Covering the soil with materials, like dry leaves, straw, grass or plastic sheets to protect it and help plants grow better.

Item/Material name	Description/Use
Collection basket/Bag	Gather leaves, seeds, fruits, gums without damage
Sickle/Hand pruner	Cut grasses, twigs and mature leaves
Knife/Blade	Trim bark, scrape gums/resins
Gloves	Protect hands during harvesting and handling
Storage jars/Containers	Store dried NTFPs and keep moisture out
Sieves	Remove dirt and impurities from collected material

Quality parameters	Safety parameters
Collection tools: Clean, sharp, safe, non-contaminated	**Personal safety:** Use gloves and proper footwear
Suitable collection site: Unpolluted forest area, no chemical exposure	**Tool safety:** Handle sickles/knives carefully, store safely
Right maturity stage: Leaves, seeds, gums, resins, or flowers at proper maturity	**Environmental safety:** Avoid disturbing wildlife
Sustainable harvesting: No uprooting; partial collection; avoid damaging host trees	**Fire safety:** Keep drying areas away from open flames and extremely dry plant materials
Clean handling: Remove debris, avoid contamination, use gloves	

Key steps in the process

1. **Selection of area:** Identification of NTFP, selection of safe and accessible forest area for collection; with sustainable practices and minimal disturbance.
2. **Maintaining growth medium of NTFP:** Soil testing (texture, moisture), gathering meteorological data (climate), sunlight availability, etc.
3. **Management of the NTFP/Host to NTFP:** Cleaning around the area, removing plastic waste/spoiled produce, protection from human activities, mulching or adding leaf–litter compost.
4. **Monitoring of the NTFP/Host to NTFP:** Observing and tracking health, checking for signs of stress, pests, stage of maturity, etc.
5. **Harvesting, packing and storage:** Safe use of tools to harvest targeted parts of the NTFP (leaves, seeds, twigs for lac, etc.), cleaning of the harvest (sorting, removing dirt, drying), storage (cloth, tie in bundles) and packaging (airtight, plastic or carboard box).

Unit II

Work with Machines and Materials

From the time humans first shaped a stone into a tool, our progress has been closely linked with our ability to use materials and build machines. Every object around us–a clay pot, a wooden chair, a bicycle or a computer–tells a story of how we have learnt to transform raw materials from nature into useful products.

Working with machines and materials means understanding both the characteristics of materials, and the tools and processes used to shape them. Whether it is forging iron, weaving fabric or building a bridge, each activity combines knowledge, skill and creativity.

In ancient India, people showed remarkable craftsmanship–the Iron Pillar of Delhi, the rock-cut caves of Ellora and the textiles of the Sindhu–Sarasvatī civilisation–all reflect deep understanding of materials and techniques. Today's industries are built upon the foundation of these traditions.

In today's world, technological advances are not only increasing efficiency but also protecting workers. 'Smart systems' are being developed that can warn workers of potential accidents and enable them to take preventive measures. For example, 'smart' helmets and vests are equipped with sensors that monitor heart rate, body temperature and even posture. Thus, if a welder's body temperature rises to a dangerous level, or a technician's spine and limbs are placed at dangerous angles, a warning will be given. Technology is also taking over jobs that are dangerous, for example, climbing up a tower to check for structural cracks or checking areas for gas leaks or structural damage.

With the arrival of machines and industrialisation, production became faster and more precise. Modern tools, automation and digital technology now help us design and make things more efficiently than ever before. Yet, the basic principles remain the same–selecting the right material based on its properties, using the right process and handling tools and machines safely and skilfully.

Supply chains, Safety and Quality Control, Transport, Advertisement, Waste management, Machinery manufacturer, Electricity, Infrastructure

Shaping Materials

Carpentry
Furniture, Construction, Utility

Pottery
Sanitaryware, Tableware, Decorative items

Construction
Houses, Factories, Infrastructure

Metal processing
Mould prep, Casting, Moulding, Fabrication, Machining

Textile, Apparels and Fashion
Raw material, Textile, Fashion

Plumbing
Housing, Industrial, Agricultural

Sheet Metal Work
Automobile, Packaging, Fabrication

Working with Food
Dairy, Meat and poultry, Fruits and vegetables

Decorator, Carpenter, Artisan

Ceramic engineer, Potter, Mould maker, Foundry worker

Engineer, Architect, Tradesperson, Labourer

Lathe machine technician, Mould maker, Foundry technician

Tailor, Weaver, Designer, Artisan

Plumber, Pump technician, Service and maintenance technician

Sheet metal fabricator, Welder

Chef, Baker, Butcher, Pickle maker, Barista

The figure overleaf depicts the livelihood ecosystem related to machines and materials. A livelihood ecosystem is an interconnected network of resources, people, institutions, activities and environmental factors that enable individuals to earn a living, while contributing to society and nation. For instance, the livelihood ecosystem related to machines and materials varies across geographies, depending on the availability of raw materials (like metal and wood) access to machines and tools (manual, electrical or automated); support services (like technicians and repair workers); infrastructure (like electricity) access to markets (like transportation) and the demand for manufactured goods at local, national or global levels. Further, this implies that no work is done in isolation–different kinds of work are deeply connected. For example, if demand for a particular kind of product reduces, then the manufacturer will not be the only one affected. Slowly, requirement for transport, production of agricultural equipment and of technicians will also decrease. As you can see from the figure, there are a range of opportunities related to working with machines and materials. Besides construction and manufacturing, the vocational area includes working with wood, bamboo and food as well as apparels, fashion, textiles, plumbing, pottery and sheet metal work; the list is long. Each level in the figure provides details of the kind of work that can be done in this area. The last level indicates the interlinkages between the work in the area and various other allied work that enable working with machines and materials, while ensuring that society benefits.

In this chapter, you will explore how materials are selected, how they can be measured, shaped and joined, and how machines make this transformation possible. It will help you trace a journey–from matter to machine and from idea to creation.

This unit will give you the opportunity to do work related to machines and materials. It is called 'Shaping materials' because you will select materials based on their properties and process them into useful products. This unit offers illustrations of seven vocations, as explained in the paragraphs below.

Chapter 5 introduces key concepts and processes that are common across a range of work related to machines and materials. This chapter is mandatory for you. Chapters 6 to 8 use the common concepts and processes to help you understand how to do specific work. At the same time, they also introduce additional concepts and processes that you can learn, while doing. Chapters 6 and 7 detail work related to construction and apparel, respectively. Chapter 8 contains guidelines for sheet metal work, plumbing, food processing, furniture making and pottery.

To reiterate, you can choose to do work related to any of these seven vocations or you can select something related to shaping materials that is entirely different. Remember to consult your teacher and/or an expert for guidance at all points. Work is to be done in groups. Remember–a big part of work is doing it together.

CHAPTER 5

Shaping Materials

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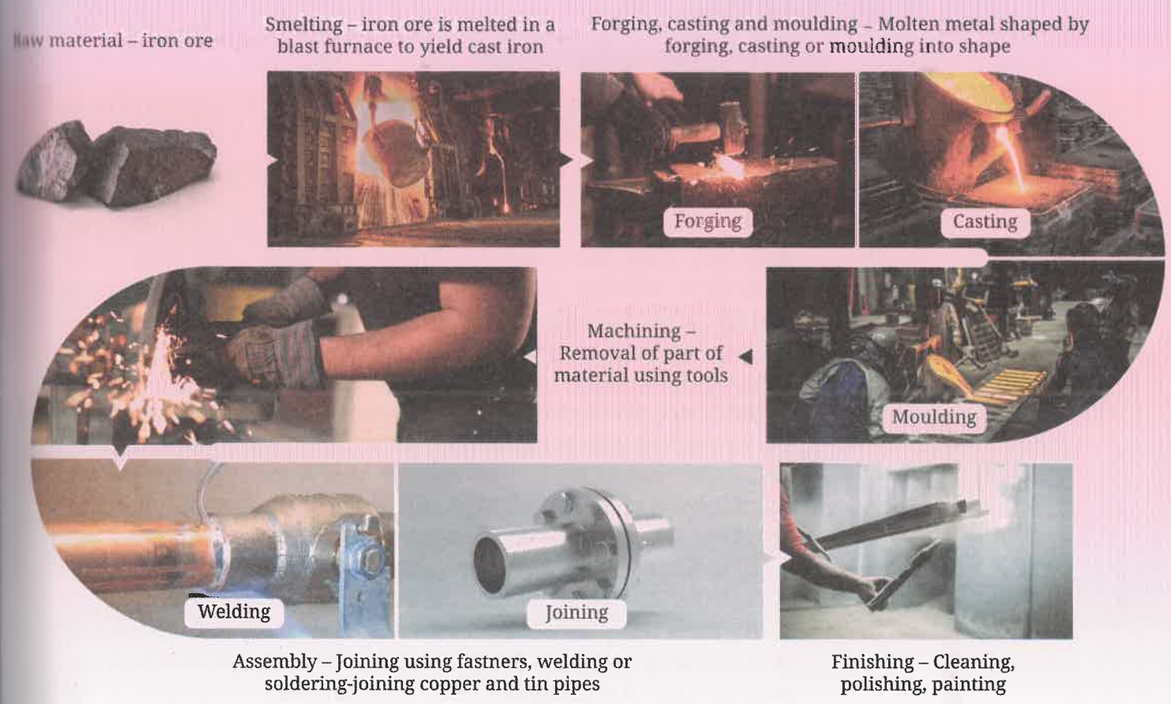

Figure 5.1: *Materials are shaped into products through different processes*

All materials come from nature, and we shape them into different forms. The process involves gathering raw materials and manufacturing them into finished products through various processes (Figure 5.1).

In this chapter, you will

Explore different kinds of materials and their characteristics	Understand common processes related to shaping materials	Identify different tools for measurement and their applications
Select materials based on their characteristics	Understand safety protocols	Read technical drawing accurately
Create simple technical drawings	Understand quality criteria	Explore vocations related to shaping materials

Importance of work

5.1 Introduction

India has a rich history of shaping materials through various processes to suit specific needs. To illustrate, evidence from the Sindhu–Sarasvatī civilisation reveals that houses were built with bricks of the same size. Harappans mass produced bricks of a standard size, ensuring perfect fit and uniform strength. This involved moulding the wet clay and then controlling the firing process (curing) in large kilns to achieve the hardness and durability required for building. Besides bricks, intricate copper and brass objects, like the famous 'Dancing Girl' were created using casting.

Evidence also exists of the knowledge of working with iron. For example, a pillar made of purified iron was created during the fourth century CE. This pillar, which now stands in the Qutub Minar complex in Delhi, still has not rusted as this natural property of iron has been changed due to a protective layer.

The Kailāśha Temple in Ellora; the Koṇārka temple in Puri, Odisha; the Bṛihadīśhvara Temple in Thanjavur; and many such temples across India stand testament to the skills of the engineers who designed and constructed them, their patience and hard work. Their work shows evidence of deep practical craftsmanship, and an understanding of concepts related to metallurgy, architecture, and engineering.

In the more recent past, carpenters, blacksmiths, weavers, tailors, masons, cobblers, oil pressers, potters, jewellers and others were present in every village. These professionals learnt about the characteristics of materials and how to shape them, using practical knowledge of metallurgy, construction, textiles, soil, etc., as well as the use of tools for making agricultural implements, pots, vessels, jewellery, weapons, etc. Manufacturing in earlier times solely depended on the skills of individuals being passed on from generation to generation.

DID YOU KNOW?

Materials with unexpected characteristics

Our planet is truly remarkable. It is filled with materials, each one with fascinating characteristics that are useful in countless ways. Some materials have unusual characteristics or are procured from unexpected sources.

Glass from sand: The transparent, hard material used in windows and jars is made simply by heating fine sand to very high temperatures until it melts.

Obsidian: It is a naturally occurring glass formed from the lava extruding from volcanoes. A blade made from obsidian can be 500 times sharper than a surgeon's steel scalpel.

Artificial spider silk: Natural spider silk is five times stronger than steel by weight. Scientists have successfully engineered a way to create artificial spider silk using bacteria fed on sugar, creating a biodegradable material with immense potential for advanced textiles (such as parachute fabric and protective clothing) and industrial applications.

After industrialisation, many manual tools were replaced by electric power tools. This increased the efficiency of processes, and the pace and quality of production. As a result, traditional jobs and skills were replaced with new kinds of work, while some basic skills, like measurement, design, safety precautions and testing products for quality persisted.

The manufacturing sector contributes about 17–18 per cent of India's Gross Value Added (Ministry of Statistics and Programme Implementation, National Accounts Statistics 2025) and remains an important source of employment.

Importance of work

Value addition

Whenever we transform materials from their natural form to useful products through various processes, their value increases. For example, the value of a simple stone lying on the hillside increases manifold when a craftsman chisels a statue out of it.

Selling a material in its natural form costs less than a finished product. As shown in the example of cotton (Figure 5.2), if we convert cotton to fabric and fabric to garment, then its value increases substantially.

Value chain of work

3. **Initiate growth:** Initiate nitrogen cycle before full fish load (add few fish or ammonia additive), introduce beneficial bacteria (natural colonisation or biofilter media, that is, the gravel or clay pellets); transplant seedlings into grow beds with correct spacing.
4. **Managing the system:** Track water levels and flow rate, recirculation of water, fish feeding based on weight, ensuring proper drainage and overflow control.
5. **Monitoring growth:** Observing and recording plant growth, observing fish behaviour for any disease or stress.
6. **Harvesting, storage and packing:** Harvesting plants as per maturity parameters (change in colour/shape/maturity of leafy vegetables, fruit vegetables and recording yield).

Pisciculture

Fish grow in water systems and their health depends on maintaining the right environmental conditions, such as clean water, appropriate temperature, dissolved oxygen and regular feeding. While fish are naturally farmed in rivers and ponds across many states, suitable growing conditions can also be created in controlled environments.

Key words

Aeration: Adding air or oxygen to the water to help fish stay healthy

Plankton: Tiny plants and animals floating in water that serve as natural food for fish

Spawn: Newly hatched baby fish

Juveniles: Young fish that are older and stronger than spawn

Item/Material name	Description/Use
Pond/tank	Holds fish and nutrient water
Nets	Sampling, catching, and harvesting fish
Feeding trays	Helps monitor feeding and reduces wastage
Buckets	For transporting seed, feed, or harvested fish
Lime and organic manure	Improve pond's soil and water quality
Aerator	Adds oxygen for fish.
Pipes	Manage clean water entry and drainage
Water testing kit	Checks pH, ammonia, oxygen and temperature
Fish feed	Nourishes fish

Quality parameters	Safety parameters
Site prep: Cleaned pond base, apply lime/manure correctly	**Protection:** Use gloves, non-slippery footwear
Pond: Clear, no foul odour	**Chemical safety:** Be cautious while testing water, apply lime/manure in correct dose
Ethical practices: No injuries to fingerlings.	**Fish ethics:** Avoid overcrowding, handle gently
Water clarity: Clean and odour-free	**Equipment safety:** Maintain aerators and electrical lines to prevent shocks or accidents
Fish activity: Active movement, feeding regularly	
Harvest: No deformity or signs of disease	
Storage: Kept cool, handles hygienically	

Key steps in the process

1. **Layout:** Selection of site, measuring and assembling materials, removal of weeds, ensuring proper inlet/outlet.
2. **Preparation of fish pond:** Filling clean water, testing water quality (pH, dissolved oxygen, temperature, ammonia, nitrite), making amendments.
3. **Initiate growth:** Add cow dung slurry/manure before introducing fish to stimulate natural plankton (starter food), introducing spawn or older juveniles into the pond based on size.
4. **Managing the system:** Feed rice bran, vegetables like kale, spinach, feed twice daily, install feeding trays for observation, avoid overfeeding (leads to ammonia), remove debris/fallen litter.
5. **Monitoring growth:** Take samples using nets every 2 weeks for observation, measure average weight, adjust feed accordingly; observe fish behaviour, feeding response, and signs of stress or disease.
6. **Harvesting, storage and packing:** Observing matured fish (size of fish as per marketable size), harvesting using net or draining of water, storage in refrigerator, sorting as per size and quality.

Backyard Poultry

Poultry farming does not necessarily need large spaces, instead it can be managed in small spaces like home courtyards, verandas or simple sheds made from locally-available materials. Well-being of poultry depends on suitable housing, balanced feed, clean drinking water and protection from predators. The essential conditions for successful poultry rearing include proper ventilation, warmth for young chicks, hygiene of the coop and regular health checks.

Keywords

Coop A small shelter or house where chickens are kept safe and protected

Brooder Special warm house for very young chicks

Feeding response How actively and eagerly chicks eat their food, showing their health

E. coli Bacteria found in contaminated water and causes sickness in humans and chickens

Wet bedding Damp litter on the floor that must be removed to prevent disease

Item/Material name	Description/Use
Nesting boxes	Space for hens to lay clean, protected eggs
Bedding material	Keeps the coop dry and comfortable
Fencing/Mesh	Prevents predators and keeps birds contained
Feed (grains, mash, kitchen greens)	Nutrition for growth and egg production
Cleaning tools	Maintain hygiene inside the coop
Health kit	For cleaning, parasite control and minor illnesses
Lighting bulb/Solar lamp	Provides light for safety and improves laying of eggs in winter

Quality parameters

Bird health: Active behaviour, clean eyes, good appetite, normal droppings

Egg quality: Clean shells, good shape, consistent size

Feed quality: Fresh, dry, balanced feed; no mould

Water quality: Clean, changed daily

Housing quality: Dry, ventilated, predator-proof coop

Hygiene: Regular cleaning, dry bedding, low ammonia smell

Security: Limited outsider entry, separate sick birds

Safety parameters

Coop safety: Strong fencing, secure doors, raised floor

Bird safety: Gentle handling, separation of aggressive or sick birds

Feed safety: Store feed in closed containers; avoid spoiled or contaminated feed

Cleanliness: Regular coop cleaning to prevent parasites and infections

Water safety: Provide clean water; prevent contamination from droppings

Environmental safety: Safe disposal of waste and dead birds; maintain good ventilation

Key steps in the process

1. **Layout:** Selection of site (clean, dry, removal of debris), for coop-elevation (if possible) to avoid water logging, using jute sac to build walls, litter layer with rice husk/sawdust on the floor as bedding, for brooder-cardboard or wooden box, electric bulb, bowl for water, sawdust, etc.
2. **Preparing the coop:** Access to fresh water and feed, set up of poultry shed (proper ventilation, sunlight, barriers from predators), water testing (for E.coli infection).
3. **Initiate growth:** Introducing clean and disinfected chicks in the coop, maintain temperature conditions.
4. **Managing the coup:** Regular cleaning, replacing drinking water, remove wet bedding, feeding the chicks as per requirement.
5. **Monitoring growth:** Observing chick activity, feeding response, signs of illness, egg laying per bird, etc.
6. **Harvesting, storage and packing:** Collecting eggs gently and storing in cool place, handling mature chickens safely for transport who have reached the desired height, etc.

Non-Timber Forest Produce

Non-Timber Forest Produce (NTFP) includes a wide variety of natural products, such as honey, medicinal plants, resins, gums, fruits, seeds, leaves and bamboo–items that support nutrition, health and livelihoods without cutting down trees. While most NTFP collection happens in natural forest conditions, processing steps, such as drying, sorting or extraction can easily be carried out in community spaces.

Keywords

Sustainable: Using natural resources in a careful way so they can continue to grow and be available for future use

Lac: A natural resin produced by a tiny insect that lives on certain trees (ber, kusum). It hardens on the branches and is collected to make products like varnish, toys, dyes and polishes.

Mulching: Covering the soil with materials, like dry leaves, straw, grass or plastic sheets to protect it and help plants grow better.

Item/Material name	Description/Use
Collection basket/Bag	Gather leaves, seeds, fruits, gums without damage
Sickle/Hand pruner	Cut grasses, twigs and mature leaves
Knife/Blade	Trim bark, scrape gums/resins
Gloves	Protect hands during harvesting and handling
Storage jars/Containers	Store dried NTFPs and keep moisture out
Sieves	Remove dirt and impurities from collected material

Quality parameters	Safety parameters
Collection tools: Clean, sharp, safe, non-contaminated	**Personal safety:** Use gloves and proper footwear
Suitable collection site: Unpolluted forest area, no chemical exposure	**Tool safety:** Handle sickles/knives carefully, store safely
Right maturity stage: Leaves, seeds, gums, resins, or flowers at proper maturity	**Environmental safety:** Avoid disturbing wildlife
Sustainable harvesting: No uprooting; partial collection; avoid damaging host trees	**Fire safety:** Keep drying areas away from open flames and extremely dry plant materials
Clean handling: Remove debris, avoid contamination, use gloves	

Key steps in the process

1. **Selection of area:** Identification of NTFP, selection of safe and accessible forest area for collection; with sustainable practices and minimal disturbance.
2. **Maintaining growth medium of NTFP:** Soil testing (texture, moisture), gathering meteorological data (climate), sunlight availability, etc.
3. **Management of the NTFP/Host to NTFP:** Cleaning around the area, removing plastic waste/spoiled produce, protection from human activities, mulching or adding leaf–litter compost.
4. **Monitoring of the NTFP/Host to NTFP:** Observing and tracking health, checking for signs of stress, pests, stage of maturity, etc.
5. **Harvesting, packing and storage:** Safe use of tools to harvest targeted parts of the NTFP (leaves, seeds, twigs for lac, etc.), cleaning of the harvest (sorting, removing dirt, drying), storage (cloth, tie in bundles) and packaging (airtight, plastic or carboard box).

Unit II

Work with Machines and Materials

From the time humans first shaped a stone into a tool, our progress has been closely linked with our ability to use materials and build machines. Every object around us–a clay pot, a wooden chair, a bicycle or a computer–tells a story of how we have learnt to transform raw materials from nature into useful products.

Working with machines and materials means understanding both the characteristics of materials, and the tools and processes used to shape them. Whether it is forging iron, weaving fabric or building a bridge, each activity combines knowledge, skill and creativity.

In ancient India, people showed remarkable craftsmanship–the Iron Pillar of Delhi, the rock-cut caves of Ellora and the textiles of the Sindhu–Sarasvatī civilisation–all reflect deep understanding of materials and techniques. Today's industries are built upon the foundation of these traditions.

In today's world, technological advances are not only increasing efficiency but also protecting workers. 'Smart systems' are being developed that can warn workers of potential accidents and enable them to take preventive measures. For example, 'smart' helmets and vests are equipped with sensors that monitor heart rate, body temperature and even posture. Thus, if a welder's body temperature rises to a dangerous level, or a technician's spine and limbs are placed at dangerous angles, a warning will be given. Technology is also taking over jobs that are dangerous, for example, climbing up a tower to check for structural cracks or checking areas for gas leaks or structural damage.

With the arrival of machines and industrialisation, production became faster and more precise. Modern tools, automation and digital technology now help us design and make things more efficiently than ever before. Yet, the basic principles remain the same–selecting the right material based on its properties, using the right process and handling tools and machines safely and skilfully.

Supply chains, Safety and Quality Control, Transport, Advertisement, Waste management, Machinery manufacturer, Electricity, Infrastructure

Shaping Materials

Carpentry
Furniture, Construction, Utility

Pottery
Sanitaryware, Tableware, Decorative items

Construction
Houses, Factories, Infrastructure

Metal processing
Mould prep, Casting, Moulding, Fabrication, Machining

Textile, Apparels and Fashion
Raw material, Textile, Fashion

Plumbing
Housing, Industrial, Agricultural

Sheet Metal Work
Automobile, Packaging, Fabrication

Working with Food
Dairy, Meat and poultry, Fruits and vegetables

Decorator, Carpenter, Artisan

Ceramic engineer, Potter, Mould maker, Foundry worker

Engineer, Architect, Tradesperson, Labourer

Lathe machine technician, Mould maker, Foundry technician

Tailor, Weaver, Designer, Artisan

Plumber, Pump technician, Service and maintenance technician

Sheet metal fabricator, Welder

Chef, Baker, Butcher, Pickle maker, Barista

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Chapter 5 introduces key concepts and processes that are common across a range of work related to machines and materials. This chapter is mandatory for you. Chapters 6 to 8 use the common concepts and processes to help you understand how to do specific work. At the same time, they also introduce additional concepts and processes that you can learn, while doing. Chapters 6 and 7 detail work related to construction and apparel, respectively. Chapter 8 contains guidelines for sheet metal work, plumbing, food processing, furniture making and pottery.

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CHAPTER 5

Shaping Materials

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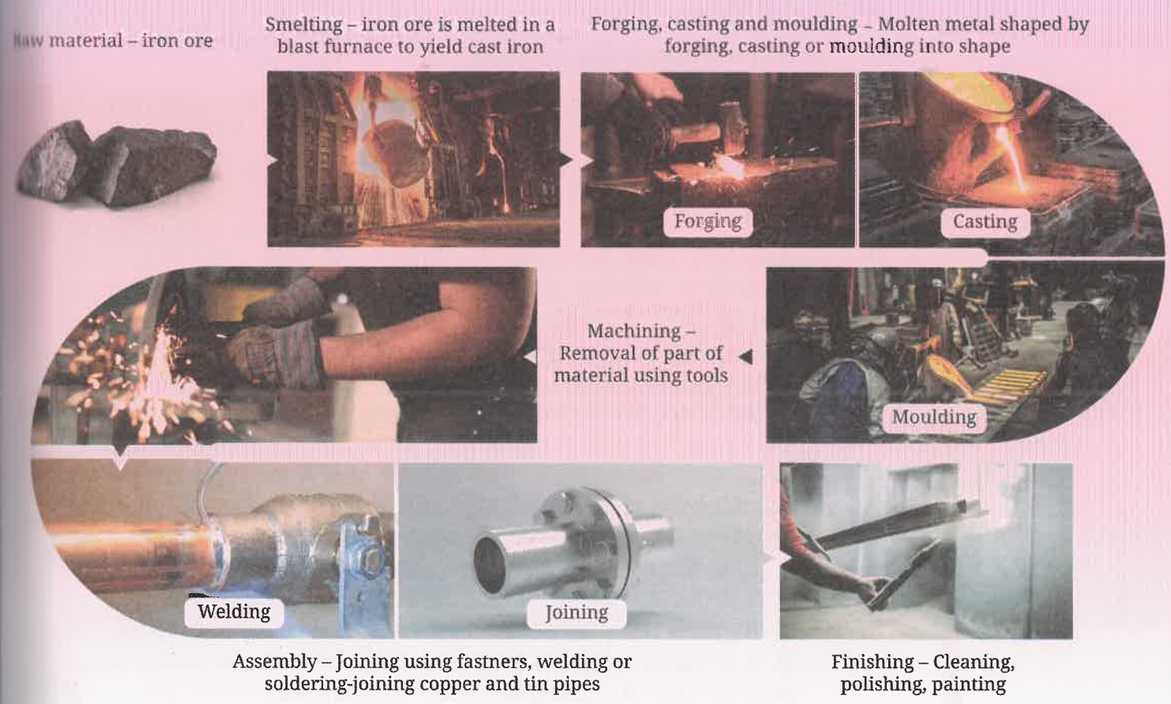

Figure 5.1: *Materials are shaped into products through different processes*

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In this chapter, you will

Explore different kinds of materials and their characteristics	Understand common processes related to shaping materials	Identify different tools for measurement and their applications
Select materials based on their characteristics	Understand safety protocols	Read technical drawing accurately
Create simple technical drawings	Understand quality criteria	Explore vocations related to shaping materials

Importance of work

5.1 Introduction

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Importance of work

Value addition

Whenever we transform materials from their natural form to useful products through various processes, their value increases. For example, the value of a simple stone lying on the hillside increases manifold when a craftsman chisels a statue out of it.

Selling a material in its natural form costs less than a finished product. As shown in the example of cotton (Figure 5.2), if we convert cotton to fabric and fabric to garment, then its value increases substantially.

Value chain of work

Value chain of work

Figure 5.2: *Value chain of cotton*

Explore different sources of information

TASK

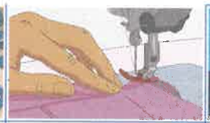
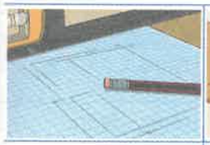
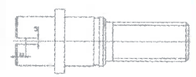
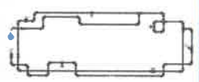
List all the factors that add value to any raw material. Ask around, search in the library, search online, read newspapers and identify experts who can help you.

Raw to final product	Value added
Metal scrap (₹ 20/kg) to kitchen utensil (₹ 1200)	Undergoes processing through which it is melted and moulded to form the shape of the utensil. It is polished or coated with anti-sticking materials to improve its quality. Wooden handles are attached for better handling of the utensil. The bottom of the utensil can be further processed, so that it is both stove and induction-friendly.

Key processes for shaping materials

5.2 Processing material – transformation to a product

Different manufacturing processes shape raw materials into useful products. These processes have evolved over thousands of years, and become more and more specialised. However, some processes are common across a range of materials, for example, fabric, cloth, leather, metals and plastics as illustrated in Figure 5.3.

Design and Estimate	Measure and mark where material is to be added or removed	Cut and shape	Join and Assemble	Finish
Fabric				
				
Use pencil to draw pattern	Mark pattern on fabric with chalk	Cut using scissors	Use thread and needle, or sewing machine	Ironing, trimming
Wood				
				
Draw product to be made on paper	Mark cuts and drilling points	Cut with a saw, wood held with a vise	Use adhesive, or hammer and nails	Sanding, polishing and painting
Metal				
				
Technical drawing/CAD	Mark with an engraving tool	Use cutting/ power tools	Use bolts and rivets, welding, soldering, etc.	Finish using grinder and paint
Plumbing				
				
Layout diagram of piping	Mark cuts on pipe and join points	Cut pipes using PVC cutter/ hacksaw	Use brazing, coupling, adhesives, etc.	Check for leakage, tighten joints

Construction				
				
Draw a sketch of the construction	Mark area using marking powder/chalk	Level site lay foundation	Lay bricks, apply mortar	Plastering, painting, flooring, electrification
Safety– Wear protective gear and follow safety rules				
				
Organise work area	Measure accurately without damaging the material	Follow all safety protocols	Handle adhesives and fasteners with care	Keep working area clean

Figure 5.3: *Common processes involved in transforming materials into products*

TASK

Note different products in your surroundings. For example, utensils in the kitchen, screw, plastic bucket, shoes, cup and saucers, bed, carpet or mat, electric wires, fan, automobile engine, etc.

Find out the raw materials used to make these products and the processes used to transform these materials into products.

Selection of material based on its characteristics

5.3 Choosing material for a specific product

The characteristics of a material determine whether it is suitable for certain uses. For example, we use steel or aluminium to make kitchen utensils and not plastic, as steel/aluminium can tolerate high heat and is safe for cooking, while plastic melts when heated and is therefore unsafe. Thus, selecting the right material is critical. Sturdy objects like a stool need a material that can hold weight, such as wood or metal, whereas a reusable shopping bag requires something flexible and light like jute fabric. Environmental/weather conditions also play an important role in selecting a product. You may have noticed that storage units or shelves in your bathrooms are often made from steel, PVC or aluminium, and not wood. Can you guess why?

In fact, a single material can be used for different purposes by utilising their specific characteristics. For example, clay, when soft and moist can be used for making craft items. Clay can also be moulded, dried and fired to make durable objects, like pots and bricks.

Selection of material based on its characteristics

TASK

You have studied the characteristics of materials in Science. Work in a group to pick one product each from the options provided in Table 5.1, and discuss which material would be most suitable for making it. Justify your response on the basis of characteristics of materials.

Table 5.1: Selection of materials based on their characteristics

List of products	Best suited material for the product (steel, copper, glass, aluminium foil, rubber, clay, fabric and wood)	Identify the characteristics of the material that make it suitable for the product (hardness, elasticity, thermal conductivity, electrical conductivity, plasticity, corrosion resistance, permeability, ductility, water resistance and transparency)
Raincoat		
Electric wire		
Water bottle		
Cooking pot		
Cushion		
Window		
Keychain		
School bell		

TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

Machines, Automation and Robotics

In the past, many manufacturing tasks were done manually, relying on skills of manual labour. Speed of completion of the task was slow, since it depended on the capacities of individuals. After industrialisation, power tools replaced manually-operated machines. This has increased the speed of production. Due to advances in technology, many repetitive tasks have been automated. Automated machines and robots are also more accurate and precise than humans. Such CNC (Computerised Numerical Control) machines and robots have enabled production in larger quantities.

Following safety protocols

5.4 Key common processes

Figure 5.3 in Section 5.2 contains some common processes used to create products from different materials. While the tools and materials used were different in some cases, the key processes were similar. This is possible because there are some essential skills that are common to any kind of work with machines and materials.

In this section, you will learn about three basic skills:

1. Following safety protocols.
2. Taking measurements using specific instruments.
3. Making technical drawings.

You will learn the basics of these skills and practise them in the vocation you choose.

5.4.1 Following safety protocol

Before beginning any work, read available manuals or instruction guides, and speak to your teacher and experts to understand any safety precautions that need to be taken.

Safety signage

Safety signage refers to visual indicators that use standardised colours, symbols and text to communicate potential hazards, required actions, the location of safety equipment, and emergency procedures in workplaces and public areas. The purpose of safety signs is to prevent accidents and injuries by providing clear, easy-to-understand information.

Table 5.2 shows what different colours in safety signage indicate, while Table 5.3 shows examples of common safety symbols.

Table 5.2: Colours in safety signage

Colours		Meaning	Examples
	Red	Fire, Prohibition	Fire extinguisher, stop buttons
	Yellow	Warning and physical hazards	Wet floor caution, construction site
	Blue	Mandatory actions	Wear helmet, safety instruction of a machine
	Green	Providing guidance/safe condition	Emergency exit rows, assembly point

Table 5.3: Safety symbols used in public places, schools and surroundings

Symbols	Purpose	Symbols	Purpose
	Warns of risk of electric shock		Indicating path for exit, especially during emergencies
	Indicates the location of a fire extinguisher for emergency use		Protective footwear to prevent foot injuries
	Shows that helmet must be worn to protect head from any heavy falling object	 SMOKING PROHIBITED	No smoking zone to prevent fire hazards and health safety
 FIRST AID	Location of first-aid supplies or support		Warns that the floor becomes slippery when water or other liquids are present

CHECK YOUR UNDERSTANDING

Safety Audit

Do you see any of the safety signs and symbols in your surroundings? Carry out a safety check of your school and nearby areas. Discuss where these symbols

should be placed and why. If you feel the need, make up your own symbol and assign it a colour. Justify its importance.

Measurement

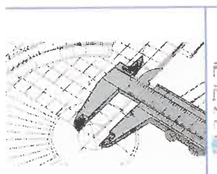
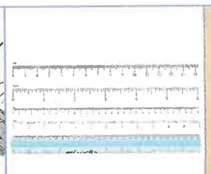
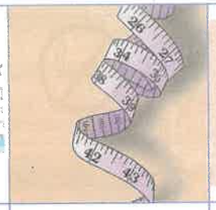
5.4.2 Taking measurements

Measurement is among the most important and basic skills for any work with materials. While you have already studied measurement in Science in Grade 6 to 8, in the context of work, measurement is needed for the following:

1. To estimate the exact amount of material required for making a product.
2. To ensure minimal wastage of material.
3. To reduce material costs and ensure the product meets the required dimensions and quality standards.

Selection of an instrument while working with materials mostly depends on how accurate the measurement needs to be (Table 5.4.) The smallest value that can be measured accurately using the instrument is called its least count. For example, the smallest measurement possible with a metre scale is 1 mm. However, the least count of a vernier callipers can be 0.02 mm, which means that it can be used to measure more precisely than a metre scale. For example, an object that measures 2.3 cm using a metre scale can be measured more precisely using a vernier callipers, that is 2.34 cm.

Table 5.4: Measuring tools and their use

				
Vernier callipers	Metre scale	Metre tape	Surveyor's tape	Distance metre
Measure diameter or thickness of small objects	Measure objects less than a metre	Measure large objects, including with curved surfaces	Measure land	Measure long distances accurately and quickly
Least count– 0.02 mm	Least count– 1 mm	Least count– 1 mm	Least count– 1 mm	Least count– 2 mm
Measurement range (Length)– 150 mm to 300 mm (Short)	Measurement range (Length)– Up to 1 m (Medium)	Measurement range (Length)– 3 m to 10 m (Medium to long)	Measurement range (Length)– 30 m to 100 m (Very long)	Measurement range (Length)– 50 m to 200 m (Long)
Required precision (Tolerance)– Very high (e.g., ±0.05 mm)	Required precision (Tolerance)– High to medium (e.g., ±0.5 mm)	Required precision (Tolerance)– Medium (e.g., ±1 mm to ±2 mm)	Required precision (Tolerance)– Low to medium (e.g., ±5 cm to ±10 cm)	Required precision (Tolerance)– Medium to high (e.g., ±1 mm over a distance)

While least count indicates the smallest measurement possible with an instrument, tolerance is the amount of error that can be allowed in a measurement. For example, if two pipes need to be joined, then the tolerance for error in measuring diameter is very low. But when measuring cloth for cutting a bag, tolerance is higher.

Therefore, selection of an appropriate measuring instrument is important. For example, to measure land, we use a 'Surveyor's tape', but to take measurement of clothes, we use a 'metre tape', or to measure the weight of a truck, a weigh bridge is used, but a grocery shop owner uses a simple balance. In a laboratory, we use a scientific balance for greater accuracy.

QUALITY

It is necessary to measure material accurately. For this, it is necessary to reduce the errors in measurement.

The following care must be taken for accurate measurement:

1. Select the instrument based on its least count.
2. Handle the instrument with care to maintain its accuracy.
3. Take due precautions specific to the material and purpose of measurement.

Quality

TASK

Select any instrument for measurement. Note the least count, the smallest measurement that can be taken by the instrument and any precaution to be taken. Two examples are given for your reference in Table 5.5.

Table 5.5: Precautions to be taken while measuring materials

Sr No.	Application	Measuring instrument	Smallest unit of measurement	Precaution
1	Measurement of cloth	Metre tape	1 mm	Keep the cloth straight without any slag during measurement.
2	Water for construction	Bucket of 15 L	1 L	Calibrate the bucket accurately.
3				
4				
5				

Technical drawing

5.4.3 Making technical drawings

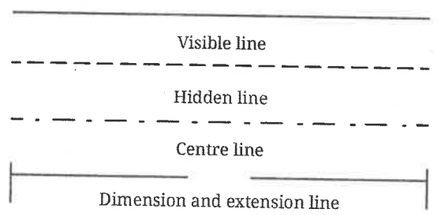
Technical drawings include details, such as dimensions of different parts and specifications of materials, enabling precise communication among designers, engineers and fabricators. This allows identical replication of products in large numbers without deviations, for example, a set of dining chairs must be of the same dimension and shape; plumbing in a set of flats in a multi-storey building must align across floors to allow smooth flow of water and sewage.

You may have seen engineers referring to drawings at construction sites, tailors sketching patterns for garments or fabricators preparing sketches before making a product–all these are examples of using technical drawings to convey exact information visually.

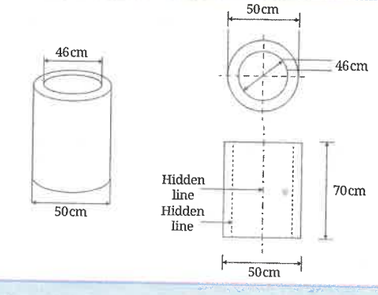
Technical drawing symbols

Technical drawing is the language of technicians. Like any other language, technical drawing has its rules and grammar. These are represented by 'drawing symbols'. You have already learnt the language of electric circuits–Figure 5.4 shows a few other commonly used symbols. Persons working with machines and materials must learn to use these symbols, and learn the basic concepts of technical drawing to convey ideas.

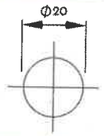
Different lines in technical drawing



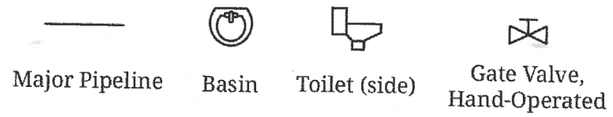
Drawing of hollow cylinder



Dimensions of circle



Plumbing symbols



Civil Engineering symbol

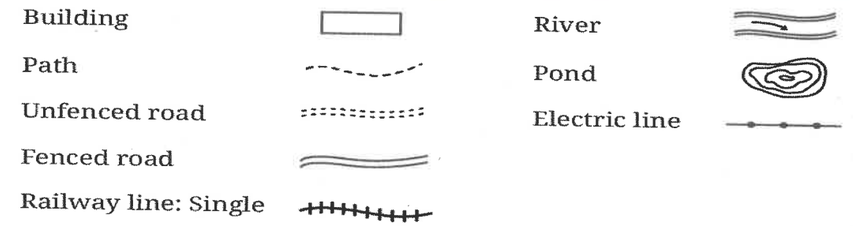


Figure 5.4: *Commonly used lines and symbols in technical drawing*

Drawing an object

Technical drawings must show the exact shape, size and proportion of an object. However, we can see the true dimensions of an object–its actual physical size and shape– only when we look at it from different angles.

For example, look at the table you are working on from the top. Does this give you the complete picture? No, because from this view you cannot see the height of the table. Similarly, from the front view alone, the width may not be visible.

Therefore, to understand the complete shape and size of an object, we need to look at it from different directions–front, top and side. A combination of these views gives a true and complete representation of the object.

Technical drawing

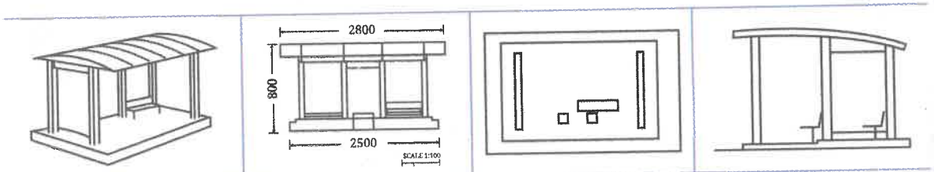
The technique of representing a three-dimensional (3D) object on a two-dimensional (2D) surface using these views is called projection.

Look at the examples of projection of different objects in Figure 5.5 to understand this further.

	Front view	Top view	Side view
Study table	250 mm, 1000 mm	500 mm, 1000 mm	250 mm, 500 mm
Bottle	260 mm, 85 mm	85 mm, 43 mm	43 mm
Coffee mug	9 cm, 6 cm	6 cm, 2 cm	0.5 mm, 3 cm, 3 cm, 0.5 mm, 1.5 cm, 6 cm, 1.5 cm

Figure 5.5: *Projections of different objects*

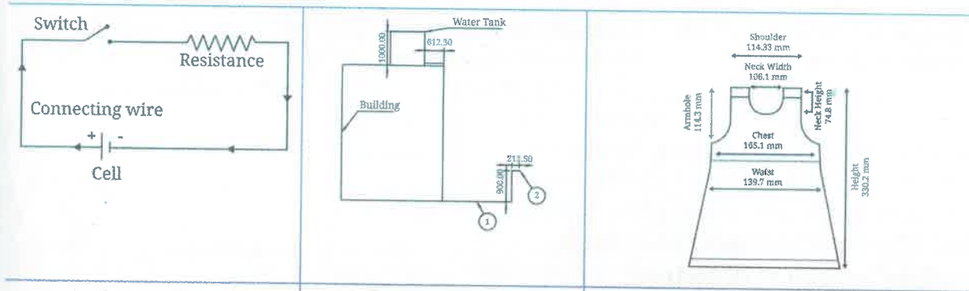
In construction, the top view, which shows the details of the 'floor plan' of a building, is called a Plan. The front view is called Elevation. Figure 5.6 shows an example.



3D drawing	Elevation (Front view)	Plan (Top View)	Side view

Figure 5.6: *Technical drawing in construction*

In the case of electric circuits, technical drawings are called circuit diagrams – you are familiar with these from Science. Similarly, a technical drawing showing a plumbing system or the outline of a dress are called a plumbing diagram and pattern, respectively (Figure 5.7).



Typical electric circuit	Plumbing diagram	Technical drawings of a pattern

Figure 5.7: *Technical drawings of electric circuits, plumbing systems and dress pattern*

Scale of drawing

It is not possible to create a technical drawing with the actual dimensions. Try to imagine drawing a full-sized chair on a piece of paper. Therefore, we need to choose a scale to reduce or enlarge the dimensions of an object on paper in proportion to the exact dimensions. The scale is indicated as 1: XX – this means that 1 unit on the drawing corresponds to XX units in real life. Table 5.6 contains a few examples of selecting the scale for different dimensions.

While reading a drawing, you need to refer to the scale mentioned. It is usually written at the bottom of the drawing, in the title box.

Reading and making technical drawings

TASK

Read and draw

Table 5.6 *contains a few examples – look around and add more.*

Table 5.6: Deciding scale of measurement

Actual dimension of object	Scale	Dimensions on the technical drawing		
Height of a shop is 6 m	1:100	1 unit of measurement on drawing is equal to 100 units on ground	100 m = 1 m; 6 m = ? = 1 × 6 / 100 = 0.06 m = 6 cm	6 cm

Length of field on ground is 400 m	1:1000	1 unit of measurement on drawing is equal to 1000 units on ground	1000 m = 1m; 400 m = ? = 1 × 400/1000 = 0.4 m = 40 cm	40 cm
Height of water bottle is 20 cm	1:10	1 unit of measurement on drawing is equal to 10 units in actual	10 cm =1; 20 cm = ? = 1 × 20/10 = 2 cm	2 cm

Now that you have learnt the basics of technical drawing – symbols, dimensions, and scale interpretation– you must apply this knowledge to both read and draw technical drawings.

Reading technical drawings

Look carefully at Figures 5.8 and 5.9 and answer the questions.

1. What is the total length and breadth of the object?
2. State the dimensions of the top of the object.
3. How many legs does each table have and what is the length of each leg?
4. What is the distance between two legs?

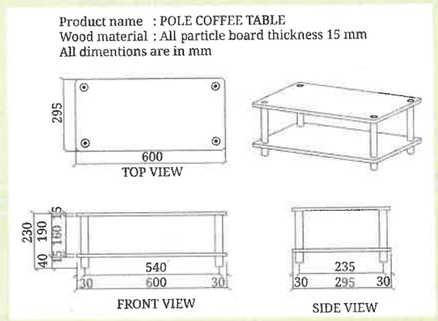


Figure 5.8: *Technical drawing of a table*

Reading the plan of a house

1. What are the dimensions of the kitchen?
2. How many windows are there in the house?
3. How many doors are there in the house?

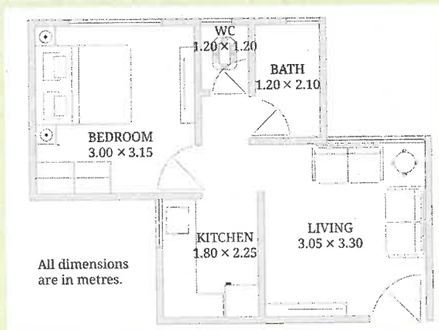


Figure 5.9: *Plan of a house*

Creating a technical drawing

On the basis of the instructions and the 3D image in Figure 5.10, draw a stool with accurate measurements.

You need to draw a stool whose actual measurements are:

1. Height – 50 cm, Seat width – 30 cm, Seat depth – 30 cm
2. You can use the scale of 1:10.

Figure 5.10: *3D drawing of a stool*

5.5 Selection of vocation

This section will help you to decide the vocation you will take up related to work with materials. The textbook provides details of construction and apparel, as well guidelines for sheet metal work, plumbing, food processing, furniture making and pottery. But before that you need to explore vocations around yourself.

TASK

Look around you and answer the following questions:

1. Exploring vocations around us

Look around you and answer the following questions:

a. What kind of work related to shaping materials do you observe around yourself? You can use different sources of information, for example, experts, site visits, libraries, online resources, specific government sites or reports.

b. Briefly describe what the work involves? What are the inputs? What are the key processes and what are the outcomes?

2. Mapping resources

Do you think it is possible for you to do the work in school? Table 5.7 below will help you decide.

Table 5.7: Mapping resource available to do work

Work related to making products from materials	Will you be able to complete the work in the time allocated?	Do you have adequate space to build structures (a wall)?	Have you identified an expert to help you?	Will you be able to collect the tools, materials and machines needed to complete the work?	Will you be able to do 'real' hands-on work?

Explore different sources of information

Mapping resources

5.6 When working with materials

1. Selection of material and manufacturing process depends on the characteristics of materials and the desired product.
2. Technical drawings help with the design of the product as well as communication with others who may be involved in developing the product.
3. Tools for measurement should be selected based on what is to be measured and to how much accuracy.
4. Safety is very important – take precautions as per the work you are doing.
5. Use safety signs and symbols wherever needed. There are common symbols and signs for communicating potential risks, and the precautions to be taken.
6. Keep the workplace clean and organised to avoid accidents.

5.7 Assess your learning

1. You are given clay and wood to make a pen stand. Which one of the two (clay and wood) will you choose? Compare the characteristics and explain your decision.
2. Create a safety symbol to caution people about extremely hot surfaces. Think about the colour and image while you design it.
3. Your teacher gives you three objects to measure – a pipe's inner diameter, a cloth length, and the length of the classroom. Which instrument will you use for each and why?
4. Your group made a wooden tray, but it looks uneven and does not stand flat. On the basis of the common steps of developing a product discussed in the chapter, identify what could be the cause of the error.
5. Create a technical drawing (with front, top, and side views) of a simple rack for storing sports items.
6. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
7. Give examples of how you can apply your learnings in a real-life situation.

CHAPTER 6

Construction

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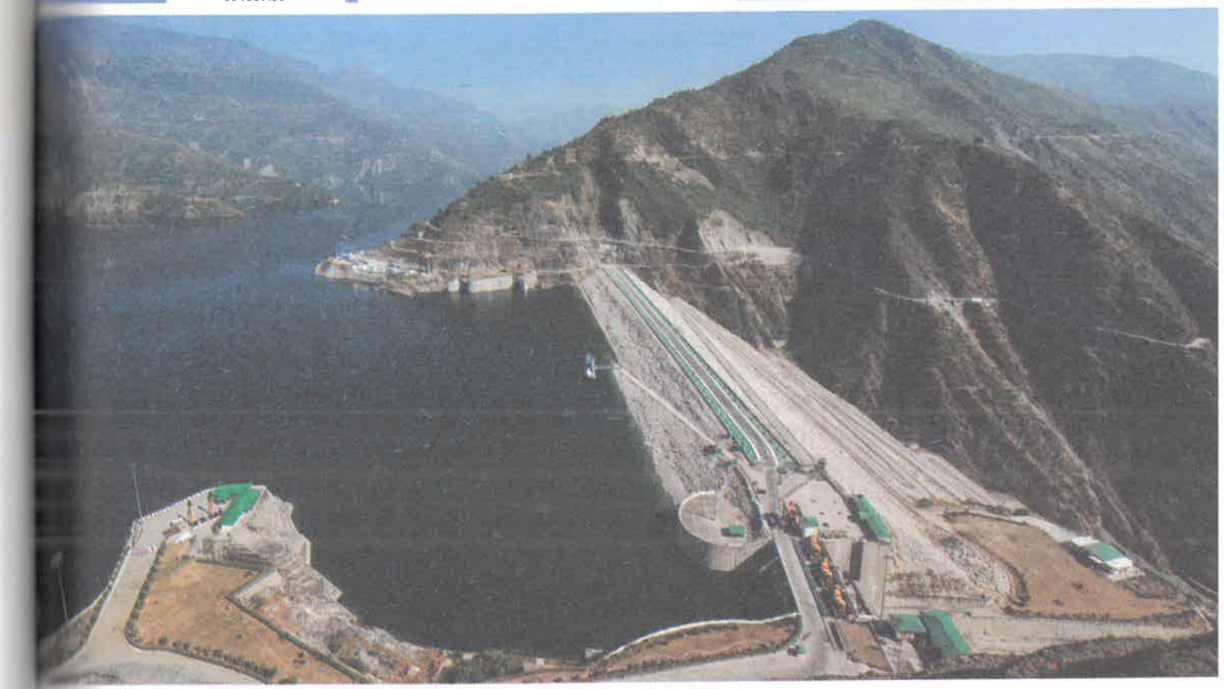


Figure 6.1: *Tehri dam in Uttarakhand*

According to the Ministry of Jal Shakti and the National Register of Large Dams (NRLD), India built over 6,138 dams between Independence and 2025. These dams are used for providing irrigation for agriculture, generating electricity, flood control and drinking water. One of the highest dams in India is the Tehri dam, with a height of 261 m built across the Bhagirathi river in Uttarakhand (Figure 6.1).

In this chapter, you will

- Prepare a technical drawing of a structure you will construct
- Prepare a bill of materials
- Mark the drawing on the field
- Prepare the foundation
- Lay bricks to construct the selected structure
- Complete the structure with curing, plastering, finishing and painting

6.1 Introduction

Construction simply means the process of building structures that people use in their daily lives. It enables us to live safely, travel and work comfortably, and protect ourselves from heat, rain and other weather conditions.

Since the beginning of human life, people have always needed a safe place to live. In early times, humans took shelter in caves. As they began to settle in one place and grow food, they started making simple homes using mud, grass, wood and stones. Slowly, as basic construction principles evolved, people learnt to use bricks, cement, iron and steel, which helped them build stronger and longer-lasting houses.

As villages turned into towns and towns into cities, the need for more houses and better facilities increased. Due to the lack of open space in cities, people started constructing multi-storey buildings. Along with houses, other structures, such as schools, hospitals, shops, factories, roads, bridges and railway stations, also became necessary. This is how the construction sector became an important part of everyday life, contributing to the nation's progress.

Today, construction uses modern tools, machines and materials, along with traditional skills. In this chapter, you will explore how structures are built through different materials and the steps involved in construction.

DID YOU KNOW?

Basic elements of building construction

Figure 6.2 shows the basic structural elements, that is, the different parts of any building.

Finishing works, such as plumbing, electrical wiring, plastering and painting are also carried out to complete the structure.

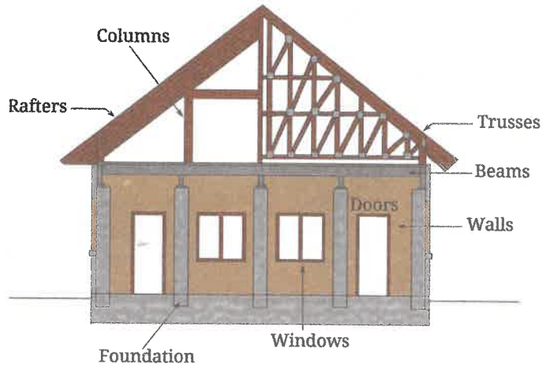


Figure 6.2: *Basic elements of buildings*

1. **Foundation:** A strong foundation is needed to increase the life of buildings, avoid cracks in the structure and safeguard against natural calamities like earthquakes. The depth of the foundation depends on the quantity of the load.
2. **Walls:** Different materials are used for making walls – bricks, stones, cement panels, wood, bamboo, etc.
3. **Beams:** Beams are the horizontal structural elements that carry the load of the slab (that is, upper floors) or roof. The size of the beam depends on the load of the slab.
4. **Columns:** The vertical structural elements supporting the beams are called 'columns'. They transfer the weight of the building to the foundation.
5. **Roofs:** The roof is the upper structural element of a building, designed and built using rafters (structural frameworks that connect different elements in a triangular fashion) or trusses (long sloping beams that make up the sloping roof) to support the load of the roof, and provide protection from weather, while completing the enclosure of the structure.
6. **Windows and doors:** These are structural openings in a building's walls to provide entry into the building, ventilation, natural light and aesthetic appeal.

Defining scope of work

6.2 Process Chart

6.2.1 Scoping work

Deciding the scope of the work means that decisions need to be taken regarding the following:

1. **What will be constructed:** This decision can be based on the need of the school or community. For example, a boundary wall, a shed, a ramp, a pavement or a wash basin. Figure 6.3 shows examples of some structures you could construct.

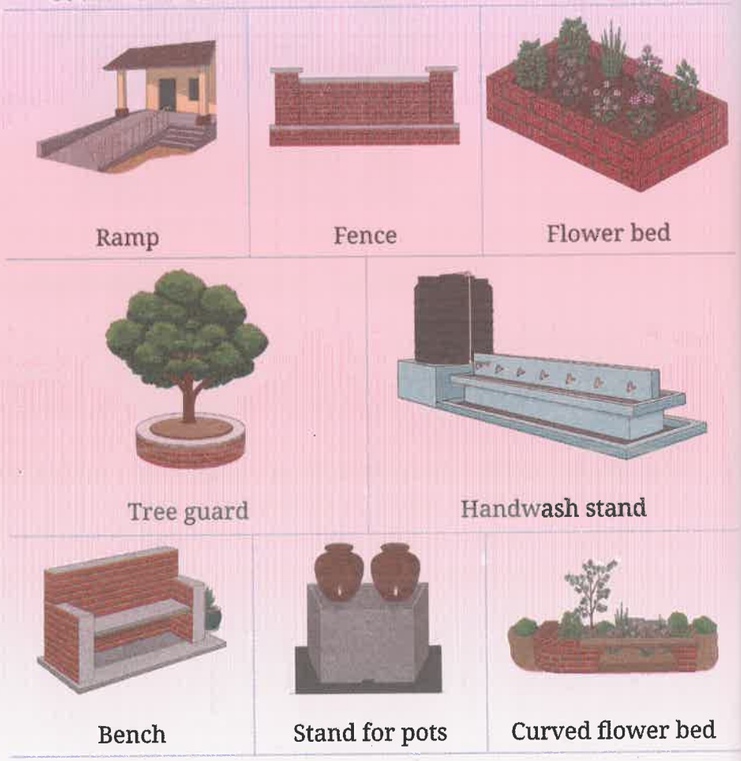


Figure 6.3: *Examples of structures you could construct*

2. **Material and resource availability:** Find out whether the materials and tools required for simple construction are available (for example, bricks, sand, cement, gravel, water or recycled materials). You should also consider the cost of these materials, and whether they can be safely managed and handled.

3. **What is useful:** Is the structure, which you have in mind, useful for the school or the community?
4. **Where will the construction take place:** You must decide the location where the structure will be built. It could be within or just outside the school. You must consider the space available, safety of the area, whether you can reach it easily, and also whether you can carry tools and materials to the site easily.

PORTFOLIO

1. What type of construction work will you take up in your school or community? Why?
2. Are there any specific considerations you will keep in mind?

6.2.2 Making a process chart

Once you identify the structure and decide where to build it, you must list the key tasks, along with estimated dates by which they will be completed. Table 6.1 contains a sample.

Making a process chart

Table 6.1: Sample process chart for construction

Tasks for construction	Dates	Responsibility
Preparing the construction drawing		
Marking the drawing on the field (line out)		
Preparation of foundation		
Brick work		
Curing (process to strengthen the construction)		
Plastering		
Finishing and painting		

6.3 Site visit

Before beginning work, you must visit a construction site in the surrounding area with a teacher and speak to practitioners. A practitioner can be a mason, civil contractor, civil engineer, architect or anyone else involved in actual design and

construction. You can ask them about the processes, tools and materials to be used. You can also take their guidance for planning the work you will do.

PORTFOLIO

Use the pointers in Table 6.2 for discussion with practitioners and take notes.

Table 6.2: Pointers for observation during site visit

Points of observation/ discussions	Description
Tools and materials used	Materials used and their storage Tools used and their maintenance
Key processes	Key steps and their importance
Schedules	Frequency and timing of key tasks, if any
Safety protocols	Using appropriate tools, safety precautions, etc.
Quality criteria	Criteria for quality inputs, process and output
Use of technology	Digital tools/apps used

Think of any other points for observation while visiting the site. For example:

- What do the practitioners value the most about the work (for example, quality of construction, specific processes, pride in building something useful, etc.)?
- You can ask about possible challenges you may face during construction and how to overcome them.

Once you have returned from the site visit, work in groups to detail out the process chart further.

DID YOU KNOW?

Construction of houses depends on how the weight of the building is supported. On the basis of this, housing construction can be of two main types:

1. Load bearing (wall-bearing) construction

In this type of construction, the walls themselves carry the entire weight of the roof and upper parts of the building, and transfer it directly to the ground.

This method is commonly used for single-storey houses and areas where deep foundations are not needed. These houses are simple in design, cost less to build and are easy to repair (Figure 6.4).

Figure 6.4: *A single-storey house showing the load bearing construction*

2. RCC (Reinforced Cement Concrete) construction

In RCC construction, the building stands on a strong skeleton of columns and beams made of concrete and steel. Here, the load of the slab and floors is transferred to the ground through this frame, not through the walls.

Figure 6.5: *A multi-storey building showcasing RCC construction*

This type of construction is used for multi-storey buildings and structures that need to be very strong and earthquake-resistant (Figure 6.5).

6.4 Making a technical drawing of the selected structure

Technical drawing

It is possible that the person who is designing the construction (for example, an architect) is different from the person who is actually doing the work of construction (for example, civil engineer and mason). Technical drawings help communicate the exact details of work to be done.

Refer to Section 5.4.3 in Chapter 5 and draw the side view, plan and elevation of the structure you plan to construct.

CASELET

Students of Government High School decided to construct a ramp. They defined a scale and then made a technical drawing of the ramp (Figure 6.6).

Actual size	On paper dimension	Scale to be written as 1: XX (1 unit on paper: XX unit on the field)
10 m (1 m on field = 1 cm on paper)	10 cm	1: 100 (1 cm on paper = 100 cm on field)

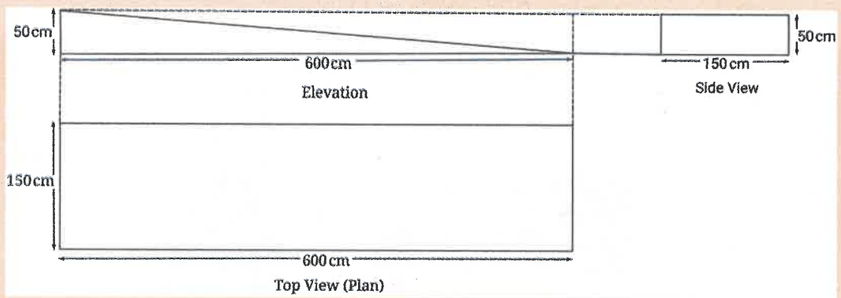


Figure 6.6: *Elevation, Side view and Plan of a ramp*

PORTFOLIO

Make a drawing to scale of the construction you want to take up. Show the side view, plan and elevation. Clearly mark the dimensions and the scale.

TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

In order to develop the technical drawing quickly and with accuracy, you can use computer-aided design (CAD) software. CAD also makes it easy to edit and rework the drawing.

Using CAD, you can:

1. Decide the exact measurements and scale of the structure;
2. Make 2D and 3D views of the structure;
3. Easily correct mistakes without erasing the entire drawing; and
4. Plan the use of materials and, therefore, reduce waste.

Further, CAD drawings can easily be shared with others as soft copies. You can search online to find suitable software as well as videos on making drawings using CAD.

Select tools and materials

6.5 Selecting materials

Table 6.3 lists the essential materials used for construction. You can select materials based on the type of structure you plan to construct in consultation with your teacher and/or the expert.

Table 6.3: Materials used for construction

Materials	Use	Safety note
Bricks	Used for building walls and partitions	Stack properly to avoid injury; handle gently – they can break or hurt someone if thrown around without care
Cement	Used as a binding material to hold bricks, sand and stones together	Avoid direct contact with skin and eyes; use gloves while handling; store material in a dry place
Sand	Mixed with cement to make mortar and concrete	Avoid inhaling dust; wear a mask while handling dry sand
Gravel	Mixed with cement and sand to make strong concrete	Lift sacks carefully to avoid back strain; handle with gloves
Water	Used for mixing cement and curing	Prevent water spills in areas used for standing and walking to avoid slipping
Paint	Used for finishing, and protecting walls and surfaces	Use in a well-ventilated area; wear mask to avoid inhaling fumes
Lime	Used in plaster and whitewashing	Avoid direct contact with eyes; wear gloves while handling

DID YOU KNOW?

Difference between mortar and concrete

Both mortar and concrete are important materials in construction. Mortar is used for binding other materials in a building (for example, 'gluing' bricks together, laying stone steps, installing bathroom tiles, etc.), while concrete is used for creating the actual structure and for supporting weight (for example, making a ramp, laying a foundation, making a fence, laying roads, etc.). Concrete 'reinforced' with steel bars (RCC) is used to support huge and heavy structures like skyscrapers (Figures 6.7 and 6.8).

Figure 6.7: *Mortar is made up of sand, water, cement and lime – it is more flexible than concrete, as it allows for slight movement without cracking.*

Figure 6.8: *Concrete is made up of sand, water, cement, and gravel or crushed stones – it is a strong and durable building material that hardens over time, getting a stone-like quality.*

6.6 Selecting tools

Table 6.4 lists tools used for simple construction. Many technology and AI-based tools are also available to reduce manual efforts, for example, robots for tasks like brick-laying and demolition, light amplification by stimulated emission of radiation (laser) scanners to detect any faults in buildings.

Table 6.4: Tools used for construction

Tools	Use	Safety note
Trowel/Karni/ Thappa	Used for lifting, spreading, and smoothening cement or mortar	Hold firmly by the handle; avoid touching sharp edges and clean after use
Hoe	Used for loosening soil, mixing sand and cement on the ground, and levelling the surface	Use with proper grip; keep a safe distance from others while working
Wooden float	Used for smoothening and finishing the surface of plastered walls and floors	Use with dry hands for better grip; avoid slipping on wet surfaces
Metre tape	Used for measuring length, width, and height of walls and structures	If it is retractable, then retract slowly to avoid finger injury
Wire brush	Used for removing rust and dirt, or for smoothening rough surfaces	Use a face shield and gloves for protection against flying debris or wire filaments
Spirit level	Used to check whether a surface is perfectly horizontal (level) or vertical (straight)	Handle gently to avoid breaking the glass tube inside
Plumb bob	Used to check whether a wall or pillar is perfectly vertical	Do not swing near others; hold the string firmly
Water level tube	Long transparent rubber tube that is filled with water used to check horizontal level	Keep the ends secured to avoid spillage
Chisel	Used for cutting bricks, shaping stone, and removing extra cement or plaster	Hold firmly and keep fingers away from the cutting edge
Hammer	Used for striking the chisel, breaking bricks and fixing nails	Hold with a firm grip; do not strike on hard surfaces without control

6.7 Bill of Materials

Estimation

Bill of Materials (BoM) helps in estimating costs in advance and avoiding waste by ensuring only what is necessary is bought.

6.7.1 Estimating number of bricks required

Before making the bill of materials, you need to estimate the number of bricks required.

Bricks of different sizes and materials are available in the market, for example, clay bricks, fly ash bricks and concrete bricks. In India, the standard size of bricks is 190 × 90 × 90 mm (Figure 6.9). However, we need to consider 10 mm extra for the mortar we will apply to join bricks together. Hence, we should consider the brick size as 200 × 100 × 100 mm.

DID YOU KNOW?

Volume as basis for estimation of materials

When you build a structure out of bricks, imagine that you are filling a 3D space. To estimate how many bricks you need, you have to compare the total space of the structure with the space taken up by a single brick – this is the 'capacity' of the ramp to 'contain' bricks.

Every brick has a specific volume. By calculating the volume of the ramp, you can find its total 'capacity' to contain the required number of bricks. Some bricks may break or may need to be cut to the required size. To cater for this, engineers calculate the volume and add 10 per cent to the number of bricks.

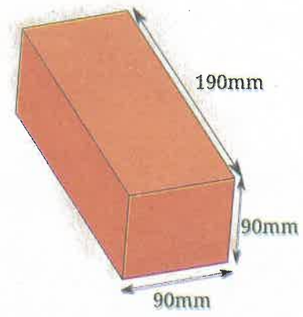


Figure 6.9: *Dimensions of a typical brick in India are 190 × 90 × 90 mm*

In India, bricks are typically made as per the specifications of the Bureau of Indian Standards (BIS), the body that maintains standards across products.

CASELET

Students of Government High School estimated the number of bricks required for constructing the ramp (Figure 6.10).

Volume of construction = Area of triangle (ramp) × width

Area of triangle (ramp) = ½ × 0.5 × 6 = 1.5 m^2

Width = 1.5 m

Volume = 1.5 × 1.5 = 2.25 m^3

By rule of thumb, 1 m^3 construction needs 500 bricks.

Therefore, 2.25 × 500 = 1125 bricks

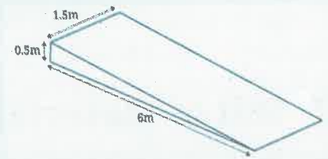


Figure 6.10: *Drawing of a ramp with dimensions*

To cater for any wastage, 10 per cent of the number of bricks is added to the total, so about 1200 bricks will need to be bought for making a structure of 1 m^3.

Please note that bricks are also available in non-standard sizes. Therefore, it is important to check the sizes of the bricks available, and then estimate the quantity.

Estimation

6.7.2 Estimate for mortar

A mixture of sand, cement and water is called mortar. Sand must be of good quality and it should be free of impurities like clay, dust, etc. Mortar is mainly used for plastering, brick work and similar tasks, as it creates a strong bond among the bricks. It is also used for the construction of walls, repair of construction and leakage, etc.

The recommended proportion for making mortar depends on the construction, as shown in Table 6.5.

Table 6.5: Ratio of cement and sand to make mortar for different kinds of construction work

Use of mortar	Ratio
Brick masonry	1:3
RCC	1:2
General repair and maintenance	1:3 to 1:6

By rule of thumb, typically to lay 100 standard bricks, approximately 5 kg to10 kg of cement is used for a ratio of 1:4 or 1:5 of cement and sand. Ask an expert about the ratio for the construction work you are doing.

Cost estimation and documentation

6.7.3 Preparing Bill of Materials

In addition to the actual cost of materials, the cost of labour must also be calculated. Cost of labour should also include the estimated time spent in doing the tasks.

CASELET

Students of Government High School prepared a Bill of Materials for construction of the ramp (Table 6.6).

Table 6.6: Bill of materials

Item	Quantity	Estimated cost (in ₹)	Remarks (if any)
Bricks	1200 × ₹ 10/brick	12000	
Cement	50 kg	400	
Sand	0.3 m^3 ~ 500 kg	500	
Water	100 L	-	

Cost of labour	Value (time spent in hours × hourly estimate × number of people)	Estimated cost (in ₹)	Remarks (if any)
Making foundation	1 hours × ₹ 50 × 2 people	100	
Marking layout	1 hours × ₹ 50 × 2 people	100	
Mixing cement and sand	2 hours × ₹ 50 × 2	200	
Brick laying	2 hours × ₹ 50 × 2 people	200	
Curing	10min/day × 28 days = 280 min ~ 4.6 hours × ₹ 50	230	
Total		**13,730**	

6.8 Minor repair and maintenance

Before you actually take up the selected construction work, you can practise making and using mortar for minor repair and maintenance work (Figure 6.11).

6.8.1 Carrying out minor repair

Identify the places in school/community/home, where minor maintenance of construction work is needed. For example, broken tiles, damaged walls, broken ramp, fencing, tree guard, small walls, etc.

TASK

Carrying out minor repairs

	**Step 1:** Mix one part cement and three parts sand.
	**Step 2:** Add water slowly to make a smooth, thick paste.
	**Step 3:** Clean the surface and lightly sprinkle water on it. Then apply the mortar on cracks, joints, tiles or uneven surfaces using a trowel.
	**Step 4:** Press, level and smoothen the applied area.

Figure 6.11: *Steps for carrying out minor repairs*

6.8.2 Curing and drying

Once you have applied mortar, it is necessary to keep it wet for 14–28 days. This process is called curing. It is necessary to complete the chemical reaction between water and mortar, which is important for 'bonding' materials together. This bonding process becomes stronger with curing. Generally, the process takes 28 days to complete. Hence, it is necessary to keep mortar wet after its application. If curing is stopped too early, then the structure becomes weak and cracks may appear, thereby reducing the strength of the structure. In case of minor repairs, you should leave the mortar to set for 24 hours. After 24 hours have passed, sprinkle water lightly for 14–28 days.

You can also perform curing by placing wet jute/gunny bags over the surface (especially if the water flows off sloped surfaces like a ramp) or sprinkling water through pipes, sprinklers or mugs to keep the surface continuously moist.

6.9 Making a structure

This section will discuss how to proceed with making the structure you have selected with the help of your teacher/expert.

DID YOU KNOW?

Brick bonds

Different types of patterns are used for arranging and laying bricks using mortar. These patterns help make the structure strong and stable.

In Figure 6.12, you can see different methods of laying bricks for constructing a wall.

Use of tools and materials

	
Stretcher bond: Length of brick facing front – used for boundary wall/partition with short span/wall of half brick thickness.	**Header bond:** Width of brick facing front – used for thick walls and also for curved walls.
	
English bond: Alternate rows of stretcher and header bonds – among strongest bonds mainly used for wall bearing structure.	**Flemish bond:** Alternate stretcher and header in each row.

Figure 6.12: *Different methods of laying bricks*

Constructing a structure

6.9.1 Preparation

The following steps are required to prepare for construction:

1. **Preparing ground:** As a first step, clean the construction site. Remove grass, loose soil, etc. Sprinkle water on the ground to settle any dust.
2. **Marking on ground:** Use a meter tape to mark the boundary of the structure; you can use a pointed stick to do so.
3. **Making the foundation:** Different types of construction need different kinds of foundations, as you read earlier in the chapter. In case of simple construction, a deep foundation is not necessary since the load is not high. However, it is necessary to ensure that the ground is flat and soil is firm for construction. Use a spirit level and water level tube to check if the ground is flat. If not, you will need to remove extra soil and flatten the surface. Spray water and let it dry to allow the soil to become firm.
4. **Putting a reference line for brick on ground:** Mark the layout of the structure on the levelled surface, using string or chalk lines to ensure the brickwork starts at the correct alignment, length and orientation before actual laying begins (Figure 6.13).

(a) (b)

Figure 6.13: *(a) Using reference lines for marking site of construction, and (b) marking lines for construction*

6.9.2 Preparing and laying bricks

Soak the bricks in water for a minimum of 6–12 hours. If you use dry bricks, then they will absorb water from the mortar.

Brick laying is done by placing bricks as required, and then applying mortar. Laying of the bricks must be done in the pattern of the selected bond, before applying mortar between them.

If you are making a ramp (or for that matter, any other structure that is not a perfect rectangle or square), you will need to cut bricks into the required shape and size so that they fit properly, ensuring structural strength and a smooth finish.

You should ensure that there are no gaps or edges protruding from the structure.

Figure 6.14: *Bricks are soaked in water before use*

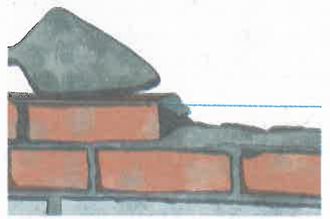


Figure 6.15: *Applying mortar while laying bricks*

Figure 6.16: *Cutting the brick using chisel and hammer*

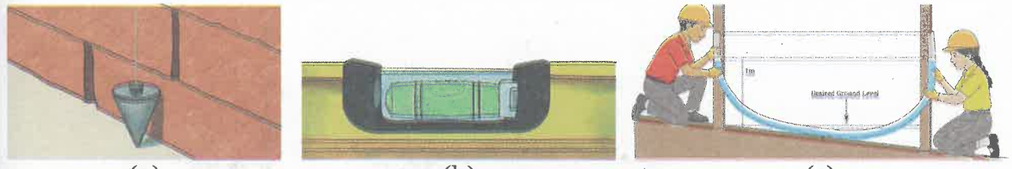
While there are advanced machines that cut the brick as per the desired shape, it needs precision and skill to handle the tool. However, you can cut the brick using a simple chisel and hammer under the supervision of an expert. You may refer Figures 6.14 to 6.16.

6.9.3 Ensuring alignment

Structures are designed to push the load straight down into the ground. If a structure is not perpendicular and parallel to the ground, or two points within it are not at the same height, gravity acts to weaken the structure.

Tools that are used to prevent this are the plumb bob (to ensure the structure is perpendicular to the ground), spirit level (to ensure the structure is parallel to the ground) and a water level tube (to ensure two points at a distance are at the same height) (Figure 6.17).

Quality



(a) (b) (c)

Figure 6.17: *(a)Plumb bob must hang parallel to the ground; (b) bubble in spirit level tube must be at the centre; and (c) level in water level tube must be the same at all points of the structure*

Finishing

6.9.4 Curing and plastering

After completing the brickwork, the next step is plastering.

Plastering is the process of applying a smooth or textured coating of plaster to a wall. This is done to increase the durability of the construction, provide protection from moisture and heat, and to make the structure look neat and attractive. Specific tools are used for plastering (Figure 6.18).

The following steps need to be followed for plastering the wall:

1. **Preparation of surface**: Use a wire brush to remove any loose debris on the wall. Also lightly dampen the wall with water.
2. **Making cement plaster for plastering:** Do not make the paste for plastering in large quantities. Mix the material and add water as required.

Generally, the proportion of cement to fine sand is taken as 1:6 for external plastering and 1:4 for interior plastering. You can add water slowly to the mixture to form the paste with the required consistency. The mix should be thick enough to not slide off the wall.

Trowel/Thappa/Karni: It is used to apply and flatten the plaster.

Float: It is used to flatten the plaster.

Wire Brush: For cleaning

Figure 6.18: *Tools used for plastering*

3. **Apply plaster:** First apply a base coat of plaster. Allow it to set, that is, become dry and hardened. Generally, the thickness of plaster is 12–15 mm. Apply a second coat of plaster to complete the plastering (Figure 6.19).

Figure 6.19: *Applying plaster on the wall*

Figure 6.20: *Plastering of a wall*

4. **Finishing:** Use a finishing tool and trowel to get a smooth texture (Figure 6.20).
5. **Drying and curing:** Carry out curing for several days. Keep the surface wet by spraying water regularly.

The construction of the basic structure is now complete except for a few finishing touches.

CHECK YOUR UNDERSTANDING

Think about the work you did. What did you enjoy? Did you face any challenges? If yes, describe them and what you did to overcome them.

6.10 Finishing the product

Finishing

Once plastering and curing have been completed, the construction work is almost complete. However, some finishing touches will make your work look professional.

Painting helps in making walls look neat and attractive. Besides aesthetics, painting helps in increasing the life of the construction by preventing leakages. It also helps in pest control.

Different types of paints are available in the market. Visit a hardware shop and select the most suitable paint based on your budget and choice.

Table 6.7 contains a summary of different types of paints commonly used in India, along with their applications and advantages.

Table 6.7: Different types of paints used in India

Type of Paint	Applications	Advantages
Whitewash (Lime wash)	Houses, temporary structures, ceilings, low-cost housing	Very cheap, antibacterial properties, reflects heat, eco-friendly
Distemper	Interior walls and ceilings in low-cost buildings	Economical, easy to apply, available in many colours, breathable surface
Cement Paint	Exterior walls, boundary walls, basements, damp areas	Water-resistant, prevents fungus/ mildew, economical for large surfaces, durable in outdoor use

CASELET

Students of Government High School decided that the most suitable finishing paint for the ramp is cement paint, since it is water-resistant and prevents slipperiness. They followed the process below to apply cement paint on the ramp (Figure 6.21):

1. **Surface cleaning:** First, clean the ramp surface properly. Remove dust, loose cement, sand, grease and any old paint using a brush, broom or water wash. A clean surface helps the paint stick better.
2. **Wetting the surface:** Before applying cement paint, sprinkle clean water on the ramp. Cement paint must be applied on a slightly wet surface for proper bonding.

Figure 6.21: *Applying first coat of paint on side of ramp*

3. **Preparing the paint:** Mix the cement paint with water as per the instructions given on the packet. Stir well to get a smooth mixture without lumps.
4. **Applying the first coat:** Apply the first coat using a brush or roller, starting from one end of the ramp and moving evenly across the surface. Apply in one direction for a smooth finish.
5. **Curing the first coat:** Allow the first coat to dry for at least 24 hours. Lightly sprinkle water on the painted surface during this time for proper setting.
6. **Applying the second coat:** Once the first coat is dried for at least 24 hours, apply the second coat in the same manner. This improves colour, durability and water resistance.
7. **Final drying and safety check:** Let the ramp dry for 48–72 hours before use. Put up a 'Wet Paint – Do Not Use' sign to avoid accidents.
8. **Post-construction cleaning:** Cleaning the place around a construction site is important for safety, and a neat and attractive appearance. Remove trash from the site and store unused material in the assigned place.

PORTFOLIO

Maintain a record of the work done by you. Take photographs, if possible, at each step of construction. Some sample images of work done by students in other schools are given in Figure 6.22.

Figure 6.22: *Structures built by students*

6.11 While constructing a structure

1. Before beginning any work, it is necessary to learn through observation. This can be done by visiting a construction site, online search or interviewing experts in the area.
2. Preparation of ground of construction is an important step. Take guidance of experts to decide the depth of the foundation, depending on the weight of the structure and soil type.
3. Use a water level tube to ensure that two distant points of the construction are at the same level and a spirit level to check that all surfaces are level with the ground. Also, use a plumb bob to check that the construction is perpendicular to the ground.
4. Always soak the bricks in water for 6–12 hours before using them. Use correct proportion of sand, cement and water for making mortar and sand, cement, gravel, and water for preparing concrete.
5. Spray water on the construction work after applying concrete or mortar for a minimum of 14–28 days.
6. Do not allow the construction to dry out. This process of applying water to new construction is called curing. After construction, clean all the surroundings for any debris, unused sand and cement.
7. Painting the constructed structure will not only make it attractive but also increase its durability.

6.12 Assess your learning

1. Look around your school or neighbourhood, and identify any one structure. Identify the basic structural elements (foundation, walls, roof, beams or columns) that you can observe and describe their functions.
2. What kind of construction has been used for your house or school (Load-bearing construction or RCC construction)? Write the reasons for selecting particular types of construction.
3. Suppose you are asked to construct a small boundary wall in your school. List the major steps you would include in the process chart and explain why sequencing of steps is important.
4. Identify three safety rules that must be followed at a construction site. Explain how ignoring any one of them could lead to an accident.
5. Cement was left exposed in the room during the rainy season for many months. What might happen to cement and why ?
6. Often, during summer season, especially during a drought year, the Government bans construction activities. Why do you think this is done?
7. A student is laying bricks to make a boundary wall and decides to skip using the plumb bob to save time, claiming they can 'see' if the wall is straight. What is the specific technical risk of relying on visual estimation instead of a plumb bob? If the wall is even slightly 'out of plumb' (not perfectly vertical), how might this affect the building's safety over the years?
8. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
9. Give examples of how you can apply your learnings in a real-life situation.

CHAPTER 7

Apparel

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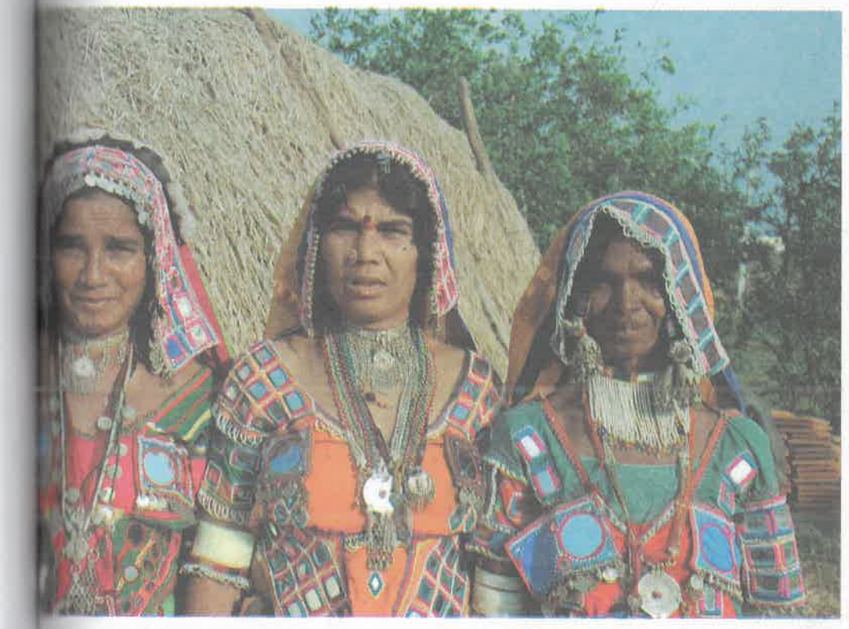


Figure 7.1: *Apparel with traditional embroidery is being adapted for high-fashion wear*

Figure 7.1 shows women of a nomadic community in their colourful, traditional attire. Creating this apparel is extremely labour-intensive and the art of making it is passed down generations. Given the unique beauty of this traditional apparel, it has moved out of these communities to global fashion. Designers work with members of these communities to create apparel, like embroidered jackets, dresses and accessories.

In this chapter, you will learn about the following:

- Technical drawing of the apparel
- Selecting fabric based on properties
- Selecting materials and tools
- Making bill of materials
- Practising stitches
- Preparing fabric, marking and cutting
- Stitching by hand and/or machine
- Finishing, packaging and labelling

7.1 Introduction

Food, shelter and clothing are the basic needs of human beings. From the earliest times, clothing has been used to protect the body from weather and the environment. The history of clothing began with the use of animal skins and natural materials for warmth and protection. In India, evidence of clothing can be traced back to the Sindhu–Sarasvatī civilisation.

Clothing today is much more than just a way to protect the body. What we wear reflects our personality and our culture. Clothing also reflects the current fashion and trends of the time.

Given the importance of this work, the apparel industry has developed around the design and manufacturing of clothing. This industry has close linkages with the textile industry, which is involved in the production of fibre, yarn and fabric, along with the fashion industry, which specialises in creating unique, branded, occasion-specific clothing (Figure 7.2). To elaborate on these linkages, as synthetic fibres became popular, traditional weaving gave way to industrial looms but as traditional weaving again become fashionable, it was 'revived'.

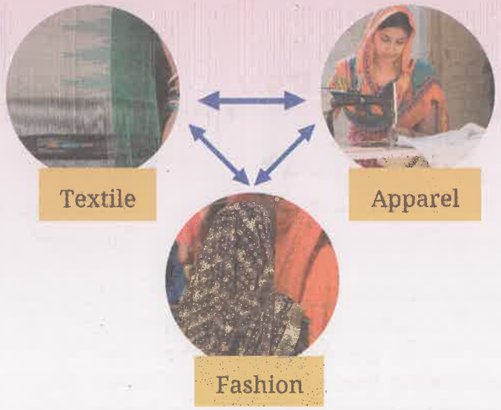


Figure 7.2: *The textile, apparel and fashion industry are closely connected, and each influences the other*

7.2 Process chart

7.2.1 Scoping work

Deciding the scope of the work means that decisions need to be taken regarding the following:

1. **Availability of resources:** List the materials and tools available, and experts who can guide you.
2. **What will be created:** Think about the apparel you want to create. The questions you need to ask are whether you have the required resources and whether you can complete the task in the given time.
3. **Understanding the need:** Some questions you need to ask are – Who will use the apparel? Will it be comfortable, strong and easy to maintain?

DID YOU KNOW?

Upcycling gives new life to old or unused clothes and fabrics by creatively redesigning them into useful and attractive products. An old pair of jeans can be transformed into a useful sling bag with decorative additions of patchwork and mirror work (Figures 7.3 and 7.4). Similarly, fabric scraps can be stitched together to make a colourful patchwork table runner or wall hanging.

Figure 7.3: *Turning denim jeans into a carry bag*

Figure 7.4: *Sewing pieces for patchwork*

7.2.2 Making a process chart

Once you have identified the apparel you will make, you can list all the tasks required to make the apparel, estimate the timelines for each task and who will take the responsibility for each of the tasks. Table 7.1 shows a sample process chart for making apparel.

Making a process chart

Table 7.1: Process chart for making apparel

Tasks for making apparel	Dates	Responsibility
Selecting fabric based on properties		
Design and measurement		
Drafting and pattern making		
Fabric preparation and cutting		
Stitching apparel		
Finishing, packaging and labelling		

7.3 Site visit

Before beginning the work, it is important to observe and interact with experts (for example, tailor, fashion designer, boutique owner, garment worker, etc.) in the presence of a teacher. You can also take their guidance in planning the work undertaken by you.

PORTFOLIO

You can use the pointers in Table 7.2 for discussion with practitioners and take notes.

Table 7.2: Points for observation during site visit

Points of observation/ Discussions	Description
Tools and materials used	Materials used and their storage Tools used and their maintenance
Key processes	Key steps and their importance
Safety protocols	Using appropriate tools, safety precautions, etc.
Schedules	Frequency and timing of key tasks
Quality criteria	Criteria for quality inputs, process and output
Technology use	Digital tools/apps used

Think of any other points for observation while visiting the site. For example:

1. What do the practitioners value the most about their work (for example, quality of apparel, specific processes, pride in making something useful, etc.)?
2. You can ask about possible challenges you may face while making apparel and how to overcome them.

Once you have returned from the visit, work in groups to add details to the process chart for your work.

7.4 Technical drawing of apparel

Technical drawing

The first step towards making the apparel is to visualise how your product will look. What will be the design? Will it have any accessories, such as buttons or zips? Or strings? What fabric will it be made of and which colour will be best suited? These are just examples of some questions you need to consider.

You also need to ensure the apparel fits – this will require measurement. Accurate measurement is important to make an apparel of the right size and shape. If you do not have a specific person in mind, you can ask an expert or learn about standard sizes through online sources. Apparel are generally made using these standard sizes when produced in bulk.

It is easy to measure something like a cushion cover – it is generally a square, rectangle or circle. But when it comes to apparel, measurements need to be taken differently (Figure 7.5).

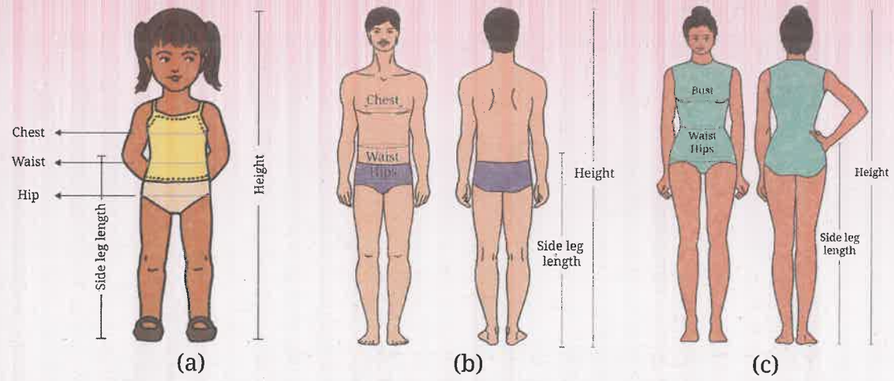


Figure 7.5: *The images show the body points where measurement needs to be taken for stitching apparel for (a) a child, (b) an adult male and (c) an adult female*

While apparel can be 'bespoke' or custom made for a specific customer, standard sizes are sold as ready-made apparel.

Quality

QUALITY

While taking measurements, the following need to be ensured:

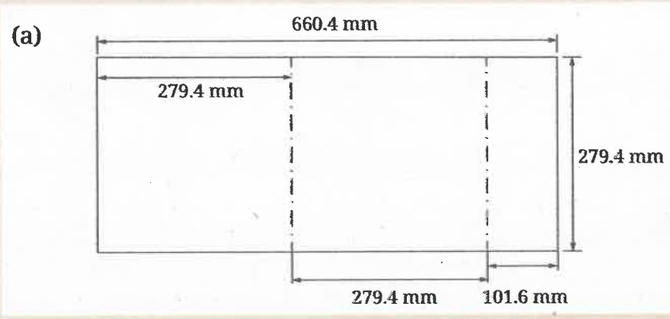
1. The person is not wearing thick clothing.
2. Use a tailoring tape since it is flexible.
3. The person should stand straight and relaxed while you are taking the measurements.
4. Do not keep the tape either too loose or too tight.
5. Take chest/bust, waist, hips, shoulder, sleeve and length measurements as in Figure 7.5.

Remember, you will have to leave extra fabric for seams or finishing while marking the fabric – this is known as 'seam allowance'.

CASELET

Students of Grade 9 of Government High School divided themselves into three groups. Group 1 decided they would start with a furnishing product – they saw that the cushion covers in the waiting area outside the Principal's office had worn out and decided to replace them. Group 2 observed that the clothes of the person serving the midday meal were getting stained and decided to make an apron. Group 3 decided that they would make a dress for their younger siblings.

Three drawings – of a cushion cover, an apron and the dress of a young child – made by each of the three groups are given in Figure 7.6.



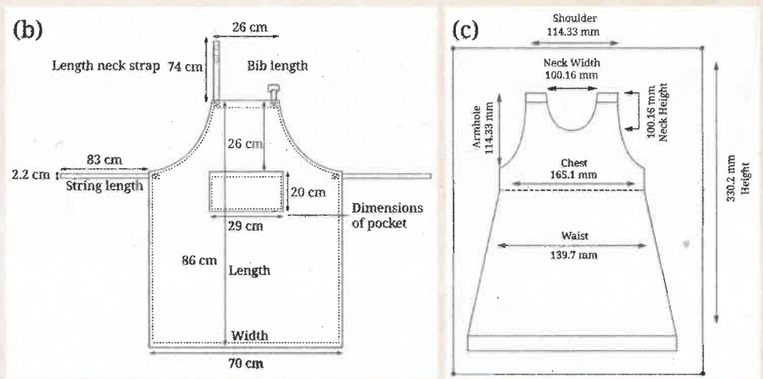
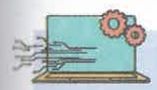


Figure 7.6: *Sketch of (a) cushion cover, (b) apron and (c) dress for a young child*



TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

You can use computer-aided design (CAD) software to make the technical drawing of the selected apparel.

PORTFOLIO

Think of different design options for the apparel you will make. Take measurements carefully. Make a neat technical drawing, detailing out the exact measurements and label all parts clearly. Also, write notes about fabric, thread or special features like zippers, buttons or embroidery.

DID YOU KNOW?

Fabric for apparel is selected based on its characteristics (Figure 7.3).

Table 7.3: Examples of some fabrics and their characteristics

Fabric		Characteristics
Cotton		Soft, breathable and comfortable for daily wear. Suitable for everyday clothing.
Wool		Breathable and wrinkle free. Depending on the processing, some wool varieties are soft while others are rough, for example, sweaters, shawls, coats, trousers, *phirans*, etc.

Silk		Naturally soft and shiny. It is expensive compared to cotton, and usually used on auspicious and festive occasions. Some silk fabrics have temperature regulating properties.
Linen		One of the strongest natural fibres. It is ideal for summer clothing, home furnishing, etc. With proper care, the longevity can be ensured.

Select tools and materials

7.5 Selecting materials

You read in Chapter 5 that materials are selected for creating different kinds of products based on their properties. This is also true for apparel making. Table 7.4 lists some common fabric, their properties and the kind of apparel they are used for making.

You may select more than one kind of fabric depending on the apparel, for example, if you plan to use a different colour or print to make a pocket or for patchwork.

Besides the fabric, you will also need thread for stitching, preferably of the same colour as the fabric(s) you have chosen.

Table 7.4: Selection of fabric is done on the basis of the apparel they will be used to make

Apparel	Suitable fabric	Reason for selection
T-shirt	Cotton	Soft, breathable, comfortable for daily wear
School uniform	Polyester-cotton blend	Durable, easy to wash, wrinkle-resistant
Dress	Cotton, rayon	Soft, breathable, comfortable for daily wear
Baby dress	Soft cotton, muslin	Soft, breathable and gentle on the skin
Kitchen apron	Thick cotton, polyester	Strong, washable, protects clothes

PORTFOLIO

Which material did you select and why?

7.6 Selecting tools

The important tools required for making most apparel are given in Table 7.5 below.

Table 7.5: Commonly used tools for making apparel

Tools	Use	Safety note
Tailoring tape	To take measurements	Do not pull tightly around the body
Scissors	For cutting fabric, thread	Avoid handling from the sharp ends
Sewing machine	Used for stitching fabric pieces together	Operate only under supervision; keep fingers away from the needle
Pins	Used to hold fabric pieces in place before stitching	Insert and remove carefully
Iron	Used to press fabric and seams for neatness	Use under adult supervision; do not touch the hot surface
Needles	To stitch the cloth with thread	Avoid touching the pointed end
Thimble	Small, hard 'cap' worn on the finger to protect finger from needle pricks	Wear it on your finger used to push the needle into the cloth
Items for decoration	Such as lace, sequins	Could have sharp edges
Fasteners	Such as buttons, zips	Could have sharp edges
Tailor's chalk/Marker	To mark measurements and outlines	Use lightly so that it can be washed away

7.7 Bill of Materials

Fabric is generally available in the form of rolls. The width of a roll is typically between 1–1.5 m. The length of the cloth you need is based on the width of the roll and material you require.

Estimation

Cost estimation and documentation

Remember, only the measurements in your drawing are not sufficient for estimating the amount of cloth required. You need to estimate 'seam clearance', that is extra cloth, for stitching and hemming edges.

You should include the cost of labour and the estimated human hours spent doing the tasks. Such 'soft' aspects will help you understand the value of labour put in to complete the work.

CASELET

The students of Government High School created the following Bill of Materials for a child's dress (Table 7.6).

Table 7.6: Bill of Materials for apparel

Items	Quantity	Estimated cost (in ₹)
Main fabric (cotton)	1.5 m	300
Thread roll	1 roll	30
Button (for decoration)	10	20
Lace (for decoration)	0.5 m	10

Cost of labour	Value (time in hours × hourly estimate × frequency per week)	Estimated cost (in ₹)	Remarks (if any)
Measuring and sketching	1 × ₹50 × 1	50	
Stitching	2 × ₹50 × 2	200	
Total		**610**	

PORTFOLIO

Prepare the Bill of Materials for the apparel you will make.

7.8 Basics of apparel making

7.8.1 Sewing

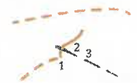
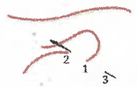
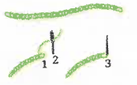
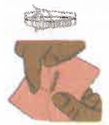
The key part of sewing is handling the needle and thread. While you can stitch an apparel entirely by hand, some stitching by hand is required even when using a sewing machine. Thus, you should be able to use a needle and thread to carry out hand stitches competently.

While hand stitching, you need to keep the following in mind (Figure 7.7 and Table 7.7).

1. Draw a reference line.
2. Decide the style of stitch in consultation with your teacher or the expert. Table 7.7 has a few examples of stitches and when to use them.
3. Keep the stitch straight and even.
4. Ensure consistent tension across all the stitches (neither too tight nor too loose).
5. Ensure no missed or uneven stitches.
6. Ensure no damage to the material being sewn.
7. Pull the needle away from yourself.

Figure 7.7: *Stitching by hand requires care*

Table 7.7: Types of stitches and when to use them

Stitches	Running stitch	Backstitch	Split stitch	Buttonhole stitch	Hemming stitch
Illustration					
When to use	Temporary stitching, joining layers, simple seams, e.g., stitching on an apron pocket.	Strong seams, repairs, outlines, e.g., stitching apron straps, repairing torn seams in a bag.	Embroidery, outlining designs, e.g., embroidery cushion cover designs or a dress.	For buttonholes, preventing fabric edges from fraying, e.g., buttonholes on a dress, securing edges of a bag flap.	Finishing hems of garments and fabrics, e.g., bottom edge of an apron, skirt hem.

Practise with a small sample

TASK

Practise different types of stitches on a sample cloth as shown in Figure 7.8. You can ask experts to teach you stitches other than those in Table 7.7 or search for videos on the Internet. You can also try to repair any apparel or stitch small covers for water glasses from recycled cloth for practice.

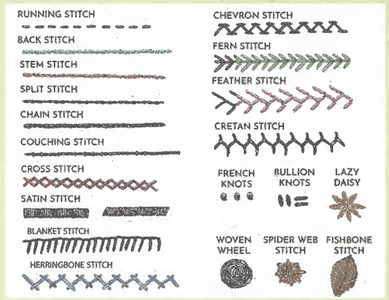


Figure 7.8: *Sampler with different kinds of stitches*

PORTFOLIO

Place the sampler or an image of the sampler in your portfolio.

Safety

SAFETY

Basic safety while making an apparel using a sewing machine (Table 7.8).

Table 7.8: Safety while sewing

			
Place the machine on a flat, stable surface.	Excess portion of the fabric should hang on the left side.	Sit upright so that the centre of your body is aligned with the needle.	Do not pull the fabric while sewing, it automatically moves forward.

			
Light should come from the left side.	Cut the thread using scissors.	Use a thimble to protect your finger when pushing or pulling the needle through the fabric.	Use both hands while lifting or shifting the machine.

7.8.2 Drafting

Drafting and pattern making

In apparel making, the process of marking measurements and drawing the shape on paper is called drafting. Drafting helps in ensuring the right shape and size of the product, avoiding mistakes and reducing fabric wastage. Once the draft has been cut out, it becomes a paper pattern since it can be reused. The pattern is placed on fabric and traced to get the same shape and size on the fabric each time. Using a paper pattern helps in making the product accurate and neat, and getting the same measurements each time.

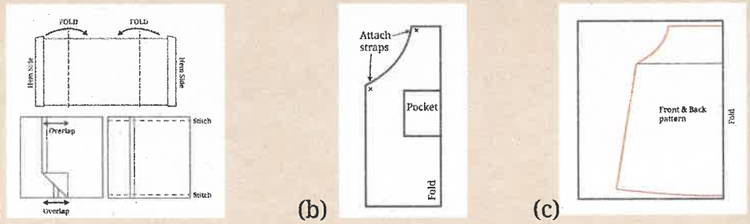
To develop a paper pattern for your product, follow the steps in Table 7.9.

Table 7.9: Developing paper patterns of apparel

Steps	What is to be done?
1.	Finalise the product design and note down all required measurements. These measurements are the actual measurements of the product, not reduced or enlarged as per any drawing scale. Unlike the technical drawing of construction, apparel patterns are drawn full size.
2.	Use chart paper or old newspaper, and draw the shape of the product using a scale and pencil, based on the actual measurements. Make sure to draw as per the design (e.g., square or round for the neck; rounded cutting for an armhole).
3.	Mark all measurements clearly on the paper pattern and label each part (front, back, strap, pocket, etc.).
4.	Recheck the paper pattern to ensure the size and shape are correct.
5.	Cut neatly along the drawn lines to prepare the paper pattern.

CASELET

Students of Grade 9 in Government High School started the process of drafting, making the paper patterns as shown in Figure 7.9.



(a) (b) (c)

Figure 7.9: *Paper patterns of different objects – (a) cushion cover, (b) apron and (c) dress for a young child*

PORTFOLIO

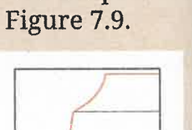
Prepare a paper pattern of the apparel you will make using chart paper or old newspaper.

Use of tools and materials

7.8.3 Preparing fabric

After the paper pattern is ready, the next step is to prepare the fabric before cutting (Table 7.10). This step is crucial and should not be skipped.

Table 7.10: Preparing the fabric for stitching

Steps	What is to be included?	Image
1.	Pre-wash (and dry) your fabric before cutting (especially natural fibres like cotton, linen and rayon). Pre-washing fabric ensures that any shrinkage happens before you cut and sew.	
2.	Press the fabric using an iron to remove wrinkles and creases. Smooth fabric helps with accurate marking and cutting.	
3.	Fold the fabric so that the two side edges (called selvage) meet.	

7.9 Marking and cutting fabric

Once the pattern is ready, it can be used for cutting the fabric. Table 7.11 shows the key steps to be followed in this process.

Table 7.11: Steps for marking and cutting

Steps	What is to be done?	Image
1.	Marking of fabric as per the paper pattern: • Place the paper pattern straight along the length of the fabric; this ensures strength and durability of the apparel. Also, place the pattern so that there is minimum wastage of fabric (e.g., along the edges). • Pin the paper pattern on the fabric and trace around it with tailor's chalk, leaving 1–2 cm allowance for seams or hemming. • Take feedback from the teacher/expert before cutting.	
2.	Cutting of fabric as per the paper pattern: • Cut carefully along the marked lines on a flat surface. • Keep front and back pieces pinned together, and label them to avoid mix-up.	

QUALITY

Tips for cutting the fabric

1. **Large, long strokes:** Make long, smooth cuts rather than many small snips.
2. **Focus on the tip:** Look at the tip of the scissors to guide the direction of cutting for better accuracy.
3. **Maintain blade parallel:** Keep the scissors parallel to the surface on which the fabric is placed.

Quality

PORTFOLIO

Place images or sketches of each of the steps you took to prepare, mark and cut the fabric in your portfolio. Write a brief description of the step.

CHECK YOUR UNDERSTANDING

Look at Figure 7.10 and answer the questions:

1. On the basis of what you learnt about marking and cutting of fabric, do you observe any errors in the figure?
2. What problems may occur due to these errors?
3. What steps should be followed to correct these mistakes?
4. State any two good practices for marking and cutting fabric. How will you apply these good practices in your work?

Figure 7.10: *Uneven marking and cutting of fabric*

Hint: Look at the placement of the paper pattern and the way the fabric has been cut.

Use of tools and materials

7.10 Sewing the product

After the fabric pieces have been cut and arranged correctly, the next stage is sewing them together. It is important to secure stitching at both the beginning and the end of the seam – this means that there must be no chance of the stitching coming loose at these points. This is done by making a few backstitches (that is, stitch 'backwards' over the initial few stitches), which help prevent the seam from opening during use or washing. Properly secured stitches increase the durability and life of the apparel.

SAFETY

While sewing, care should be taken to keep the stitches straight, even and properly aligned along the marked lines (Figure 7.11). Uneven stitching can affect both the appearance and strength of the product. Sewing should be done at a steady pace, so that the fabric does not slip (which will cause a few stitches to be missed) or gather (which will case the fabric to become 'scrunched' up in some places).

Figure 7.11: *Handstitching an apparel*

CHECK YOUR UNDERSTANDING

In Figure 7.12, a few images are marked as incorrect while some are marked as correct. Do you agree? Give reasons for your answer.

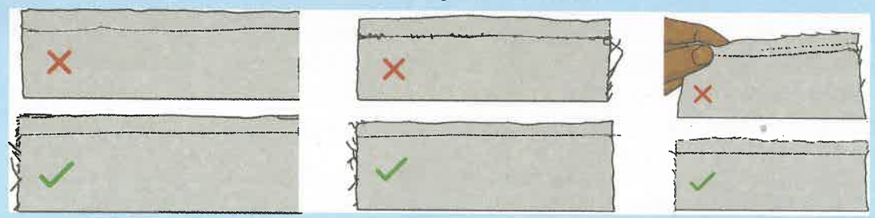


Figure 7.12: *Samples of sewing*

7.11 Finishing the product

Finishing

Once stitching is complete, finish the raw edges of the seam allowance inside your garment by trimming or overlocking. This is done to prevent fraying, increase strength and ensure comfort. You will also need to neatly hem the bottom, sleeves and neck of the apparel. This is important for durability and a neat appearance. Unfinished edges, especially on woven fabrics, tend to fray with washing and wear. Seam finishing prevents this. Figure 7.13 shows simple methods to finish the raw edges of the seam allowance.

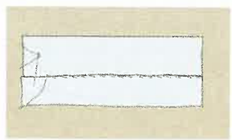
Close hemming	Vertical hemming	Hand rolled hemming
		

Figure 7.13: *Different methods of hemming*

PORTFOLIO

Place a sketch or image of each step of the process in your portfolio. Briefly describe each step.

Did you need to redo the stitching? If yes, why and what did you do differently the second time?

DID YOU KNOW?

Surface Decoration

After stitching and finishing, you can use surface decoration to make your product more attractive or unique. Examples of some surface decoration techniques are embroidery, painting, patchwork, tie-and-dye, block printing, quilting and bead and lace or sequin work (Figure 7.14).

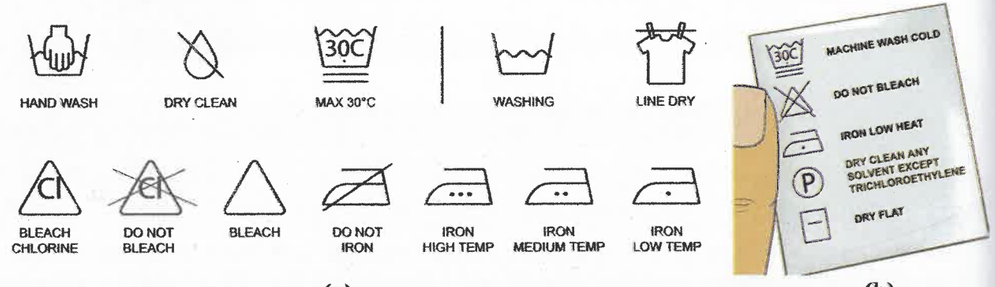
Figure 7.14: *Embroidery used for surface decoration*

7.11.1 Packaging and labelling

After finishing and checking the apparel, the last step is to pack it neatly for delivery, storage or display. Packing is not just about wrapping the apparel. It involves careful thought about protecting it from dust, dirt and damage, and presenting it in a professional manner to the customer (Figure 7.15).

Figure 7.15: *Packing apparel for protection and presentation*

Similarly, labelling is important not only to display your brand name but also to inform the customer of the size of the apparel and how to ensure that it continues to look fresh. It is the primary means of communication between the manufacturer of the apparel and the customer. The label also helps the person selling the apparel to guide the customer. Figure 7.16 (a) provides some frequently used symbols, while Figure 7.16 (b) shows an example of a label.



(a) (b)

Figure 7.16: *(a) Frequently used symbols in labels of apparel and (b) example of a label providing care instructions – the label cautions that trichloroethylene (a spot remover) cannot be used since it has carcinogenic properties.*

PORTFOLIO

Design a label for your apparel, sharing the size and care instructions. Attach it to the apparel and place the finished product or its image in your portfolio.

7.12 While making apparel

1. Before beginning any work, it is necessary to gather information related to the work. This can be done by visiting a tailoring shop or boutique, doing an online search or by interviewing a fashion designer or tailor.
2. Pre-wash, dry and press fabric before cutting to prevent shrinkage and uneven stitching.
3. Mark and cut fabric neatly and carefully, keeping pieces labelled to avoid confusion. Make long, smooth cuts rather than many small snips. Keep the scissors parallel to the cutting surface.
4. While using a sewing machine, sewing should be done at a steady pace so that the fabric does not slip or gather at once place.
5. Finish the product with hemming, trimming, pressing and checking quality.
6. Try to reuse materials, upcycle old clothes to reduce waste and protect the environment.

7.13 Assess your learning

1. Your task is to stitch a *pajama* set suitable for daily use. You can use cotton, polyester or a cotton-polyester, blend. Which fabric will you choose and why?
2. A learner takes measurements for (i) an apron and (ii) a dress while a person is wearing thick winter clothes. Explain how this may affect the final apparel and suggest steps for correction.
3. How, in your experience of making an apparel, does preparing a paper pattern before cutting help reduce fabric wastage?
4. Why is pre-washing and pressing fabric before cutting considered an essential step? What could happen if this step is skipped?

5. During stitching, a student notices uneven stitch length and that the stitching is loose. What problems could this cause during use and washing, and how can these issues be corrected?
6. Write down ten things you can do with your old dress. Find out what is sustainable fashion?
7. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
8. Give examples of how you can apply your learnings in a real-life situation.

CHAPTER 8

Additional Vocations

0916CH08

Sheet Metal Work

Sheet metal work involves shaping thin metal sheets (such as steel, aluminum and copper) into useful products by processes including cutting, bending, forming, joining and finishing. This work requires careful measurement, correct tool selection, safe handling of sharp edges, and attention to quality and finish.

Key words

- **Forming:** shaping metal without cutting it
- **Burr:** sharp unwanted edge after cutting
- **Rivet:** fastener used to join metal sheets
- **Gauge:** thickness of a sheet

Item/Material name	Description/Use
GI/Aluminium sheet	Main material for fabrication
Fasteners/Rivets	Joining sheet metal parts
Cardboard/Paper	Prototype
Tin snips/Shears	Manual cutting of sheet metal
Hammer/Mallet	Shaping and forming
Files/Grinder	Smoothing sharp edges
Drill/Hand tools	Making holes
Measuring scale/Tape	Accurate measurement
Marking pen/Scriber	Marking layout
Safety gear	Gloves, goggles, apron

Quality parameters	Safety parameters
Accurate dimensions: proper measurement and marking	Wear safety gloves, goggles, ear plugs and apron while working
Smooth edges: burrs removed and edges finished	Use cutting and forming tools only as demonstrated
Strong joints: secure riveting or joining	Keep fingers away from cutting and bending zones
Proper shape: correct bends and alignment	Maintain a clean and organised workspace
Minimum waste: efficient use of material and reuse of scrap	Dispose waste as per protocol

Key steps in the process

1. **Scoping:** Choose a simple item, such as a dustpan, dustbin, chalk box and box clamps. Decide the quantity to be made.
2. **Design and draw:** Draw simple sketches of the product. Mark dimensions and decide the forming technique.
3. **Make a prototype:** Create a prototype using cardboard to get an idea of the design, especially folds and joints.
4. **Select materials and tools:** Select suitable sheet metal and cutting tools (tin shears).
5. **Prepare the product:** Mark on sheet using scriber; cut the metal; use punching tools, riveting or folding and hammering sheet metal, or soldering as required.
6. **Finish the product:** Smooth surfaces, trim edges and apply colours.

Plumbing

Plumbing is the work of installing, maintaining and repairing systems that carry water, liquids, gases, fluids or waste through pipes. Plumbing includes planning pipe routes, selecting suitable materials, cutting and joining pipes, fitting taps and valves, checking water flow and repairing leakages.

Keywords			
	Valve: device used to control water flow	**Joint:** connection point between two pipes or fittings	**Flow:** movement of water through a pipe system

Item/Material name	Description/Use
Pipes (PVC/GI/CPVC)	Carrying water
Pipe fittings	Couplings, elbows, tees, end caps
Taps/Valves	Controlling water flow
Pipe wrench/Spanner	Tightening and loosening joints
Hacksaw/Pipe cutter	Cutting pipes to length
Thread seal tape/Adhesive	Preventing leakage at joints
Plunger	Clearing blocked drains
Measuring tape/Spirit level	Measuring and alignment
Cloth/Bucket	Cleaning and water collection
Safety gloves/Goggles	Personal safety

Quality parameters	Safety parameters
Leak-free joints: No dripping or seepage from pipes or fittings	Wear basic protective equipment, such as gloves and safety glasses
Proper alignment: Pipes are laid straight and level	Keep hands dry while handling tools and fittings
Secure fittings: Valves and fixtures are tightly fixed	Ensure the work area is clean and free of obstacles
Smooth water flow: No blockages or air locks	Dispose waste as per protocol
Minimum waste: Efficient use of pipes, fittings and water	

Key steps in the process

1. **Scoping:** Observe plumbing systems through site visits, videos or interaction with plumbers working in homes, schools, farms or in the community. Choose a simple and safe task, such as fixing a leaking tap, replacing a joint, clearing a blocked drain, or installing a short pipe section.
2. **Design and draw:** Study the water flow path and prepare a simple sketch showing pipes, joints and fixtures.
3. **Prepare detailed plan:** Prepare a step-by-step plan covering material selection, tool use, safety checks and execution.
4. **Select materials and tools:** Identify suitable pipes, fittings and tools based on the task and availability.
5. **Carry out the work:** Ensure water supply is shut off. Measure, cut and join pipes; tighten fittings; apply sealing material; and fix fixtures carefully.
6. **Finish the work:** Restore water supply and check for leaks, blockages or improper flow.

Food Processing

Food Processing involves transforming raw food materials into safe, usable and longer-lasting food products through simple activities, such as cleaning, cutting, drying, cooking, fermenting and preserving.

Keywords

Raw material: unprocessed food such as grains, fruits, vegetables or milk

Processing: clean, cut, cook, preserve raw material

Preservation: methods used to increase shelf life of food

Item/Material name	Description/Use
Raw food materials	Grains, fruits, vegetables, pulses, etc.
Clean water	Washing and processing food
Knives/Peelers	Cutting and cleaning ingredients
Chopping board	Safe food preparation
Bowls/Containers	Mixing and holding ingredients
Stove/Heating source	Cooking or roasting (teacher-supervised)
Drying trays/Cloth	Drying food materials
Weighing scale/Cups	Measuring quantities
Packaging material	Jars, pouches, paper labels
Cleaning supplies	Cloth, soap, waste bins

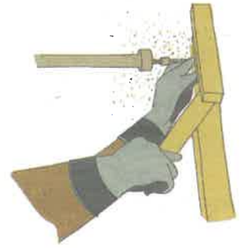
Quality parameters	Safety parameters
Freshness: Raw materials are clean and suitable for use	Wash hands thoroughly before handling food
Hygiene: Processing is done in a clean and orderly manner	Keep work surfaces, tools and containers clean
Consistency: Product has uniform texture, taste and appearance	Use knives, peelers and heat sources carefully
Safety: Food is properly cooked, dried or preserved	Avoid cross-contamination between raw and processed food
Minimum waste: Efficient use of food, water and materials	Store ingredients and finished products properly
	Dispose waste as per protocol

Key steps in the process

1. **Scoping:** Choose a simple product, such as roasted grains, dried vegetables, pickle, papad or snack item.
2. **Follow a recipe:** List ingredients required, and check their quality and freshness; organise work area for cleaning, preparation, processing and packaging.
3. **Prepare ingredients:** Wash, peel, cut or sort food materials following hygiene practices.
4. **Carry out the work:** Perform selected processing techniques such as drying, roasting, cooking, or fermenting using safe methods; note changes in colour, texture, smell, and taste during processing, and take necessary actions.
5. **Finish the work:** Check the product for cleanliness, safety and consistency; pack the food safely using clean containers or pouches. Add simple labels, if required.

Furniture Making

Furniture making involves designing and creating useful objects, such as stools, tables, shelves, benches, storage units and simple seating. Furniture making combines practical skills with creativity, while promoting responsible use of materials, reuse of waste wood or metal, and careful workmanship.



Keywords

Joinery: methods used to join two or more parts of furniture

Seasoned wood: wood that has been dried to reduce moisture

Finishing: final surface treatment such as sanding, polishing or painting

Item/Material name	Description/Use
Wood/Bamboo/Engineered boards	Main material for furniture
Metal rods/Pipes (optional)	Frames or supports
Measuring tape/Steel rule	Measuring dimensions
Try square/Spirit level	Checking right angles and alignment
Hand saw/Chisel/Plane	Cutting and shaping material
Drill/Screwdriver	Making holes and fixing joints
Bench vice/Clamps	Holding parts securely
Hammer/Mallet	Assembling joints
Fasteners (nails, screws, and bolts)	Joining parts
Sandpaper/Paint/Varnish	Finishing and protection
Waste bins	Safe disposal of scrap

Quality parameters

Strength and stability: Furniture can safely support its intended load

Accuracy: Measurements and joints fit properly

Finish: Surfaces are smooth and edges are safe

Useability: Furniture meets the user's need comfortably

Material efficiency: Recyling, minimum wastage and reuse of leftovers

Safety parameters

Wear basic protective equipment, such as gloves and safety glasses when required

Keep tools sharp, clean and stored properly after use

Keep the workspace clean and free of obstacles

Dispose waste as per protocol

Key steps in the process

1. **Scoping:** Choose a simple product, such as a stool small table, shelf or box.
2. **Design and draw:** Draw a simple sketch with dimensions; decide materials, joints and basic layout; digital tools may be used if available.
3. **Prepare a prototype:** Make a test model using cardboard or paper to check shape, joints, stability, etc.
4. **Select materials and tools:** Choose locally-available materials and suitable tools, considering strength, cost and safety.
5. **Prepare the product:** Measure, mark, cut and shape parts carefully; join parts using nails, screws, glue or joints. Check alignment and stability.
6. **Finish the product:** Sand surfaces and apply paint, polish or varnish for protection and appearance.

Pottery

Pottery involves preparing clay, shaping it using simple techniques, drying it carefully, strengthening it through firing or hardening, and finishing the surface for use or decoration.

Keywords

Wedging: kneading clay to remove air bubbles and ensure even moisture

Firing: heating clay in a kiln or open fire to make it hard and durable

Slip: clay mixed with water, used for joining parts or surface decoration

Item/Material name	Description/Use
Clay (local)/Terracotta	Main material for pottery
Water	Softening clay and making slip
Sand/Grog	Improving strength and reducing cracks
Rolling pin/Paddles	Shaping clay
Wire cutter	Cutting clay lumps
Carving tools	Trimming and decoration
Sponges/Brushes	Smoothing and finishing
Moulds	Creating uniform shapes
Drying boards/Trays	Safe drying of products
Apron/Gloves	Personal safety and cleanliness

Quality parameters

Material quality: clay is clean, well-prepared and suitable for the product

Uniform thickness: product walls are even and balanced

Safety parameters

Use tools such as wire cutters and carving tools carefully

Keep hands, feet and work surfaces clean to avoid slipping

Stability: base is flat and the product stands firmly	Follow safety instructions during firing or hardening processes
Finishing: surface is smooth and free from cracks	Avoid inhaling clay dust; clean surfaces with wet cloths
Minimum waste: clay and water are reused wherever possible	Wear basic protective gear, such as apron or gloves if required
	Dispose waste as per protocol

Key steps in the process

1. **Scoping:** Choose a simple item, such as a *diya*, bowl, cup, tile or planter. Decide the quantity to be made.
2. **Design and draw:** Draw simple sketches of the product. Mark dimensions and decide the forming technique.
3. **Make a prototype:** Create a small test piece to observe cracking, drying behaviour and strength.
4. **Select materials and tools:** Select suitable clay; knead and wedge it to remove air and control moisture. Procure tools required, based on the process you have selected.
5. **Prepare the product:** Use pinch, coil, slab or mould techniques. Join parts using slip and maintain even thickness; allow slow and shaded drying. Monitor for cracks or warping; harden the product through kiln firing, open firing or extended sun drying, following the safety norms.
6. **Finish the product:** Smooth surfaces, trim edges and apply simple textures or natural colours.
7. **Strengthen the product:** Harden the product through kiln firing, open firing or extended sun drying, following safety norms.
8. **Finish and decorate:** Smooth surfaces, trim edges and apply simple textures or natural colours.

Unit III

Work in Human Services

Work in Human Services involves interaction with people to understand their needs and requirements. From prehistoric times, humans have lived in communities, where helping one another was essential for survival. Caring for the sick and elderly, protecting oneself and others from danger, teaching younger generations and sharing resources—most of this work was in the form of services to others or *sevā*.

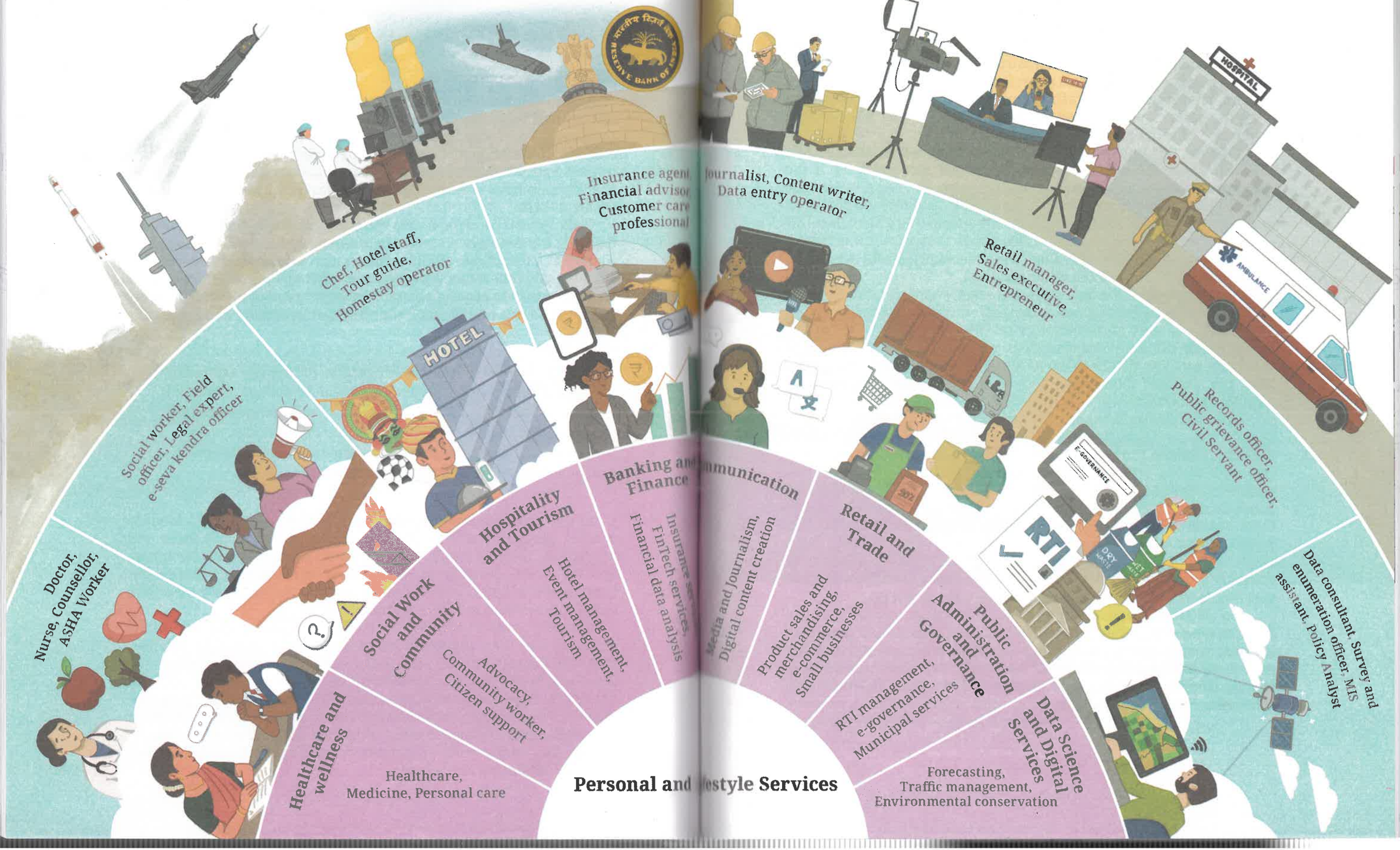
Today *sevā* is fundamental to societies and has become a part of our daily life. For example, a student helping an elderly person cross a road, a guard at a school gate guiding parents or volunteers serving people at a temple. At other times, *sevā* is given as part of a job or profession, for example, a doctor treating a patient, a teacher guiding students, a waiter serving food or a tourist guide showing visitors around a monument.

In the modern world, human services are rapidly expanding and transforming. Advances in digital technology, telehealth, online learning and e-governance are reshaping how people access health care, education and information. At the same time, challenges such as climate change and ageing societies are creating new types of work.

At the core of human services is empathy–the ability to identify another person's needs by putting oneself in the other's shoes and responding to these needs. In order to do so, compassion for others and the ability to place their needs at the centre are necessary. Compassion in the context of human services means caring for others and a commitment to fulfil their needs.

Empathy involves treating everyone with respect and sensitivity, ensuring that their dignity is maintained, while providing services. This core value is rooted in the Indian ethos of *sevā* and it bridges the process of identifying needs and fulfilling them with dignity. This form of work is, therefore, central to human well-being and social progress. While some services focus on physical health and safety, others nurture the mind, spirit and relationships that hold communities together. In essence, this sector exists to improve the quality of life for individuals and the community as a whole.

Technology and Digital systems, Infrastructure and Logistics, Regulation and Quality assurance, Open-data platform designers, GIS mappers, Data-protection officers



The figure overleaf depicts the livelihood ecosystem related to human services. This ecosystem is an interconnected network of resources, people, institutions, activities and environmental factors that enables individuals to earn a living while meeting the needs of end-users, for example, related to health and well-being, finances, entertainment and information. This ecosystem varies across geographies, depending on the availability of digital infrastructure (for example, internet, FinTech platforms, etc.), access to professional expertise (for example, doctors, lawyers or hotel staff), support services (for example, data analysts, technicians, etc.), and the demand for services, like tourism, healthcare or retail at the local and national levels.

Further, this implies that no service is provided in isolation and different kinds of work are deeply connected. For example, if the demand for hospitality and tourism increases, the requirement for banking and finance (for example, to handle payments), transportation and logistics (for example, for a tour), and media and journalism (for example, to promote destinations) also grows. Conversely, if there is a disruption in public administration and governance, it will eventually affect the efficiency of all the other services.

As you can see in the figure, there are many opportunities for work in Human Services. Beyond healthcare and education, the field includes social welfare, safety and emergency services, hospitality, counselling, financial and communication services, retail, and more. Each level in the figure provides details of the kind of work that can be done in this area. The last level shows how these roles are interlinked, supporting individuals and society in a continuous cycle of care and service.

You can choose the work you will do either from options in the Unit or you can identify some other kind of work related to human services. Chapter 9 introduces key concepts and processes that are common across a range of work related to human services. This chapter is mandatory for you. Chapters 10 and 11 use these common concepts and processes to help you understand how to do specific work. At the same time, they also introduce additional concepts and processes that you can learn while doing. Chapters 10 and 11 detail work related to healthcare and tourism, respectively. Chapter 12 contains guidelines for hospitality, event management, data-based services, interior design and public information services.

To reiterate, you can choose to do work either related to any of these seven vocations or you can select something related to human services, that is, entirely different. Remember to consult your teacher and/or an expert for guidance at all points. Work is to be done in groups. Remember–a big part of service is working together with others, for others.

CHAPTER 9

Personal and Lifestyle Services

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Figure 9.1: *Similar services provided in different contexts.*

A parent cooking for their child and a food-cart vendor both provide nourishment. A voluntary group cleaning an area has the same goal as sanitation workers. This is what distinguishes human services from other forms of work–these services are deeply personal and oriented towards the well-being of both self and others. These acts of service shape the world around us (Figure 9.1).

In this chapter, you will

- Understand different aspects of human services
- Explore the value chain of services
- Start developing a service orientation
- Learn how to create a service environment
- Prepare a consent form
- Identify quality criteria
- Explore vocations related to services

Importance of vocation

9.1 Introduction

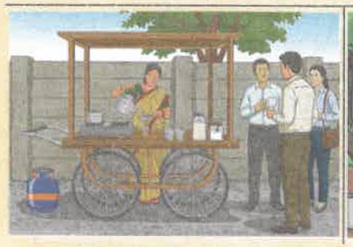
Services provided on an everyday basis in the home or community are informal, while services organised so that large numbers of people can benefit from them are either voluntary or professional. Please note that the word 'professional' refers only to how the work is organised; it does not mean that greater dignity or value is associated with some kinds of work. Dignity is the inherent respect and honour that every person deserves, regardless of their job title. Whether someone is a trained professional or an untrained worker, their work is equally worthy of respect, because it fulfils a human need. Professional services are offered by trained people like nurses, drivers, counsellors, cooks, clerks or technicians, who combine skill and commitment, and act to support others. Yet, all forms of service–informal, voluntary and professional–share the same core value, which is respecting and fulfilling the needs of others. In India, this idea connects with our civilisational ethos of *sevā* (selfless service) and *sahabhāgitā* (working together). When we serve others, we also strengthen ourselves and our community.

In India, the service sector was reported to be contributing nearly 55 per cent of Gross Value Added (GVA), providing work to 30 per cent of the workforce, as per the Economic Survey of India 2024–25, Government of India.

Value chain

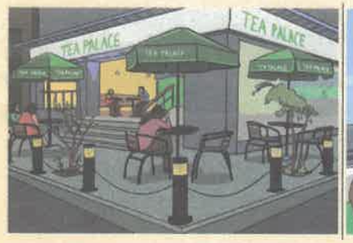
A service becomes better when each step is planned with care. A smile, a polite gesture and a few kind words make the person receiving the service feel comfortable. Hygienic places make them feel safe, while beautiful surroundings make them happy. Such intangible elements add value to a service.

Thus, when providing a service, value does not only come merely from doing the work, but also from the elements added at each step, for example, the people involved, the effort taken, the environment and the clarity offered to users. Figure 9.2 elaborates this further.



Roadside tea being served with elements of hospitality, hygiene and quality.

This roadside shop has additional elements of seating along with readymade snacks and fruits.



Elements of comfortable seating, decor, and a variety of teas and snacks have been added to this cafe.

The element of beautiful, natural surroundings adds value to the experience of drinking tea.

Figure 9.2: *Value chain grows as service options grow from a roadside stall where tea is served with a smile to a restaurant in a beautiful setting*

Value chain of work

TASK

Select any service you have experienced. Find out how the value of this service increases in different scenarios. You can do an Internet search and ask different stakeholders. Identify the elements that add value. Also, list the sources of information you used to gather this data.

9.2 Developing service orientation

Service orientation: user at centre

We are both givers and receivers of service. Just as we expect good service when we receive it, we too must offer thoughtful service when it is our turn. The ability to empathise with others helps us understand how to interact with them, and how to identify and respond to their needs.

This way of thinking–valuing people's needs, acting with care and finding satisfaction in serving others–is called service orientation. For example, if we visit a shop and the salesperson listens patiently, explains where things are kept and guides us without irritation, we feel at ease and happy. We are also likely to return to the shop again due to the service provided.

A service orientation comprises four key qualities, namely, keeping the person receiving the service at the centre, fair and ethical decision-making, contribution to society, and organisation and teamwork.

9.2.1 Being centred on the user

Every service exists to meet someone's need. Therefore, before starting, ask–Who am I serving? What do they really need? Think about how to make sure users are able to receive the service as intended. Figure 9.3 shows the distribution of clothes and other things, like food items and bedding in a flood relief camp.

The camp is housed in a school, with limited toilets; hence, portable toilets have been organised. People may have been hurt or they may fall ill due to exposure–a first aid centre has been set up to take care of this aspect.

Although the space is mostly makeshift, it has been planned with the user in mind. The basic questions guiding the organisers would have been–What do people need if they are abruptly displaced from their homes (for example, clothes, bedding, medicine, clean water, food, etc.)? What kind of materials will give them immediate relief and make them feel more in control of their lives (for example, rations and stoves instead of simply distributing precooked meals)?

Figure 9.3: *Distribution of a variety of materials catering to specific needs of flood-affected persons*

In Figure 9.3, different tables consisting of different sections (grocery, clothing, bedding, toys for children, etc.) are placed, so that people can easily move around. Can you think of any other way to organise the space?

Above all, the persons who have been displaced will be distressed. What must be done to ensure that they are treated with the utmost respect and sensitivity?

Service orientation: user at centre

TASK

Suppose you are a volunteer in the camp. How will you cater to the different needs of people in the camp (for example, the elderly, children, *divyāṅg*, etc.)?

PORTFOLIO

Observe a service in your neighbourhood

You must have observed services that people around you use daily, like a ration shop, anganwadi centre, milk booth, bus stop, village water point/handpump, local

grocer or panchayat help point. Choose any one place that you pass by regularly on your way to school and record the following observations:

1. Name of the service observed
2. How will you identify the service provider (for example, uniform, name plate, and where they are seated, etc.)?
3. How is information communicated to the user (for example, labels, timings, tokens, and announcements, etc.)?
4. Which tools or materials are used (for example, weighing scale, register, phone, tokens, and vessels, etc.)?
5. What are the things that appear to make the users of the service happy? Justify your answer based on your observations.

Service orientation: fair and ethical decision making

9.2.2 Making fair and ethical decisions

Fair and ethical decision-making is about reflecting on a situation from all angles and choosing what is correct. When users know they will be treated fairly and ethically, they feel respected and the quality of service improves. In practise, this means choosing actions that are fair, safe, trustworthy and inclusive for everyone, irrespective of their background. It includes:

1. Following agreed processes, like maintaining a queue and serving persons as per their turn, while making exceptions for a few, for example, seats are earmarked for the elderly in public transport;
2. Making sure everyone is treated with dignity and their privacy is maintained, for example, making sure that the door is closed while treating a patient in a clinic;
3. Making decisions that consider everyone's needs, not just of those who speak the loudest or are the nearest, for example, serving customers as per token numbers in a restaurant, and not allowing any person to shout and push to the counter, demanding they be served first; and
4. Maintaining confidentiality by not sharing any data without providing information regarding how it will be used and seeking permission. For example, a photographer cannot share images without due permission and a person conducting a survey cannot share any data with an unauthorised person.

Sometimes, it is difficult to know what to do in unexpected situations, therefore, rules and protocols have to be established to ensure that all the persons providing the service know what is to be done. This also helps with managing conflict.

CASELET

Consideration of special circumstances

Anita and her family have migrated from another state. She has taken her grandfather to the Primary Health Centre (PHC), but is unable to read the signs, which are in the state language. The nurse notices that Anita has seated her grandfather on a bench and has been waiting for almost 30 minutes. In the meantime, the queue is growing longer.

What would you do if you were the nurse at the PHC? Would you help Anita skip the queue or ask her to join it now? What processes should be set up to handle not just cases like Anita's but other persons in need (for example, *divyāṅg* and pregnant women)?

Adherence to work related rules and safety protocols is, therefore, critical for efficiency of processes. This helps all members of the team to work towards the same objective smoothly, and with fairness and trust.

9.2.3 Contribution to society

Every act of service–big or small–helps improve society. When we try to understand what others need and respond with patience, service does not feel like a burden. Simple actions like helping an older neighbour read a message on their phone, showing a new student the right classroom or helping keep a shared space clean, slowly build a kinder, more responsible community. When these actions are placed in a professional space, for example, an elder care worker, an administrator in a school, a sanitation worker, etc., they become part of professional services. However, often professionals also go beyond the call of duty, and contribute to society and the nation.

We saw this during the COVID-19 pandemic which was declared a global threat by the World Health Organisation (WHO) from March 2020 to May 2023. During the pandemic, many professionals continued to serve others (Figure 9.4). Doctors, nurses and hospital staff worked day and night to care for patients. Sanitation workers kept the streets and hospitals clean. Grocery shop owners, delivery staff and drivers ensured food and medicines reached homes. Police, journalists and volunteers shared accurate information and helped persons in distress. Even when factories, schools and offices were closed, these services never stopped, but

Service orientation: contribution to society

continued online. These professionals showed that service through care, communication, safety and support is the backbone of every community and remain essential in both ordinary times and emergencies.

Figure 9.4: *During the pandemic in 2020, persons from different professions provided a range of services to ensure lives were saved and society continued to function*

9.2.4 Organisation and teamwork

Service orientation: organisation and teamwork

In a service environment, teamwork and organisation are extremely important, for ensuring that each professional is working towards the same goal. Many services, such as retail, hospitality and healthcare, depend on a 'chain of service' where one person's work directly affects the next person's. For example, in a restaurant, if the waiter (front-end) does not communicate well with the kitchen staff (back-end), the customer receives the wrong order. Similarly, when nurses change shifts, they ensure the next person is aware of the patient's requirement, and there is no change in the service that the patient was receiving.

This is possible through organisation, which involves detailed planning, ensuring all tools and materials are available, scheduling work as per time available and deadlines, assignment of responsibility, and having standard processes, so that the same quality of service is provided each time.

TASK

Figure 9.5 shows an annual inter-school sports event. It involves participation from 35 schools. Care has been taken to ensure the comfort and safety of all students. Separate areas were allocated for different activities. Water and refreshments have been provided at different points. Which elements do you observe that will help ensure smooth implementation of the event?

Figure 9.5: *Organising an inter-school sports event requires a great deal of planning and organisation*

CASELET

A community health camp was organised in the Primary Health Centre (PHC) near Government High School on a Saturday. The service team included one doctor, one nurse and volunteers (Figure 9.6) to help with registration and guide visitors, and a teacher to guide the students when needed.

During the first hour, the service moved smoothly. The student volunteers greeted each visitor, checked their names on the list, helped them to fill the registration form and took them to the correct desk without delay. Each visitor was assigned a token and guided to a waiting area. The doctor explained each step of the check-up and told visitors what they needed to do next. The nurse listened carefully to every question and answered without rushing.

Initially, the response of visitors was positive. Some said, "I understood everything the doctor told me." Others said, "I did not have to search for where to go," and "My turn came as soon as I finished registration."

However, as time passed, certain gaps affected the experience. The registration desk temporarily ran out of forms, which resulted in a crowd. The microphone used for calling token numbers stopped working, leading to confusion. The waiting area became crowded and uncomfortable, because visitors moved the chairs around.

The team responded by collecting extra forms from the office, marking pathways on the floor, using voice announcements and opening the windows for ventilation. These adjustments improved the flow and restored visitors' satisfaction.

Figure 9.6: *Volunteer at the health camp*

Think and Discuss

During the health camp, certain problems arose, but were dealt with immediately. The team changed certain things and the service improved. According to you, what aspects of services discussed in this section can be observed in the caselet? Which changes would you recommend the next time such a camp is planned? Justify your answer.

9.3 Creating service environments

Service environment comprises both the physical and social environment, including safety considerations.

Service environment: physical, social, safety

Physical environment

The physical environment of a service space should be clean, well-organised and safe (Figure 9.7). Some questions that highlight these aspects are – Is the place clean with well-placed furniture? Is it well-ventilated, without any bad odour? Does the place have basic amenities, for example, clean bathrooms, water dispenser and first-aid kit?

Social environment

Imagine going to a dental clinic that is neat and well-furnished. It has the best of amenities, but on enquiring about your appointment with the dentist's assistant, you get a very cold response or you are told that your appointment has been cancelled without any prior notice. How would that make you feel? You would not be happy and will probably not return, even though the dentist had a reputation for good work. Interaction with the service user, and service provider's attitude, attire and communication creates the social environment.

Safety

In the context of services, safety is not just about avoiding accidents; it is about building trust. Persons receiving the service must be confident that their needs will be taken care of, they will be heard and respected, and any information they share will be treated as confidential. A safe service space must follow the 'Three Cs'–cleanliness, care and caution. A good service environment is not only about what people see but also about how smoothly things work. It is created when everyone knows what to do, when to do it, how to avoid delay, and what is the second plan of action, for example, if someone gets sick or is unable to do the work.

Figure 9.7: *Arranging the physical environment for a school event*

TASK

Figure 9.8 shows two scenarios in the same grocer's shop?

Figure 9.8: *The same grocer's shop in varying situations*

1. Identify three steps in the picture on the left that help the service move smoothly.
2. Identify three missing steps in the picture on the right that cause delay or confusion.
3. If you had to fix the process in the picture to the right with only one change, what would you choose? Why?

A good service environment is not only about what people see but also about how smoothly things work. It is created when everyone knows what to do, when to do it, how to avoid delay and what is the second plan of action, for example, if someone gets sick or is unable to do the work.

CASELET

Every year, Government High School participates in the 'Swachhta Pakhwada Abhiyan'. This year, students of Grade 9 volunteered to clean the area within the school boundary and a bus stop close to the school (Figure 9.9). A week before the event, they met to plan the work. They formed teams of five each and nominated a team leader.

Planning and role distribution

Each team selected one of these responsibilities–material procurement, communications, documentation and photography, and safety and processes. They walked around the area to identify what needed attention–litter near the wall, broken posters, dry leaves under the trees and a corner where water collected after rain. The material procurement team made a list–gloves, brooms, masks, buckets, labelled bins and a first-aid kit. The safety and processes team prepared a duty chart, while the communications team checked for permissions with the panchayat office and informed the traffic policeman. The documentation and photography team accompanied the other teams and started taking notes for their report.

Figure 9.9: *Swachh Bharat Swachh Vidyalaya (is a government mission) ensure every school has clean drinking water, along with hygienic toilets and handwashing facilities*

Providing service

On the morning of the Abhiyan, the students reached early. They cleaned the space before starting, set up clearly labelled bins (Wet/Dry) and placed drinking-water pots under the large neem tree. The safety team checked that everyone had gloves and masks. Two students stood near the road to guide pedestrians safely around the cleaning site. Another group put up posters on 'Keep Your Surroundings Clean' and 'Use the Right Bin.'

Work began smoothly. Teams spread out, sweeping the dry leaves, collecting them into buckets and scraping posters from the wall. A few Grade 7 students who were passing by stopped to help and the Grade 9 group guided them on how to work safely. At the bus stop, a teacher pointed out that the dustbin was overflowing. Within minutes, two students replaced it with a larger bin they had kept ready.

Throughout the activity, the record and documentation group noted how much waste was collected in each category, and how long each team took for their area. The processes and safety team ensured that everyone, especially younger helpers, got drinking water and short rest breaks under the shade. The group took care to keep communication polite and clear, especially while working near pedestrians.

Cleaning up post-service

After the clean-up, the students thanked the passersby, who had cooperated, washed the tools and stored them with the left-over cleaning materials. They folded the posters, returned unused materials to the storeroom and handed the filled bins to the sanitation workers

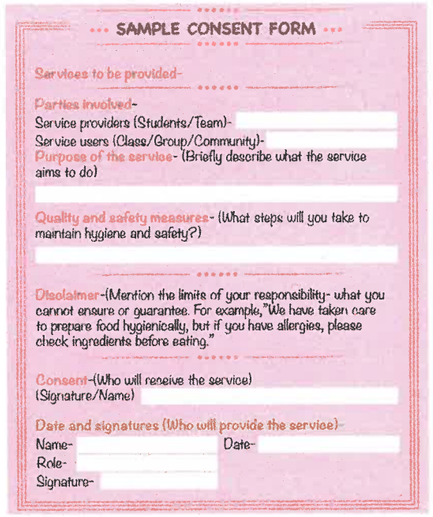
Review and reflection

In the afternoon, the group met again to reflect on the experience. They observed that the work was completed efficiently, since roles were clear. However, they realised that they needed more effective adhesive remover for the posters next time and more shade near the bus stop. They also felt proud that their teamwork and thoughtful planning had made the space cleaner, safer and easier for everyone to use.

1. Describe the elements of service orientation demonstrated in the caselet.
2. What kind of service environment has been demonstrated in the caselet? Justify your answer with examples.
3. What kind of safety precautions are necessary for the activity described in the caselet?

9.4 Consent

In human services, a consent form is an agreement between the service provider and the person being helped. It tells the person exactly the service they will receive and what is expected of them in return. Consent acknowledges the right of the service user to make decisions regarding their comfort and safety, and helps build a safe and trusting relationship between the service user and provider. Figure 9.10 shows a sample consent form.



SAMPLE CONSENT FORM

Services to be provided-

Parties involved-
Service providers (Students/Team)-
Service users (Class/Group/Community)-
Purpose of the service- (Briefly describe what the service aims to do)

Quality and safety measures- (What steps will you take to maintain hygiene and safety?)

Disclaimer-(Mention the limits of your responsibility- what you cannot ensure or guarantee. For example,"We have taken care to prepare food hygienically, but if you have allergies, please check ingredients before eating."

Consent-(Who will receive the service)
(Signature/Name)

Date and signatures (Who will provide the service)-
Name- Date-
Role-
Signature-

Figure 9.10: *Sample consent form*

Consent is important since it is rooted in respect for every person's right to control what happens to their body and lives. This implies that, in the context of services, service users must have both a complete understanding of what is being offered and willingly give their permission before an action is taken. They must also be aware of potential risks, however, minor they may be.

Consent is critical when data is involved. The service provided must ensure the services user has correctly understood what will be done with any data they provide. Another important aspect of consent is that it can be withdrawn at any point.

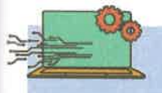
9.5 Service quality criteria

Quality

Working in services involves step-by-step practices that we follow 'before', 'during' and 'after' the service, leading to the satisfaction of those receiving the service. Each of these steps can be categorised into input (before), during (process) and after (output) the service. Table 9.1 lists criteria for quality that should be kept in mind while providing any service.

Table 9.1: Key focus areas and quality parameters at every stage of the service

Stage	Key focus areas	Quality parameters
Input	• Resources, materials and preparation required before starting the service	• Needs of service users identified • Space is clean and hygienic • Tools and materials have been procured • Task checklist has been prepared • Consent has been received • Service environment is oriented towards efficient processes
Process	• How people, processes and time are managed while delivering service	• Smooth workflow and coordination • Timely and respectful interaction • Adherence to rules and protocols • Safe and hygienic practices, including cyber safety where relevant • Active listening and problem-solving • Confidentiality maintained, where relevant
Output	• Reflection and feedback on whether the service met the user's needs and expectations • Clearing the workplace	• Cleaning and safe waste disposal • Feedback collected related to user satisfaction and comfort • Follow-up on feedback in terms of reflections on improvement



TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

Service providers can use AI and technology in various ways to support delivery of services. Technology can help by providing digital maps, signs and kiosks. AI-powered chat assistants can be trained to answer common questions, while multi-language translations and audio guides can be made available through AI tools. AI can be trained to handle tasks that usually consume human time, for example, auto-filling forms, collecting and analysing feedback, and automatic reminders for safety checks or materials. At the same time, safety and ethical use must be kept in mind (please refer to project on AI Assistant in Grade 7 *Kaushal Bodh*).

9.6 Selection of vocation

This unit contains details of work related to healthcare and tourism, as well as guidelines on doing work related to hospitality, event management, data-based services, interior design and public information services. This section will help you to decide the vocation you will take up related to human services.

Explore different sources of information

Explore different sources of information

Mapping resources

TASK

Exploring vocations around us

Look around you and answer the following questions:

1. What kind of work related to human services do you observe?
2. Briefly describe what the work involves–what are the inputs, what are the key processes and what are the outcomes.

Mapping resources

Do you think you can do this work in school? Discuss in a group why or why not. Table 9.2 will help you decide.

Table 9.2: Mapping resources

Work related to human services around us	Will you be able to complete the work in the time allocated?	Do you have adequate space to provide the service?	Have you identified an expert to help you?	Will you be able to manage the resources needed to provide the service?

PORTFOLIO

Which vocation have you decided to take up and why.

9.7 While delivering human services

1. Before you begin any service, whether it is serving water at a community event or helping at a school desk, ensure the service environment is clean, hygienic, welcoming and attractive.
2. Human service is all about interaction. Always let the other person finish speaking before you respond. By listening carefully to their requirements, you ensure that the service you provide actually addresses their needs. Your attire and demeanour also play an important role.
3. Following a set schedule and fixed rules (protocols) ensure that the service is fair for everyone, and that no one has to wait unnecessarily.
4. Always ask for permission before you start. Whether you are helping an elderly person cross the road or collecting data for a school project, always seek consent. Additionally, keep any personal information you learn about a person private.
5. Plan in advance and allocate responsibility amongst different groups to ensure smooth and efficient delivery of service.
6. A service is not finished until waste is managed–leaving a place cleaner than you found is a hallmark of quality service.
7. Always ask yourself and others, 'How can I do this better next time?' By talking to the persons you served and your teammates, you can identify service gaps (where things went wrong) and discuss how to prevent these gaps.

9.8 Assess your learning

1. You read about several situations in the chapter. In your opinion, which actions (not words) showed a strong service orientation in these examples? Which of these actions would you like to practise while providing a service?
2. Imagine two service spaces–one clean, organised and welcoming, the other messy or confusing. In your view, how does the environment change the feelings and behaviour of persons using the service? Explain using an example from your school or neighbourhood.
3. In your opinion, what adds value to service in a shop, for example, the range of materials, the physical arrangements, décor, interaction, labelling of shelves, etc.? Which actions (for example, clear instructions and polite communication) make the biggest difference in user experience?
4. Identify any two safety or hygiene measures you would ensure during a service provided in the school. Explain their importance.
5. During a crowded event, some guests demand to be served first. How will you respond? Are there any actions you could have taken during the preparation stage to prevent this?
6. Imagine you are organising a cloth donation drive in your locality. A big hall is available for collection. Four volunteers are managing the drive and 60 donors are expected in a period of two hours. Plan the event; some guiding questions for the group to think about are given below:
   i. How will you arrange the space for collection, sorting and packaging?
   ii. How will you assign roles?
   iii. What steps will ensure that the process is fast, fair and safe?

7. Every service ends with review and improvement. Imagine you have managed a cultural event in the community during Diwali. What feedback would you collect after the event, how would you collect it and what would you do with the feedback?
8. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
9. Identify a Voluntary Service activity in your surroundings. For example, Pulse Polio vaccination, village fare, community event, Gram Sabha, Swachhta Abhiyan, animal vaccination drive, etc. Participate in the service and prepare a report of the event.
10. Give examples of how you can apply your learnings in a real-life situation.

CHAPTER 10

Healthcare

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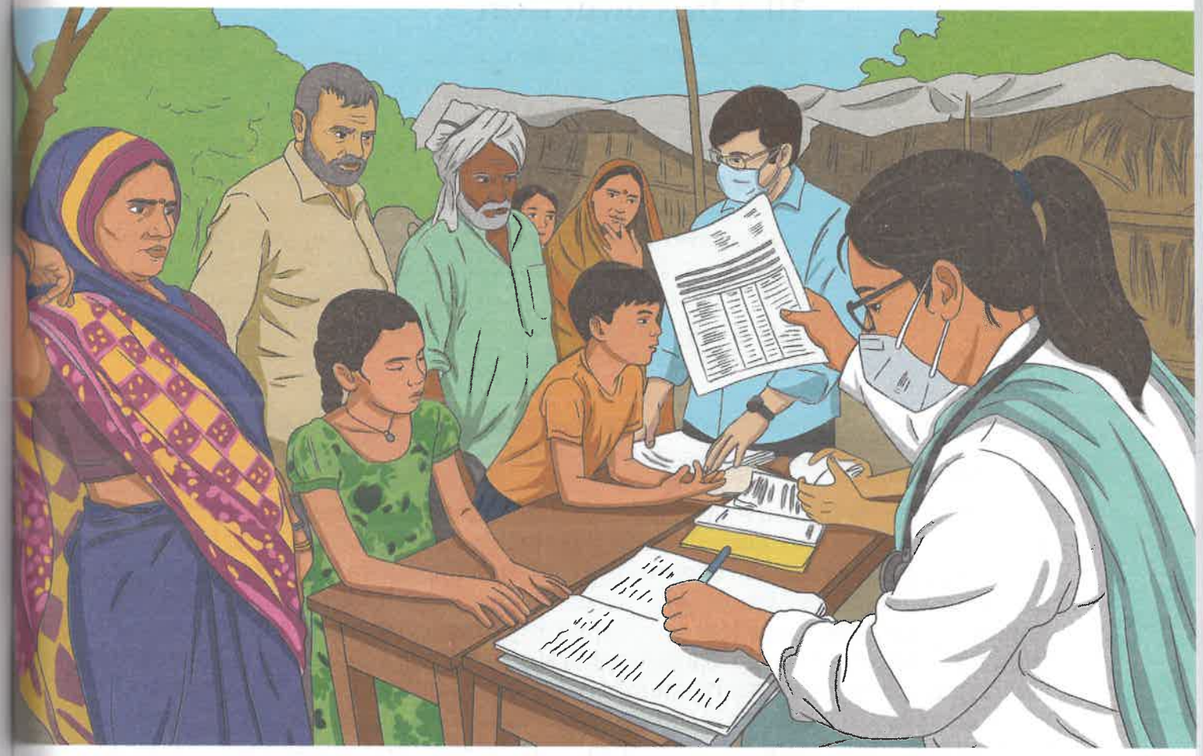


Figure 10.1: *A health camp organised for members of a community*

The purpose of health camps (Figure 10.1) is to ensure that all eligible people are vaccinated and their general health parameters are checked, including those related to malnourishment and eye health. These camps also serve to generate awareness of preventive healthcare among community members.

In this chapter, you will

- Identify healthcare service to be provided
- Apply safety and hygiene requirements
- Prepare to provide healthcare service
- Promote the service being provided
- Create a service environment
- Prepare a consent form
- Provide service
- Collect feedback

10.1 Introduction

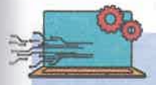
Health is the foundation of life. When people stay healthy, they can learn, work and enjoy their daily activities. As you have learned in Science and Physical Education and Well-being, looking after one's health is not limited to visiting a hospital when someone falls ill. It is shaped daily by clean surroundings, safe water, nutritious food, physical activity, mental well-being, timely care, and support from people around us. Healthcare focuses on these everyday needs and brings health services closer to where people live. India has a long tradition of caring for health through both preventive and curative practices.

DID YOU KNOW

In the Indian healthcare system, especially in rural areas, Auxiliary Nurse Midwives (ANMs) and Accredited Social Health Activist (ASHA) workers serve as a vital link between the community and formal medical facilities. ANMs are trained health professionals who focus on maternal health, child health and immunisation. ASHA workers are community health volunteers, usually women from the village itself, who are trained to support their neighbours. They spread awareness among community members regarding nutrition, hygiene and family planning. They are also trained to provide basic first aid and escort patients to the hospital. They were recognised as 'Corona Warriors' during the COVID-19 pandemic, when they tirelessly spread awareness, facilitated vaccinations and delivered essential medicines.

The *Charaka-Saṁhitā* compiled during 100 BCE–200 CE, described the principles of healthy living, disease prevention, diagnosis, diet and treatment. It emphasised careful observation, recording patient history, lifestyle factors, and the importance of balance of mind and body. Many ideas from this text, such as daily routines, hygiene, seasonal care and the role of food in health, continue to influence modern wellness practices in India.

This chapter will help you understand how healthcare services work and how you can support your community to stay healthy.



TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

Digital Healthcare Opportunities

Technology, especially AI, is transforming how people access care, how diseases are diagnosed and how health services are delivered. India is witnessing a rise in telemedicine platforms that connect doctors and patients across distances; AI-based diagnostic tools that help detect diseases faster; the use of health data to understand health trends in communities; wearable devices that monitor sleep, steps, heart rate and stress; digital health records that improve accuracy and continuity of care; and health apps for nutrition, fitness, mental wellness and early detection. Robotic medicine is also evolving, helping doctors treat with accuracy and precision, even if they are distant from patients.

10.2 Process chart

10.2.1 Scoping work

Deciding the scope of the work means that decisions need to be taken regarding the following:

1. **What type of service will be provided:** You could organise a health awareness camp or take part in hygiene and sanitation activities. Other options are to create materials about nutrition and fitness, or create awareness about basic first aid. Please remember that your service should focus on support, awareness and assistance. You must not provide medical diagnoses or treatments.
2. **Availability of resources and support:** The services you plan to provide will require resources; these will range from stationery for posters to devices for

Defining scope of work

checking health parameters. You should also identify whether you will need support from a nurse, a doctor, local health worker, or any other expert.

3. **Usefulness to the school or community:** You must consider whether the service you plan to offer is actually useful. For example, does the school need better hygiene awareness? Would a health desk help parents and students understand nutrition and fitness? Is there a need for basic first-aid readiness during events?
4. **Where will the service be provided:** The service could be provided within the school (for example, in a classroom, corridor, assembly area or health corner) or in a nearby community space. While choosing the location, you must consider safety, cleanliness, availability of space and ease of setting up and managing your service.

Needs identification

PORTFOLIO

1. What type of healthcare services are required in the neighbourhood? Do a quick survey in the community to determine what will be useful.
2. Based on the survey, decide the type of healthcare service you will provide in your school or neighbourhood.
3. What resources, support and safety considerations will you keep in mind while planning this service?

Process chart

10.2.2 Making a process chart

For smooth delivery of the service, it is important to list all the tasks you will be doing, along with the estimated date of completion and responsible people or group in a process chart.

CASELET

Students of Government High School decided to set up a health camp, where they plan to monitor health parameters through check-up of vital signs [temperature, blood pressure, blood sugar, oxygen saturation, body weight and height, and BMI (Body Mass Index)]; demonstrate how to make homemade remedies for common ailments and build awareness of how to prevent occupational hazards. They developed the process chart as shown in Table 10.1.

Table 10.1: Process chart for setting up health camp

Tasks for community and healthcare services	Dates	Responsibility
Identifying experts to help with preparation for the health camp		
Learning to use instruments for monitoring health parameters		
Collecting and documenting home remedies		
Identifying common health risks related to occupations		
Setting up the health camp		
Delivery of services in the health camp		
Waste disposal		
Feedback collection and reflection		

10.3 Site visit

Before beginning the work, it is important to visit a site where healthcare services are provided, with a teacher. In addition to the visit, a short interaction with a practitioner (for example, doctor, nurse, ASHA/ANM worker, pharmacist or lab technician) will help you observe the use of tools and materials, as well as the procedures they follow, including safety precautions.

Think of any other points for observation while visiting the site. For example:

1. What do the practitioners value the most about the work (for example, helping people feel better, pride in providing services, etc.)?
2. You can ask about possible challenges you may face, while providing healthcare services and how to overcome them.

PORTFOLIO

Use the pointers in Table 10.2 for discussion with practitioners and take notes.

Table 10.2: Pointers for observation during site visit

Points of observation	Description
Tools and materials used	Materials used and their storage; tools used and their maintenance
Key processes	Key steps and their importance
Safety protocols	Using appropriate tools, and following safety precautions
Records	Maintenance of information related to patients
Quality criteria	Criteria for inputs, processes and outputs
Technology use	Digital tools/apps used

After the site visit, prepare a process chart for your work.

Select tools and materials

10.4 Selecting materials

Once clarity is gained on the tasks you will be doing while providing the health service, the next step will be to list and collect the materials required. Table 10.3 will help you take decisions for gathering materials.

Table 10.3: Materials used for providing healthcare-related services

Materials	Use	Safety note
Personal protective equipment (gloves, masks, etc.)	To maintain hygiene	Use a new pair for each person; dispose of used gloves and masks in a covered biomedical waste bin
Waste bin	For disposing of used cotton, tissues, gloves or other waste	Keep separate bins for regular and biomedical waste; always close the lid after use
Measuring tape and weighing scale	To measure height and body parameters during health checks	Avoid pulling the tape tightly while measuring
Yoga mats	For conducting simple stretching or relaxation activities	Ensure mats are clean, dry and placed on a flat surface to prevent slipping

10.5 Selecting tools

Table 10.4 provides the list of tools generally used in healthcare. You can add more as per your requirements.

Table 10.4: Tools used for providing healthcare-related services

Tools	Use	Safety note
Thermometer	To measure body temperature	Sanitise the tip before and after each use; handle gently to prevent breakage
Pulse oximeter/ Smartwatch that checks O_2 level	To measure oxygen saturation and pulse rate	Clean the sensor area after each use; ensure the person's finger is dry
Stopwatch	To measure pulse rate, breathing rate or exercise duration	Use with dry hands; do not reset accidentally during measurement
Blood pressure monitor (sphygmomanometer)	To measure blood pressure levels	Wrap the cuff properly; clean the cuff and monitor after each use; do not overinflate the cuff
Glucometer	To measure blood sugar levels	Use only for observation purposes

SAFETY

Table 10.5 shows rules to be followed while doing health-related tasks.

Safety

Table 10.5: Basic safety rules for health-related tasks

1. **Hand hygiene:** Wash your hands with soap and water or use a 70 per cent alcohol sanitiser before and after handling any tool or touching surfaces.

2. **Masks and cleanliness:** Wear a clean mask when needed and keep your area tidy. Wipe tables and tools before and after demonstrations.

3. **Safe use of tools:** Use thermometers, oximeters and weighing scales only as taught, and never for diagnosing or giving medical advice. You must not give medicines or suggest treatments.

4. **Waste disposal:** Throw used tissues, masks and disposable items in the correct waste bin. Keep bins apart and labelled.

A teacher, nurse or health practitioner must be present during all demonstrations and visitor interactions.

Cost estimation and documentation

10.6 Bill of Materials (BoM)

A Bill of Materials (BoM) helps in estimating costs in advance and avoiding waste by ensuring that only what is necessary is bought. In addition to the actual cost of materials, the cost of labour must also be calculated.

CASELET

Students of Government High School decided to hold a health camp. They prepared the following Bill of Materials (Table 10.6).

Table 10.6: Bill of Materials

Item	Quantity	Estimated cost (in ₹)	Remarks (if any)
Disposable gloves	50 pairs	250	Single use
Hand sanitiser (500 ml)	2 bottles	300	Refillable
Face masks	50	200	Single use
First aid kit	1	Borrowed from PHC/School	
Stationery	1 set each	400	For posters
BP monitor, oximeter, thermometer	1	Borrowed from PHC	
Cost of labour	Value (time spent in hours × hourly estimate × number of people)	Estimated cost (in ₹)	Remarks (if any)
Cleaning and waste disposal	2 hours × ₹ 50 × 2 people	200	
Preparing awareness material	4 hours × ₹ 50 × 2 people	400	
Registration	1 hour × ₹ 50 × 2 people	100	
Set-up and conduct of health camp	2 hours × ₹ 50 × 4 people	400	Arranging physical environment
Total (material items + cost of labour)		2250	

10.7 Consent

Preparation

As you have learned in Chapter 9, a consent form is a simple way to communicate that both the student team and the person receiving the service clearly understand what is being offered.

A consent form is not a legal document, but a means to clearly state expectations from both sets of individuals, thereby building trust, avoiding confusion and ensuring safety during the service. When taking consent, remember the following points:

1. Share the healthcare services to be provided.
2. Share safety expectations.
3. Clarify that this is not a substitute for medical treatment.
4. Take consent for health data and photographs.

CASELET

Students of Government High School developed a short consent form for visitors to the health camp. Visitors were asked to fill and sign the form during registration (Figure 10.2).

CONSENT FORM

Date: Time:

Name of Person receiving the service:

Mobile / Contact:

PLEASE NOTE

We will provide the following healthcare services:

- Monitoring health parameters through checkup of vital signs: temperature, blood pressure, oxygen saturation, body weight and height, BMI (Body Mass Index).
- Demonstrate making homemade remedies
- Build awareness on prevention of occupational hazards

Any data we collect (including contact details and photograph) will not be shared without your permission.

Acknowledgement of person receiving the service

I understand that:

- The health camp provides basic screening and health awareness only
- I must follow instructions given by health professionals and volunteers
- This service does not replace hospital treatment or medical diagnosis
- The student team is not responsible for issues arising due to non-cooperation or incorrect information.
- I give / do not give (circle one) permission for my photograph to be taken for the school project record.

Signature / Thumb impression:

Figure 10.2: *Sample consent form*

PORTFOLIO

Create a consent form based on the services you will be providing.

List the possible areas for any conflict between expectations of persons receiving the service and the service being provided (for example, a visitor to the camp expects to be given medicine by a registered medical practitioner, whereas you have not made any arrangements for a doctor to be present).

10.8 Preparation for the service

10.8.1 Monitoring health parameters

TASK

Measuring vital signs

Vital signs are important body signals that help us understand how well our body is functioning. Practise measuring the health vitals of your peers under supervision (Figure 10.3 and Table 10.7). You have already learned about body parameters, like height, weight and Body Mass Index (BMI) in your textbook on Physical Education and Well-being.

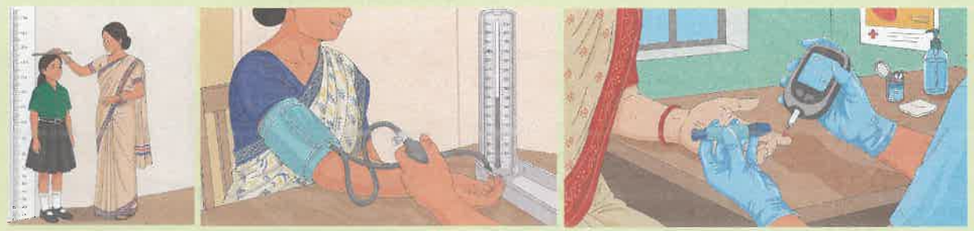


Figure 10.3: *Measuring health parameters – height, blood pressure, blood sugar level, etc.*

Learn to use these instruments (under adult supervision)

Table 10.7: Instruments for basic health parameters

Instrument	What it measures	Normal value	When it is a concern
Thermometer	Body temperature	97–99°F (average 98.6°F)	Above 99°F = Fever Above 103°F = Medical emergency
Blood Pressure Monitor (sphygmomanometer)	Force blood uses to move through arteries	Less than 120/80 mmHg	Above 140/90 mmHg requires medical attention
Pulse Oximeter	SpO_2 – oxygen saturation in the blood	98–100%	Below 94 per cent needs urgent attention
Glucometer (demonstration only)	Blood suger level is used to check diabetes status	Fasting: 70–100 mg/dL; after a meal: below 140 mg/dL	Fasting above 125 mg/dL or random above 200 mg/dL needs medical attention

Important Reminders

1. These tasks must only be done under adult supervision.
2. You should not diagnose or interpret results, only practise safe measurement and recording.
3. If any reading seems abnormal, call a teacher or practitioner immediately.

Use of tools and materials

10.8.2 Home remedies for common ailments

Traditional home remedies are often used for minor, everyday health complaints. They are made using natural ingredients, such as herbs, spices and household items. These remedies do not replace a doctor, but may be used for prevention or quick relief until medical help is available.

TASK

Learning to prepare simple home remedies for common ailments

For this task, speak to your parents, grandparents or elders in your neighbourhood to identify simple home remedies commonly used in Indian households (Table 10.8). Some remedies, like herbal teas and turmeric milk, are also recommended in Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy (AYUSH). Others like aloe vera gel are traditional practices passed down through families (Figure 10.4).

Choose one or two that are safe and easy to prepare, practise making them using basic equipment in school and prepare a small poster explaining the recipe.

Table 10.8: Examples of common home remedies

Home Remedy	Used For	Ingredients	How to Prepare
Turmeric milk	Immunity-boosting drinks	Milk, turmeric, jaggery (optional)	Warm the milk, add ½ teaspoon of turmeric and a little jaggery for taste. Stir well and drink warm.

Tulasī–ginger tea	A type of herbal drink or infusion	*Tulasī* leaves, ginger, water, sugar or honey	Boil water with crushed ginger and *Tulasī* leaves. Strain and add a little sugar or honey. Serve warm.
Aloe vera gel	Dry skin, minor skin irritation	Aloe vera leaf	Cut the leaf, scoop the gel and apply gently on skin (patch test recommended).

Please note that:

These are not medical treatments but home remedies. They should be prepared under the guidance of an adult.

If symptoms continue or worsen, the person must visit a doctor.

You must not give remedies to persons visiting the health camp; only demonstrate and explain what you have learnt through discussion with family and community members.

Figure 10.4: *A few ingredients for homemade remedies*

Preparation

10.8.3 Common occupational hazards

Different kinds of work put different kinds of strain on the body. Long hours, repeated movements, heat, noise, pollution or uncomfortable postures can slowly harm a person's health. For example, a rickshaw driver may develop back pain, a tailor may suffer from eye strain, a cook may face heat and smoke while cooking, and a computer user may suffer from neck or shoulder pain, or eye strain. Understanding such 'occupational hazards' and practising simple preventive actions help people stay healthy.

TASK

In this task, you will identify common occupational hazards, learn preventive measures, and practise simple posture correction and yoga routines.

Some examples of occupational hazards are given in Table 10.9. Conduct a small survey in the community and add to the list.

Table 10.9: Common occupational hazards

Occupation	Common health risks	Preventive actions
Working on computers – IT professional, graphic designers, computer job	Eye strain, dry eyes, neck pain	20-20-20 rule (look 20 m away from screen for 20 seconds after every 20 minutes), blinking, correct screen height (neck should not bend up or down while looking at the screen), stretching exercises for neck.
Sitting for long hours – Driver, bankers with desk job	Back pain, stiffness	Straight-back posture, lumbar support through a small cushion, standing breaks, back stretches
Lifting heavy weights – Farmer, technician	Muscle or joint injuries	Lift with knees bent, avoid twisting or bending the back. Hold with proper grip, ask for help if required.
Working in polluted areas (kitchen smoke, garbage, depot, traffic) – Chef, sanitation worker, traffic police	Breathing problems, skin irritation	Cloth masks, hydration, deep breathing, taking breaks
Noisy environment – Factory worker, traffic police	Hearing strain	Ear protection through earplugs
Working in heat – Factory worker, food processing	Dehydration, heat stress	Drinking water/electrolyte, resting in shade, light clothing

10.8.4 Occupational hazards: a few preventive measures

Generating awareness and sharing simple preventive measures, as shown in Table 10.10, will help workers avoid injury.

Table 10.10: Examples of methods to prevent occupational hazards

Posture correction	• Sit with a straight back and feet flat • Align screen at eye level • Use simple back supports (rolled towel or lumbar roll) • Avoid slouching or twisting	

Stretching exercises (2–3 minutes each)	• Knee to chest stretch • Standing forward-bend stretch • Side-lunge stretch • Kneeling stretch • Upper-arm stretch • Arm-bent-over stretch	 Stretching exercises
Breathing routines	• Deep breathing (5 slow cycles) • Diaphragmatic breathing • *Anuloma-Viloma* (alternate nostril breathing)	 Breathing exercise

Simple *Yogāsanas*

Tāḍāsana – improves posture

Bhujaṅgāsana – reduces back stiffness

Vajrāsana – aids digestion after meals

Makarāsana – relaxes body and mind

Halāsana – improves flexibility

Do inform the participants of the health camp to practise *yogāsanas* regularly to avoid harm due to excessive work strain. You may refer to the Physical Education and Well-being textbooks. Please ensure that you work under the supervision of an adult.

10.8.5 Basic emergency response

In Grade 7 *Kaushal Bodh*, you have learnt simple first-aid skills, like cleaning small wounds, cooling burns and preparing oral rehydration solution (ORS). These skills help you respond calmly until a trained adult arrives. You can prepare posters and demonstrate basic, safe steps for common situations.

TASK

Find out the basic emergency response to accidents and common ailments. For example, fever, heat cramps, nose bleed, small cuts or scrapes and snakebites, etc. You can list the symptoms, how to respond and what not to do.

Important Safety Notes

1. First aid is only the first response and does not replace medical care.
2. Always call an adult first.
3. Do not give medicines or home remedies.
4. Do not attempt advanced procedures, such as CPR; only trained adults should perform these.

Safety

TASK

Explore two mobile apps or online platforms that support health and well-being. These may include apps for fitness, yoga, doctor consultations, emergency services, vaccination records, medicine reminders or health monitoring. Note their key features and how they can help people stay healthy. Examples of apps or platforms you may explore:

1. e-Sanjeevani – free online doctor consultation
2. CoWIN / ABHA – vaccination details and digital health ID
3. FIT India – fitness and activity tracking
4. mYoga – guided yoga sessions
5. Step Counter / Pedometer apps – track daily steps
6. MANODARPAN – supports mental well-being of students, teachers and families

10.8.6 Promoting the service being provided

Promoting the service is important not only to inform people but also to encourage them to take action based on what they have learnt. You can consider the following for promoting and encouraging large numbers to avail of the services:

1. Making simple posters with clear information (date, time, place and services offered).
2. Making short announcements during school assemblies or community meetings.
3. Informing parents, neighbours and community members through community walks.

Communication

4. Displaying notices at schools, community centres, anganwadis or local shops.
5. Using school notice boards or social media platforms with due permission.

CASELET

Students of Government High School developed a poster providing essential details about the health camp services to share within the school and the community (Figure 10.5).

Figure 10.5: *Poster of a health camp*

PORTFOLIO

Develop promotional material for the service you will be providing.

10.9 Providing the service

In Grades 6–8, you have learned how to plan and organise a Kaushal Mela. You can now apply those learnings to provide services. This will involve planning, setting up the space, delivering the service and completing post-event tasks, such as documentation and cleaning up of the space. Please reach out to your teacher or other experts for help in coordinating with health professionals.

10.9.1 Event checklist

Before providing a service, you will need to first finalise the list of processes that will be followed on the final day and assign responsibilities for each of them.

CASELET

Students of Government High School listed the following processes that would be followed in their health camp, and then developed the final checklist of resources to ensure everything is available on time and in sufficient quantity.

1. Health parameters screening – temperature, pulse rate, blood pressure, oxygen saturation, BMI.
2. Demonstration – basic first aid, *Yogāsana*, making home remedies.
3. Meeting with a doctor and a nurse. The students developed a checklist (Figure 10.6) to ensure everything was ready for the camp.

Materials	Quantity	Available/Yet to arrange	Remarks
Healthcare stalls/desks (five)			
Tables	5	Available	
Chairs	40	Available	
Displays	5	Available	
Dustbin	5	Yet to arrange	Need to get from community hall
Thermometer	2	Available	
Weighing scale	1	Available	
BP monitor	1	Available	
Oximeter	2	Yet to arrange	Borrow from PHC
First aid kit	1	Available	
Gloves	50 pairs	Available	
Tissues	5 pack	Available	
Sanitiser	2 bottles	Available	

Figure 10.6: *Image of the checklist prepared by students of Government High School*

PORTFOLIO

Prepare a checklist for the service you will provide. Note your reflections related to whether all the tools, materials and safety items are ready and in good condition. Anticipate any potential problems, and how you will deal with them.

Arranging physical environment

10.9.2 Service environment: Design of physical space

You have learned about the importance of a suitable physical environment in Chapter 9. Apply those learnings to decide the layout of the space where you will provide the service as well as the mode of interaction with the persons being provided the service.

CASELET

Students of Government High School discussed the setting up of the health camp in detail. They first focused on the layout of the camp in the selected location. The first question was: would the venue be outdoor or indoor? Next, how much space is available? How many visitors are expected? How should the layout be planned so that crowding does not happen in any one area? What kind of signboards are required to direct the visitors from the entrance to the stalls and finally to a smooth exit from the camp?

The students developed the following layout (Figure 10.7) for setting up their health camp.

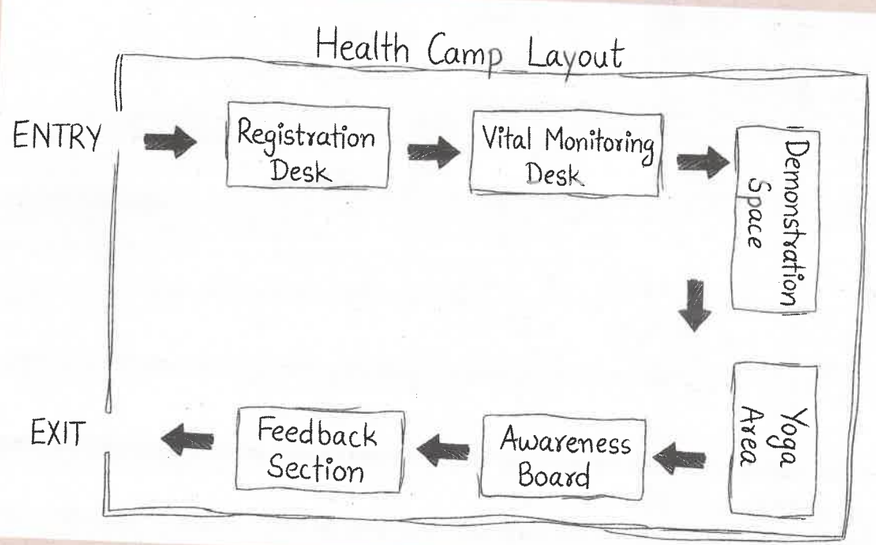


Figure 10.7: *Layout of the health camp set up by students of Government High School*

PORTFOLIO

Design the layout of the space you will use for providing the service:

1. Which essential elements need to be included in the layout?
2. How should they be placed in the layout?
3. Are there any places with potential for crowding?
4. How can you ensure that the persons being provided the service have a smooth and comfortable experience?

Draw a rough sketch of the layout or route if you plan to organise an awareness march.

10.9.3 Service environment – Engaging with persons being provided services

Arranging social environment

Chapter 9 emphasised not only developing a physical but also creating a positive social environment, wherein service is provided with a helping and respectful service orientation.

It is also crucial that you follow safety protocols associated with each process and ensure that others follow them as well.

CASELET

Figure 10.8 shows how students of Government High School provided the service.

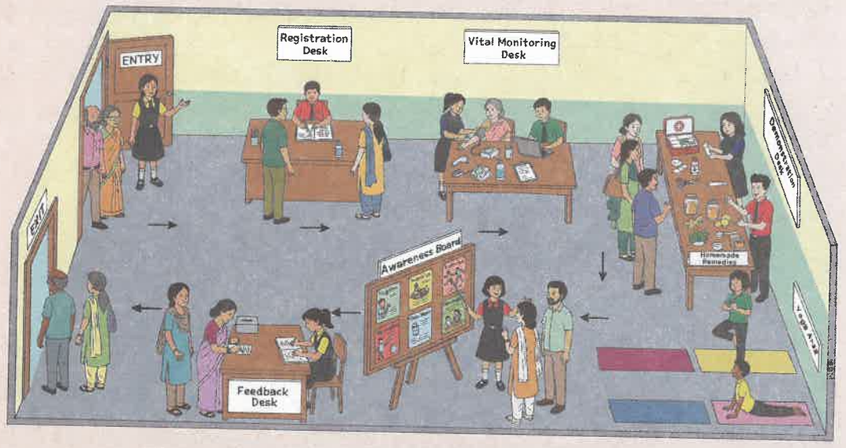


Figure 10.8: *Conduct of health camp by students of Government High School*

10.9.4 Feedback, Cleanup and Reflection

Feedback and Reflection

In *Kaushal Bodh* for Grades 6–8, as well as Chapter 9, you have learnt that quality services are user-centric and improve through feedback. Feedback helps you understand whether the service met users' needs and how it can be improved further. It can be obtained through a short form or a few verbal questions.

Record only general comments with no names or personal details. This feedback will help your class understand what went well and what can be improved next time.

PORTFOLIO

1. Prepare a feedback form based on the service you provided.
2. Collect and analyse feedback.

Note the improvements you would like to make the next time you provide the service.

Waste management

Once the camp activities are over, it is equally important to clean the area and ensure that all materials are cleaned, sorted and safely stored or disposed of.

1. Pick up used papers, empty bottles and disposable cups. Wipe down tables and chairs.
2. All reusable items (posters, recording sheets, measuring tools, first-aid kits, etc.) should be placed neatly in a labelled storage box or returned to their original place.
3. Remember to safely dispose of used items in separate bins for different waste, that is dry, wet and sanitary waste (Figure 10.9).
4. Remember to wear gloves when handling waste or cleaning tables that might have been used for health checks. Wash hands thoroughly after clean-up.

Figure 10.9: *Colour-coordinated bins to collect different kinds of waste*

After the clean-up, each group should compare what they planned and what actually happened. Think about the service environment and whether safety rules were followed at all times. Discuss how well you worked as a team and whether the process moved smoothly or needed adjustments.

These reflections will help you understand your strengths and the areas you can improve in future activities.

10.10 While delivering the service

1. Use health tools and materials only as taught and for awareness purposes. Do not interpret results or provide medical advice.
2. Use the tools and materials safely and carefully. Ensure that they are not damaged and are stored in hygienic conditions.
3. Ensure consent, privacy and respectful communication with all visitors.
4. Explain the procedure before starting, ensure privacy during checks and communicate results politely without causing fear or confusion.
5. Emphasise healthy habits, exercise, hygiene, nutrition and safe work practices.
6. Ensure that you have cleaned the service area and disposed of the waste as per protocol.

10.11 Assess your learning

1. Compare two types of healthcare needs in the community. Which one should be prioritised for a school-based healthcare service and why?
2. Based on the healthcare service you provided, create a safety checklist.
3. According to you, what are the essential elements related to service orientation and environment that are especially important in healthcare services? Explain with examples.
4. Why is it especially important to keep the patient or visitor at the centre while providing healthcare services? Give one example to support your answer.
5. Read the scenario below and respond to the questions:

   During a school health camp, a group of students focused mainly on completing tasks quickly. Visitors were not greeted properly and were asked to move from one desk to another without clear explanations. Some students spoke hurriedly, while others continued their work without noticing visitors, who seemed confused or uncomfortable. At the health check stall, tools were

used without explaining their purpose, making a few visitors anxious. Safety rules, such as cleaning tools and proper waste disposal, were sometimes ignored due to the rush. When a visitor asked questions, the response was brief and no one took time to listen carefully. As a result, several visitors left the camp, and feedback indicated that the experience felt rushed and unclear.

i. What went wrong in this situation?
ii. How could the students have improved their behaviour and communication?
iii. Which safety practices were missed and why do they matter?
iv. How would you change this situation to make visitors feel welcomed and cared for?

6. During a health camp, many people are waiting for check-ups. An elderly person and a pregnant woman arrive late. How should the service team respond? Explain your reasoning based on fair and ethical decision-making.

7. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?

8. Give examples of how you can apply your learnings in a real-life situations.

CHAPTER 11

Tourism

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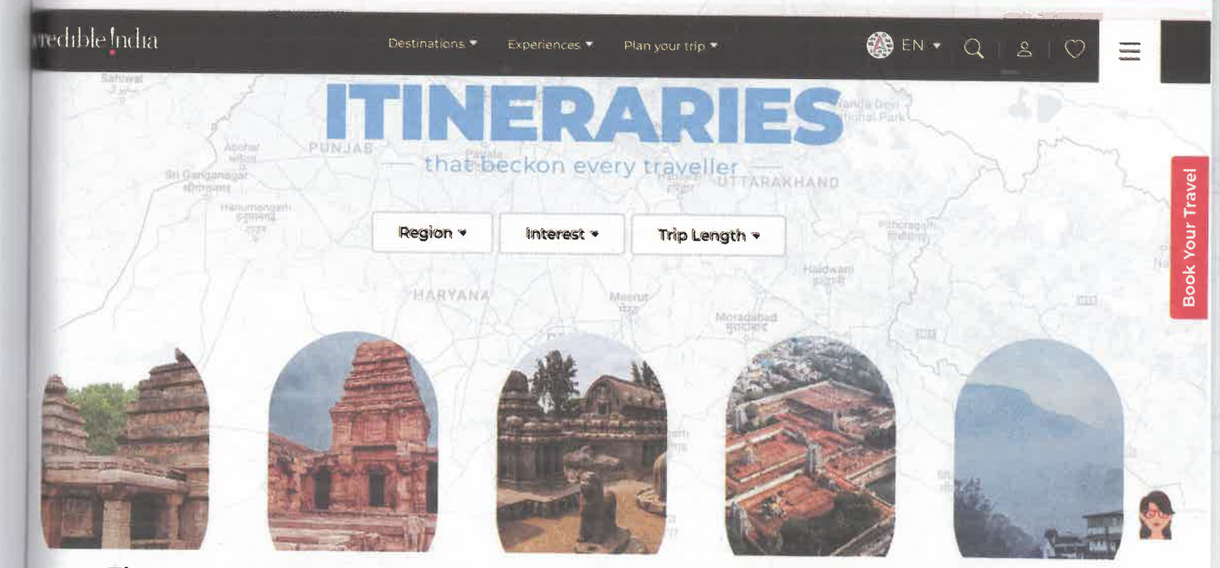

Figure 11.1: *The Ministry of Tourism, Government of India launched a campaign called 'Incredible India' in 2002 to encourage travellers from India and abroad, to explore tourist destinations in the country*

यस्तु सञ्चरते देशान् सेवते यस्तु पण्डितान् ।
तस्य विस्तारिता बुद्धिस्तैलबिन्दुरिवाम्भसि ॥

yastu sañcharate deśhān sevate yastu paṇḍitān ।
tasya vistāritā buddhis-tailabindu-rivāmbhasi ॥

Source: *Subhāṣhita-ratna-bhāṇḍāgāra*

"One who travels the world, and one who serves the learned, their intelligence expands, just as a drop of oil expands on water."

India's diverse landscapes and cultural heritage attract many tourists from within the country as well as from abroad (Figure 11.1).

In this chapter, you will

- Identify tourism-related services based on locality and interest
- Understand safety and hygiene requirements
- Prepare a consent form
- Prepare to provide tourism service
- Promote service being provided
- Create a service environment
- Provide services
- Collect feedback

11.1 Introduction

India is a country where every few kilometres the land, the language, the food and the stories change. Each place has something unique to offer, whether it is culture, monuments, places of worship, landscapes, food, sports, festivals or museums. While some places have been developed as tourist sites, some remain off the beaten path. The tourism industry helps people visit places that enrich them by their uniqueness and beauty.

People travel across India for many reasons. Some wish to rest and rejuvenate; others travel to learn from different cultures and ways of life. Travel enriches our lives by helping us understand people beyond our immediate surroundings, and also carry messages of equality, diversity and compassion across regions. It is important to remember that behind every pleasant journey are the efforts of many people – guides, storytellers, drivers, artisans, photographers, hospitality staff and volunteers. In our culture, we believe in 'अतिथि देवो भवः' *(Atithi Devo Bhava)*, which means that guests are equivalent to gods.

In this chapter, you will plan and deliver a service related to tourism in your own locality.

DID YOU KNOW?

Different kinds of travel experiences

A variety of experiences are available for tourists in India. A few examples are:

1. **Community and eco-village stays, homestays**: Families open their homes to tourists, offering simple, local food and stories of their land in deserts, hills or farms.
2. **Tribal and cultural heritage tourism**: Tourists meet artists, farmers and elders to understand local culture, music, art and traditions.
3. **Cycling and walking trails**: Students and travellers explore old towns, forts or village lanes through guided walks or cycle rides.
4. **River, lake and forest tourism**: Boat rides, nature walks and birdwatching trips introduce travellers to India's wetlands and forests.
5. **Spiritual and wellness journeys**: Pilgrimages, yoga camps and Ayurveda centres combine faith, rest and healing; helping tourists renew both body and mind.

Above all, the concept of 'responsible tourism', which means leaving no waste, keeping noise levels low and protecting the habitat, is being highlighted as the way ahead for modern tourism.

11.2 Process chart

Defining scope of work

Needs identification

11.2.1 Scoping the work

You would be aware of the sites of tourist interest in your locality. This section will help you make decisions related to the work you would like to do around tourism:

1. **Type of service you will offer:** This can be based on where your school is located. For example, you could organise a visit to an old school, the celebration of a festival in the community, a *mandi*, a famous food street in your area or a religious site – identify what can be of interest to any visitor to your locality.
2. **Availability of materials and resources:** These may include maps, photographs, digital devices (like tablets with internet access) and stationery for making brochures. You will need access to elders in the community who can tell you all kinds of interesting stories.
3. **Usefulness and relevance:** You must consider whether the work you have planned is useful for the school or community. For example, will it highlight local heritage and make people want to visit your locality? Will creating a local tourism map and placing informative signages help tourists navigate the area? Therefore, seeing your surrounding from a fresh perspective, and speaking to members of the community will help enhance and enrich

Needs identification

the experience. Explore your surroundings, observe, ask local people and any tourists what is special in your locality.

4. **Where the service will be delivered**: This could be within the school, for example, an exhibition of photographs of local sites of interest or a promotional video. Service could be delivered outside the school in nearby sites of interest. You must consider accessibility, safety, distance and ease of movement while carrying materials or interacting with people. You will also need to check if any permissions are required, for example, from the owners of an old house you want to spotlight. Ensure the service is small-scale and manageable, and can be easily organised around the school.

PORTFOLIO

1. What type of tourism service will you provide? Why have you chosen this service?
2. Are there any specific considerations you will keep in mind?

Making a process chart

11.2.2 Making the process chart

Before you begin working on the tourism service you have chosen, you will need to develop a process chart. With reference to the efficiency of processes in Chapter 9, developing a process chart will help you organise and allocate each task systematically. This will prevent confusion and ensure your service is delivered safely and on schedule.

CASELET

Students of Government High School decided to arrange a walk to a local site of interest near the school. They developed the following process chart (Table 11.1).

Table 11.1: Process chart for a walk to a local site of interest

Tasks for tourism service	Dates	Responsibility
Preparatory visit to site		
Gathering information about the site		
Developing a route map		
Preparation of promotional materials, maps, script for narration, refreshments and arrangements for waste disposal		
Promoting the service		
Delivering the service		
Feedback and reflection		

PORTFOLIO

Develop a process chart for the tourism service you have selected.

11.3 Site visit

Before beginning the work, you must visit a tourism-related site and interact with an expert in the presence of a teacher. An expert can be a tourist guide, travel agent, hotel or homestay staff member, museum attendant, information desk staff, local artisan involved in cultural tourism, or any other person who can help you learn (Figure 11.2).

Figure 11.2: *Students visit a nursery to prepare for a nature walk*

PORTFOLIO

Use the pointers in Table 11.2 for discussion with practitioners and take notes.

Table 11.2: Points to guide observation during the site visit

Points of observation/ discussions	Description
Tools and materials	• What tools (for example, computers or mobile devices) or materials (for example, brochures) do they use in their work?
Key processes	• What are the main steps involved in their daily work (for example, receiving enquiries, planning, guiding, payments, clean-up)? • How do they prepare before interacting with tourists?
Scheduling and organisation	• What tasks do they perform daily? • How do they manage the different needs of tourists?
Safety	• Are there any considerations related to safety? • How do they ensure all the tourists are comfortable? • Are there any considerations related to confidentiality and privacy of persons being provided the service?
Quality and visitor satisfaction	• What does 'good quality service' mean to them? • How do they ensure respectful communication? • How do they check if tourists are satisfied?
Use of technology	• Do they use digital tools, such as online booking, digital payments, maps, messaging apps or QR codes? • How do they ensure safe and ethical use of technology?

Once you have returned from the site visit, work in groups to finalise the process chart for the service you will provide.

Select tools and materials

11.4 Selecting materials

Once clarity is gained on the tasks you will be doing related to the tourism service, the next step is to list the materials required. Table 11.3 provides examples of some materials.

Table 11.3: Materials for tourism service

Materials	Use	Safety note
Stationery	Making posters, signages, notebooks, charts; using cardboard, cutters, pins, scissors, tape, etc.	Reuse and recycle as far as possible
Dustbins or Disposable bags	To collect dry and wet waste during tours or events	Ensure bins are placed away from walking paths; handle waste hygienically
Water bottles	To ensure hydration for students and tourists	Use clean, reusable bottles or glasses
Safety kit	Includes basic first-aid items	Take note of the expiry dates on the items

11.5 Selecting tools

Table 11.4 provides a list of tools commonly used while providing tourism services.

Table 11.4: Tools used for tourism services

Tools	Use	Safety note
Tablet/ smartphone	For digital mapping, taking photographs, recording audio notes or checking information	Use responsibly; avoid use while crossing roads or walking in crowded areas
Map/GPS	To guide tourists, plan routes and mark important locations	Verify routes in advance; refer to maps and do not rely only on GPS in unfamiliar areas
Speaker	To address a group during a tour or give instructions	Keep volume low; avoid disturbing public spaces

11.6 Bill of Materials (BoM)

Every service has a cost. Some costs are small and visible, like chart paper for a map or pens for signboards. Others are less visible, like the time spent in preparation. Unpredictable situations, such as delays, cancellations and weather changes also increase costs.

Professionals also have to deal with the fact that the duration of the tourist season is limited to the months with pleasant weather. In addition, the cost of running services in remote areas is higher. Therefore, a service provider must cover all these costs.

Cost estimation and documentation

CASELET

The students at Government High School developed a Bill of Materials that not only covers the materials bought but also includes the efforts to provide the service (Table 11.5).

Table 11.5: Bill of Materials

Item	Quantity	Estimated cost (in ₹)	Remarks (if any)
Markers	2 packets	120	
Waste bags	5 packets (50 bags)	150	Different colour for dry and wet waste
Itinerary sheet	50	100	To be printed
Chart papers	10	50	
First-aid kit		Borrowed from school	
Gloves	10	50	
Smartphone and speaker	1	Borrowed from school	
Cost of labour	**Value (time spent in hours × hourly estimate × number of people)**	**Estimated cost (in ₹)**	**Remarks (if any)**
Cleaning and waste disposal	1 hour × ₹ 50 × 2 people	100	
Guiding tourists	1.5 hours × ₹ 50 × group of 5 people	375	
Preparation	2 hours × ₹ 20 × 5 people	200	
Total		**₹ 1,145**	

PORTFOLIO

Make a Bill of Materials for the service you will provide.

11.7 Consent form

Before providing the service, it is important that both you and the person receiving the service clearly understand what is being offered. As you learnt in Chapter 9, a consent form is simply a clear communication of what the service provider will provide, what the tourist can expect and what each person is responsible for.

A consent form is not a legal document, but a means to clearly state expectations from both sets of individuals, thereby building trust, avoiding confusion and ensuring safety during the tourism service.

The following should be kept in mind while developing the consent form:

1. Share what you will provide.
2. Share expectations related to safety.
3. Clarify charges and refunds.
4. Take consent for photographs.


CONSENT FORM

MODEL HIGH SCHOOL

TOUR / SERVICE NAME: _____
DATE: _____
TIME: _____

TOURIST DETAILS

NAME: _____
PHONE: _____
EMAIL: _____

OUR COMMITMENT (Student Team)

- ✓ Safe & Guided Route
- ✓ Informative Experience
- ✓ First-Aid Support
- ✓ Fee refundable on cancellation
- ✓ Access to clean drinking water

TOURISTS' COMMITMENT

- Follow Instructions
- Stay with Group
- Respect Environment
- I am responsible for my own safety
- Consent for photo (Y/N)

PAYMENT: ₹

TOURIST'S SIGNATURE:
STUDENT GUIDE'S SIGNATURE:

Figure 11.3: *Example of a consent form for a guided walk to a tourist site*

CASELET

Students at Government High School developed the consent form as shown in Figure 11.3.

PORTFOLIO

Develop a consent form for the service you will provide.

Preparation

11.8 Preparation for service

Once you have chosen the tourism service that you will provide, selected the required materials and tools, and prepared the process chart and bill of materials, it is time to start getting ready for the actual work. Preparation makes your service smooth, safe and enjoyable for tourists. It also helps your team stay organised.

SAFETY

Before you begin, plan for safety

As a tourism service provider, one of your most important responsibilities is to keep tourists safe. This also means taking care of your own safety and protecting the place or property where the service is being delivered.

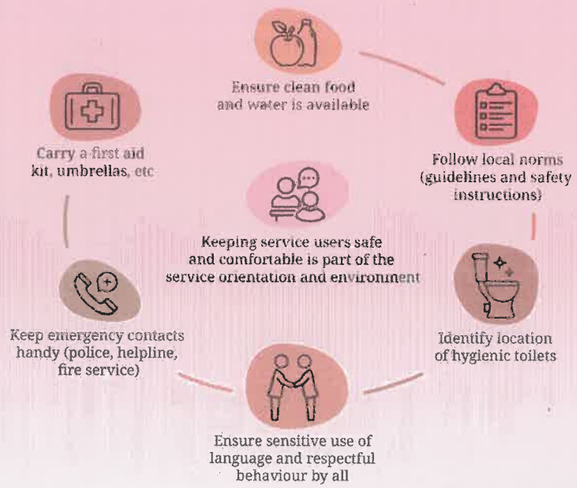

Figure 11.4: *Safety while providing a service related to tourism*

Figure 11.4 highlights some simple safety points that apply to most tourism activities. You can add more based on your location.

Discuss whether you need to add any other aspects related to safety for the particular service you will provide.

TASK

An important consideration while planning your service is of accessibility. Persons with disabilities must be accommodated through identification of their needs and how to meet them. For example, you must identify locations of toilets they can access and check whether any restaurants you plan to take your group to have ramps. If you have planned a guided tour, you must carefully go over the route to identify any stretches you feel may be tough for them to negotiate. Identify alternative paths that will be easier for them to cross.

What arrangements will you make to help persons with disabilities to fully participate in the tour?

You can also explore apps that will help you accommodate any special needs. Ask an expert to guide you.

11.8.1 Preparing a tourism map

Preparation

A map is one of the most important tools used in tourism. It helps tourists understand a place, locate important landmarks and plan their movement. While providing tourism-related services, maps are used not only for navigation but also to highlight attractions, facilities, and cultural or natural features of an area. Unlike detailed geographical maps, tourism maps focus on:

1. Places of interest (for example, heritage sites, parks, temples, markets, beaches, museums, etc.)
2. Useful facilities (for example, washrooms, drinking water, parking, bus stops, eateries, etc.)
3. Routes and directions that help tourists move safely and comfortably

Tourism maps are drawn with clear symbols, colours, labels and short descriptions, so that people from different backgrounds can easily understand them.

CASELET

Students of Government High School created a map (Figure 11.5), detailing the route from their school to the site and back. They indicated the sites for refreshment, clean water and toilets along the way.

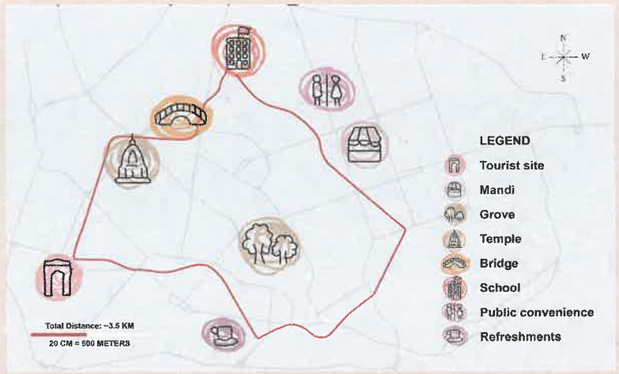

Figure 11.5: *Map for a walk from Government High School to a local heritage site*

PORTFOLIO

Prepare a map related to the service you will provide. For example, while students of Government High School decided on a walk tour, you may have decided to invite tourists to participate in the celebration of a festival. Therefore, your map will show the meeting point, route to the site of celebration, important landmarks and facilities (for example, water, accessible toilets, etc.).

If possible, mark the important places on a map downloaded from the Internet. You can also create a blog around the map, or make and post reels in a closed group for tourists who prefer digital versions.

11.8.2 Making an information brochure

Communication

The history or stories connected to a place, any specialty of culture, language or cuisine are interesting.

In case you did the project related to making an AI Assistant in Grade 7 *Kaushal Bodh*, you may remember the categories of interest – food, flora and fauna, dance and music, places of interest, common terms in the local language, and so on. In addition, if there are museums or theatres, then timings, weekly holidays, entrance fees, places to park and so on will also be important for tourists.

You can collect information related to your service from books, the internet, older people in the community or local guides, and present it in a short, clear handout or brochure.

A brochure usually also includes information about toilets and drinking water points, health or first-aid support, emergency numbers (police, ambulance, fire station, etc.), lost-and-found point, nearby hotels or homestays, and their tariff and basic services. Please note that all this information should be verified and authentic.

You can create the brochure in different ways – it can be handmade, printed or in the form of audio-visual content (Figure 11.6). Creating the brochure in different ways means that you are making it possible for tourists to choose the medium they are most comfortable with.

Figure 11.6: *A brochure containing essential information*

TECHNOLOGY AND ARTIFICIAL INTELLIGENCE

You can use apps to create informative as well as creative e-brochures for your tour. These tools help you organise information clearly, using headings, icons, maps and images. You can choose suitable templates, adjust colours and fonts for readability, and ensure that important information, such as timings, facilities, safety and contact details, are easy to find.

PORTFOLIO

Prepare a brochure that includes information related to the tourism service you will offer.

Communication

11.8.3 Preparing a script

When providing services related to tourism, you must prepare a script, like the one you may have developed while doing the project on puppet making in Grade 7 *Kaushal Bodh*. Write a short script about what makes the place or event interesting.

For example, what is the history of the tourist site? Are there any legends, festivals or anecdotes that are unique to the place?

You can watch online videos of famous guided tours to understand how guides mix facts with local history and narratives. Create your own 'script'–an account of the uniqueness of the experience you have designed for them (Figure 11.7).

Make sure you weave in the operational or logistical aspects of the tour in an interesting manner. For example, when to stop for rest or local guidelines (for example, removing shoes while entering a place of worship). Your script should be detailed with these minute instructions, so that you are prepared for the final day.

A good way to know if your script and presentation will be impactful is to have a mock presentation, either within your group or class in the presence of a teacher or an expert, and incorporate their feedback in your revised script.

Figure 11.7: *Component of storytelling while preparing the script for tourists*

Use of tools and materials

PORTFOLIO

Develop a script for your selected tourism service. The more detailed your script, the more insightful and effective your tour will be.

11.8.4 Signages for effective communication

Signages refer to the entire system of signs you will create to make your service efficient. Tourists feel welcome when they can easily spot clear and visible signs for toilets, drinking water, resting spots, entry/exit points, ramps and so on. Depending on the service you are providing, you may:

1. Prepare simple labels for exhibits, old photos or artefacts, with a brief description.
2. Prepare signs for safe and unsafe spots.
3. Prepare signs to indicate positions of volunteers to manage crowd movement.
4. Prepare signs for 'rest points' with shade and drinking water.
5. Prepare a small 'Do Not Touch' or 'Fragile' sign where needed.
6. Prepare signs for 'zero-waste' messages.

Communication

TASK

Prepare signages for your service.

Discuss the kinds of signs and how many of signs you will need related to your service. You will also need to discuss where and how (for example, on a stand, pasted on a wall, etc.) they will be placed. Prepare the signages accordingly.

DID YOU KNOW?

Protection of monuments

Protecting heritage sites is our constitutional responsibility. Article 51A(f) makes valuing and preserving the country's rich heritage and culture a fundamental duty.

Further, Section 30 of the Ancient Monuments and Archaeological Sites and Remains Act, 1958, states that destroying, removing, injuring, altering, defacing (including by writing, scribbling, carving or painting) or misusing a protected monument is punishable by up to two years of imprisonment, a fine of ₹1 lakh or both.

The Prevention of Damage to Public Property Act, 1984 also punishes individuals for causing damage to public property, which includes heritage sites. Therefore, do remember to stop people from writing on the walls of monuments and other public places.

11.8.5 Promoting the service

Once your service is planned and ready, the next step is to let people know about it. It is important to know how the target audience prefers to receive information. Is it through digital media like closed messaging groups, printed pamphlets or posters? Also, how many people would you like to reach? If it is a few, you can promote the service through personal invitations or printed material. If it is a large number, then digital media and social group platforms are better options. Whatever you decide, your communication must be inviting and catchy to attract people.

CASELET

Students of Government High School developed a poster for promoting their walk from the school to the tourist site in their locality (Figure 11.8).

You can design a similar or any other form of invitation (like an advertisement, announcement or a short video clip). You can refer to the project on creating advertisements in *Kaushal Bodh* Grade 8 for more ideas.

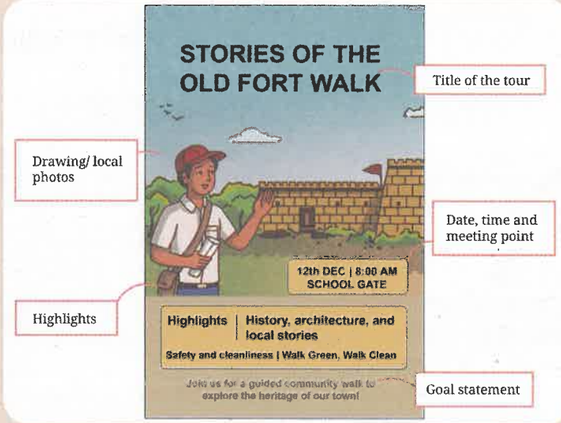

Figure 11.8: *Poster for promoting a walk from school to an old fort*

11.9 Delivering the service

Preparation

11.9.1 Pre-tour checklist

Now create a detailed schedule of activities, which comprises the course of events on the day the service will be provided, along with time and details of the location. Also, prepare a checklist of materials required throughout the service.

CASELET

A schedule developed by students of Government High School is shown in Table 11.6. It details the itinerary, that is, the entire plan of the walk tour.

Table 11.6: Itinerary of walk tour to the tourist site

Walk tour to the tourist site	
Time	**Task**
08:50 a.m.	Assembly at school gate
09:00 a.m.	Welcome and brief on walk tour; registration and filling in of consent form
09:30 a.m.	Start walk; one rest stop (optional)
09:55 a.m.	Reach the site
11:00 a.m.	Refreshments
12:00 p.m.	Return walk; one rest stop (optional)
12:25 p.m.	Reach the school gate; fill feedback form

The students also made a checklist of materials required on the day of the walk (Table 11.7).

Table 11.7: Checklist of materials

For tourists			
Materials	**Quantity**	**Available/ Yet to arrange**	**Remarks**
For Tourists			
Itinerary	50	Available	
Welcome board	1	Available	
Feedback form	50	Available	
Consent form	50	Available	
First-aid and safety			
First-aid kit	1	Available	
Safety manual	10	Available	Developed as small note
For tour guide			
Script	2	Available	

Visitor list	2	Available	
Route map	10	Yet to arrange	5 extra to be printed for portfolios
Microphone	1	Available	
Waste disposal			
Waste carry bags	5 packets (50 bags)	Available	
Gloves	10 pairs	Available	
Promoting the tour			
Brochures	50	Available	

PORTFOLIO

Prepare your own schedule and checklist based on the kind of service you are providing.

As discussed in Chapter 9, ensuring that quality materials are arranged on time will help in building a suitable physical environment, wherein the tourists will have easy access to useful resources (for example, itinerary, tour map, safety guidelines, etc.).

Service environment

11.9.2 Engaging with tourists

Tourism-related services are not only about information but also about behaviour, care and confidence (Figure 11.9). The first thing you must keep in mind is to dress appropriately. Wear neat and comfortable clothes suitable for walking, climbing steps or standing for long periods.

Always remain patient and calm. Large groups, heat, noise or crowding can make situations stressful. At times, tourists may give suggestions or ask for things that are not possible. Do not reject them quickly or rudely, and do not raise your voice or show irritation. Explain gently and with an apology.

For example, "Sorry Madam, we understand your suggestion. But if we go there now, it may get dark. You can explore it during your next visit." Polite but firm communication builds trust.

You must take special care of elders and children, and any other person with specific needs. Some tourists walk slowly,

Figure 11.9: *Engaging with tourists during a tour walk*

get tired easily or need more support. Offer help when needed. Remind them of uneven ground or steps, offer water and suggest resting points.

Share helpful tips before the tour begins – give tourists a few friendly reminders to carry an umbrella, wear sunglasses or caps, drink water, wear comfortable shoes, carry a light jacket and keep food packets inside their bags rather than in hands. Such advice shows responsibility and makes the tour smoother.

Service environment

CHECK YOUR UNDERSTANDING

Your class has planned a local walk for parents and community members to a famous food street. Two students are assigned as tour guides, while others support crowd movement and visitor care. During the tour:

1. The weather is hot and humid.
2. One elder walks slowly.
3. A visitor suggests visiting another spot that is not part of the planned route.
4. Some children start moving ahead of the group.

As a tourism-related service provider, your responsibility is to guide tourists safely, politely and confidently, while ensuring everyone feels respected and cared for.

1. How should you speak and behave in this situation?
2. What steps should be taken to support elders and children?
3. How can suggestions be handled without offending anyone?

11.9.3 After the service

Waste management

After the service is completed, you must take written feedback or short video or audio comments from service users. This will help you understand what went well and how to improve in the future. You also need to check the areas in which the service was provided, to ensure all waste has been disposed as per protocol.

After the tourists leave, ensure that the site is cleaned and restored to its original condition. Collect and segregate waste, such as food wrappers, paper, bottles and decorations into dry and wet waste. Dispose the waste responsibly using dustbins or designated collection points. This shows respect for the place, the local community and the environment, and reflects responsible tourism practices.

TASK

Make a list of waste generated during your tourism service (paper, food waste, plastic wrappers, water bottles, etc.). What steps did you follow to reduce waste? Finally, how did you dispose of the waste?

Feedback and reflection

PORTFOLIO

Document Your Tour

A short write-up or photo story for your school blog or notice board, or the school's web page helps others learn about your work. You can share the write-up or digital content with the tourists you served to help them remember you and recommend your service to others. Remember to take your teacher's permission first and to ensure confidentiality (for example, not sharing photographs of any person without written consent).

1. Name of the tour
2. Date of the tour
3. Time
4. Number of tourists
5. Tourists' comments or feedback
6. Any challenges or difficulties faced
7. What went well
8. What you would improve next time

Feedback and reflection

Remember that in Chapter 9, you learned that quality services are user-centric and improve through feedback. Here, feedback helps you understand whether the service met users' needs and how it can be improved further.

11.10 While performing the service

1. A clear tour map is prepared in advance to mark routes, entry and exit points, important locations, rest stops, water points, and emergency support areas. This ensures smooth movement of tourists, better time management and safety during the tour.
2. Careful observation of practitioners helps in understanding effective communication, sequencing of information and managing visitors. This helps in developing a guided script that includes key information, safety instructions and interesting facts to guide tourists clearly and confidently.
3. Essential signages, such as directional signs, safety signs and information boards should be developed using simple language, symbols and visuals. Clear and visible signages help tourists navigate easily and follow safety instructions without confusion.
4. Effective engagement involves polite communication, active listening, clear responses to questions and encouraging participation. Friendly interaction improves tourists' experience and makes the tour informative, interactive and enjoyable. Suitable and neat attire is also important.
5. Ensure you leave all the places visited clean; do not allow anyone to damage sites visited in any way.

11.11 Assess your learning

1. Review the tourism service your class designed. Which three decisions improved the visitor experience the most and which two decisions should be changed if you were to provide service again? Give reasons for each point.
2. Compare any two tourism services you explored (for example, participation in a festival vs a heritage walk, hiking vs visit to a museum) which services would you choose to provide, and why?
3. Tourists sometimes ignore local rules, or damage natural and cultural sites. Why do you think such behaviour occurs? What are the responsibilities of tourists and service providers to prevent this from happening?
4. During a tourist visit to a remote area, the bus breaks down. What kind of preparations are necessary to ensure tourist safety, minimise inconvenience and maintain trust under these unexpected circumstances?
5. Imagine your school wants to continue the tourism service every year. Design a plan for how the next batch of students can maintain and improve the service. Include guidelines for training, materials, safety, communication, costing and documentation.
6. Create a new tourism service idea for your area that is not included in this chapter. Describe its purpose, the people it will help, the process chart and the safety plan. Explain how it reflects the values of empathy, quality and responsibility.
7. Of the tasks that you did, which did you enjoy the most? Which did you enjoy the least? Give examples of what went well and what did not go well. What would you do differently next time?
8. Give examples of how you can apply your learnings to a real-life situation.

CHAPTER 12

Additional Vocations

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Hospitality

Work in hospitality includes welcoming, guiding and taking care of visitors, so that they feel comfortable, respected and safe. Good hospitality depends on polite communication, clean and well-organised spaces, clear guidance and care for people with different needs (for example, children, elders, persons with disabilities, etc.).

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Keywords

Guest experience: how comfortable and supported a guest feels during the visit

Etiquette: polite behaviour that shows respect (greeting, tone, posture and listening)

Item or Material name	Description
Signage or Placards	Entry and exit, seating, water point, help desk, washrooms
Seating arrangement	Chairs, tables, mats; waiting area setup
Cleanliness items	Waste bins or bags, tissues, cleaning cloth, sanitiser
Team attire	Uniform or apron, name tag or badge, gloves or masks (if needed)
Recording materials	Notebook, pen, simple feedback sheet, AV device
Safety kit	First-aid kit, list of emergency contacts
Serving items	Trays, cups or glasses, water jugs or dispensers
Measuring scale or Tape	Accurate measurement

Quality parameters

Welcome: guests are greeted politely and guided without confusion.

Comfort: seating, shade or ventilation, and water points are easy to access.

Cleanliness: service area stays clean; waste is collected and managed properly.

Communication: clear, calm, respectful language; helpful tone and body language.

Inclusion: elderly guests and those with disabilities can move and participate comfortably.

Feedback: guests share positive feedback or useful suggestions for improvement and organisers reflect on their processes.

Safety parameters

Personal hygiene: Clean hands, clean uniform or apron, trimmed nails, neat hair.

Safe crowd movement: Avoid pushing, keep clear paths, manage queues with ropes/cones.

Food and water safety: Serve clean drinking water, use clean utensils and avoid uncovered food.

Emergency readiness: Mark way to emergency exits, keep emergency numbers ready; keep first-aid kit accessible.

Waste safety: Place bins at visible points, avoid spills, dispose waste responsibly.

Respect and privacy: Do not share guest phone numbers or photos without consent.

Key steps in the process

1. **Identify need or opportunity:** Choose a real situation where hospitality service is required (for example, school events, exhibitions, parent meetings, community gatherings, yatras, village fair, etc.).
2. **Plan the service and roles:** Decide roles such as greeters, guides, water or refreshment servers, seating or queue managers, cleanliness team and record-keepers.
3. **Prepare the service environment:** Mark entry and exit, arrange seating, place water point, put up signage, create a clear queue path and keep bins at key points.
4. **Preparation:** Practise greeting, guiding, polite communication, listening and handling common situations (lost guest, crowding, shortage of cups/water, etc.).
5. **Delivery:** Welcome guests, guide them, support seating and movement, serve water or refreshment safely, and keep the area clean.
6. **Monitor quality during service:** Watch for confusion, crowding or discomfort; adjust signage, seating and water point if needed; support elders and children.
7. **Collect feedback and record learnings:** Note what worked well, what challenges came up, what guests said and what improvements are needed.
8. **Post-service activities:** Clean up the area, dispose waste responsibly, pack materials safely and reflect on how the service can be improved next time.

Event Management

Event management is the work of planning, organising and managing events that bring people together for a purpose. It involves understanding the purpose of the event, planning the programme flow, coordinating people and materials, managing guests, and responding calmly to unexpected situations.

Keywords

Ambience: the overall atmosphere or mood of an event created through décor, lighting, music and arrangement.

Programme flow: the sequence in which activities take place during an event.

Logistics: planning and managing materials, equipment, people and time.

Item or Material name	Description/Use
Stationery	Event schedules, signages, information boards, banners, name tags, feedback forms
Sound system (microphone, speakers)	Announcements and performances
Tables, Chairs and Stands	Seating, stalls, registration counters
Hospitality items	Water, glasses, welcome materials
Cleanliness supplies	Dustbins, waste bags, sanitiser
First-aid kit	Handling minor injuries

Quality parameters

Event activities follow the planned programme and timeline.

Guests and participants feel welcomed, informed and safe.

Team members perform roles responsibly and cooperatively.

Cleanliness and waste management are maintained before, during and after the event.

Feedback from organisers, teachers and participants is used for improvement.

Safety parameters

Keep walkways, exits and emergency routes clear at all times.

Follow fire safety, electrical safety and crowd movement guidelines.

Keep first-aid materials and emergency contact numbers available.

Maintain safe sound levels and lighting arrangements.

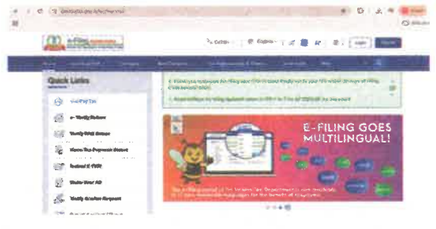
Use tools, décor items and electrical equipment carefully and responsibly.

Key steps in the process

1. **Identify need/opportunity:** Select a school or community event, understand its purpose, audience and scale.
2. **Plan service and roles:** Discuss requirements, such as space, timing, permissions, budget and safety. Prepare a simple process chart covering programme flow, logistics, hospitality, safety and execution.

3. **Preparation:** Decide the theme, stage arrangement, seating, décor, signage and refreshment points. Draw simple sketches or layouts; list required materials and services. Choose low-cost, reusable or locally-available options; allocate responsibilities within the team, and plan timelines for preparation and rehearsal; conduct a rehearsal to check flow, timing, equipment and coordination. Identify gaps and improve.
4. **Delivery:** Manage setup, welcome guests, coordinate programme flow, handle issues, and ensure safety and cleanliness.
5. **Monitor quality during service:** Watch for confusion, crowding or discomfort; adjust signage, seating or water point if needed; and support elders and children.
6. **Collect feedback and record learnings:** Note what worked well, what challenges came up, what guests said and what improvements are needed.
7. **Post-service activities:** Clean up the area, dispose waste responsibly, pack materials safely and reflect on how the service can be improved next time.

Data-based Services



Data-based services involve collecting, organising, analysing and using information to support decision-making for people and communities. When data is collected carefully and used responsibly, it helps schools, families, communities and governments understand problems, identify patterns, and plan improvements. Data-based work supports services in education, health, governance, environment, welfare and local development.

Keywords

Data analysis: studying data to identify patterns and trends.

Data visualisation: showing data using charts, graphs, or tables.

Survey: a method of collecting information from people using questions.

Insight: meaningful understanding drawn from data that helps decision-making.

Item or Material name	Description
Computer/Tablet	Data entry, analysis and preparing charts
Smartphone (supervised use)	Data collection, photos, voice notes
Survey forms (paper/online)	Collecting information
Notebook/Register/AV device	Recording observations and reflections
Consent forms	Ethical data collection

Quality parameters	Safety parameters
Clear purpose: data collected matches the problem being studied.	**Data privacy:** Do not share personal details, documents or OTPs.
Reliable collection: questions are simple, relevant and unbiased.	**Consent:** Take permission before collecting information from anyone.
Ethical handling: information is used only for the stated purpose.	**Accuracy:** Record information carefully without guessing or changing responses.
Clear presentation: charts and tables are easy to understand.	**Digital hygiene:** Use trusted tools; log out after use and avoid unknown links.
Useful insight: findings help explain the issue and suggest actions.	**Secure storage:** Keep paper forms and digital files safe and organised.

Key steps in the process

1. **Identify need or opportunity:** Select a real-life problem that needs informed decision-making (for example, attendance, water use, waste, screen time, maintaining stock register in store or library, pollution records, traffic control, etc.); and decide what you want to understand and who the data is about.
2. **Preparation:** Prepare simple survey questions or observation sheets; and plan use of computers, questionnaires (for example, Google Forms), mobile phones, data visualisation tools – spreadsheets, AI tools.
3. **Data collection:** Collect information carefully, with consent and respect for privacy.
4. **Data analysis and visualisation:** Sort responses, check for errors and prepare tables; and create charts or graphs to identify patterns.
5. **Data interpretation:** Discuss what the data shows and why it matters.
6. **Monitor quality during service:** Ensure service etiquette, ethics, inclusion, accuracy and safety.
7. **Post-service activities:** Present findings, and reflect on improvements and next steps.

Interior Design

Interior design involves planning and improving indoor spaces, so that they are comfortable, functional, safe and visually pleasing. It involves understanding how people use a space and making thoughtful changes in layout, colour, lighting, furniture and décor to improve everyday use.

Keywords

Layout: arrangement of furniture and elements in a space.

Theme: overall style or idea used in designing a space.

Sustainability: using materials and methods that reduce waste and protect the environment.

Item or Material name	Description
Measuring tape/Scale	Measuring room dimensions and furniture size
Ruler or Set square	Drawing accurate layouts and angles
Stationery	Sketches, layouts, mood boards
Cardboard, Foam board or Recycled boxes	Making models or mock-ups
Paint swatches or Fabric samples	Selecting colours and textures

Quality parameters

Fit for use: The redesigned space supports its intended purpose.

Comfort and ergonomics: Furniture placement allows easy movement and use.

Aesthetics: Colours, lighting and materials work well together.

Sustainability: use of recycled, reused or locally-available materials.

Neatness: clean finishing and house-keeping after work.

Safety parameters

Tool safety: Use cutters, scissors and measuring tools carefully, and as instructed.

Workspace safety: Keep tools organised; avoid clutter while working.

Material safety: Use paints, glue and finishes in well-ventilated areas.

Posture and movement: Avoid lifting heavy items alone; maintain safe body posture.

Clean-up: Clear waste and leftover materials after work.

Key steps in the process

1. **Identify need/opportunity:** Select an indoor space, such as a classroom, study room, hostel room, office corner or community space that needs improvement; speak to users to understand comfort, storage, lighting, movement and usage needs.
2. **Plan service and roles:** Measure the space carefully and note dimensions; draw a simple floor plan (top view); and decide furniture placement, colours, lighting and décor.
3. **Preparation:** Make drawings or simple 3D models, using cardboard or recycled materials; list required materials, estimate quantities, and plan within a budget; present the plan or model to users or teachers, and note feedback.
4. **Delivery:** arrange the space as per the plan; placement of furniture and storage, colour and lighting decor; apply finishing techniques, troubleshooting, quality check
5. **Monitor quality during service:** Maintain safety, cleanliness and etiquette.
6. **Collect feedback and record learnings:** Maintain a project journal – before/after sketches or photos, action taken, quality checks, timeline status, budget tracker; and take feedback.
7. **Post-service activities:** Reflect on improvement in design, and use of tools and materials.

Public Information Service

Many citizens face difficulties, because they do not know how to get information, and how to fill forms or track their requests, especially when services are available online. This service plays an important role in ensuring transparency, inclusion and timely access to benefits related to education, health, housing, utilities and social welfare. Public information services are provided through places such as Common Service Centres (CSCs), *e-Seva Kendras*, *panchayat* or municipal offices, help desks and helplines.

Keywords

E-Governance: use of digital technology to provide government services and information.

Transparency: making government processes and information open and easy to understand.

Grievance: a complaint raised to request action or correction from an authority.

Item or Material name	Description
Computer or Tablet	Accessing official portals, filling forms, tracking applications
Smartphone (supervised use)	OTP verification, communication
Paper forms or Printouts	Collecting details, offline reference
Notebook, register or AV device	Recording requests, issues and outcomes
Stationery	Displaying service steps and key information
Consent form	Informing people about data use and privacy

Quality parameters

Correct information: Services and guidance are accurate and up to date.

Clarity: Instructions are explained in simple, understandable language.

Respect: Citizens are treated patiently and politely, regardless of literacy level.

Ethical handling: Personal data is used only for the stated purpose.

Effectiveness: People are able to complete tasks or understand next steps clearly.

Safety parameters

Data privacy: Do not share personal details, documents, or OTPs with unauthorised persons.

Verified sources: Use only official and trusted government websites and centres.

Secure handling: Keep forms, documents and records safe and organised.

Consent: Take permission before collecting or using anyone's information.

Digital hygiene: Log out after use; avoid unknown links or downloads.

Key steps in the process

1. **Identify need or opportunity:** Identify common services required by people (for example, scholarship forms, certificate updates, service complaints, utilities – phone, electricity, property tax, railway and bus reservation, application for admissions, application for government schemes, hospital bed availability, etc.).
2. **Plan service and roles:** Learn the purpose of the service, required documents, eligibility and official process.
3. **Preparation:** With consent, note down basic information, and procedure to obtain the services as well as any documentation required.
4. **Delivery:** Visit verified government websites or service centres to proceed; enter information carefully, upload documents if required and submit the application.
5. **Follow up after service:** Use reference numbers or messages to check application status; explain next steps, timelines or follow-up actions to the person.
6. **Collect feedback and record learnings:** Review what worked well, what difficulties arose and how the process can be improved.

NOTES