



GENERAL SCIENCE

STANDARD SIX

सामान्य विज्ञान इयत्ता सहावी (इंग्रजी माध्यम)

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FREE
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Tele MANAS Helpline

Tele MANAS (Tele Mental Health Assistance and Networking Across States)
(14416/ 1800-89-14416)

Under the National Mental Health Program, the centrally sponsored scheme Tele MANAS is being implemented in the state of Maharashtra from October 2022. Under the Tele MANAS Program, free 24 × 7 integrated and comprehensive mental health services are provided through the helpline number 14416. This includes treatment and counselling by experts for various mental problems. The information provided by you after calling the Tele MANAS helpline remains completely confidential, so students, parents and teachers should feel free to call the helpline number and tell them about their problems and doubts and get guidance on it. Tell others to take help from this facility as well.

Manodarpan

The Manodarpan Helpline (8448440632) is a free telephone service that has been made available since July 2020. It is provided by the Ministry of Education through the Manodarpan Cell at the National Council of Educational Research and Training (NCERT) to offer psychological guidance and support to students, parents and teachers. This service is available every day of the week from 8:00 AM to 8:00 PM. Students, parents and teachers can call this helpline to receive the necessary guidance and counseling.

This textbook aligns with the curriculum and syllabus developed by the State Council of Educational Research and Training, Maharashtra, Pune-30 and has been verified by them. The Coordination Committee, established under Government Resolution by GR No. Abhyas - 2116/(Pra.Kra.43/16) SD - 4 dated April 25, 2016, approved this textbook in its meeting held on 01 June, 2026 for use from academic year 2026-27 onwards.

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समग्र शिक्षा



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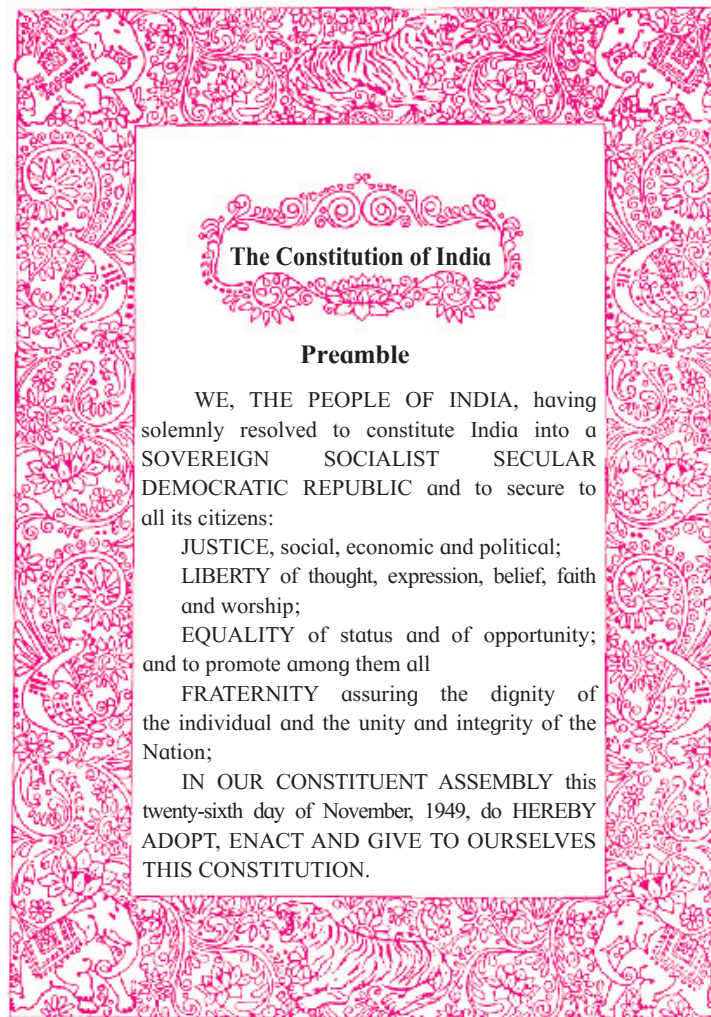
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The Constitution of India

Chapter IV A

Fundamental Duties

ARTICLE 51A

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
- (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 wild life 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.

NATIONAL ANTHEM

Jana-gana-mana-adhināyaka jaya hē
Bhārata-bhāgya-vidhātā,

Panjāba-Sindhu-Gujarāta-Marāthā
Drāvida-Utkala-Banga

Vindhya-Himāchala-Yamunā-Gangā
uchchala-jaladhi-taranga

Tava subha nāmē jāgē, tava subha āsisa māgē,
gāhē tava jaya-gāthā,

Jana-gana-mangala-dāyaka jaya hē
Bhārata-bhāgya-vidhātā,

Jaya hē, Jaya hē, Jaya hē,
Jaya jaya jaya, jaya hē.

PLEDGE

India is my country. All Indians
are my brothers and sisters.

I love my country, and I am proud
of its rich and varied heritage. I shall
always strive to be worthy of it.

I shall give my parents, teachers
and all elders respect, and treat
everyone with courtesy.

To my country and my people,
I pledge my devotion. In their
well-being and prosperity alone lies
my happiness.

राज्यगीत

जय जय महाराष्ट्र माझा, गर्जा महाराष्ट्र माझा
जय जय महाराष्ट्र माझा, गर्जा महाराष्ट्र माझा ॥धृ॥

भिती न आम्हा तुझी मुळी ही गडगडणाऱ्या नभा
अस्मानाच्या सुलतानीला जबाब देती जिभा
सह्याद्रीचा सिंह गर्जतो शिव शंभू राजा
दरी दरीतून नाद गुंजला महाराष्ट्र माझा
जय जय महाराष्ट्र माझा, गर्जा महाराष्ट्र माझा ॥१॥

काळ्या छातीवरी कोरली, अभिमानाची लेणी
पोलादी मनगटे खेळती, खेळ जीवघेणी
दारिद्र्याच्या उन्हात शिजला
निढळाच्या घामाने भिजला
देश गौरवासाठी झिजला

दिल्लीचे ही तख्त राखितो, महाराष्ट्र माझा
जय जय महाराष्ट्र माझा, गर्जा महाराष्ट्र माझा
जय जय महाराष्ट्र माझा ॥२॥

Preface

The State Curriculum Framework (school education) prepared in accordance with the National Education Policy 2020 and the school education curriculum 2026 based on it. This will be implemented stepwise from academic year 2026- 2027. Through this text book of 'General Science' students from class Six will study Science as an independent subject. The preparation for this subject has been done from classes three to five through the textbook 'The World Around Us-1'. Accordingly this textbook for class six has been prepared.

The National Education Policy 2020 has made a drastic change in education system. Education is not only the collection of information, instead of it is the thinking tool. This is the Holistic approach of this policy. According to National Education Policy 2020 the role of teacher is facilitator instead of information provider. Meaningful science education means motivation for class discussions, participation in experiments and activities of the student and connect Science to nature is important.

Instead of rote memory **Do this, Observe** and **Think**, such type of activities lead the student understanding of the knowledge and pleasure of learning. Science textbook is not the burden of study, it is the key of the journey of unlocked secrets of the world. The thoughts and questions arising in student minds are essential to the process of scientific inquiry. Therefore students must be encouraged without fear or hesitation to voice their questions and doubts. Chapters addressing topics such climate change, sustainable development and advancement in modern technology have been included in this textbook to foster awareness. The textbook also seamlessly illustrate how the subject of Science correlates with Geography, History, Mathematics and our daily lives. The primary objectives of this textbook are to nurture the students' innate curiosity and cultivate their capacity for logical reasoning. When performing activities are making observations involving plants and animals it is imperative to exercise in Environmental responsibility, specifically taking precaution to ensure that no harm is inflicted upon them is absolutely essential.

To ensure that this textbook is flawless and of as high quality as possible it has undergone a rigorous review process conducted by teachers and subject experts from every region of Maharashtra. The final form of this textbook has been shaped by carefully incorporating their valuable suggestions and feedback. The Science Committee of text book bureau and Illustrator have crafted this material with immense dedication and care. The bureau expresses its gratitude to all those involved.

It is our sincere hope that students, teachers and parents will warmly welcome this textbook.



(Anuradha Oak)

Director,

Maharashtra State Bureau
of Textbook Production and
Curriculum Research, Pune.

Pune.

Date: 1 May, 2026

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Maharashtra Din

■ GENERAL SCIENCE - STANDARD SIX ■

CG-1 Explores the World of Matter and its constituents, properties and nature.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-1.1 Classifies matter based on observable physical (solid, liquid, gas, shape, volume, density, transparent, opaque, translucent, magnetic, non-magnetic, conducting, non-conducting) and chemical characteristics (pure, impure; acids, bases; metals, non-metals; solutions, mixtures, separation techniques; elements, compounds)	• Tells object is made up of substance.	50,51,53
		• Explains states of substances with examples.	51,52,53
		• Classifies substances according to their states.	52,53
		• Explains shape of substances.	51,52,53
		• Classifies substances according to their shapes.	51,52,53
		• Explains volume of substances.	54
		• Measures volume of the liquid with the help of measuring cylinder.	54
		• Explains mass of a substance.	54
		• Explains density of a substance.	54
		• Explains states of a substance by giving examples in nature.	53
		• Explains property of materials of different densities.	54
		• Explains transparency of a substance.	55,56,57
		• Explores effect of other substances on transparency.	55,56,57
		• Explains non transparency characteristics of a substance.	55,56,57
		• Explains translucent characteristics of a substance.	55,56,57
		• Classifies transparent, non-transparent and translucent substances.	55,56,57
		• Explains magnetic property of a substance.	55,88,89,91
		• Gives examples of magnetic substances.	55,89,93,94
		• Makes toys using magnet.	94,95
		• Explains non-magnetic property of a substance.	88,92
		• Classifies substances as magnetic and non-magnetic.	93
		• Explains innovative use of magnetic materials in various fields.	88
		• Explains method of separating grains.	22,23,28,29
		• Explains method of winnowing grains.	22,28,29
		• Explains method of sieving grains.	23,28,29
		• Explains methods of separating salt from seawater.	26,28,29
		• Explains separation methods like sedimentation and decantation.	25,29
		• Explains filtration methods.	24,28,29
		• Explains method of churning yogurt.	25
		• Explains magnetic separation method.	26,27,28,29
2	C-1.3 Explains the importance of measurement, and measures physical properties of matter (volume, weight, temperature, density) in indigenous and Standard units using simple instruments.	• States physical properties of substance.	51,52,53,54,55,57
		• Measures length of an object using traditional and nonstandard methods.	10,11
		• Measures length of an object using standard method.	11,12,13,14
		• Measures temperature using a thermometer.	14,15,16,17,18,19,20
		• Explains structure of a thermometer.	15,16,17,20
		• Prepares model of thermometer.	20
		• Identifies different types of thermometer.	15,16,17,18
		• Takes reading on the thermometer.	16,17,20
		• Measures temperature of given substances.	18
		• Measures length of a given object using standard method.	11,12,13,14
		• Explains contributions of Indian meteorologists.	18

3	C-1.4 Observes and explains the phenomena caused due to difference in pressure, temperature, and density (breathing, sinking-floating, water pumps in homes, cooling of things, formation of winds)	• Explains concept of force.	96
		• Explains types of force.	97,98,99,100,101
		• Explains pressure and units of pressure.	101,102,104
		• Explains concept of atmospheric pressure.	102,104

CG-2 Explores the physical world around them in scientific and mathematical terms.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-2.1 Describes one-dimensional motion (uniform, non uniform, horizontal, vertical) using physical quantities (distance, time, speed and changes in speed) through mathematical and diagrammatic representations.	• Explains concept of motion.	106,107
		• Explains concept of linear motion through various examples.	107,110
		• Explains concept of nonlinear motion through various examples.	108,110,111
		• Describes concept of circular motion through various examples.	108,111
		• Explains concept of oscillatory motion through various examples.	108,110
		• Classifies various types of motion observed in the surrounding.	108,111
2	C-2.3 Describes the properties of a magnet (natural and artificial, earth as a magnet)	• Tells history of the discovery of magnets.	91
		• Explains different types of magnets.	90
		• Describes uses of magnets in daily life.	89
		• States properties of magnets.	90
		• Studies properties of magnets.	90
		• Verifies properties of magnets through simple experiments.	90,91
3	C-2.4 Demonstrates rectilinear propagation of light from different sources of light (natural, artificial, reflecting surfaces) and verify the laws of reflection through manipulation of light source and objects and use of apparatus and artefact (plane and curved mirrors, pinhole camera, kaleidoscope, periscope)	• Explains concept of light.	58,59
		• Verifies straight line propagation of light through experiment.	59,60,64
		• Explains concept of light reflection.	60,61,62
		• Studies reflection of light from a plane mirror and the laws about it.	61,62,63,64, 65
		• Illustrates types of light reflection regular and irregular through simple activity.	62
		• Explains construction of pinhole camera.	60,65
4	C-2.5 Observes and identifies celestial objects in the night sky using simple telescope and images (planets, stars, natural and artificial satellites, constellation, comets) and explains their role in navigation, calendars and phenomena (phases of the moon, eclipse, life on earth)	• Explains concept of space.	67,68
		• Observes celestial objects in space such as stars planets natural satellites artificial satellites constellations and comets using a simple telescope.	69,70 ,71,72,77
		• Provides information about celestial objects in the sky.	69,70,71,72, 77
		• Clarifies misconceptions in society through Sky observation and study of celestial objects.	73
		• Explains contributions of Indian astronomers.	74

CG-3 Explores the living world around us, and its interaction with the inanimate world in scientific terms.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-3.1 Describes the diversity of living things observed in the natural surroundings (insects, earthworms, snails, birds, mammals, reptiles, spiders, diverse plants and fungi) and other microscopic organisms.	• Identifies plants and animals found in the surroundings.	30,31,32,34, 35,36,37
		• Classifies plants based on their height, stem characteristics, leaf shape, colour and fragrance.	30,31,32
		• Names various parts of a plant.	31,32,33,34
		• Identifies types of venation found in plant leaves.	33,34
		• Explains differences between root systems of various plants.	34,35
		• Explains differences between stems of various plants.	31
		• Identifies monocot and dicot plant seeds.	33,39
		• Provides examples of animals based on their habitat.	36,37,39
		• Names animals found in water.	37
		• Names animals that live on land and those live in burrows within the soil.	37,38,39
		• Names animals of Living in both Terrestrial and aquatic environments.	37,38

2	C-3.2 Distinguishes the characteristics of living organisms (need for nutrition, growth and development, need for respiration, response to stimuli, reproduction, excretion, cellular organization) from non-living things.	• Understands characteristics of living organisms, the need for nutrition, growth, development, movement, respiration, excretion, reproduction, respond to stimuli and cellular structure.	1 to 9
		• Explains contribution of Indian scientist regarding the responsiveness of plants to stimuli.	6
		• Understands differences between living and Non-living things based on their characteristics	1,2,9
		• Classifies objects in the surroundings as living or Non-living.	1,2,9
		• Explains importance of factors necessary for plant growth.	4
		• Verifies plant growth through practical demonstrations.	6
		• Understands life cycle of mosquitoes and frogs.	7
		• Studies life cycles of mosquitoes and frogs.	7
3	C-3.3 Analyses patterns of relationship between living organisms and their environment in terms of dependence on and response to each other.	• Explains concept of natural resources.	112,113,122
		• Explains concept of soil.	112,113
		• Creates various objects from soil.	122
		• Studies various properties of soil based on its type.	113
		• Natural resources : Explains the significance of water for living organisms.	114,122
		• Natural resources: Explains the utility of solar energy in daily life.	116,122
		• Constructs small toys based on solar energy.	122
		• Natural resources :Explains the concept of air.	117
		• Explains concept of fossil fuels.	118,119,120,122
		• Provides examples of various types of fossil fuels.	119
		• Explains crisis occurred by the potential depletion of fuel resources.	119,122
		• Provides information regarding forest based products used in daily life.	117,118,122
		• Engages in tree plantation and forest conservation to maintain environment balance.	122
		• Describes products derived from medicinal plants.	118,122
		• Explains contributions of the Indian sage and scientist Maharshi charak.	118
		• Understands concept of natural balance based on principles found in the Rigveda the Rut.	82
		• Describes importance and utility of marine resources in daily life.	115,116
		• Explains inter relationship between natural resources and human beings.	114
		• Classifies available resources into renewable, non-renewable and sustainable categories.	120,121
		• Describes adverse consequences of the over use and wastage of resources.	119,120,122
		• Explains Limited availability of natural resources and to use them for judicious manner.	119
		• Explains concept of disasters through various examples.	40
		• Explains two types of disasters (1) Natural (2) Man made.	41,44
		• Explains consequences of earthquake.	41,42,48
		• Explains consequences of flood.	42
		• Explains consequences of storm.	43
		• Explains consequences of forest fire.	43,48
		• Explains manmade disasters through various examples.	44
		• Explains effect of war.	44
		• Explains causes and consequences of Industrial and simple accidents.	44,45
		• Gives examples of cyber crimes and frauds.	44
		• Explains precautions to be taken to avoid fraud due to cyber crimes.	45
		• Explains concept of disaster management.	41
		• Explains precautions to be taken before and after a disaster.	45
		• Explains concept of first aid.	45,49
		• Explains first aid to be perform in case of external bleeding.	46

		• Explains first aid for burns and scalds.	46,48
		• Explains first aid for sunstroke.	46,48
		• Explains first aid for Snake bite.	46
		• Explains first aid for dog bite.	46

CG-4 Understands the Components of health, hygiene and wellbeing.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-4.1 Undertakes a nutrition-based analysis of food components with reference to Indian and modern dietary and culinary practices and explain the effect of nutrition on health	• Clarifies concept of cooking.	80
		• Tells about changes which have taken place in Indian cooking overtime.	80,81
		• Compares traditional and modern food culture.	81
		• Explains importance of balance diet for proper nutrition.	85
		• Explains views of Indian scientist on the subject of Nutrition.	85
2	C-4.2 Examines different dimensions of diversity of food –sources, nutrients, geographical, social, time-period based, diets	• Tells variety in daily diet.	78
		• Identifies various components of food for example carbohydrates, proteins, fats etc. and states their sources.	80, 81
		• Explains functions/ importance of a food ingredients.	80,81,82,83
		• Tells sources of vitamins, calcium, iodine and iron etc.	82,83
		• Explains function of vitamins A, B, C, D, calcium, iodine and iron.	84
		• Tells names and symptoms of diseases caused by deficiency of vitamin A B, C, D, calcium, iodine and iron.	83,84
		• Identifies carbohydrates, proteins, fats by using different tests and draws conclusions.	84
		• Explains the contribution of Indian nutritionists.	85

CG-5 Understands the interface of science, technology and Society

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-5.1 Illustrates how science and technology help improve the quality of lives in every walk of human life (health care, communication, transportation, food security, mitigation of climate change, judicious consumption of resources, applications of artificial satellites etc.)	Explains how science and technology help to improve the quality of human life for example optimal use of available Health care resources.	Included in integrated manner in Textbook.
2	C-5.2 Shares views on news and articles related to the impact science and technology and society have on Each other.	• Explains information about the misuse of science in history.	Included in integrated manner in Textbook.

CG-6 Explores the nature and processes of science through engaging with the evolution of scientific knowledge and conducting scientific inquiry.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-6.1 Illustrates how the scientific knowledge and ideas have changed over time (description of motion of objects and planets, spontaneous generation of life, number of planets), and identifies the scientific values that are inherent and common across the evolution of scientific knowledge (scientific temper, science as a collective endeavour, conserving biodiversity and ecosystems)	• Explains how scientific knowledge and ideas have changed over the time.	Included in integrated manner in Textbook.

2	C-6.2 Formulates questions using scientific terminology (to identify possible causes for an event, patterns or behaviour of objects) and collects data that is usable as evidence (through observation of the natural environment, designing simple experiments or use of simple scientific instruments)	Effectively uses basic scientific tools and equipment to collect information in scientific terms.	6,12,13,14,15,16,17,18,88,89,115,116,117
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CG-7 Communicates own questions, observations and conclusions related to science.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-7.1 Uses scientific vocabulary to communicate inferences and ideas about science accurately in oral and written form and through visual representation.	Uses appropriate scientific vocabulary to explain concepts phenomena and processes accurately and effectively.	Included in integrated manner in Textbook.
2	C-7.2 Designs and builds simple models to demonstrate scientific concepts.	Designs and creates simple models to illustrate scientific concepts.	Included in integrated manner in Textbook.

CG 8 To understand and discuss India's contribution to the entire field of science from historical times to the present day and be proud of it.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-8.1 Clarifies India's significant contributions to all aspects of Curriculum, concepts, explanations and methods in an integrated manner.		Included in integrated manner in Textbook.

CG 9 To develop Awareness of emerging discoveries ideas, unanswered questions and limitations in all areas of science.

Sr. No	Curriculum Competencies	Learning Outcomes	Page No.
1	C-9.1 States the concepts that are appropriate to the development stage of the students being studied and are conceptually understood.	Does small activities in science.	Included in integrated manner in Textbook.
		Presents concepts that are appropriate to the development stage of the students being studied and that are conceptually understood from the concrete.	Included in integrated manner in Textbook.
2	C-9.2 Asks questions about current information gaps related to an event in the curriculum.		Included in integrated manner in Textbook.

■ Inside the textbook.... how and why? ■

The textbook of standard six is new for students similarly it is different for the teachers. To memorize, re-reading printed text over and over again as it is not included in this. The writing style, language for skill development and giving opportunities for different aspects will be seen in this textbook everywhere. Such deliberate changes will bring joy and satisfaction to teachers.

The style of describing the situation in such a way that we feel like we are there, someone is talking to us and asking about observations, telling and naturally wish to pass on the experience with others will foster a deeper interest, and passion among students for this textbook and extension for the subject of science itself. The various boxes are included such as 'Think', 'Try this', 'Do you know?' along with the opening questions embedded within the narrative style. This style do not offer readymade answers, should not be viewed as speed breakers rather they are designed boosters to enhance observation skills and the spectrum of experience and cultivate linguistic approach in that. e.g. 'List the living organisms' found near a large tree the insistence on a comprehensive inventory that found on the branches, leaves and flowers those spotted within the crevices of the rough bark on the trunk, those and its bitter beneath the tree and those within the surrounding soil is not merely to inflate the length of the list. Instead of this approach develops skills of observation itself, awakening of curiosity from it and appreciation for biodiversity. The unique sense of discovery having made special observations of 'my own' that went unnoticed by others becomes a rewarding experience for some students. It serves as an inspiration to their peers. Similarly curiosity develops regarding the observations made by their friends constitutes a significant step towards achieving the intended learning outcomes. Making the fullest possible use of every opportunity within the classroom environment will prove to be a truly pleasure experience for teachers.

The style of the illustrations included in the lessons along with the exercises and activities is grounded in a conceptual framework derived from extensive experience. Where appropriate simple line drawings are utilised, photographs depicting learners engage in hands-on activities serve to inspire students with the title 'try it out' themselves. Furthermore various illustrations designed to elicit a gentle smile on students face. Each lesson is stimulating and instrumental in fostering a sense of affection and ownership among students towards their textbook and it reaches to the gravity of science subject. The inspiration to create similar illustrations on their own would be also serve as an opportunity for skill development. The exercise includes numerous questions that extend beyond the conventional framework of having a single predetermined correct answer. Such questions serve as seeds for fostering lateral thinking, analytical reasoning and skill development. If a student chooses an answer different from the expected one, exploring why they feel that way reveals the educational significance and value of the thought process. Indeed appreciating such valid unconventional thinking serves as a powerful motivator. In various context pertaining to traditions, customs, the local environment and so forth students are encouraged to gather information and present it in the class or share with a peer group. An immediate response from students is not expected in such instances rather ample time and frequent follow up is essential.

The prudent and judicious utilization of national wealth and resources has in the current context become an essential civic value. From this perspective the reuse of these valuable text books by students in the subsequent academic year holds significant importance. Naturally the textbook must be maintained in good condition, therefore practise search writing on the pages filling, in charts directly within the textbook should be avoided. It is expected that both teachers and parents will remain vigilant in ensuring this. For the purpose of evaluation of answers to exercises, activities and the questions based on the information given in boxes from lessons in the textbook, maintaining a separate notebook will be more convenient. Conduct the teaching learning process for students with special needs, sign language  as well as other supplementary pedagogical methods should be used. Students with special need should be given the opportunity to express themselves in whatever way is possible for them.

Best wishes for the beginning of a new journey on the path of Science!!!



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1

Characteristics of Living Organisms



This is our Moti. Two years ago, when we brought him home, he was a small puppy. At that time, he could not even stand properly. He used to drink the milk we gave him and sleep for a very long time.

Now, Moti has grown. If a ball is thrown far away, he runs to get it; he catches the ball in his mouth and brings it back. If a biscuit is tossed high up, he jumps and catches it in the air. When taken for a walk, he now pulls me along.

Moti grew up, but during that time, his dog collar, his leash and his toys have all remained the same size. They did not grow like Moti. Why this must have happened?



Many things are shown in the picture. Which of them need food? Which things in the picture don't grow? Make lists of both separately.





Go to a large tree near your school or home. Carefully observe all the small and large living organisms, around it. Make a list of all those living organisms.

Take a close look at the tree trunk, branches, leaves and flowers. Did you spot any living creatures in the rough bark of the trunk, on the leaves or in the soil beneath the tree? Are there any living organisms hidden in the piles of fallen leaves?

Make a list of everything you find. Compare your list with your friends' observations. Does your combined list include grass growing under the tree and small saplings?

Some living organisms are so large that they can be seen from a distance while others are very small. Some are even microscopic—so tiny that they cannot be seen with the naked eye. Regardless of their size every living thing needs

air, food and water. They gain energy from food which allows them to grow.

◎ **Growth and Development-** Growth in living beings is not just the increase in their size, height and weight. As a baby grows, it also learns new skills such as crawling, standing, walking and jumping. **Development** is the progress in an organism's body, intelligence, work capacity and skills.

Although all living beings grow, growth in animals occurs only for a specific period of their life. Plants continue to grow as long as they are alive. We can observe growth in all the organs of animals. Some parts of plant grow throughout its lifespan such as the girth of the tree trunk, the length of branches and length of the roots. Growth of some organs of the plants occurs for a limited period. For example- increase in size of the leaves.

Find out the differences in the growth patterns of the trees like Peepal, Banyan, Bamboo, Coconut and Mango.

Plants produce their own food through the process of photosynthesis. Animals depend on plants and other animals for their food. The intake of food resulting in to growth is a characteristic of all living organisms.

What Will Happen, if...

- There is a large beehive on a tree branch. Some children light a fire under that tree.
- A hen and her chicks are picking grains. A cat or a snake approaches them.
- Water is poured on one side of a mound of dry soil. A live earthworm is then placed on the dry soil near the moist edge of the mound.
- Many pigeons have gathered on the ground near a building and on wires. Suddenly, there is a loud noise of firecrackers.
- A small baby in a cradle feels hungry or its clothes get wet.
- Lotus buds were closed during the night. After sunrise, sunlight fell upon those buds.
- The sun set. Many birds returned to their nests. They slept quietly on the tree throughout the night. It is now dawn and a reddish glow is visible near the eastern horizon.



☉ **Response to Stimuli** - We often see how different animals behave in various situations. Whether it is a tiny insect like a fly or a mosquito or a large animal, they all sense what is happening around them. Earthworms move away from sunlight and seek out damp soil. Animals change their behavior when they sense danger. The ability of a living being to sense its surroundings is called 'Stimulus' and the way it acts because of that sense is called a '**Reaction or Response**'.

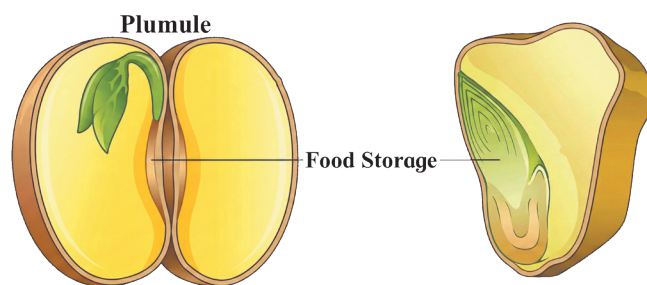
Animals respond to different stimuli instantly. Plants also respond to stimuli. Their roots grow in the direction of water in the ground and their branches grow towards sunlight in such a way that leaves receive sufficient sunlight. Besides these they sense changes in weather, temperature and injury too.



What is the stimulus and what is the response?

☉ **Excretion** - Many life processes occur inside the body of living organisms. Some waste materials are produced due to these processes. Removal of such waste materials from the body is called '**Excretion**'. While breathing out, animals release water vapour and carbon dioxide. They release sweat and they pass out urine. In this way they excrete waste. Plants store waste in their bark or in old leaves e.g. excess salts, tannins, resin, gum, crystals like calcium oxalate etc. When these leaves or pieces of bark fall off, the waste is excreted. Some plants also release a sticky liquid from their stems due to some man made or natural injury. When this liquid is dried, it forms gum. This is also a form of excretion. The roots of plants also release some waste material.

☉ **Reproduction** - Every living organism produces another living organism like itself. This process is called '**Reproduction**'. Some animals lay eggs. Their babies hatch from the eggs. Some animals directly give birth to the young ones. Some organisms can even grow into a whole organism from just a small part of their body.

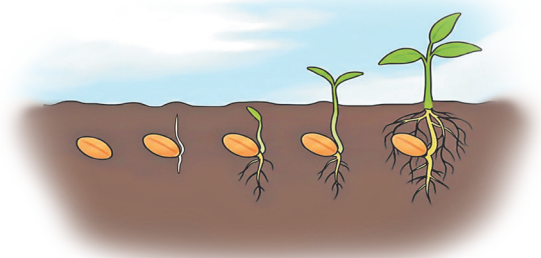


Most plants reproduce through seeds. Inside the seed, there is a seedling. Seed grows into small leaves and roots. When a seed is planted it grows into a new plant, the process is called '**Germination**'. The seedling needs food to grow. This food is stored inside the seed. If you look at seeds like beans or peas, they have two halves. These halves contain the food for the growing seed. The seeds of grains like wheat, Jowar also contain such stored food.



Sprouting and germination are the beginning stages of a plant's growth. For seed germination and continuous growth of plant, it needs sunlight, moisture and fresh air in the surroundings.

Observe the process used at home to make chickpeas, moth beans (*matki*), moong beans sprout. Find out the information about how saplings of plants like roses and Jasmine are prepared. Try to grow some saplings.



Growth and reproduction are the main characteristics of living organisms. These are the most important signs used to distinguish between living and non-living organisms.



Do You Know? In many places, there are long stretches of sand along the seashore.



On some beaches in the Konkan region, sea turtles lay their eggs in the sand during December to March. Nowadays, the Olive Ridley species of sea turtles is becoming rare. The female turtle of this species digs a hole in the sand on the beach and lays her eggs there. These eggs are usually laid in areas where the rays of the rising sun fall.

Once the hatchlings have grown inside the eggs, the eggs break open and the babies come out. Hundreds of hatchlings emerge from these eggs almost at the same time. It is vital for these babies to reach the seawater quickly; if they do not, they may not survive. It is truly amazing to see hundreds of eggs hatching all at once around dawn.

Just before sunrise, the eastern sky begins to turn a reddish hue. When this sunlight falls on the surface of the sea, it starts glowing brightly. As soon as the hatchlings emerge from their eggs, they immediately start moving towards this bright light and enter the water. However, since electric lights were installed near the shores, the hatchlings confused by the artificial light, start moving towards the light of electric lamps, away from the sea. Once the local villagers realized this, they began to turn off the lights near the beach during the turtle-hatching season. They now keep a watch on the shore to help all the hatchlings reach the sea safely. During this time, hundreds of villagers become friends of the turtles (*Kasav mitra*). Some villages even celebrate a Turtle Festival (*Kasav Mahotsav*) to honour this event.



- **Why is this care taken for sea turtles?**
- **Find out where and when the Turtle Festival (*Kasav Mahotsav*) is held in Konkan.**



☉ **Respiration** - Many animals breathe through their nose. Taking air into the lungs through the nose is called inhalation and releasing carbon dioxide gas and water vapour is called exhalation. The processes of inhalation and exhalation continue one after the other. Animals that do not have a nose or lungs take oxygen by other means.

The process of producing energy in the body through the reaction of oxygen and the food consumed by a living thing is called '**Respiration**'. Plants are living organisms, respiration occurs within their cells too. Breathing and respiration are two different processes. Observe animals like earthworms, flies and butterflies. Check if they breathe.



Think.

Are there any living organisms that can never leave their place?

☉ **Movement** - Movement is shown by the animals to obtain food, protection, shelter and as a response to stimuli. Besides walking, jumping and swimming which type of movements you have observed. Plants cannot move from one place to another on their own, but they give response to the stimuli. If sunlight comes only from one side, the branches grow in that direction. Roots grow towards the moisture. This shows that plants are aware of their surroundings.

After the sun sets and it begins to get dark, the pairs of leaves on certain branches fold together like joining the hands; when the sun rises in the morning, they open up again. Find with your friends where such large trees are located nearby. When do the buds on plants bloom? When buds bloom, their petals separate from each other. Therefore, movement is necessary for this. Even though plants do not change their position, movements such as roots growing in the right direction, branches growing, the opening and closing of leaves and blooming of buds during the day and night are all movements that occur in plants.



Opening and closing position of leaves during-day and night





Do You Know?

Earlier we knew that the roots of plants grow towards the moisture and the stem grows away from the ground. However, we did not know whether the plants feel heat, cold or pain. Sir Jagadish Chandra Bose was the first to prove through experiments that plants have a special system of their own to perceive such sensations.



He was the great Indian physicist and botanist. He invented an instrument, which could magnify the movements of a plant and growth of the plant ten thousand times and record it. Through his experiments at the Royal Society of London, he demonstrated that plants have feelings. Sir Jagadish Chandra Bose received great honours for his various discoveries.

- Sometimes a glass or an earthen pot, or a wooden object, gets chipped or a piece of it breaks off. Does that object return to its original shape after a few days?
- In animals, small or large wounds heal over time. However, those parts of the body become the same as earlier. New shoots emerge from the trunks of trees, from which new branches and new leaves grow. This is because new cells are constantly being formed.
- There are differences in the structure of cells in various parts such as bones, muscles and skin.
- The body of all living organisms is made up of cells. Every living cell in the body requires nutrients and oxygen.



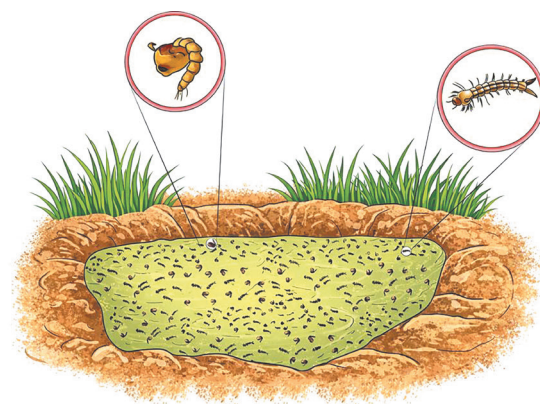
Try this.

Get five to six empty cups or small clay pots. Fill each cup with a mixture of soil and a little sand. Sow a few seeds of each type in the cup of soil mixture. For example, use seeds of plants like red chili, brinjal, beans, tomato and corn. Keep the soil in the cups moist by adding a little water every day.

Keep a record of time required for the seed germination, the size, number and shape of the leaves at that time. Draw their figures. After every third day, maintain its record. You can observe the growing vine, its leaves and pods for a long time by planting bean seeds. Keep recording your observations by planting such a vine. Let everyone in your family enjoy the beans you harvest!



The water tanks, which are, not cleaned regularly, containers where water is stored for a long time, you might see mosquito larvae in such places. If a container of water is left uncovered in a dark corner of the home, small larvae of mosquitoes can be seen moving up and down from the bottom to top of the water. If you observe them daily, you will notice that within a few days, these small larvae transform into mosquitoes. Why are there so many mosquitoes in puddles or near the edges of a pond?



Uniquely us...

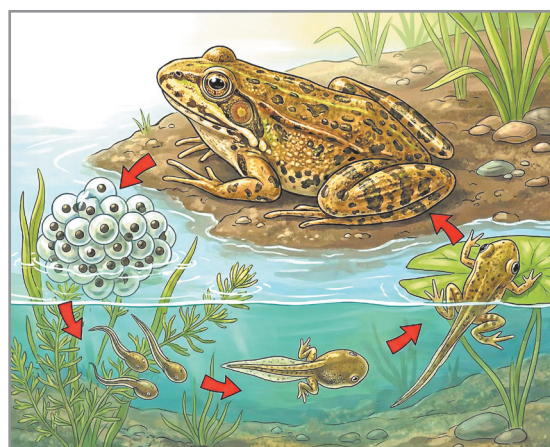
You must have seen the young ones of many animals like cow, dog, mice and cockroaches. You must have seen the young ones of fish and birds as well. Some animals are born from eggs, while in some animals, mother gives birth to young ones. Even though these young ones are small, their body structure and features are very similar to their parents. For example, as soon as you see a kitten, you identify it as a young cat. The same is true for the young ones of buffaloes, cows or elephants.

Sometimes there is a great difference between the bodies of the young ones and their parents. You cannot even tell which animal the young one belongs to, have you ever seen this?

☉ **Life Cycle of a Frog** - At the beginning of the rainy season, observe the branches of small plants present near the edge of the pond closely. You might see clusters of eggs that look like white foam. Bring some of those eggs, along with a small piece of the branch and put them in a large jar filled with water. Make sure that the branch stays slightly above the water. If possible, use water from the pond itself. Put a leaf in the jar for them. Observe the jar for a week, thrice a day. Do not forget to write down the date. Draw pictures of what you observe each day. Discuss among your friends about the pictures they have drawn, observation they have made and in how many days changes took place.

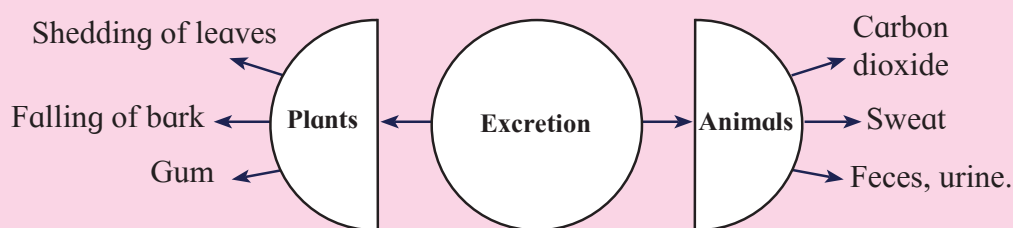


The larva that hatches from the egg does not look like a frog at all. As the larva grows into a frog, it goes through several stages. During the different stages, tadpole breathes through gills. Then it develops two hind legs and a tail. Slowly, its body transforms and looks more like an adult frog. **These stages of change are called the Life Cycle or Metamorphosis.** Note down which changes you see and after how many days they occur. Observe your friends' records. Compare the time required for these developmental changes. Is it the same or different?



What We Have Learnt?

- There is a great diversity among all the living organisms, ranging from microscopic to macroscopic. Some living organisms are so small that they cannot be seen with the naked eye.
- Every living thing needs food for energy and growth. The nutrition in the living organisms occurs because of the food. Different living organisms have different types of food; hence, there is diversity in their food.
- The ability of a living being to sense its surroundings is called stimulus and the way it acts because of that sense is called a reaction or response. Plants also respond to stimuli.
- **Excretion:**



- Animals can move and change their location. Plants cannot change their place on their own, but various types of movements do occur in plants.
- The growth of a new plant from seed is called germination.
- Growth, response to stimuli, excretion, respiration, reproduction and movement are the characteristics of living organisms. Among these, growth and reproduction are the main characteristics.
- During the period of growth, significant changes occur in the body structure of some living organisms. Such changes are called the life stages or life cycle of that living thing.

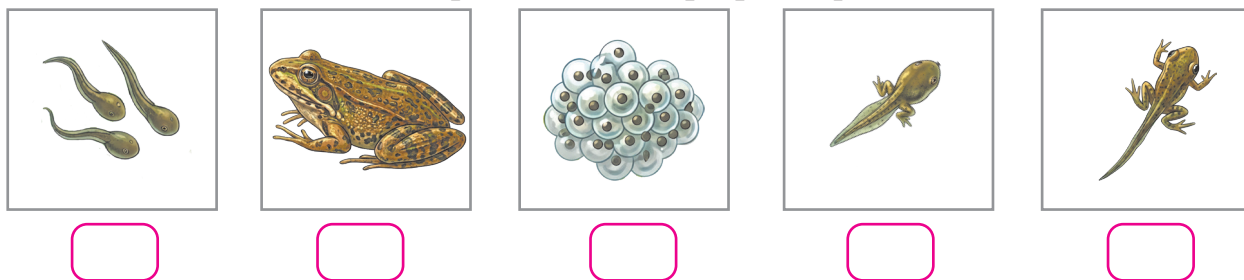
Exercises

(1) Suggest the appropriate word for the blanks.

- Every living organism produces another living organism like itself is called as
- and are the main characteristics of living organisms.
- The growth and development of living organisms due to food is called the of living organisms.
- The body of living organism is made up of



- (2) Birds, fish and animals can move and change their position on their own. Shed leaves, as well as vehicles like tractors and bullock carts can also change their position. What are the important differences between these two types of movements?
- (3) Germs of many diseases are extremely microscopic. They are so small that they cannot be seen with the naked eye. Do such living organisms reproduce? What do you think? Explain how you decided this.
- (4) Explain that animals like rats, cats and dogs show awareness of their surroundings through their behaviour? Write down your experiences about it and observations of how they behave in different situations.
- (5) Make a list of different types of animal movements along with the animals that move in those ways.
- (6) Plants respond to stimuli. Write down as many observations and experiences as you can which demonstrate this.
- (7) Turtles stay in water for a long time. Why do they come to the surface repeatedly and poke their heads out of the water? Fish, however, do not try this. Why?
- (8) The life cycle of a frog is given below in a jumbled order. Give the correct number in the boxes to put them in the proper sequence.



- (9) Classify the following into living and non-living groups based on their characteristics.

(Stone, butterfly, bicycle, book, fish, air, tree, kite, bus)

(10) Write answers to the following questions.

- (A) What are the effects on the animals when there is a drought and there is no food or water available for them?
- (B) A tiger cub grows; does it also develop? Explain this statement.

◎ Project-

Talk to the elders and collect information from them about where and how natural gum is obtained and what other substances are obtained in the similar way.



2

Measurement



In the above picture, every person is measuring something. Measurement means to measure some quantity. Observe carefully - Who is measuring what? When the milkman fills the milk-measuring cup, then exactly what is being measured? What is the cloth seller measuring using a measuring tape before cutting the cloth? What a doctor is checking using the instrument shown in the picture? What the vegetable vendor is measuring?



While playing the game of *gilli-danda*, two friends came to measure the distance covered by *gilli*. One had a slightly shorter stick, while the other had a longer one. For the game of cricket, they decided that the distance from the stumps to the bowling point should be measured as fifteen steps. But where to mark the other end? Both of them measured the fifteen steps distance. The results were different! Why did this happen? What could be the reason for this confusion?





Measure the length of your school desk or table using your hand span and finger-width. Ask your friends, siblings, or parents to measure the same distance. Is everyone's measurement the same?

In the past, units like finger-width (angul), fist (mushti), hand span (hasta) and footstep were used to measure length. However, because age, body

sizes vary, the measurements taken by different people also vary. This is called **'Non-standard measurement'**.

Instead, if everyone uses a fixed unit, the measurement remains the same regardless of who measures it. This system is known as **'Standard measurement.'** For example, if you buy one metre of cloth from a shop where it is measured with a metre scale and your grandfather measures it again at home with his metre scale, will the measurements be the same or different?



Do You Know?

In ancient Egypt, the distance from a person's elbow to the tip of the middle finger was used as a unit of length called a Cubit. Since this varied from person to person, the King's cubit was established as the Royal Cubit.

The Romans had their own version of the cubit, divided into two feet. Each foot was divided into twelve equal parts called inches. For long distances, they used a unit called mille passus (meaning one thousand paces). The distance we call a mile today is slightly more than that.

© **Standard Measurement**- Earlier, different regions used different instruments and units to measure distance, grains and liquids. This caused significant difficulties in trade and other daily tasks. To solve this, a uniform system of measuring instruments and units was established for everyone. This is known as the Standard System or the **International System of Units (SI Units)**.

If one metre of distance is divided into 100 equal parts, each part is called a centimetre (cm). 1 metre = 100 centimetres

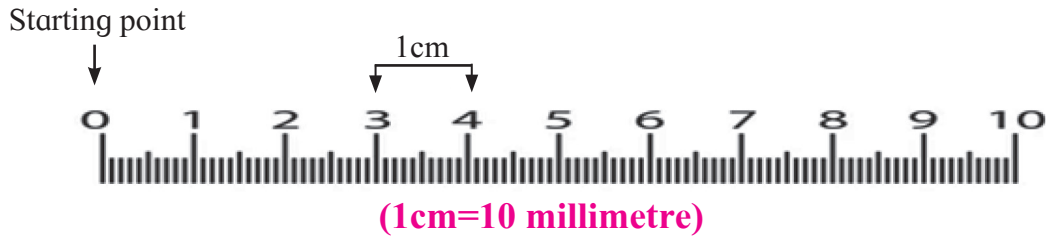
Measurement	Unit	Symbol
Length / Distance	Metre	m
Mass	Kilogram	kg
Time	Second	s

Observe the 15 cm ruler in your compass box.

You will see markings from 0 to 15. The distance between two big markings is 1 cm. **Each centimetre is further divided into ten small parts.** Each of these small parts is called a millimetre (mm).



A millimetre is the tenth part of a centimetre.



To measure the length of a line segment, the centimetre is a convenient unit. Whereas for measuring the length of cloth, the length and breadth of a playground metre is a more suitable unit. Since the distance between two cities is thousands of metres, a larger unit called the kilometre (km) is used to measure it. $1 \text{ km} = 1000 \text{ metre}$

Accurate Measurement of Length

You must have seen various instruments used to measure length and distance. Are the markings on the different types of measuring tapes used by cloth merchants, carpenters and surveyors the same?

Measuring tapes have convenient markings based on their requirements. It is essential to use the appropriate type of tape according to our needs.



A ruler is necessary to measure the distance between any two points. To measure the length of a piece of chalk a ruler of 15 cm is perfect. To measure the height of a door, a metre scale or a measuring tape will be required; however, to measure the circumference of objects with curved surfaces, we must use the flexible measuring tape (tailor's tape).

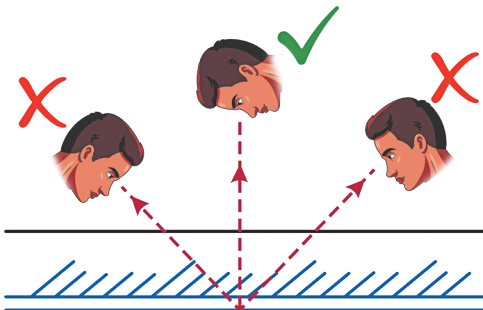
Some important points for measuring the accurate length

Correct Position of the Ruler:

- The object whose length is to be measured must be in direct contact with the ruler.
- The ruler should be held such that its starting point (the 0 mark) aligns with the beginning edge of the object.
- While measuring the distance between two points, place the starting point of the scale on the first point and observe which mark on the scale aligns with the second point.



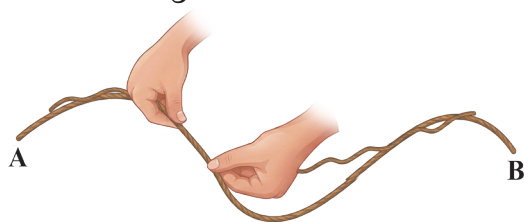
- If the zero mark or the starting point of the ruler is not clear or if the ruler is broken at that end, start measuring from the next clearly visible number. By subtracting that initial number from the final reading, you can obtain the exact length of the object.



From which side the reading should be taken?

Can the circumference of a ball or a large jar be measured with a ruler?

The length of a curved surface can be measured using a thread.



◎ **Reference Point**- Playgrounds must be marked for sports competitions. Each sports field has a specific length and breadth. Your sports teacher uses a metre tape to mark the boundaries for each sport as shown in the adjoining picture.

Whenever a distance is measured, it is measured from a fixed object or a specific point. This point is called a '**Reference Point**'.

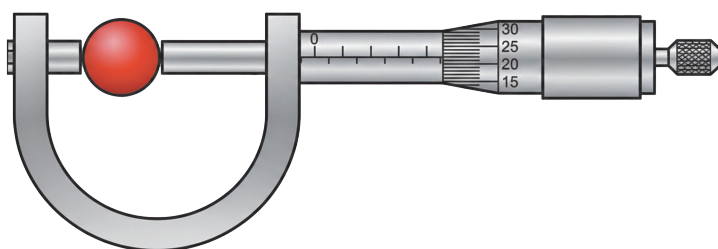
In the game of *Kho-Kho*, there is a fixed distance between two poles. While marking the field, the first fixed pole serves as the reference point for the second pole.



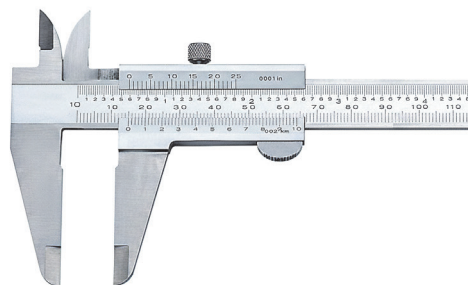
On highways connecting major cities, there are boards or stones (milestones) indicating the distance to the next big town. From which specific location in the town is the distance measured? Collect the information.



While measuring the length and breadth of a playground or the length of a shirt, the difference of one or two millimetres is acceptable. While manufacturing parts of a machine that match and fit together perfectly, their length and thickness must match accurately as per the requirement. For this, one must make accurate measurements up to much smaller range than a millimetre. Special instruments are used for such measurements. The factories that produce machinery need such precise and exact measurements. Such instruments are mainly used in industries.



Screw Gauge



Vernier Caliper



Think.

Which units will you use to measure the length of a classroom, a handkerchief, a saree and a playground? Which instruments will you use to measure the thickness of a notebook, a newspaper and a pencil?

Temperature and Thermometer –

Surabhi did not come to school one day, as she was not well. After school was over, *Jiya* went to her house to meet her. *Surabhi* told her that she is feeling feverish. *Jiya* touched *Surabhi*'s forehead with her hand and felt that it was quite warm.



After a short while, the doctor arrived. He measured her temperature using a thermometer. He said, “Yes, she is having fever”.

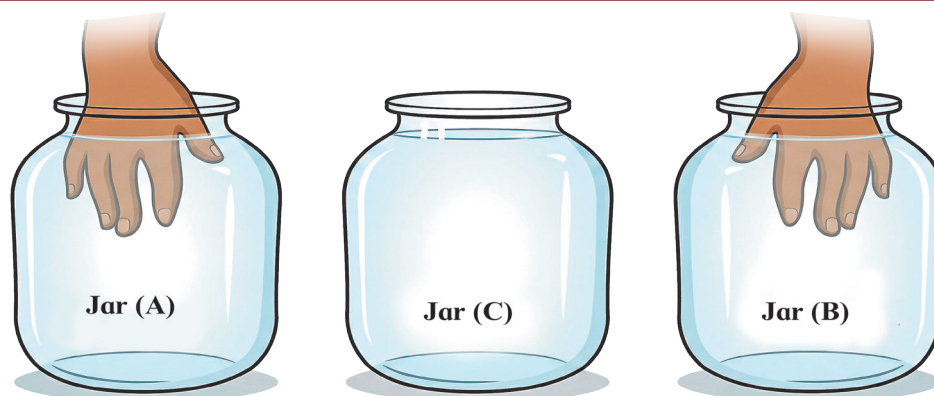
We often touch an object with our hands to determine whether it is hot or cold. We check the warmth of water taken for a bath. We can sense if a vessel of milk taken from the fridge is cold. However, temperature estimated by different people can vary.





Try this.

- (1) Take three jars of glass or plastic. Label them as A, B and C.
- (2) Fill jar 'A' with hot water as you take for bathing and fill jar 'B' with cold water.
- (3) In bowl 'C', transfer one cup of water from jar 'A' and one cup from jar 'B'.
- (4) Dip your right hand in the water of jar 'A' and your left hand in jar 'B' for a short while.
- (5) Now, dip both your hands into jar 'C'
Decide whether the water in jar 'C' feels hot or cold to your right hand. Does that same water feel hot or cold to your left hand?



Relative Sensation

An object that feels cold to one person may feel warm to another. That is why a thermometer must be used to measure the accurate temperature.

We can infer how hot or cold something is by touch, but that is not a measurement of temperature. You cannot know what is the exact temperature, without measuring it. Therefore, a separate instrument is needed to measure the temperature. A thermometer is the device used for this purpose. Temperature is measured in units of Celsius or Fahrenheit.

To check our body temperature, a thermometer with a range of 35°C to 42°C is sufficient. The thermometers required in the laboratory can measure the temperature of boiling liquids or steam. For that, a thermometer ranging from 0°C to 110°C is convenient. When you have a fever due to illness, doctors use a small thermometer to check your body temperature. Such a thermometer is called a clinical thermometer or a medical thermometer.

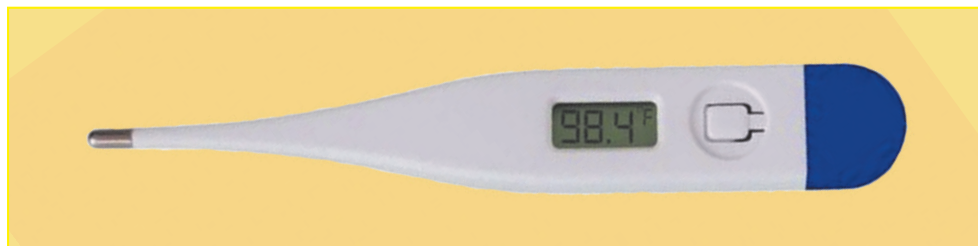
The thermometer shown in the adjoining picture was used for many years to measure the body temperature. It was difficult to determine the exact temperature by looking at the level of mercury and the markings for many people. Nowadays, a thermometer that shows the temperature as a digital number is used. This is called a digital thermometer.



Clinical Thermometer



◎ **Digital thermometer** - Have you seen the thermometer shown in the picture? This is called a Digital thermometer. It operates on a small button cell. This thermometer can measure temperatures from 35 °C to 42°C. The normal temperature of a human body is approximately 37°C. These thermometers are designed to show the temperature in units either Celsius or Fahrenheit, depending on the need.



How to measure body temperature using a digital thermometer?

- (1) Wash your hands thoroughly with soap and water.
 - (2) Press the reset button on the thermometer. Then, place the tip of the thermometer in the armpit so that it touches the skin.
 - (3) Wait until you hear a beep sound. Take the thermometer out and note the temperature reading.
 - (4) Clean the tip of the thermometer and wipe it dry with a clean cloth.
- Use such a thermometer to check the body temperature of your friends or family members.

◎ **Infrared thermometer** - If a person suffering from a contagious disease enters a crowded area, others can get infected by that disease. Such epidemics spread very rapidly. Places like malls and airports are very crowded. Due to massive crowds, it becomes difficult to check everyone's temperature individually. To avoid this problem, there was a need for a device that could read a person's body temperature quickly without touching.



A device held at a short distance from the face can quickly determine a person's body temperature. Such a device is a different type of Thermometer. It works using Infrared rays. Therefore, it is called an '**Infrared thermometer**'. Nowadays, it is used in many crowded places.

During the COVID-19 pandemic, these thermometers were used worldwide to identify people with fever. It is a great convenience that the body temperature of a person can be measured instantly from a distance using this thermometer.



Degree Celsius ($^{\circ}\text{C}$) is a unit used for measuring temperature. Fahrenheit ($^{\circ}\text{F}$) and Kelvin (K) are also other units used to measure the temperature. Kelvin is specifically used for experiments carried out for scientific research. The SI unit of temperature is Kelvin and it is denoted by the symbol K.

☉ **Laboratory thermometer-** A laboratory thermometer is used for experiments in a lab. As shown in the diagram, it consists of a long, narrow, hollow glass tube with one end sealed. At the bottom of the tube, there is a small bulb. This bulb is filled with mercury or coloured alcohol. A very fine capillary tube extends from this bulb to the other end of the glass tube. When the bulb receives heat, the volume of the liquid inside it increases. The mercury or alcohol expands and rises through the hollow tube. The temperature is recorded based on the mark where the liquid level stabilizes. These marks are usually on the Celsius scale. Observe a laboratory thermometer and record the following in your notebook:

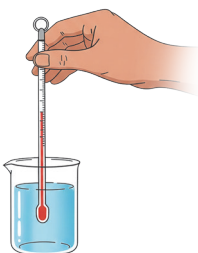
- (1) The lowest temperature mark on the thermometer: $^{\circ}\text{C}$
- (2) The highest temperature mark on the thermometer: $^{\circ}\text{C}$
- (3) Temperature measuring capacity of the thermometer: $^{\circ}\text{C}$ to $^{\circ}\text{C}$
- (4) Number of small divisions between two big marks:
- (5) Temperature difference between two adjacent small marks: $^{\circ}\text{C}$



Always Remember.

If the temperature difference between two big marks on a thermometer is 10°C and there are 10 divisions between them, then each small mark represents 1°C . Laboratory thermometers come with different ranges and different scales for small divisions. Before measuring temperature, one should observe the markings and determine what each small division represents. This is essential for recording precise and accurate temperatures.

The correct method of measuring temperature using a thermometer

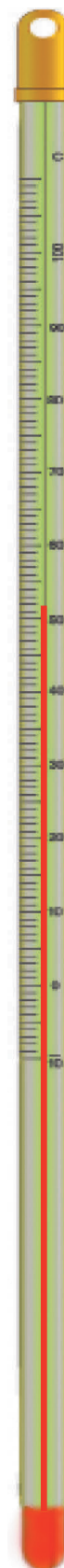


- (1) The bulb at the bottom of the thermometer should be in contact with the substance whose temperature is being measured. Only then, one can measure the temperature accurately.
- (2) While measuring temperature, the thermometer should ideally be held straight and vertical. Ensure that the bulb of the thermometer does not touch the bottom or the sides of the container.
- (3) To record the temperature accurately, hold the thermometer so that the level of the liquid in the tube is at your eye level.



? Think.

If you are standing on an open ground with a thermometer and you are not measuring the temperature of any specific substance, what temperature will the thermometer show? What should be done to measure the temperature of a leaf on a tree?



To measure the temperature of the air in a room, a thermometer that can be hung on a wall is used. By using this type of thermometer, we can determine the room temperature. Eventually, it indicates the temperature of the air within that room.

The India Meteorological Department (IMD) records temperatures at various locations daily. These records are used to formulate weather forecasts.

Every day, in newspapers and in television news, information regarding the minimum (lowest) and maximum (highest) temperatures of major cities in the country is provided.



• Introduction to Scientists

Anna Mani (1918–2001)

Anna Mani is known as the ‘Weather Woman of India’. She designed numerous instruments useful for weather forecasting. An instrument called a radiosonde is extremely useful for measuring atmospheric pressure, temperature, and humidity at high altitudes. Because of Anna Mani’s research, the use of such instruments began in India. She conducted her research work at the India Meteorological Department in Pune and Bengaluru. Because of her contributions, India’s dependence on other countries for weather forecasting was reduced.



What We Have Learnt?

- Measurement means measuring using the suitable tool. The unit in which a measurement is expressed is called the unit of measurement.
- In the past, different units were used at different places. Measurements taken by different people are not the same. Such measurements and methods are called non-standard measurement methods.
- Now a days, standard units are used for measurement.
- The SI unit of length is the metre.
- $1 \text{ km} = 1000 \text{ m}$ $1 \text{ m} = 100 \text{ cm}$ $1 \text{ cm} = 10 \text{ mm}$
- The fixed point from which distance or length is measured is called the reference point.
- A Thermometer is the instrument used to measure temperature.
- The units Celsius, Fahrenheit and Kelvin are used to measure temperature.
- In thermometers, mercury or coloured alcohol is used.
- Digital thermometers or infrared thermometers are used to measure body temperature.



Exercises

(1) Suggest appropriate words for the following blanks.

- (1) The instrument used for measuring temperature is called a
- (2) The normal temperature of the human body is.....
- (3) When measuring distance from a fixed point, that point is called the
- (4) 1 Metre = Centimetres.
- (5) In the glass bulb of a thermometer, coloured is filled.
- (6) The SI unit of temperature is.....

(2) Which instrument will you use for the following measurements? State the name of the appropriate instrument.

- (1) Length of a pencil or pen
- (2) Your own height
- (3) The girth (circumference) of a large tree trunk
- (4) The thickness of an eraser

(3) Find my pair

Group 'A'

- (1) SI unit of length
- (2) Unit of temperature used in research experiments
- (3) Measurement using a hand span
- (4) Red coloured liquid in thermometer

Group 'B'

- (a) Alcohol
- (b) Non - standard method of length measurement
- (c) Metre
- (d) Kelvin

(4) Write whether the following statements are true or false.

- (a) 1 km = 100 cm.
- (b) If a ruler and a measuring tape are used to measure length, the length of the table will be different.
- (c) Digital thermometer is used to measure the temperature of boiling water in a laboratory.
- (d) Errors in observation can lead to mistakes while recording temperature.
- (e) The accurate temperature of an object can be told just by touching it.

(5) Arrange the following units in the correct order from biggest to smallest.

- (a) 1 cm. (b) 1 km. (c) 1 mm. (d) 1 m.



- (6) What is the smallest length that can be measured using a ruler from a compass box?
- (7) Which unit will you use while measuring the following?
- (a) Length of a book
 - (b) Thickness of a key
 - (c) Distance between Nagpur and Mumbai
 - (d) Length of a cloth
- (8) Why there is a need of standard measurement tools?
- (9) Obtain information about the measurements used in earlier days in your area to measure distance, weight and volume.

◎ Projects -

- (1) Measure the lengths of the curved part of five different cylindrical items like a water bottle and record it.
- (2) Determine the thickness of a single page of a science textbook using the following activity:
 - Measure the total thickness of the entire textbook using a ruler from your compass box. Record the total thickness.
 - Divide the total thickness of the textbook by the total number of pages. The resulting answer will be the thickness of a single page. Record your answer.
- (3) When you see a bundle of a hundred notes tied together, use the same method to determine the thickness of a single note.
- (4) Make a model of a laboratory thermometer using materials like a plastic tube, coloured thread etc. Organize an exhibition of such models under the guidance of your teacher.



3

Let's Separate the Components



It was time for school. *Saina* was getting ready in a hurry to avoid being late. She filled her own bottle with water and started for school. Her mother stopped her and said, “*Saina*, look what you did in your rush! Unknowingly you mixed water into the oil bottle! We must not waste that oil. Now you will have to separate that oil from water. *Saina* replied, “I’ll do it after I return from the school” and she left for the school.

After the school was over, *Saina* returned home. Right there in front of her was the bottle where the oil and water had mixed! Two separate layers were visible in the bottle. They needed to be separated from each other. How can this task be done? What ideas can you think of? Try this at home. Take half a cup of oil in a bottle or a glass. Add half a cup of water to it. Try to separate using your own method. Note down what happened while separating the oil and water. Talk to your friends about it afterwards.



Why do two different layers of liquids appear in the bottle? Which of them is the oil layer and how will you determine that?



Try slowly pouring the liquid from the top layer into an empty container.

Is it possible to separate all the oil from the mixture this way? Try it two to three times.

Try to separate all the oil using a plastic tube or a needleless syringe. Think about what difficulties you faced during these attempts and why they occurred.

Find a large transparent plastic glass or bottle. Make a hole at its bottom using a nail.

Keep the hole closed with a finger and fill the container with the mixture of oil and water. As before, the two layers of the liquids will remain separate and distinct.





Now, hold this filled container slightly above another empty container. Remove your finger from the hole. Which liquid will start flowing out of the hole at the bottom first? When should you quickly place your finger back over the hole to stop the liquid from coming out? Which liquid will be in the top container and which liquid will be in the bottom container?



When two or more substances are mixed together, it is called a mixture. The substances that are mixed are called the components of the mixture. From the mixtures like *chivda*, *farsan* or *bhel*, the components can be easily picked out and separated. However, the components from many mixtures cannot be separated so easily. For that, certain techniques must be used. **By identifying the differences between the mixed substances, a trick or method can be planned that utilizes those differences. Such methods are called methods of separation.**



Try this.

Take some roasted peanuts or roasted chickpeas on your palm and rub them slightly. Spread them out on your palm and blow on them. Clean peanuts or chickpeas will remain in your hand. How do farmers use a similar method to separate grains from a mixture of dried leaves, chaff and grains?

© Winnowing-



Winnowing machine

If a mixture of grains and chaff is dropped from a height, the heavy grains fall straight down. The chaff and other light trash, being lighter in weight, are carried away by the wind. This same task can be done in less time by creating a strong flow of air using a large fan of machine.

The method of separating heavy and light substances with the help of wind is called **‘Winnowing’**.



☉ **Handpicking** - Small stones or pieces of trash found in grains can be separated by picking them out by hand after observing their shape and colour. This method is called '**Handpicking**'. This task is easy if the components to be removed from the grain are few in number. Similarly, while eating your tiffin during the school break, you use the same method to pick out the chilies from your vegetables.



☉ **Sieving** - Stones that are smaller in size than the grains can be separated by using a sieve. Grains cleaned in this way are then ground into flour. To separate the coarse particles (bran) from the flour, a sieve with even finer mesh must be used. Flour particles that are smaller than the holes of the sieve fall through, while particles larger than the holes remain on the sieve mesh. Therefore, when the components of a mixture of two solid substances differ in size, we can use this method for separation.

At a construction site, sand and gravel have accidentally mixed. Is it possible to separate the sand and the gravel? How is a mixture of coarse and fine sand separated from each other?



◎ **Filtration** - When a mixture consists of two solid substances and their particles differ in size, we separate them using an appropriate sieve. But what if the mixture consists of a liquid and an insoluble solid? In such cases they can be separated using a **strainer or sieve** with a very fine mesh.



Think.

While using a tea strainer, what is the state of the substance that remains on the strainer? What is the state of substance that falls through?

If muddy water is filtered through a cloth or a tea strainer, do we get clean water?

In the laboratory, there is a special type of paper called filter paper. This paper is actually a mesh of extremely microscopic pores. Substances like muddy water or buttermilk can be filtered using this filter paper.



Use of filter paper





Think.

During an epidemic, why should we wear a mask and cover our nose and mouth while travelling in crowded vehicles or visiting hospitals?



Do You Know?

After harvesting some crops, the leftover straw is often burnt. Scientists at the Energy and Resources Institute in Delhi have created a curtain with very tiny pores on it using the ash left over from burning crop straw. It is used like a filter to clean industrial wastewater.

◎ Sedimentation and Decantation-

If muddy water in a glass is left undisturbed for a long duration, the soil particles settle at the bottom. If that water is carefully poured into another glass, clean water is obtained. The soil remains behind. The process where insoluble, heavy solid particles settle at the bottom is called '**Sedimentation**'. By tilting the vessel, the liquid can be slowly poured out. This is called '**Decantation**'.



Always Remember.

Sometimes during the rainy season, muddy water comes through the taps. Such muddy water is cleaned using alum. If a piece of alum is partially dipped in a muddy water and is swirled 4 to 5 times a small amount of alum dissolves in it. These alum particles stick to the soil particles. Because these combined particles become heavier, they settle to the bottom of the vessel more quickly.

◎ Churning - When curd is churned for some time using a churner (ravi), butter starts floating on the buttermilk. Churning the curd pushes the butter particles to the edges of the vessel. They stick together to form a large lump of butter. Since butter is fatty and light, it floats on the buttermilk and can be separated. Just like a hand-operated churner, machine-operated churners are also used for this process.

In large dairies, different methods of separation and modern machines are used to separate cream from milk. Similarly, in blood banks, machines are used to separate components of blood. Here machines that rotate the liquids at very high speed are used.



◎ Evaporation -



Try this.

Take a little water in a saucer. Dissolve a spoonful of salt in it to prepare a salt solution. Now, place this saucer in the sun. Over a day or two, the water in the saucer gradually decreases. The liquid in the mixture turns into vapour and the salt is left behind in the saucer in its solid state.

Srushti kept her saucer in the shade, *Yash* kept his saucer in the Sun and *Sanskriti* kept her saucer in a window with a constant breeze. In whose saucer dry salt will be collected first? Why?

The process of a liquid turning into a gaseous state due to heat is called '**Evaporation**'. This method is used worldwide to obtain the salt. No extra fuel needs to be burnt. Solar energy is used for this purpose.



Sea water is collected in salt pans along the coast. With the help of sunlight, the water evaporates and salt remains behind. This raw salt also contains stones, dirt and other impurities. Pure salt is obtained by using various other methods of separation. There are many salt pans in Maharashtra, Gujarat, Tamilnadu and Rajasthan, which provide us with salt.

◎ **Magnetic Separation** - Metals like iron, cobalt and nickel are attracted towards the magnet. These are called '**Magnetic Substances**'. By using a magnet, we can separate magnetic substances from non-magnetic. Iron, cobalt and nickel are used in the manufacturing of many items. In the waste collected from large towns and cities, these magnetic materials are separated with the help of magnets.



? Think.

Why is it necessary to separate magnetic material from garbage collected in large quantity?



• Introduction to Scientists



Padmashri Dr. Uddhab Bharali is a worldwide renowned Indian inventor. He has received numerous national and international honours and awards. In 1988, while his family was facing a financial crisis due to loans, he decided to start a small factory to make plastic bags for tea gardeners in Assam. At that time, instead of purchasing a foreign machine worth 5.5 lakh rupees, he developed a new machine himself for just 60,000 rupees. Since then, until the year 2015, Dr. Bharali has created more than 160 useful machines and tools for agriculture, industry and persons with disabilities. Notable inventions include machines that peel fruits and separate seeds and tools that extract pomegranate seeds, which are particularly important for large factories. Along with many other awards, Dr. Bharali received an international award from the world-famous organization NASA in the 'Technology of the Future' competition. Dr. Bharali has also started a special center for the research and creation of various machines.

What We Have Learnt?

- Separating mixed substances from a mixture is called separation.
- By identifying the differences in the properties of the substances in a mixture, a trick to separate them can be found. Such tricks are called methods of separation.
- In the handpicking method, substances in a mixture are picked out and separated based on their colour and shape.
- In fields, the method of winnowing is used to separate light substances from heavy solid substances with the help of the wind.
- The method of separating small particles from a mixture with the help of a suitable mesh is called sieving.
- Through filtration, we can separate solid substances that are not dissolved in a liquid.
- The process where heavy, insoluble solid particles in a liquid settled at the bottom is called sedimentation or decantation.
- The process of converting a liquid into a gaseous state is called evaporation.
- Sea salt is obtained by the evaporation of seawater.
- Magnetic substances in a mixture can be separated using a magnet.



Exercises

(1) Choose the correct option.

- (1) In magnetic separation, is used.
(a) difference in density (b) difference in size
(c) magnetic property (d) solubility property
- (2) To separate small stones from wheat, the method is useful.
(a) threshing (b) handpicking (c) winnowing (d) sieving
- (3) Alum dissolved in water can be separated using the method.
(a) evaporation (b) sedimentation
(c) filtration (d) decantation
- (4) There is a doubt that water is mixed with milk. Separating the milk and water will be possible through method.
(a) filtration
(b) evaporation
(c) sedimentation & decantation
(d) not possible by any of these methods.

(2) State whether true or false. If false, state why.

- (1) The filtration method is used to separate substances that are not dissolved in a liquid.
 - (2) Using magnetic properties, all metals can be separated from garbage.
 - (3) The sedimentation method is used to separate salt from seawater.
 - (4) The winnowing method is used to separate lightweight debris from grains.
 - (5) The decantation method can be used to separate two liquids, one heavy and one light.
- (3) For which type of mixture is the filtration method useful and how?
- (4) How will you separate sawdust mixed in a container of water?
- (5) While working, a carpenter finds that iron nails have mixed with sawdust. Which different methods can the carpenter use to separate them? Which of those methods is the easiest?

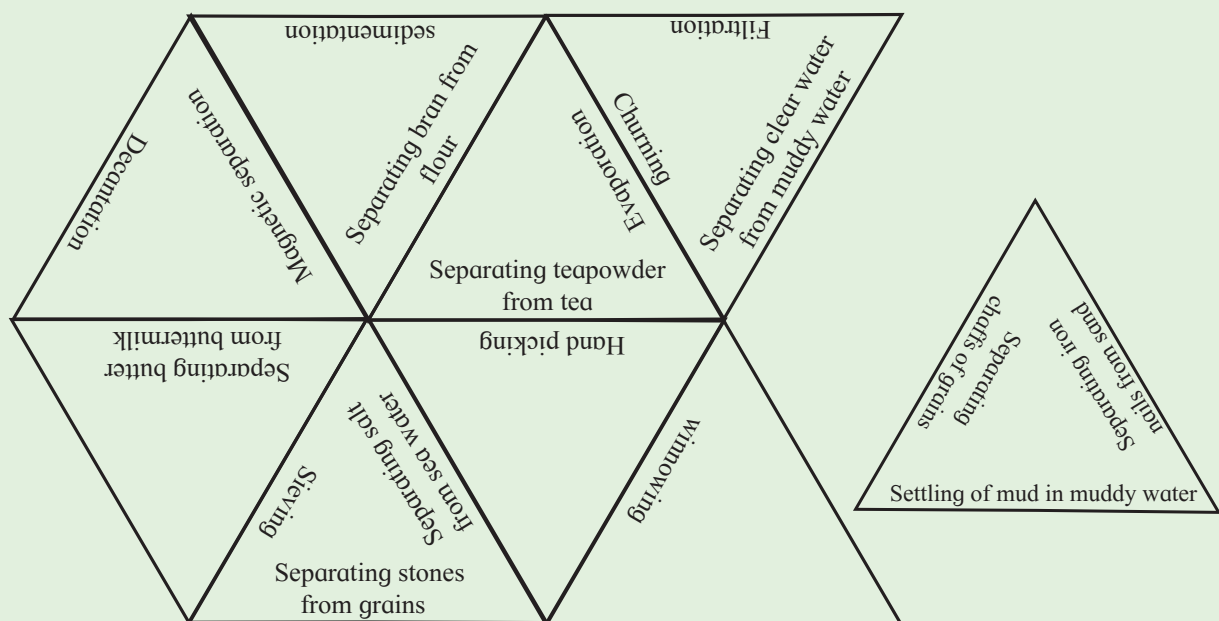


- (6) In the word search below, some words related to separation are given. One example, has been circled for you. Find all such words in the word search and write them down.

s	e	d	i	m	e	n	t	a	t	i	o	n	a	a	b	b	c
p	q	r	s	h	t	u	v	w	x	y	a	k	l	m	n	o	p
o	t	u	v	n	a	b	c	d	e	f	g	h	i	j	k	l	m
x	y	z	w	w	i	n	n	o	w	i	n	g	n	o	p	q	r
p	q	r	s	t	u	v	d	e	c	a	n	t	a	t	i	o	n
h	i	j	k	l	m	n	n	p	q	r	s	t	u	v	w	x	y
a	b	b	c	c	d	d	e	s	i	e	v	i	n	g	a	b	c
n	o	i	t	a	r	a	p	e	s	c	i	t	e	n	g	a	m
p	r	t	v	x	z	b	d	f	g	i	k	k	m	o	r	t	v
a	b	c	d	e	v	a	p	o	r	a	t	i	o	n	a	b	c
f	g	h	i	f	i	l	t	r	a	t	i	o	n	j	k	l	m
n	o	p	q	r	s	t	c	h	u	r	n	i	n	g	u	v	w

Project -

Cut out nine triangles from paper. Copy the puzzles shown below onto them. Sitting in a group, arrange these nine triangles in such a way that they form one large triangle and every separation method written on a side faces its correct example. Try to solve this puzzle by sitting together.



4

Diversity in Living Organisms

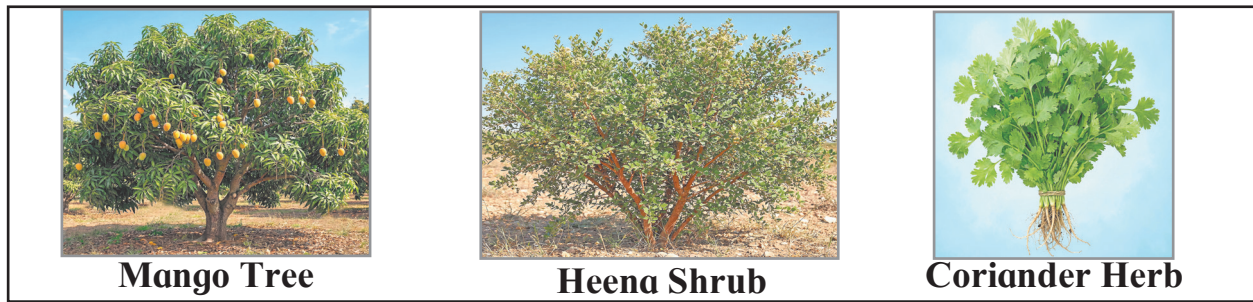


This is not a photograph of a forest. This is actually a huge single tree! This is a 250-year-old banyan tree located in the Botanical Garden at Kolkata. It stands supported by more than 3,500 thick aerial roots that have reached the ground. Foreign tourists frequently visit this garden in Kolkata to see this colossal tree. In 1925, the main trunk of this tree had to be removed, yet the tree has continued to grow. The world's most massive Banyan tree is located in Andhra Pradesh. Ten thousand people can sit in its shade at a time! What an incredible expanse!

Can the shrubs along the road in the photograph grow as large as this tree? Do shrubs like *holy basil*, rose or *karvanda* grow as tall as *neem* or tamarind trees? We have seen many large trees that grow very high. However, several plants like rose, oleander (*kanher*), hibiscus and *heena* (*mehendi*) only grow to a height of 5 to 6 feet. We call them shrubs. Some types of grass grow taller than a human, while others remain very close to the ground. Look at the moss-like plants that grow on wet walls during the rainy season; they don't have branches, no roots and no flowers. The algae growing on wet floors is even smaller. If you look at the plants around, you will realize the immense diversity which exists in nature such as huge trees, tall palms like coconut, various types of shrubs and grasses etc.

There are some plants that cannot be seen with the naked eye; they can be only seen through a microscope.





Make a list of the following types of plants found in your surroundings.

- Trees with strong trunks and branches that are sturdy enough for people to climb.
- Shrubs, whose branches grow close to the ground and are not very thick or strong.
- Plants that have no branches, but the trunk grows very tall with leaves located at the apex.
- Plants with very weak stems which cannot stand upright. These plants wrap their green stems around nearby trees or some support.

Vines that grow upwards by wrapping around a support or by using spring-like parts (tendrils) to grip it are called climbers. Have you seen vines and grasses like *harali* that spread across the ground instead of growing upwards? Such plants are called creepers.

When we think of plants, we usually think of their parts like roots, stems, leaves, flowers and fruits. There is diversity in all these aspects among the plants around us.

Observe the leaves of different plants. What differences do you notice in their size, shape and edges?



Diversity in Leaves

Which plants in your area have leaves like these? Have you seen any other types of leaves with different characteristics? Draw pictures of them. Write down as many names as you can for each type. Collect as many different leaves as you can. Play a game in your friends group to identify which plant each leaf belongs to.



Gently run your finger over each leaf to determine if it feels smooth or rough. Make a list of the various aspects in which you see differences—such as size (small or big), the stiffness of the leaf, the veins visible on the leaf, the leaf margins (edges) and the length of the leaf stalk. This difference is called diversity.

Some plants never bear flowers, some plants bloom only in specific seasons, while some flower throughout the year. There is diversity in the shapes, colours, number of petals and the arrangement of flowers on the stem. Draw pictures of different flowers and write the name of the plant to which the flower belongs and shows this diversity.

Some flowers have a pleasant fragrance, while the smell of some flowers is unpleasant.



Diversity in some flowers



Observe.

Do plants like holy basil, mango or sugarcane bear flowers? What do you think? Observe them and collect information.

Fruits are formed from flowers. Fruits contain the seeds of that plant. How many seeds are found inside fruits like mango, *jamun* or *bor*? On the contrary, fruits like oranges, lemons and jackfruit contain many seeds. Plants show a great diversity in terms of the shape, colour and taste of their fruit, the number of seeds they contain and the thickness of the fruit's skin (peel).

- Which fruits do you know that have more than 20–25 seeds in a single fruit?
- Do you know any fruits that do not have seeds ?



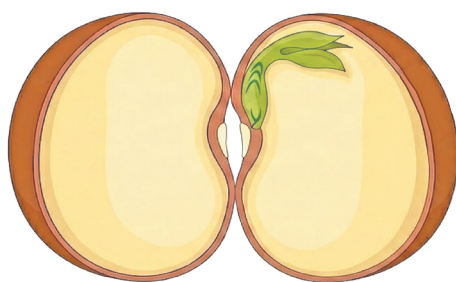


Do You Know?

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In Kashmir, many varieties of rose plants are found. Some of them are small shrubs, while others spread over fences and walls like vines. In some of these varieties, the rose plants even produce rose seeds.

Grains of wheat, rice, jowar, corn and bajra are all seeds of those respective plants. Similarly, chickpeas, peas, mustard and groundnuts are also seeds. Collect a few seeds of each of these types. Give each seed a light tap to open it. See if it splits into its parts. Observe which seeds divide into two equal halves and which ones break into unequal pieces. Now, soak the intact seeds in water for a day. Afterwards, remove the outer seed coat. You will notice that some seeds naturally have two equal parts. Seeds which possess two equal independent parts are called dicotyledonous seeds. 'di' means two. Seeds that have one such independent part are called monocotyledonous seeds.



Dicotyledonous



Monocotyledonous

☉ **Venation-** If a peepal leaf is kept in water for a few days, its soft part rots away. Eventually, only a net-like skeleton remains. What do you think this 'web-like network' is made of? If leaves of peepal or teak are left in water for a few days, you get this kind of net. However, leaves of other plants like holy basil and chrysanthemum do not form such a web-like network even if kept in water. Why there is such a difference? Guess.

The water absorbed by the roots of the plant reaches all parts of the leaf. Could there be a connection between this process and the web-like network of the leaf?





Try this.

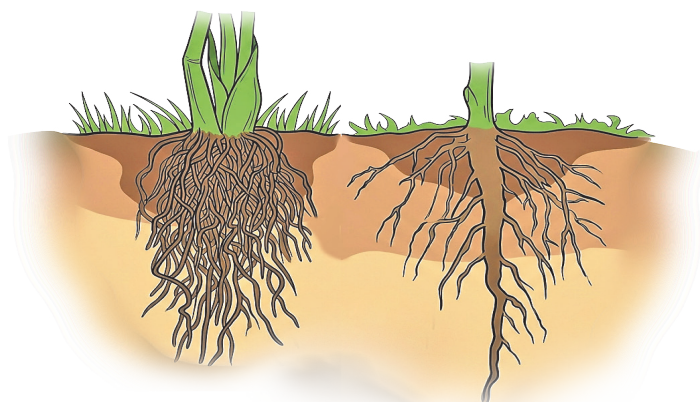
Take a few leaves of mango, banyan and peepal. Hold one leaf in your hand and using your fingers, try to tear it in a perfectly straight line from the outer edge toward the center. Try this with a few more leaves.

Now, take a leaf of a banana or canna (*kardali*) plant. Try to tear it from the edge to the center in the same way. This time, the leaf should get torn in an uneven pattern easily. Try this repeatedly. What happened in these two activities? Why?

Leaves that have a complex network of veins do not tear along a straight line. Whereas leaves in which the veins are parallel to each other—like the ruled lines on a notebook page—will not tear unevenly. The arrangement of veins inside the lamina of a leaf is called '**Venation**'. There are two types of venation: **Reticulate Venation** and **Parallel Venation**. You can guess the type of venation just by looking at the leaf. Based on this, determine what kind of venation is found in the leaves of sugarcane, jowar and wheat.

● **Roots** - The roots of plants grow underground in the soil and are usually not visible from outside. However, we can see the roots of leafy vegetables available in the market or sugarcane and jowar-bajra stalks pulled out for animal fodder. Observe the roots of such plants carefully.

- When a strong storm occurs, standing crops like jowar and bajra, as well as coconut trees bear heavy damage. Such trees can be uprooted by strong winds. However, trees like tamarind, mango and *jamun* do not collapse so easily.
- If you pull grass or sugarcane with a little force, they come out with their roots. However, saplings of roselle (*ambadi*), okra (*bhendi*) or eggplant (brinjal) are not uprooted so easily. A root system where a main primary root grows from the base of the stem, with secondary and smaller branches growing off it is named as '**Tap root**'. Roots that grow like a bunch of threads from the base of the stem are known as '**Fibrous roots**'.



Which of these roots can provide a firm support to the plant?



Wheat, rice, jowar, bajra and corn are monocotyledonous plants. Is the venation in the leaves of these plants parallel or reticulate? What type of roots do they have? One very important thing can be observed from these findings:

All monocotyledonous (monocot) plants have fibrous roots. The venation in all these plants is parallel. Reticulate venation and taproots are characteristic features of dicotyledonous (dicot) plants.

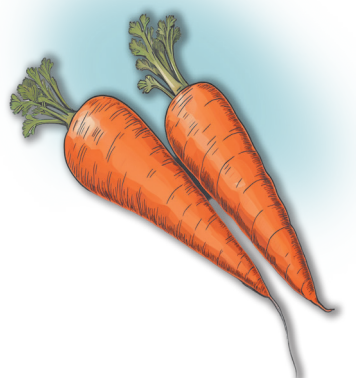
Now, decide whether banana and sugarcane are monocots or dicots. Are banyan, holy basil and mustard plants monocotyledonous?



Do You Know?

The functions of roots are to provide support to the plant and to absorb moisture and minerals from the soil. In some plants, roots also perform the task of storing food prepared by the plant. This arrangement is found in certain specific plants.

Root hairs, which look like fine threads, absorb water from the ground and supply it to the plant. These are part of the roots. Sprouts grow from the buds on potatoes and some other tubers. These are the parts of the stem.



Some plants floating on the water of rivers and lakes grow very rapidly. They spread so densely over the water surface that one cannot even see water beneath them. Would plants like lotus or aquatic grass grow in the soil?

Will plants that grow in extremely cold, snowy regions like the Himalayas survive in a desert?

The environment that is convenient and favourable for a plant's growth is called its habitat. The habitat of the lotus plant is aquatic (water). On the other hand, the habitat for plants like acacia and cactus is arid, meaning areas with very little water or desert regions.

Desert plants cannot survive in snowy regions and likewise, plants from snowy regions do not grow in the desert.

A habitat is influenced by many factors, such as soil type, temperature, the total duration of sunlight available during the day and other living organisms present in the vicinity.



☉ Try this game -

Everyone in the class should be ready with a pen and paper. When the teacher taps a spoon on the table, everyone must write down the names of fifteen animals. After three minutes, the teacher will tap the table again and you will stop writing. Then, each student will read their list loudly. Note down which animal names appear frequently and write unique names on the blackboard.

Once a comprehensive list is prepared on the blackboard, look for answers to the following questions.

- Which animal names were written by almost everyone?
- Think about how many legs each animal in the list has. How many four-legged animals did everyone remember? Which animals in the list have less than four legs, and which ones have more than four?

Ramesh was reading his list. When he said “Crow”, everyone in the class laughed. Someone said, “Hey, a crow is a bird! Why is it in the list of animals?” When Sushama mentioned a Mosquito in her list, they laughed again, saying, “That’s an insect, not an animal.”

What do you think?

Looking at the names on the board, you will realize that when most people think of animals, they only think of four-legged animals like cows, buffaloes and dogs, or perhaps elephants, tigers and lions. However, names like bat, cockroach, earthworm or termite are rarely seen in such lists.

Actually, all of these are animals. ‘Animals’ and ‘Plants’ are the two major groups of living organisms. Microbes in river or lake water, tiny insects, birds, and reptiles are all animals. While there are differences between them, there are similarities too. We have seen some animals and we know some animals even though they don’t live in our local environment. We know about giraffes, kangaroos and ostriches, but they are not found everywhere. Only the animals that can adapt to the surrounding environment are found in a particular region. That region is their habitat.

Bears in the snowy Himalayan regions live there by adapting to the local conditions, available food and the cold. It would be difficult for them to survive in our local forests. The same applies to giraffes, kangaroos and ostriches. The environment where an animal can live comfortably is its habitat. The desert is the habitat for camels, while the areas near large water bodies are the habitat for crocodiles and alligators.

The habitats of different animals depend on the local temperature, available food and other animals in that area.



Do You Know?

In some countries, buffaloes are kept in large zoos. Many people pay money to visit there and see them! What could be the reason for this?



◎ **Some habitats and animals found there** - Many animals around us live on land. You can think of many names like tiger, goat, fox and wolf. Animals like mice, bandicoots, shrews and rabbits live in burrows. **All animals that live on land are called terrestrial (Bhuchar).** In Marathi, 'Bhu' means land and 'Char' means one who moves; hence, those who move on land are *bhuchar*. These animals move in various ways—such as walking, running or jumping.

Fish spend their entire lives in water. They swim using the fins and tails. They take oxygen dissolved in the water through their gills. They cannot take oxygen from the air directly. Animals that live their entire lives in water are called Aquatic. Some animals spend one stage of their life entirely in water and later can live both on land and in water. **As they live in both places, they are called Amphibians.** They can stay underwater for a long time, but to breathe oxygen, they must periodically poke their noses out of the water to take in air.

Birds spend much of their time on trees or flying in the sky. Therefore, they are called Aerial.

After making detailed observations and the relationships among different observations, in ancient times *Maharshi Charak* gave a classification system in his script '*Charak Samhita*'. He has described classification of animals and their characteristics not only based on the animals living on the land, but also those living under ground (*Bilashaya*), living on dry lands (*Dhanvachara*), wild buffaloes living in muddy wetlands (*Aanup*), living on branches of trees (*Shakhad*), animals like fish living in water (*Varishaya*), birds, like swans floating on the surface of water (*Varichara*) and animals living in caves (*Guhashaya*).

- **Do the elephants in India look the same as elephants from the African jungles? Are bears in snowy regions the same as the bears we know or are they slightly different?**



Do You Know?



Camel in the Desert



Camel in Ladakh

- Desert Camels have long legs. This keeps their bodies high above the hot sand, preventing their bellies from getting burnt by the heat. In contrast, Camels in snowy regions like *Ladakh* have shorter legs. Their feet are broader, which allows them to walk easily through the snow. The thick hair on their necks and bodies keeps them warm and prevents accumulation of snow on them.
- River and lake water contains particles of soil and dried leaves. To prevent these particles from entering their eyes fish have a transparent membrane (nictitating membrane) over their eyes.



What We Have Learnt?

- Roots, stems, Leaves and flowers are the various parts of a plant.
- Plants are classified according to characteristics such as height, the nature of the stem, the shape of the leaves, the number of cotyledons in the seeds, the presence or absence of flowers and the type of roots.
- Trees, shrubs, herbs, climbers and creepers are groups of plants based on the types of their stems.
- Based on the number of cotyledons, plants are of two types: monocotyledonous and dicotyledonous.
- There are two types of leaf venation: reticulate (net-like) and parallel.
- A plant can be identified as a monocot or a dicot based on its leaf venation and its root type.
- Different animals and plants are found in environments that are favorable to them. These environments are called their habitats.

Exercises

(1) Match the following correctly.

Group A	Group B
(1) Aquatic	(i) Frog
(2) Living in muddy wetlands	(ii) Swan
(3) Amphibian	(iii) Wild buffalo
(4) Floating on the surface of water	(iv) Fish

(2) Find the odd one out and give reason for the same.

- (a) Cow, Horse, Goat, Fish
- (b) Mango, Peepal, Guava, Coriander
- (c) Kangaroo, Cheetah, Cockroach, Deer.
- (d) Moong, Jowar, Wheat, Bajra



(3) Write True or False.

- (a) *Heena (mehendi)* is a type of shrub.
- (b) Trees with taproots collapse easily in a light storm.
- (c) Mango trees do not bear flowers.
- (d) Polar bears live in the desert.
- (e) Some species of snakes are amphibians.

(4) Observe the relationship in the first pair and complete the second pair.

- (a) Living on branches of trees : Monkey :: Living underground :
- (b) Living on dry lands : Horse :: Living in caves :

(5) Look at the following pictures carefully. What information do you understand about these plants? Note down all points in your notebook.



- (6) Which characteristics would we consider to determine if a holy basil plant is a tree, a shrub or a herb?
- (7) Explain the difference between monocotyledonous (monocot) and dicotyledonous (dicot) plants.
- (8) What is the habitat of a duck and why?
- (9) Observe any five animals in your surroundings and determine their habitat.

© Project -

Due to changes in the surrounding environment, it becomes difficult for some animals to survive there. Their numbers start decreasing. Collect the information and pictures of some animals in Maharashtra that are at risk of disappearing (endangered species) and write it down in your notebook.



5

Disaster Management



- September 30, 1993 : At 3:50 AM, people were fast asleep. An earthquake struck at a small village 'Killari' in Latur district due to movement of rocks deep underground. **The Earth Surface in that area shook for two minutes, causing 150,000 stone and mud houses to collapse. About 10,000 villagers were buried under the debris and lost their lives.**

- December 26, 2004: Around 7:00 AM, an earthquake on the ocean floor of the Indian Ocean triggered a massive Tsunami. Giant waves hit the coasts of 14 countries. Roads, buildings and entire cities were submerged. **Over two lakh twenty thousand people died and the loss of animals and trees was immeasurable.**



- December 3, 1984 : A poisonous gas leaked from a factory in Bhopal in India through a huge tank where a poisonous chemical was stored. The gas spread out for miles in minutes. People suffered from breathing difficulties, suffocation and burning of eyes and they ran to save their lives. Similarly living animals and birds were breathless. In the first 2 hours, 40 tonnes of poisonous gas got mixed up in the air. Thousands of people died within an hour. **Survivors still suffer from long-term health issues.**

- **Cloudbursts:** This is an unpredictable, extreme weather event where it rains so heavily in a short time that it feels like a dam in the sky has burst. These floods wash away villages and forests in minutes, leaving only mud behind, no traces of a village remain behind. This flood moves towards other villages. What would have happened to the houses, schools and the villagers over there?



These are examples of sudden calamities. Other disasters include major train accidents, river floods and massive forest fires. A sudden calamity that causes large-scale damage to life and property is called a '**Disaster**'.



Some disasters occur due to events happening in nature. These are called **‘Natural disasters’**. For some disasters, we can make arrangements in advance to avoid them. However, one can not avoid certain disasters. In such cases, it is essential to always be ready to face them and to ensure that necessary help reaches the required place on time. The planning, preparation and actions taken for this purpose are called **‘Disaster Management’**.

Some natural disasters

☉ **Earthquake** - Movement of deep underground rocks causes the earth to shake; this is called an **‘Earthquake’**. A huge amount of energy is released from the earth's interior. The point where this energy is released somewhere in the earth crust, is called the **‘Epicenter’** of the earthquake. This movement occurs due to cracks in the rock layers or due to weak sections in the crust. Sometimes these movements are so intense that they cause buildings to collapse, producing deep cracks on the ground and resulting in a massive loss of life and property.



The intensity of the earthquake can be low or high. The machine which records the intensity of earthquake is known as a **Seismometer** and **it is measured in ‘Richter Scale’**. An intensity of 9 Richter Scale can destroy entire cities.

If an earthquake’s epicenter is on the ocean floor?



If an earthquake’s epicenter is on the ocean floor, massive waves are created. These waves, appearing like walls of water, travel at high speeds and cause total destruction when they hit the coast. This is called a **‘Tsunami’**. These waves barge in and can sweep far inland and cause a lot of damage.

What to do and what not to during an Earthquake:

Do's	Don'ts
- Stay calm. Do not panic - Take shelter under a sturdy table or bed. Cover your head and neck with your hands. - Take shelter at safe place until the vibrations due to earthquake stop. If outdoors, stay in an open area away from buildings. - Check the condition of the building before re-entering. - Provide First aid to the injured people.	- Running in a panic. - Use of elevators (lifts). - Standing near windows, mirrors or heavy furniture. - Believing rumours. - Spreading rumours.





? Think.

Cables that provide electricity to cities and pipes that supply water are often placed underground. If an earthquake occurs, will these cables and pipes remain intact? What will happen to bridges, roads and railways? After a major earthquake, can the flow of a river change? Do earthquakes affect the natural springs that bring water into wells and bore wells?

Effects of an earthquakes

- Many houses and buildings collapse.
- Roads and bridges are destroyed, making it difficult for rescue and relief to reach the affected areas.
- It is difficult to take the injured to hospitals. Electricity cables snap, cutting off power.
- Finding where underground cables or pipes have broken is a painful and difficult task.
- Railway tracks become twisted and bent. The course of a river may change, which can lead to floods in some areas and droughts in others a double disaster.

☉ **River Floods** - Villages located on the banks of a river face a high risk of flooding. A river flows a long distance from its source. If it rains heavily in any part of its catchment area, the river overflows. This causes significant damage to downstream villages and farms. If the flood is exceptionally large, it is called a heavy flood. Why do floods or heavy floods occur?

(A) Natural Causes-

- Due to excessive rain or a cloudburst, a massive amount of water suddenly flows onto the land in a short time. This results in floods. Massive amounts of water enter rivers when snow on mountains melts. This creates flood-like situations along the riverbanks. Because of this, rivers originating in the Himalayas often flood during the summer. Massive hailstorms and extreme rainfall are other natural disasters which cause heavy damage.

(B) Man-made Causes-

- Building houses or roads by filling in riverbanks causes the river water to spread elsewhere.
- Dam burst due to lack of maintenance of large dams.
- In urban areas, failing to clean drains regularly and improper disposal of plastic waste causes drains to clog, creating flood-like conditions in cities.

Floodwater entering houses, water flowing over roads and people getting stranded are common difficulties. Rescuing trapped individuals becomes very hard. For such situations, having small boats, long ropes, food, drinking water and medicines ready is essential. This preparation, along with training brave rescue teams, is what we call Disaster Management.



☉ **Storm** - When air pressure in a particular area decreases for some reason, winds begin to blow rapidly from high-pressure areas toward the low-pressure area. This creates a storm. Storms formed over the ocean move towards the land. A cyclone is a type of storm that originates over the ocean and is extremely destructive.



Effects of Storm-

- (1) Tremendous loss of life and property.
- (2) Huge damage to agricultural crops and fruit orchards.
- (3) Large trees and electric poles collapse, causing disruptions in power supply and communication.

Nowadays, large storms can be predicted in advance. Information about them is shared through radio, TV and newspapers. Warning instructions are also issued through mobiles, These should never be ignored.

What to do during a storm	What not to do during a storm
- Take shelter in a safe place. - Close all doors and windows. - Listen to instructions from the Meteorological Department. - Stay away from electric wires and trees. - Keep essential items like drinking water and some food with you.	- Spreading rumours. - Believing in rumours. - Going into water or near riverbanks. - Standing under trees or near electric poles. - Stepping out of the house during the storm.



Think.

What should farmers do as soon as they receive weather department alerts regarding storms or heavy rain?

Forest Fires-When dry branches of trees in a forest rub against each other, a fire breaks out. It spreads very rapidly to the surrounding areas. Such a fire in the forest is called a 'Forest Fire'. Forest fires destroy trees, shrubs, and even animals and birds. They cause large-scale destruction of plant wealth. Incidents of thousands of acres of forest burning down in fires occur frequently in many countries.

Have you read news about forest fires that could not be brought under control for many months, even after using helicopters, planes and modern machinery?





Do You Know?

The 2025 California forest fire was one of the most devastating in the world. Numerous helicopters, planes and hundreds of people worked day and night for several months to extinguish it. More than 37 thousand acres of forest were reduced to ashes. Animal habitats were destroyed and due to the shortage of fodder, it became impossible for animals and birds in the surrounding forest areas to survive.

☉ **Man-made Disasters** - Some disasters occur due to human errors, negligence, or the excessive use of technology. Such disasters are called '**Man-made disasters**'.

The expansion of cities, the construction of roads and highways and the clearing of open spaces for large industries leads to deforestation. Over the past few years, massive deforestation and the excessive use of fuels have had a severe impact on the environment. The temperature of the atmosphere and oceans is rising. Rainfall patterns and timings are changing. As a result, disasters like floods, crop damage and landslides are occurring.

There are several other disasters that create new difficulties and crisis:

(1) Accidents - Sometimes, while driving a vehicle or working in a factory, sudden accidents occur due to human error or negligence. Incidents such as chemical leaks in factories, major road accidents and electrical mishaps happen because of carelessness and mistakes. These major disasters have a fatal impact on humans, animals and the environment. Workers can be injured or lose their lives due to machinery, chemicals, electric currents, working at heights or other dangerous factors in a factory. These are known as '**Industrial Accidents**'.

Along with personal injuries and damage to machinery, accidents can also result in fires and building collapses.

Causes of Industrial Accidents	Measures to Avoid Industrial Accidents
- Disregarding safety regulations, recklessness - Faulty or improper machinery. - Lack of proper training - Incorrect handling of chemical or flammable substances. - Fatigue due to continuous work	- Use proper safety equipment. - Provide safety training to workers. - Perform regular maintenance of machines and equipment. - Ensure proper storage and handling of chemicals. - Maintain a proper work schedule.

(2) War - Wars occur due to conflicts between two or more countries. Wars take place to protect one's own country, resolve disputes or sometimes to acquire land. The consequences of war are more severe than natural disasters. During wartime, many calamities occur, such as buildings collapsing due to bomb blasts, massive fires and the contamination of water bodies. At such times, it becomes difficult to receive treatment and medical help. Wars cause many deaths and the destruction of property. Thousands of people are forced to migrate. Farming becomes difficult. Pollution increases due to the use of weapons like poisonous gases and chemicals. Fear and mental stress are created among the people.

(3) Cyber Crimes - Cyber crimes are crimes committed using computers, the internet, mobile phones or digital devices. These include theft of personal information, financial fraud, harassment, threats, spreading obscene content and hacking.



New types of cybercrimes are emerging. **Phishing** involves obtaining information through fake emails; **Cyberstalking** means following a person online; a **Ransomware** attack involves locking computer data and demanding money and digital arrests are some types of these crimes.

In India, there is the Information Technology (IT) Act. Under this law, action is taken against cybercrimes. For safety, it is essential for everyone to protect their personal information, use secure passwords and avoid clicking on unknown links.

Certain phone numbers have been fixed to get immediate help during a disaster. These numbers are the same for all cities in our country.	Phone Number	Service
	100	Police Assistance
	101	Fire Brigade
	102 and 108	Ambulance
	1077	Emergency Services

Disasters come suddenly, therefore it is better to be prepared in advance to face them.

Precautions to be taken before disaster and after a disaster

Before Disaster	After Disaster
Identify the disaster and find a safe place	Stay calm, go to a safe place. Turn off the electricity.
Prepare a disaster management plan and keep essential items ready.	Help others. Administer first aid to the injured.
Practice the disaster management plan	Do not believe in rumors.
Memorize important phone numbers.	Contact the administration/authorities.
Observe cyber security.	Encourage and comfort those panicked by the disaster.

◎ **First Aid** - First aid refers to the immediate help given to an injured or ill person before they receive hospital treatment. This can save lives, reduce pain and prevent infection.

While working, playing or due to an accident, injuries sometimes occur. When a large amount of blood flows from a wound, it is called '**External Bleeding**'. It needs to be brought under control quickly. First aid is essential for this.

Items needed for temporary remedies on wounds, such as applying bandages or ointment, if the skin is burnt, should always be kept ready in a small kit or a closed box. This kit should be kept in a place where it is easily visible and can be used quickly. Such a kit is used for first aid in accidents. It is necessary to have such a kit containing tools and medicines ready for immediate help in emergency situations at home, in school, in the office and in vehicles.



◎ First Aid for Bleeding-

- | | |
|---|---|
| (1) Apply pressure to the wound using a clean cloth. | (2) If possible, raise the injured part above the level of the heart. |
| (3) If the bleeding does not stop, take the injured person to the hospital. | (4) Calm and encourage the injured person. |

◎ **Sunstroke** - Staying in hot weather for a long time or excessive physical exertion increases body temperature, which disturbs the functioning of vital organs like the brain, heart and kidneys. This condition is called **Sunstroke**. In this state sweating stops. The skin becomes dry and hot. Symptoms like confusion, dizziness, fainting, vomiting and headaches are also observed. If treatment is not received in time, sunstroke can be fatal. A person suffering from this should be moved quickly to a cool, shaded place. To lower the body temperature quickly, first aid should include wiping the body with a wet cloth or lightly spraying water on the body. If the person is semi-conscious due to sunstroke, do not give him water or any liquids to drink. Take him to a hospital as soon as possible to start further treatment.

◎ **Burns** - Sometimes, due to carelessness or an accident, a person's clothes catch fire. In such a situation, the person often panics and starts running. This causes the fire on the clothes to flare up even more and creates a risk of fire in the surrounding area. It is necessary to extinguish the fire on the clothes immediately. Making the person roll quickly on the ground helps extinguish the fire on the clothes faster. If blisters have formed due to the burn, do not burst them. It is also important not to pull off clothes that are stuck to the burnt skin.

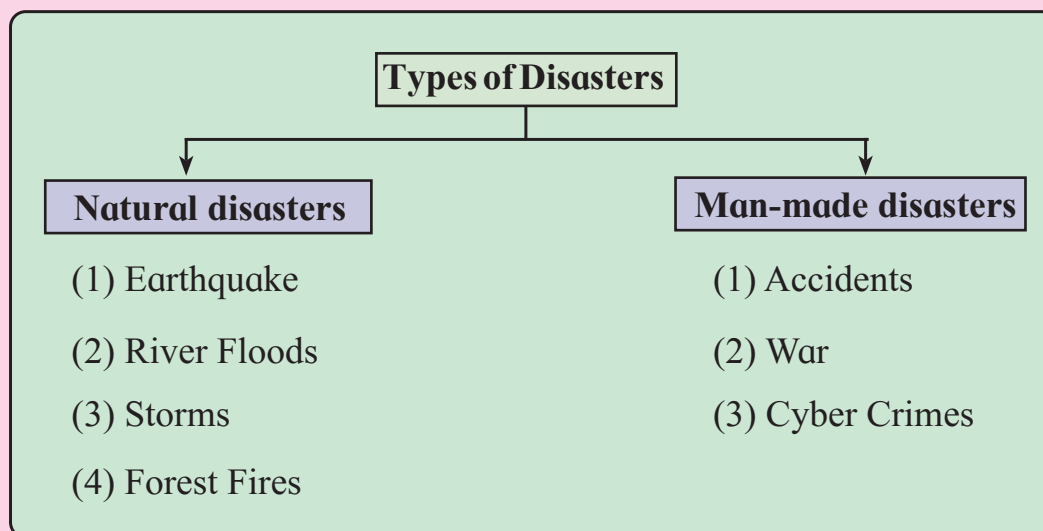
◎ Some Accidents and their First Aid-

Accident	What to do	What not to do
Snake Bite	• Minimize movement. • Take the person to a medical centre as quickly as possible. • Provide emotional support. • If possible, take a photo of the snake to show the doctor	• Running or excessive movement. • Use of home remedies. • Going to fraudsters out of superstition. • Making a cut or wound at the bite site. • Sucking out the infected blood by mouth.
Dog Bite	• Wash the wound repeatedly with clean water. • Seek medical help immediately. • Get the Rabies vaccine from a health centre.	• Use home remedies. • Taking medicines on your own. • Hitting or killing the dog.



What We Have Learnt?

- A disaster is a sudden, critical situation that arises unexpectedly.
- Some disasters are natural, while others occur due to man-made causes.



- Earthquakes, floods and storms cause massive loss of life and property.
- The intensity of an earthquake is measured in Richter scale.
- Due to forest fires, thousands of acres of forests are reduced to ashes globally every year. This destroys wildlife habitats. The destruction of natural resources and pollution are the harmful effects of forest fires.
- Wars, major railway accidents and industrial accidents result in tremendous loss of life and property.
- First aid means the immediate help given to an injured or ill person in an emergency. It can save lives, reduce the severity of injuries and prevent infection.
- In case of burns, do not burst blisters formed on the skin.
- If someone suffers from sunstroke, make them sit in the shade. Seek medical help as soon as possible.
- A person bitten by a snake is often very terrified. It is vital to provide him/her with emotional support and take him/her to a hospital.
- In case of a dog bite, wash the wound repeatedly with clean water and seek medical assistance.



Exercises

(1) State whether the following statements are true or false and give reasons.

- (1) A person bitten by a snake should be made to run quickly to the hospital.
- (2) The body of a person suffering from sunstroke should be wiped with cold water.

(2) Suggest appropriate first aid for the following situations. Explain your answer with reason.

- (1) Boiling water falls on your colleague's hand. The hand has turned red and is causing severe pain.
 - (2) A person's clothes on the street have caught fire and he started running in panic.
- (3) Some wells in a village that had plenty of water suddenly started drying up. At the same time, water levels began to rise in wells that were previously dry. Yash thought this was a miracle. Priya thought this happened because of underground movements caused by an earthquake. Whom do you agree with? Give reasons for your answer.

(4) Answer the following questions.

- (a) What are the various effects of earthquakes on human life?
 - (b) Write the harmful effects of war.
 - (c) What will you do if you receive a call from an unknown number asking for an OTP?
- (5) Find information about the risks involved in pulling off clothes that are stuck to the skin of a person injured in a fire accident. Write it down in your notebook.
- (6) Why should people avoid crowding at the site of a major accident, fire or river flood just to watch the situation or take videos and photos?
- (7) List the ways in which we can help during a railway or vehicle accident.
- (8) Now a days, air-conditioned buses and trains are available for comfortable travel. These vehicles have large glass windows, but why are these windows always kept completely closed? Also, a large hammer is kept in a prominent, easily visible place in such vehicles. What could be its purpose?



(9) Some words related to disasters are hidden in the grid below. Identify these words and write them in your notebook.

a	p	f	o	r	e	s	t	f	i	r	e
s	e	b	q	j	a	f	s	d	g	h	f
n	a	c	r	i	w	e	r	t	y	u	i
a	r	d	h	m	z	x	c	v	b	n	r
k	t	e	g	s	g	y	u	i	k	n	s
e	h	s	u	n	s	t	r	o	k	e	t
b	q	w	k	i	t	e	t	u	f	b	a
i	u	a	r	d	o	a	s	g	j	k	i
t	a	r	y	e	r	c	f	t	j	m	d
e	k	e	i	g	m	a	n	m	a	d	e
k	e	a	f	g	n	m	s	t	r	y	l
f	c	y	b	e	r	c	r	i	m	e	b

☉ Projects-

- (1) **My First Aid Kit :** Make a list of items required for a first aid kit. Collect these items and prepare a kit for your family.
- (2) News about major disasters often appear in newspapers. Collect cuttings of such news articles and photos. Categorize these cuttings into different groups, such as disasters caused by rain, storms or accidents.



6

Properties of Substances



We are familiar with both words, objects and substances. But what do we call an object and what exactly is a substance?



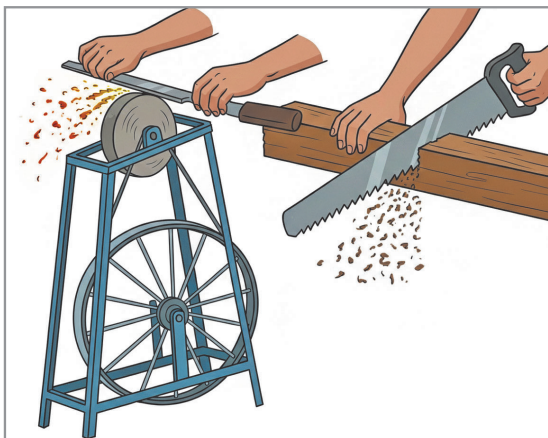
Which objects do you see in the room shown in the picture? Make a list of each visible object and the material it is made of. Which objects in the picture are made using more than one substance?

Things that are named based on their shape and use are called objects. A chair, a pair of scissors, a glass and a clock are some of the objects seen in this picture. The material from which an object is made is called substance.

For example, a chair can be made of wood, iron or plastic. Whether it is small or large or made of different substances, we still call it a chair. This means the chair is the object and the wood, iron or plastic it is made from are the substances.

While applying talcum powder to our face, we spread a little powder on our palms. At that time, the palm looks whitish. However, each individual particle of the powder on the hand is not visible separately. Such a tiny particle is made up of even smaller particles. All substances are made of such extremely minute particles. Milk, oil, air and gas are made up of small particles.





The tiny sparks that fly while sharpening a knife are actually small particles of iron that have become red-hot due to the heat. All the substances in the universe are made up of tiny particles. The properties of substances and the relation between them, arrangement of particles in them, the distance and space between the particles, the energy which binds them together depends on five different elements. This is mentioned in ancient Indian scripts. The Earth, Water, Fire, Air and Space are those five elements. Our ancestors called them *Panchtatve*.

What will happen, if the particles of a substance are very close to each other and hold on each other tightly? Those particles neither move away from each other nor will they change their own positions. That is why the shape and form of such objects do not change easily. This state is called the **‘Solid state’**.



A finger can be easily dipped into water, milk or oil. Water can be drawn out of a well or a pond. A mug of water can be easily taken from a bucket of water. As soon as you take it out, your fingers get wet. It means the particles of water are loosely bound to each other. Because of this, they separate from each other easily and flow towards the slope. Such a state is called the **‘Liquid state’**.

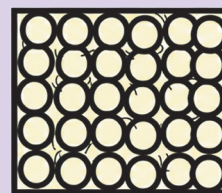
If solids are given enough heat, their particles begin to move away from each other. This causes the solid to transform into a liquid. Some substances melt with just a little heat, while others require more heat. To make objects out of glass or iron, the glass or iron must be melted in a furnace. This means those substances are then in a liquid state. Lava flowing out of a volcano is actually a liquid formed by melting rocks from the earth crust. That is why it is also known as molten rock. A lot of heat is required to melt solids like rocks and iron. If that much heat is provided, even these solids can turn into liquids.



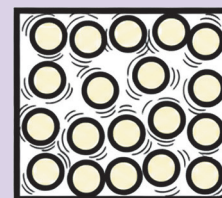
What will happen if heat is given to a liquid? The particles of the substance go away from each other and scatter in the available space. This state is called '**Gaseous state**'. If an incense stick (*agarbatti*) is lit in a room, smoke is seen rising a short distance from its burning tip. That smoke consists of burnt particles of the substance that have separated free from each other. Because they are crowded together near the tip of the incense stick, the smoke is visible there. Further away from the incense stick, the smoke is not visible, but the fragrance is noticed. This means that these particles can travel long distances by scattering from one another. This state of a substance is called the gaseous state. Solid, liquid and gas are the states of matter.

Whether particles will easily leave their positions depends on how tightly they hold onto each other. This also determines whether the shape and form of the object or substance will remain the same or change easily.

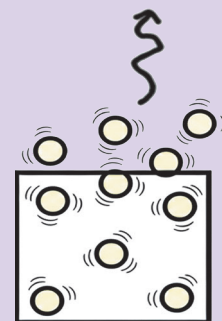
Particles are very close to each other and hold each other tightly; therefore, they remain in their fixed positions. – **Solid state**



Particles are slightly further apart and loosely bound; therefore, they flow towards the slope and take the shape of the container they are placed in. – **Liquid state**



Each particle is independent of the others; therefore, the particles scatter everywhere in the available space and move far away from each other. – **Gaseous state**



When such changes occur, the substance remains the same, only its state changes. This is called the change of state. The state of a substance at any instance is determined by how tightly its particles hold each other.

What will happen, if...

- A piece of ice is placed in the sunlight on the ground.
- Wax is heated and then the heating is stopped.
- Water is kept boiling.
- The cap of a petrol tank of a vehicle is left open.



Stone, gold, glass, iron are not always solid and oil, water, milk are not always liquid. These are their states at the normal temperature. Ice cream is made by freezing the milk and some other ingredients. We have seen that coconut oil solidifies on cold winter days. When a liquid is boiled, it turns into vapour, conversely, when cooled enough, vapour turns into liquid and liquid turns into solid.

We are familiar with gases like nitrogen, oxygen and carbon dioxide. By cooling them, they can be converted into a liquid state. Liquid nitrogen is used in laboratories to keep certain things extremely cold. Liquid oxygen is used in rockets used for space missions. If cooled sufficiently, carbon dioxide gas turns into a solid. It is very cold, that is why it is called dry ice. The gaseous state of substance at normal temperature can be changed.



Think.

- ★ A brick maintains its shape whether it is kept vertically or horizontally. However, oil, milk and water take the shape of their container. Why does this occur?
- ★ Why do bubbles form when air is pushed into a liquid using a syringe or a pipe?

Fill a plastic jar halfway with water. Mark the water level on the jar. Then, gently drop a large potato into the water in the jar. Is the water still at the previous mark? Even without adding more water, why did the water level rise?

Solids, liquids, and gases are all made of particles. Whether the number of particles is small or large, those particles will occupy space and have some mass. This meaning is conveyed by the single word 'Matter'.

- There is no separate, independent substance in the world called matter.
- Matter does not just mean liquids like oil, water or milk.
- The word matter simply suggests something that is made of particles, occupies space and has mass.
- Every substance in the universe can be called matter. This means the substances in the Moon, the Sun, stars and comets are also matter. Matter means 'made up of particles'.

The state of a substance at a given instance is determined by how tightly its particles hold each other. Accordingly, solid, liquid and gas are the common states of matter. However, in places like the interior part of the sun, where an immense amount of energy is being created or in lightning during the rainy season, the situation is very different. The nature of particles there is slightly different. Therefore, it is considered as a separate state. This state is called as the **Plasma state**.



☉ **Density** - If an object like a potato, a stone or an iron block is dropped into a vessel filled with water, the object pushes the water aside and occupies that space. How much water will be pushed aside? Exactly as much as the volume of that object! How can we measure this water exactly? By using tools like a measuring cylinder or an injection syringe, the volume of that water can be measured; that is precisely the volume of the object immersed in the liquid.

Mass is measured in units of grams or kilograms. **The volume of solids is measured in cubic centimetres (cm³) or cubic metres (m³), while the volume of liquids is measured in millilitres (ml) or litres (L).** Volume of 1 cm³ liquid is 1ml. If both the mass and volume of a given sample are known, we can determine the mass of a 1 cm³ piece of that substance. This is achieved without breaking the object, simply by using the formula: Mass divided by Volume. Stating the mass of a substance for 1 cubic centimetre volume is called the Density of that substance.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$



The units of density are g/cm³ or kg/m³.

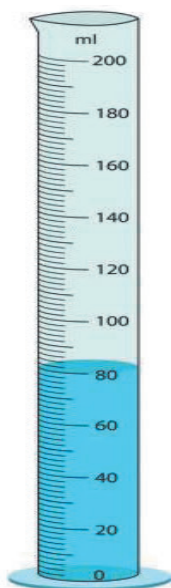
Collect objects like a stone, a large potato and an iron or glass block.

Measure the weight of each and note it down.

Take a vessel of sufficient size, place it in a deep plate and fill the vessel to the brim with water. Gently drop one of the objects into the vessel. Measure the volume of the water that spills into the plate using a measuring cylinder or an injection syringe. Use the formula to determine the density of each object. Repeat this for different objects.

A measuring cylinder is a tall vessel made up of glass or transparent plastic. The level of liquid inside can be seen from the outside. Based on the markings on the vessel, the exact volume of the liquid can be determined.

Mass is measured using a pan balance. When an object is hung on a spring balance, it measures how strongly the earth pulls that object towards itself; this is called the **Weight of the object**. The unit of mass is the gram. For convenience, this activity can also be performed using a spring balance.



If the density of concrete and steel is known, it is possible to calculate the total weight of bridges or buildings even before they are constructed. Based on this, it can be decided how strong the foundation or support pillars need to be. Whether samples of gold, milk, petrol etc. are of high quality can also be checked through their density.

Every substance has its own specific properties, which allow it to be precisely identified. Every substance has a fixed density. Therefore, by measuring the density of a sample, one can estimate whether substances like gold or petrol are pure or if they have been adulterated. The density of pure water is 1g/cm^3 , while the density of pure gold is 19.3g/cm^3 .

◎ Some Properties of Substances -

(A) Optical Properties : There are differences in the optical properties of different substances. Light passes through some plastics and clean water. Light falling on glass passes through it; therefore, we can see things on the other side of the glass. Such substances are called **Transparent substances**. Transparent means you can see through them. Wood, cardboard, metal sheets and soil are **Opaque**. The thin white plastic of milk bags, oily paper and frosted glass allow a small amount of light to pass through them. Therefore, such substances are called **Translucent**.



? Think.

- ◆ Is muddy water transparent, opaque or translucent?
- ◆ The image of objects in front of a mirror is seen in the mirror. Is a mirror transparent or opaque?



Try this.

Cut wide, long strips of newspaper, notebook paper and the colourful shiny paper used for gift wrapping. Hold each strip one by one in front of your eyes. First, guess whether objects on the other side will be visible or not. Then hold each strip in front of your eyes and observe what you see.



(B) Magnetic Properties : There is an attraction between magnets and iron. Many people think that a magnet pulls iron toward itself. Small, light objects like pins and nails are attracted toward a magnet. But what happens if a magnet is brought near a large iron cupboard, an iron table or a chair? Try it and see.

Have you seen decorative discs that stick to the doors of iron cupboards? A small black coin-like disc is stuck to the back of them. If it comes off, does the decorative disc still stick to the iron? Try it yourself. Substances that are attracted to a magnet are called '**Magnetic Substances**'. Iron, nickel and cobalt are magnetic substances.



What We Have Learnt?

- All substances are made up of particles.
- Solid, liquid and gas are the states of matter.
- In places like the sun, stars and lightning, there is a state called Plasma, which is different from solid, liquid and gas.
- The word matter means something made up of particles.
- Matter occupies space and has mass.
- The state of a substance at that instance is determined by how tightly its particles are bound to each other.
- The conversion of a substance from one state to another is called a change of state.
- Substances through which light passes are called transparent.
- Substances through which a little light passes are called translucent, while those through which light does not pass at all are called opaque.
- The density of a substance can be calculated using the formula $\frac{\text{Mass}}{\text{Volume}}$

Exercises

(1) Choose the correct option and complete the sentences.

- (a) Ice is thestate of water.
(solid, liquid, gas)
- (b) When light rays fall on an opaque substance,
(Some light passes through, all light passes through, light does not pass through)
- (c) Oil floats on water; this means the density of oil iswater.
(less than, equal to, greater than)

(2) Which of the following statements represent the solid and gaseous states respectively?

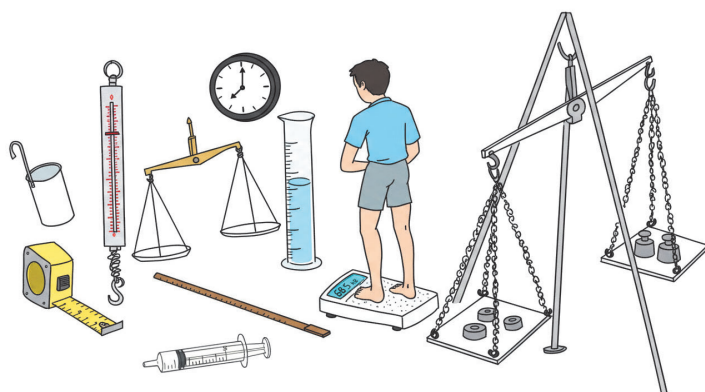
- (a) Particles are very close to each other and hold each other tightly.
- (b) Particles are slightly further apart and loosely bound.
- (c) Particles scatter everywhere in the available space.

(3) Observe the relationship in the first pair and complete the second pair.

- (a) Glass : Transparent substance :: Butter paper :
 - (b) Solid : Has a specific shape :: Liquid :
- (4) Stand close to the mirror and look at your face. Now exhale onto the mirror. What difference do you see? What could be the reason for it?



- (5) There are two boxes of the same size. One is filled with stones and the other with small pieces of sponge. Without opening the boxes, how will you identify which box contains what?
- (6) Identify the group in which all the substances are in the liquid state.**
 (a) Stone, water, smoke (b) Milk, oil, sherbet (c) Air, iron, steam
- (7) From the following, which are transparent and which are translucent? Make two separate lists. Piece of glass, butter paper, notebook-cardboard, plastic sheet, sandpaper, oiled paper.
- (8) Onion fritters (*Kanda-bhaji*) are being made in the neighbor's house and you came to know this without going there. What is the connection between this and the states of matter?
- (9) If a liquid has a volume of 3 ml and a mass of 7.5 grams, what will be its density?
- (10) Nowadays, a different type of glass is used for windows in newly constructed buildings. From the outside during the day, these look like coloured mirrors. Objects inside the room cannot be seen from the outside. However, those inside can see outside through the window. What should these glasses be called: Transparent, Opaque or Translucent?
- (11) A thin dark film is stuck to car windows. What happens due to this?**
 (a) The glass becomes more transparent.
 (b) The glass becomes opaque.
 (c) The glass becomes translucent.
- (12) Which one will have a greater volume, 1kg cotton or 1 kg of iron?
- (13) If 1 kg of cotton and 1 kg of iron are placed in the two pans of a balance scale, which pan will go down?
- (14) Several measuring instruments are shown in the picture.**



- Make two separate groups of instruments that measure volume and mass.
- Which of these instruments must be transparent? Why?

◎ Project -

You might have seen some toys made using magnets. Try to make one such toy yourself, show it to your friends and explain how you made it.



7

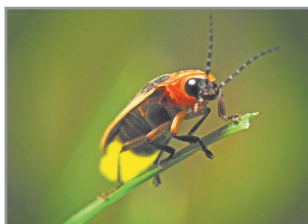
A Journey of Light



Seeing is closely related to the eye. Without eyes, seeing or visibility is impossible. But is there something else just as necessary for seeing and visibility as the eyes? When we are in a completely dark room, the objects in the room are exactly where they are, yet we cannot see them. Why does this happen? As soon as a candle is lit or a lamp is turned on in the room, the objects become visible. For seeing or visibility, light is just as essential as the eyes. If there is no light, we will see nothing even with our eyes wide open. The absence of light is what we call darkness!

Objects or instruments that produce their own light are called sources of light. A source means an origin. The light from some sources is bright and intense, while from others, it is very dim. Every object that produces light is a source of light. When a lamp is lit in a dark place, surrounding objects become visible because of its light. This means that the light emerging from a source spreads in all directions.

Things like the oil lamp, torch, lantern and various types of electric bulbs have been created by humans to give light. These are called **Man-made sources** of light. The sun, stars, the lightning that occasionally flashes in the sky and fireflies are **natural sources of light**.

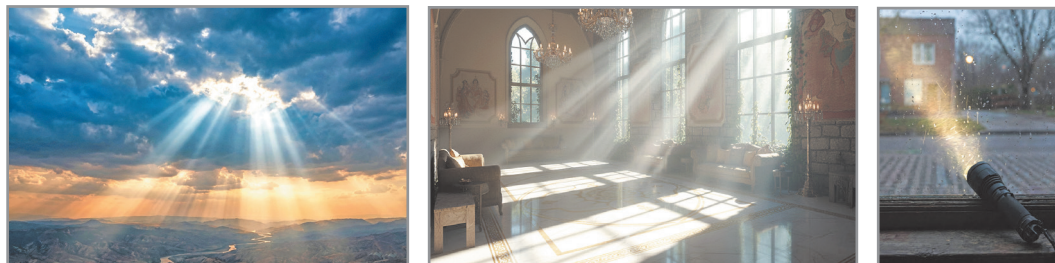


Have you ever gone near a stream, pond, marshy place or a dense forest area on a dark night during the rainy season? Hundreds of fireflies fly in the dark, blinking like tiny lamps and emitting a green light from their bodies. It is a sight you feel like watching for a long time. In reality, that blinking light is a signal sent to other fireflies nearby.

In the deep parts of the ocean, there are certain species of fish and algae that produce light in a similar way. Are these sources of light man-made?



The Sun is the largest source of light for the Earth. With the help of sunlight, plants prepare their own food. They use some of this food for their own growth, while the rest is available for animals. Sunlight is necessary for flowers to bloom and for trees to grow. Light is essential for the lives of humans, micro-organisms and animals too.



Determine on which side is the source of light in each of the above images.

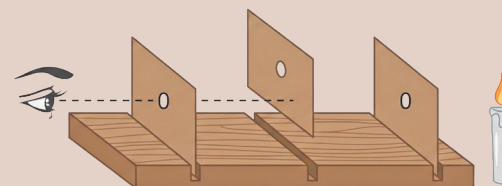
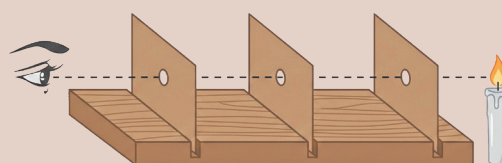
We see a beam of light entering the house through a window in the morning or evening, a beam of light from the headlights of a vehicle at a distance in the dark and beams of light moved across the sky during big events. We actually see the dust particles floating in the air along the path of light, objects are visible because of light, but light itself is never seen.

Two friends are holding pipes and looking at a candle flame. Who will be able to see the flame?



Try this.

- (1) Take three pieces of cardboard of the same size.
- (2) Make a small hole exactly in the center of each cardboard.
- (3) Arrange the pieces of cardboards exactly in a straight line.
- (4) Place a candle on the other side of the last cardboard so that the flame is aligned with the holes.



- Look at the flame through the hole of the first cardboard. Can you see the candle flame?
- Now, move one of the cardboards slightly to the side or up and down. Can you still see the candle flame?
- Place the cardboard back in its proper position and observe again.



From These Observations

We have learnt that light travels in a straight line. This property of light is called the 'linear propagation of light'.

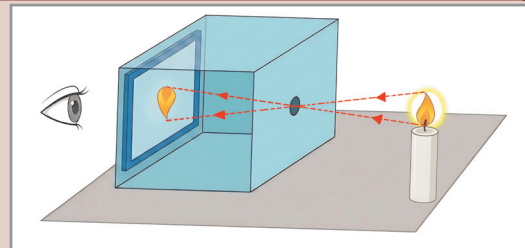
☉ **Propagation of Light** - If you place your ear against a railway track, you can hear the sound of a train that is very far away. If you tap lightly on one end of a long wooden plank, the sound is heard clearly at the other end. Even if you dive underwater while swimming, you can hear sounds. This means sound can travel through solids, liquids and gases. Such substances are called a '**Medium**'.

While sound requires a medium to travel, light does not need any such medium to move from one place to another. The atmosphere of air around the Earth exists only upto a height of about 100 km. Beyond that, the Sun is 15 crore km away. This means there is a vacuum between the Sun and the Earth. However, the sunlight can still reach us. From this, we realize that light does not require a medium for its propagation.



Try this.

Take a large cardboard box. Cut out a square window-like section on one side and paste butter paper or white kite paper over it. On the opposite side, make a tiny hole using a needle. Place a lit candle at some distance in front of this hole. Observe from the side with the butter paper. Draw a picture of how the image looks on the butter paper.



Light rays emerge from the flame in all directions. Only the rays coming towards the hole can enter the cardboard box.

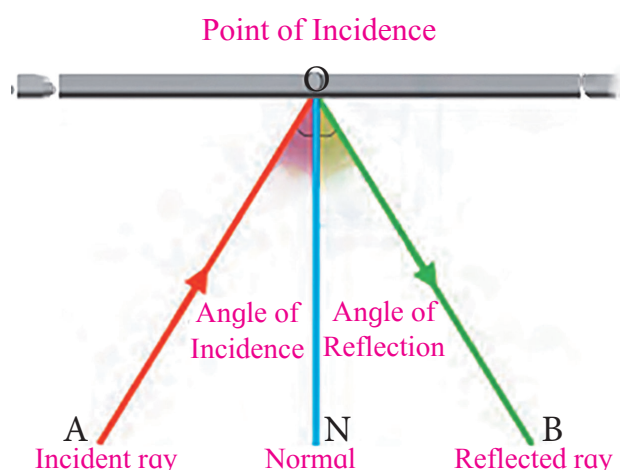
Rays coming from the top of the flame pass through the hole and go to the bottom of the screen. Rays coming from the bottom of the flame pass through the hole and go to the top of the screen. Because of this, an inverted (upside down) image of the candle flame is formed on the screen. This happens because light rays travel in a straight line. Draw the picture of the image which is formed on the butter paper. No lens is used in this device. Since an image is formed using only a tiny hole, it is called a **Pinhole Camera**. The smaller the hole, the clearer the image.

Looking at the Sun with the bare eyes during a solar eclipse can damage your eyes. Therefore, many people view the images of the solar eclipse using a pinhole camera.

In a dark room, place this box near a window and try to view outside scene on a screen.

☉ **Reflection of Light** - Light rays travel in a straight line. What happens if an obstacle comes in the path of these rays? If the obstacle is a transparent glass, light passes through it. If it is semi-transparent, some light passes through and some reflects back. If there is an opaque obstacle like wood or cardboard, light will not pass through it; it will turn back from there. The turning back of light rays from the surface of an object is called the '**Reflection of Light**'.





The ray of light falling on any surface is called the '**Incident ray**'. In the diagram, AO is the incident ray. The point at which the incident ray falls on the surface is called the '**Point of incidence**'. Point 'O' is the point of incidence. A line perpendicular to the surface at the point of incidence is called the '**Normal**'.

The ray that returns from the surface is called the '**Reflected ray**'.

$\angle AON$ is the angle made by the incident ray with the normal. It is denoted as the **angle of incidence**. $\angle BON$, the angle made by the reflected ray with the normal, is called the **angle of reflection**.



Try this.

Take a white sheet of paper, two ballpoint pen refills or two thin straight sticks of similar length, a pencil, a protractor from a compass box, a large wooden block or a water bottle and adhesive tape or thread. If possible, colour the sticks differently.

Draw a straight line near one edge of the white paper using a pencil. Mark a clear point near its center and name it M.

Draw a perpendicular line from that point. Let's call this perpendicular line MN, the normal.

Place the protractor on the paper as shown in the picture. Stand a mirror upright on the line using the wooden block or water bottle for support. Use tape or thread to ensure it doesn't fall.

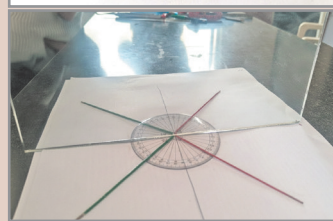
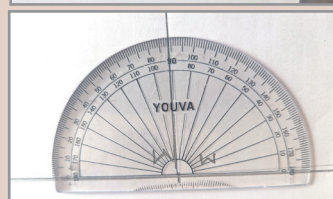
Now, place one end of a coloured stick so that it touches the mirror, as shown in the diagram. You will see its coloured image in the mirror.

Place the second stick in such a way that it and the image of the first stick in the mirror appear to be in a single straight line. Measure the angles that both sticks make with the normal, MN.

Repeat this activity for three different angles.

Check the measurements of the angles each time. What do you notice?

What happens if you place the coloured stick exactly on the normal? Try it and see.

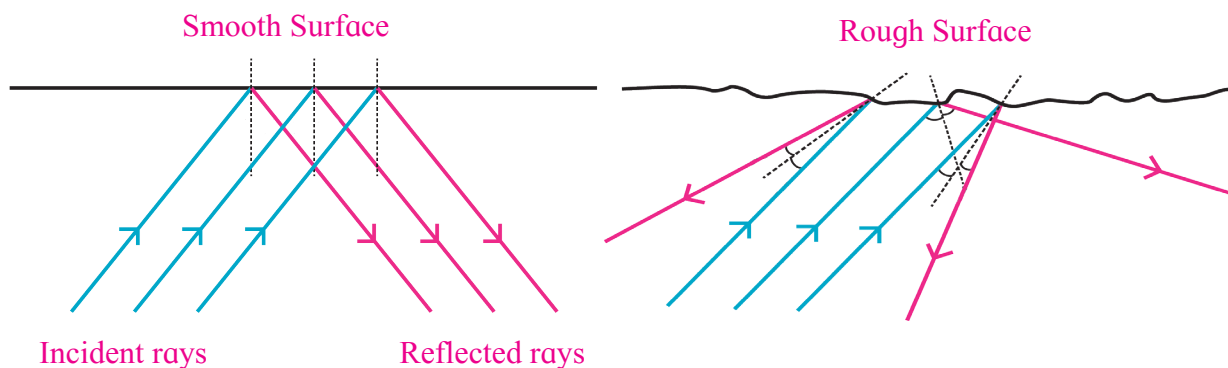


Whenever a light ray is reflected-

- (1) The incident ray and the reflected ray are on opposite sides of the normal.
- (2) The angle of incidence and the angle of reflection are of equal measure.
- (3) The incident ray, the reflected ray and the normal all lie in the same plane.

These are called the Laws of Reflection.

Light rays parallel to each other falling on a smooth surface like a plane mirror remain parallel to each other after reflection. This is called the '**Regular reflection**' of light. However, light rays parallel to each other, falling on a rough surface reflect in many different directions. This is called the '**Irregular reflection**' of light.



Whether a surface is smooth and flat or rough, the angle of incidence and the angle of reflection remain equal at every point of incidence. If the surface is smooth and flat, all reflected rays will be parallel and travel in one direction. That is why we can cast a 'beam of light' on a wall by holding a mirror in the sunlight.



? Think.

To see an image in a mirror, you have to look at it from a specific direction. However, objects in a room or trees outside can be seen from any direction. Why does this difference happen?

Even in irregular reflection, the laws of reflection are followed at every single point. The rays returning from a rough surface go in different directions. For example, a stone on the road is visible from any direction. This is because even though the sunlight comes in one direction, it reflects from the rough surface of the stone in many different directions. We are able to see most of the objects around us because of this irregular reflection.



- Light is a form of energy.
- Light always travels in a straight line. It does not require a medium for propagation.
- An instrument based on the straight-line propagation of light is the Pinhole Camera.
- Sources of light are of two types: Natural (e.g., sun, stars) and Man-made (e.g., bulbs, torches).
- Reflection of Light: When light rays from a source fall on an object and turn back from its surface, it is called the reflection of light.
- Laws of Reflection of Light: (1) The incident ray and the reflected ray are on opposite sides of the normal. (2) The angle of incidence and the angle of reflection are always equal in measure. (3) The incident ray, reflected ray, and the normal all lie in the same plane.
- There are two types of reflection: Regular Reflection and Irregular Reflection.
- We are able to see objects around us due to the irregular reflection of light from rough surfaces.
- Reflection from a mirror or new, shiny metal utensils is regular reflection.

Exercises

(1) Fill in the blanks.

- (1) The is the major natural source of light for the Earth.
- (2) When light falls on opaque objects, the of light occurs.
- (3) The functioning of a camera depends on the straight-line propagation of light.
- (4) A beam of light coming through a window is visible due to
- (5) Reflection of light from still water is of thetype.

(2) Choose the correct option.

- (1) If the angle of incidence is 30° , then the angle of reflection is degrees.

(a) 0
(b) 60
(c) 30
(d) 90
- (2) A clear image is seen in a plane mirror because

(a) regular reflection of light occurs.

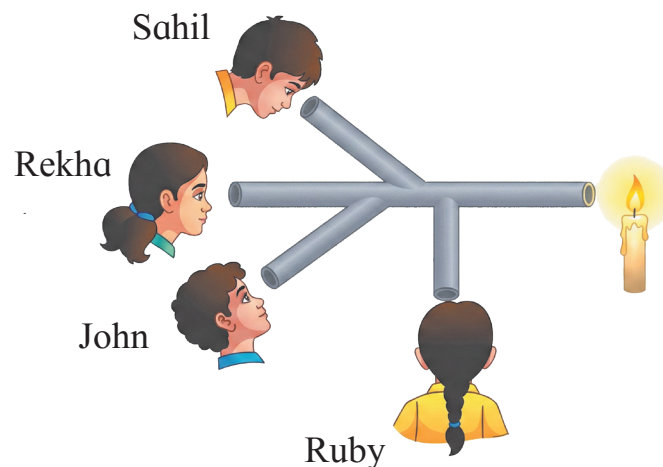
(b) the surface of the mirror is rough.

(c) the mirror is transparent.

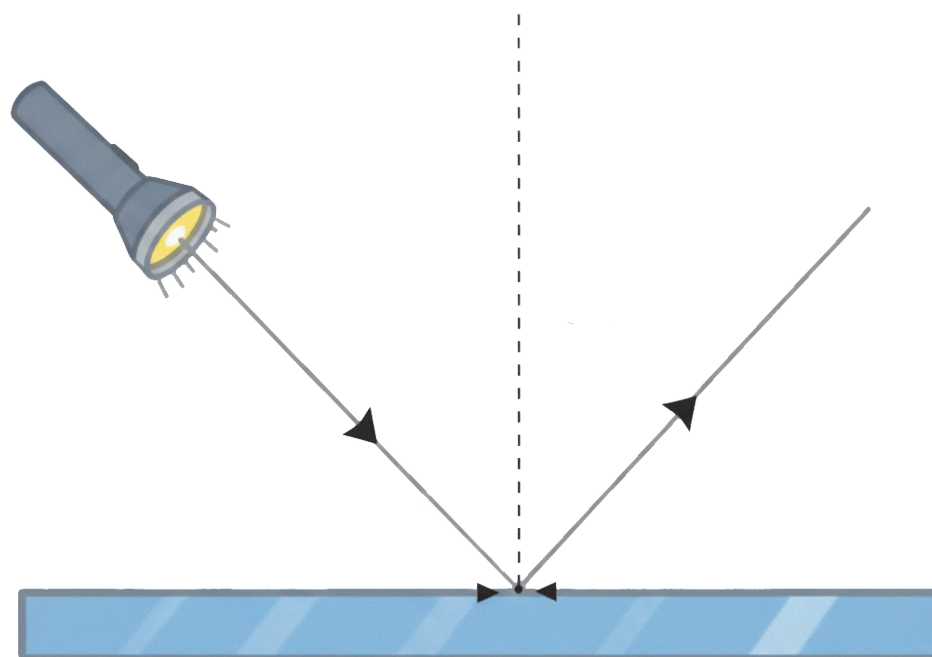
(d) irregular reflection of light occurs from the mirror



- (3) We can see the moon because-
- (a) The moon is self-luminous.
 - (b) The moon is a satellite of the earth.
 - (c) Sunlight is reflected from the surface of the moon.
 - (d) The moon is close to the earth.
- (4) When the angle of incidence and the angle of reflection are equal during reflection of light ?
- (a) Always
 - (b) Sometimes
 - (c) Under specific conditions
 - (d) Never
- (3) The moon is approximately four lakh kilometers away from the earth. The moon is visible from earth, but any sounds produced there cannot be heard on earth. Why is this so?
- (4) **Identify whether the following statements are true or false. Rewrite the false statements after correcting them.**
- (1) The incident ray is called the normal.
 - (2) We can see an object placed in front of us through a bent pipe.
 - (3) Objects are clearly visible to us in a dark room.
 - (4) The image obtained in a pinhole camera is inverted.
- (5) **Who will be able to see the candle flame?**



(6) **Label the diagram.**



(7) An image of the moon is visible on calm water. If there are ripples on the water, does the image remain the same? What is the difference and what is the reason for it?

(8) **Classify the following into two groups: Self-luminous and Non-luminous.**

An aeroplane visible in the sky, a book, the sun, gold, fire, the moon, the flame of an oil lamp, the oil lamp itself, the oil in the oil lamp.

☉ **Projects -**

- (1) Astronauts who landed on the moon via the Apollo missions placed two large mirrors there. Find the reason for what these mirrors are used.
- (2) Construct a slightly larger pinhole camera. What trick or technique would you use to make the image appearing in it clearer? Show this camera to your friends and display it in an exhibition.



8

Beyond the Sky



Around 15-20 thousand years ago, humans were not aware of shelter, clothing and eating cooked food. When hungry, they wandered in the jungles in search of food, hunted animals, drank water from nearby sources and rested in caves. Their life was similar to that of wild animals.



Since then, humans have been curious and amazed by the glittering stars in the sky. They used to observe the sky minutely at night. From the thousands of stars scattered across the sky, they observed specific groups of stars and their changing positions to predict the monsoon and winter seasons and had knowledge of many other similar things. While wandering in the jungle at night, they identified directions by looking at the stars. They observed comets which disappeared suddenly and also had knowledge about the effects of collisions of comets against the surface of earth. Some of them drew paintings of these events on the stones of the caves. These cave paintings are found at many places all over the world.



Extinction of Humans and Animals due to collision of comets against Earth. Cave paintings from fifteen thousand years ago.





Think.

Which material did those humans use to draw paintings on the stones of caves? Why did they draw such paintings?

◎ **Sky and Space** - When we think of the sky, we imagine its blue colour, birds, kites and aeroplanes flying high in it. Some of us imagine the moon, the sun and stars. What exactly is the sky?

There is a thick envelope of air around the earth, which is called the atmosphere. At sea level, the layer of air is dense. The air is rarer on high mountains like Himalayas and much rarer on further greater heights. At around 100 km from the surface of the earth, the air becomes very rare and beyond that, there is no air.

Particles of different gases are present in the atmosphere. Besides this, dust particles and tiny particles of water vapour are also present in it. When sunlight falls on these particles, blue colour scatters around more and that part appears blue. Hence, the sky appears blue during the day. This effect can be seen as far as the atmosphere exists around the earth. Beyond that, no atmosphere means no particles of gases and water vapour. No scattering of sunlight hence, the sky does not appear blue. The space around the earth as far as the atmosphere extends called the '**Sky**'. **Where the sky ends, space begins.** The empty region beyond the sky is called space. Space is endless.

Jet airplanes fly at higher altitudes than the Himalayas. Clouds are found below that height. A high-flying kite and birds are at a lower level closer to the surface of the earth. The sun, stars and planets are far away at billions of km distance from the earth. Let's find out which of the above objects are celestial objects? Which of the celestial objects do you know?



Think.

- ★ Why are Chandrayaan, Mangalyaan, and yaan sent to know more about the Sun, Aditya L-1 called spacecraft? Can a Jet aircraft be called a spacecraft?
- ★ Many times lightning occurs during monsoon. Does that occur in the sky or space?



Aditya L1 Space craft
Around 15-lakh km

Geostationary
Satellites
Around 36,000 km

Space station
Around 450 to 550
km

Navigational satellites
Around 300 to 450 km

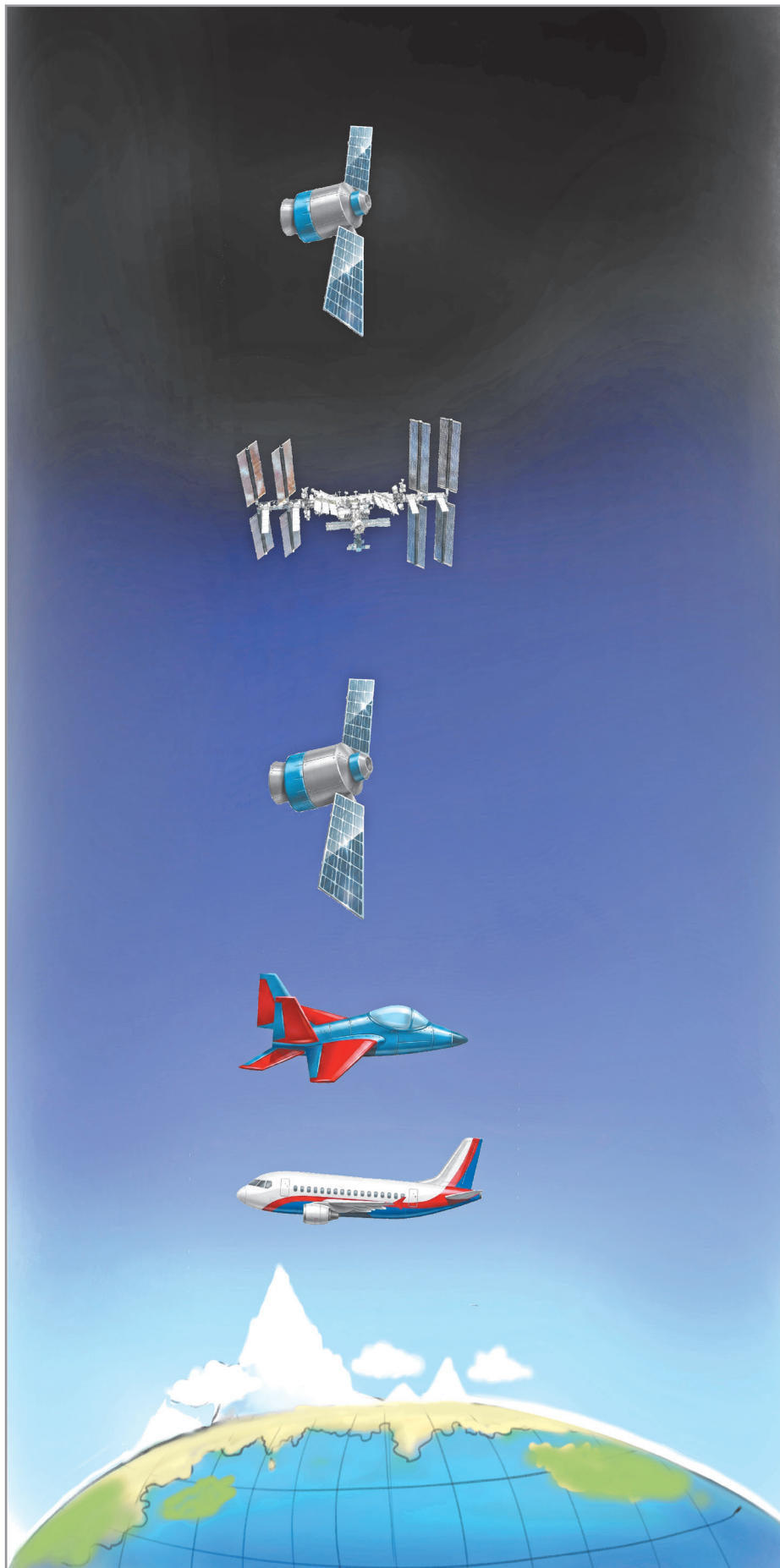
Fighter planes
Around 20 km

Passenger aircrafts 10
km

Mount Everest 8.8 km
(From sea level)

Clouds from the
surface of the earth
Around 6 km

Flying kites and birds
Very close to the
surface of earth



In earlier times, telescopes were not invented. Information that people learnt just by observing with their naked eye, making predictions and calculations based on that, was only known to humans. They also knew about the time taken by planets to revolve around the sun, when solar and lunar eclipses occur, which planets and constellations can be seen when and where in the sky.

For observing stars and planets, the use of telescopes started around 400 years ago in 1609 A.D. Using earlier telescopes, little information was obtained about craters on the moon, sunspots and the four satellites of Jupiter. Later, scientists made more powerful telescopes and started getting new information. It collected information about a few unknown planets, the conditions on planets and the satellites of these planets. They started getting information about celestial events taking place far away in space and their effects. The instruments which could take photographs and gather information of events happening billions of kilometers away in space were designed using X-rays, Ultra-violet and Infrared rays. Spacecrafts which travelled to far away planets sent information about them. Because of this study, we have gathered a lot of new information about space in the last hundred years.

Many stars are seen in the sky at night. Out of which, planets revolving around the sun are only eight and remaining are self-luminous stars like the sun. Some stars appear clearly and are very bright, while some are dim. Some stars are in specific groups or collections. These groups of stars keep changing their places over the time from east to west. The figures of these groups of stars remain the same but their position in the sky changes. Have you seen such a group of stars? Such groups are called constellations or *nakshatra*.

- Find the constellations in the sky at night as shown in the picture and find out their names with the help of elders.



- Collect the information about the names of constellations related to monsoon and agriculture. Share that information with your classmates.

- The farmers know some proverbs which tell the relation between names of the constellations and agriculture. For example, 'पडतील स्वाती तर पिकतील मोती'. This means, timely and beneficial rain, (especially during the swati constellations period) leads to a rich crop yield. Here 'Moti' means a rich crop. Collect some more such proverbs from the elders and note them down in a notebook.





The earth is a huge sphere like a ball. If we look at the sky standing on the surface of the earth, we can see only a little part of the sky above our head. Hence, we cannot see all the constellations in the sky at one time.

The part of the earth that lies above the equator is known as the northern hemisphere and the part that lies below is the southern hemisphere. The people from the southern hemisphere cannot see the stars, sky and constellations present in the northern hemisphere. The pole star present in the north direction cannot be seen from the southern hemisphere of the earth.

☉ **Comet** - Comets are celestial objects formed out of dust, frozen gases and ice. Many comets are a part of our solar system. Some comets enter the solar system and after orbiting elliptically around the sun, escape into space. While going away from the sun they appear like a tiny star. When they come closer to the sun, this frozen material gets converted into gas due to solar heat.



These gases are thrown in a direction away from the sun. It looks like the tail of a comet. Comets come from billions of kilometers away and move towards the sun. After revolving around the Sun, they go away from it and return after many years. Different comets have different revolution periods. Halley's comet takes 76 years to revolve once around the sun. According to scientists, comet A3 requires 80,000 years to complete one revolution around the sun.



Do You Know?

Generally, comets revolve around the sun. In the year 1993 Shoemaker - Levy 9 comet was found revolving around planet Jupiter. Due to the strong gravity of Jupiter, it broke into many pieces and collided on it between 16th to 22nd July, 1994. This resulted in the formation of clouds of gases, which could be observed, from a telescope for many months thereafter.



According to scientists, comets might have collided with the earth also. At that time, major changes in atmosphere, extinction of plants and animals, formation of large craters and lakes must have occurred due to that impact. Millions of pieces of rocks, remains of comets' tails left behind, keep on revolving around the sun. Sometimes one of the rocks is pulled due to earth's gravity and starts coming towards earth. When it enters earth's atmosphere, due to friction with air, a tremendous amount of heat is produced and it starts burning. At that time it appears as if a star is falling from the sky, this is called **'Meteor'**.



Lonar Lake

If the rock is very big, then some part of it reaches the earth and it forms a big crater. Water collects in it and forms a lake. This is how the big salty lake in Buldhana district was formed thousands of years ago. Many scientists from different countries visit Lonar lake to study the lake and the specimens of rocks.

Los Angeles is a big city in America. Bright, dazzling lights are always present here so, one doesn't even realize when night falls. In 1994, electricity was cut off in the whole city for some days due to a massive earthquake. People who looked up at the sky in the darkness of the night suddenly got scared. They saw a shining, smoky white band like a river in the sky from south to North direction. Thinking it might be an enemy bomb attack or a new danger, everyone panicked and started running in all directions! What was that smoky white band made of?



This smoky and milky white band was known to all since thousands of years all over the world. It looks like a river in the sky, so this band is named as '*Akashganga*', or 'Milky Way'. People were unaware of this band and they never saw it due to bright light. So they got scared when they saw it. Have you ever seen *Akashganga*?

Observe the night sky from the places where many electric lights are around you. Also observe from farms, hills away from city or village. Share your experience and observations with your friends.

When observed with the naked eye, the milky way appears like a smoky white band. If we observe it through telescopes then we can see thousands and lakhs of big and small stars. Some stars are big while some are small. Some are bright and some are dim. Every star emits light, heat and different types of energies like the sun. Our Sun is one star among the countless stars. How big is our Sun?



Earth is a big sphere. We know that India and America lie on the opposite side of this sphere. The distance between Mumbai located in India and New York in America is around 13,000 km. From that we get an idea of how big the earth is! If about 1.3 million earths were put together like a 'Boondi ladoo', they would form something as large as the Sun. Compared to other stars in the Milky way our Sun is quite small and dim. There are many stars present in it, thousands of times bigger and brighter than our sun. In addition, there are millions of small and bright stars like the Sun.

Billions of stars are present in the entire *Akashganga*. While looking at the stars we think that they are very close but actually in reality they are millions and millions of kilometres away from each other. The sun is at a distance of around 14 crore kilometres from the earth. The second closest star is three lakh times farther away than this.

☉ How big is our *Akashganga*? -



Our *Akashganga* is a collection of billions of stars arranged spirally in a huge cluster called '**Galaxy**'. Actually, the galaxy '*Mandakini*' is named as '*Akashganga*'. The family of a huge Sun, eight planets revolving in their own orbit around the sun, their moons, millions of asteroids and many comets together constitute our '**Solar System**'. Such a vast and huge solar system is shown using a tiny dot in a picture of *Akashganga*. Many stars from this galaxy have their own planetary systems around

them. *Akashganga* is widely spread. Light travels three lakh kilometres in a second. It takes one-lakh years for light to travel from one corner of the *Akashganga* to the other. The galaxy closest to us, Andromeda (*Devyani*) which is slightly bigger than our *Akashganga*, has been known to humans for over four thousand years. So vast every galaxy is! Such millions of galaxies are scattered in space. We know that, they are constantly moving away from each other. The vast expanse of all known galaxies is called the '**Known Universe**'. What exists beyond that is not known to us, however, continued efforts are taken to gather information about it.

On nights when there are no clouds in the sky, observing the sky from a place without any bright lights in the surrounding becomes a very enjoyable experience. Many stars can be seen due to surrounding darkness. You can find information about what can be seen in the sky, as on that day and from that place from magazines and mobile apps.

With the help of expert, one can observe *Akashganga*, surface of the moon, Jupiter and its moons, phases of Venus etc. using telescopes. Even without telescopes, one can gather a lot of information from such activity. It is wise to get information from well-informed persons.

During such activity, first observe the stars and planets in the west, since they disappear sometime after sunset.



Continuous efforts are being taken to gather information about planets in space and celestial events. Many spacecrafts capable of traveling millions of kilometres, collecting data from there and sending it back to earth are being developed. For this purpose, several plans are made and many scientists work diligently with great dedication. Such efforts of sending a developed spacecraft to gather information are called ‘**Space missions**’.

Indian Space Research Organization (ISRO) is well known all over the world for conducting such space missions. The ***Chandrayaan-1*** mission of 2008, which mapped the minerals present on the moon’s surface and made the first discovery of water on the Moon, the ***Mangalyaan*** mission of 2014 and the ***Chandrayaan-3*** mission of 2023 were famous space missions of ISRO. After these many new missions are being undertaken.

☉ Indian Space Missions - Aditya L1

Aditya - L1 is India’s spacecraft sent to study the sun. It was launched by the Indian Space Research Organisation (ISRO) on 2nd September, 2023 from Satish Dhawan Space centre at Sriharikota. It has been placed in a stable position in space at a distance of about 15 lakh km from earth. It constantly observes the sun. The instruments fitted on it continuously send us information about solar storms and the material ejected during such events, solar flare and similar phenomena.



NISAR

NISAR is a very advanced satellite jointly developed by NASA and ISRO. It was launched on 30th July 2025 from Satish Dhawan Space centre at Sriharikota. This satellite is observing earth by completing one revolution around it every 12 days. It sends a lot of information about forests, climate change on earth, change in earth’s crust due to earthquakes, speed of melting of glaciers etc. This satellite also helps in disaster management.



Always Remember:

Events like celestial happenings, the rising and setting of planets and stars, change in their positions, appearance of comets are natural. They do not affect human life. One should not follow blind beliefs like when a comet is seen, danger arrives and seeing a falling meteor (shooting star) brings good luck.





Do You Know?

- About 1500 years ago, everyone believed that the earth was stationary and that the moon, sun and stars revolve around the earth. The sun does not go around the earth, but the earth goes around the sun was first explained by Indian scientist Aryabhatta.
- When there were no advanced instruments, the astronomer Aryabhatta calculated the time taken for the earth to complete one rotation around its own axis, using only observation and mathematics. The time measured with modern instruments and the time calculated by Aryabhatta long ago are exactly the same. The same applies to the time taken by the moon to orbit the earth. Aryabhatta has given information about this in 'Aryabhattiya script'.
- Bhaskaracharya (II) was the head of the observatory at Ujjain. He made important contributions to the study of solar and lunar eclipses and the phases of the Moon.

- **Introduction to Scientists**

Dr. Vainu Bappu (1927-1982)

An Indian student, Vainu Bappu, made a spectrometer at home that shows the different components of light coming from the stars. He discovered a new comet in July 1949. That comet was named after him. He has proved mathematically that it comes once in sixty thousand years. He also designed the structure of a large telescope in a modern observatory in India. He was awarded a Doctorate in 1952 by Harvard University. Vainu Bappu was the head of a joint astronomy organization of several countries.



Dr. Jayant Narlikar (1938- 2025)

Dr. Jayant Narlikar was a world famous astronomer. He set up an organization called IUCAA in Pune for research in astronomy. Research at this institute led to the discovery of different types of stars and galaxies. He wrote many interesting books to create interest in astronomy among students and the public. For many years, he regularly answered science questions asked by curious students.





The Giant Metrewave Radio Telescope (GMRT) located near Khodad village in Junnar Taluka



Jaipur- Jantarmantar
An observatory built about 300 years ago



Hanley India (Ladakh Observatory)
The highest observatory in the world



Hubble Space Telescope



The ultra-modern James Webb space telescope 15 lakh km away from the Earth in Space



What We Have Learnt?

- In earlier times, humans have been curious and amazed about planets, stars and celestial events. Since then, humans have gathered knowledge through observations.
- The space around the earth as far as the atmosphere exists is called the sky. The empty region beyond the sky is called space.
- The phenomenon of lightning, the clouds and aeroplanes are seen in the sky. Stars, the moon and comets are far beyond that, in space.
- A group of stars always with fixed figure and arrangement of stars in it is called Constellations or Nakshatra.
- Comets are celestial objects formed out of dust, frozen gases and ice. Some comets, after orbiting around the sun, go far away in space after some time.
- Our Solar system is a very small part of a huge and vast galaxy. The universe is made up of billions of such galaxies.
- Continuous efforts are being taken to gain more information about space.
- ISRO is conducting various missions for space research.

Exercises

(1) Identify and write the name.

- (a) The galaxy closer to Akashganga
- (b) The father of Indian Astronomy
- (c) The star closest to the Earth
- (d) A celestial object made of rocks, dust and frozen material

(2) Write true or false. Correct the false statement.

- (1) The stars do not have their own light.
- (2) The pole star is situated in the south direction.
- (3) Sometimes meteors fall on the surface of the earth without burning completely.

(3) Complete the co-relation.

- (a) Chandrayaan - 1 : 2008 :: Mangalyaan mission :
- (b) Aditya L1 : Study of the Sun :: NISAR



(4) Which of the following activities are necessary for sky observation?

- (1) Selecting a place without light and pollution.
- (2) Use of Binoculars, telescopes for sky observation.
- (3) Begin sky observation from western stars.
- (4) All of the above.
- (5) What blind beliefs do people have about various celestial objects and events in the sky? Make a list.

◎ Projects -

- (1) Gather information about, how to find the pole star in the night sky, locate the pole star on your own.
- (2) Collect information about monsoon and some agricultural activities and about constellations from the people around, share that with your friends.
- (3) You can make a telescope with the help of your teacher and expert. Workshops regarding the making of telescopes are conducted at some places for the students. Take advantage of that; make a telescope and try to use it for observing the moon and Jupiter.
- (4) Chandrayaan - 3 was a very famous and successful mission conducted by ISRO. Get a picture of Chandrayaan - 3 and make a model of it.



9

From Diet to Health



‘अन्न अंगी लागणे’ - ‘Food nourishes our body’ - Have you heard this before?

Though a person is not sick, but always looks weak and tired. Eat meals regularly but does not feel hungry. There is no enthusiasm for playing and working. If such situation continues for many days, then elderly people say - “Whatever he eats, does not nourish his body”.

On the contrary, a person is healthy, well built, strong, active has lot of enthusiasm for playing and working, rarely falls sick, what shall we say about such an individual? “The food nourishes his body!”.

Energy is necessary to perform different activities, movements and playing games. Food helps the body recover from wear and tear, supports growth, and provides immunity to fight against diseases. It keeps the body healthy. Body remains healthy because of food. For this, body needs different things. If our diet can fulfill all these needs, then the food we take can nourish our body.

What are the needs of the body? What is diet? What are nutrients? What is nutritious diet?

Think about your usual meal. What different food items does it contain? Jowar or bajra *bhakari*, wheat *roti*, various vegetables, *chutney* and *pithala* are a part of our regular food. During festivals there is some variety in food items.

Would the people of the Kashmir and Bengal regions also have the same food? Food items like *idli*, *dosa*, rice and *sambar* are a major part of food in the south. Wheat, butter, ghee and potato are used more in the north. What must be the reason?

At different places there is a diversity in climate, amount of rainfall and the types of soil. So the crops are not the same in different regions. The crops grown in that particular region are used more, therefore in north India the food items made from wheat are used. In south India jowar and wheat are not cultivated, rice farming is more common, so rice is used more. Some types of rice like *masala* rice, lemon rice and *pulav*, *idli*, *dosa* are included in the main food. The food items prepared from the crops available in surrounding regions is the regular food. This regular food is called ‘**Regional Diet**’.



Think.

Which food ingredients must be used more in the local diet of *Konkan* region of Maharashtra?



We do not eat grains and pulses obtained from the farm as it is. Various processes are carried out on them to prepare different food items. We get bored of eating the same food items everyday. The taste of the food can be changed using different food items and spices available in different seasons. Because of this there is variety in food items. Variety is also seen due to different cooking methods like roasting, cooking and frying that are used for preparation of food.

Our meals and breakfast include different food items like *bhakari*, *chapati*, vegetables, rice, *shira*, *upma*, *dosa*, *pohe*, *idli*, tea, coffee, *sherbet*, buttermilk etc. These are called food items. Not every item in such a list is eaten every day. All the food items that we eat together are called a ‘Diet’.

Food items in our diet in different seasons

Winter	Summer	Monsoon
- Sesame, jaggery, <i>dink laddoo</i>, ghee etc. - Carrot, beet root - Meat, <i>bhakari</i> (Bajra) - Seasonal fruits - orange, guava, sweet lime, <i>chickoo</i> etc.	- Buttermilk, curd, lemon water, <i>panhe</i>, <i>ambil</i>, coconut water etc. - Salad, <i>varan bhat</i>, <i>bhakari</i> etc. - Seasonal fruits - <i>Bor</i>, banana, mango, jackfruit etc.	- Easy to digest and hot food items, boiled vegetables, tea, <i>khichadi</i>, <i>bhakari</i> etc. - Seasonal fruits - <i>jamun</i>, custard apple etc.

Climate changes in every season and the needs of the body about the diet changes accordingly. In summer, drinking buttermilk, lemon juice, and coconut water reduces the risk of dehydration. It gets colder in winter. It is better to eat energy rich food items like, *bhakari* made of bajra, jowar, *tilgul*, eggs, meat, butter, ghee etc. in winter. Digestion slows down in monsoon. So, eating light and boiled food helps in digestion.

Seasonal fruits and vegetables are nutritious. If we include such food items in our diet, immunity increases and we stay healthy. Mangoes and amala are not available throughout the year. Make a list of seasons and seasonal foodstuff.

Some special foodstuff is necessary to make the teeth and bones strong, for physical activities, to stay healthy and for growth of the body. The food items that fulfil all the needs of our body are together called a **Balanced diet**.

* Food related needs of our body -

- Giving energy to the body.
- Helping the body to grow.
- Fighting against pathogens.
- Keeping the body fit.



◎ **Variety in everyday diet** - Make a list of different food items. There is a great variety in it. However, this variety depends on certain things. The food grains, vegetables and fruits available in that area are foodstuff. The food items are obtained after cooking this foodstuff. The useful components necessary for our body obtained from these food items are called '**Nutrients**'. Even if the components are the same, they can be used differently to make food items with different tastes.

In earlier times, the life of humans was just like wild animals. People only knew to eat whatever food they found in the raw form. They learnt how to make fire, also to make *chulha* and bonfire, then they started eating roasted food. The methods of cooking food using water, using steam and frying were used over the time.

Different methods of cooking food items and use of spices started. Information about dishes from other regions became available. Due to this, people started cooking new dishes. Nowadays, a microwave oven, a small furnace, which cooks food on electricity and refrigerators, which keep the food frozen, are used. Experiments are conducted and many efforts are taken to make new recipes. Therefore, there is progress in cooking or culinary art. Preparing food with different tastes, without any loss of nutrients is an art. This skill is called '**Cooking skill**'.

◎ **Food culture in the past and present** - The daily diet of the local people, food during festivals and celebrations and their food-related habits together called the '**Food culture**' of that place. Since earlier times, using local grains and ingredients to cook food and enjoying meals together as a family has been our food culture. The food items prepared at the time of festivals, weddings or any other programs were different from regular food, but were homemade and same for all. Care was taken to avoid food wastage.

Nowadays, many people ignore these good habits. The food is ordered from outside for feasts or get-togethers. We usually do not have any information about where, by whom and how the food is prepared or whether the ingredients used are of good quality. Sometimes such food turns out to be harmful. Thinking that everyone should eat what they like, many food items like *panipuri*, *chaat* along with ice cream are also arranged. Actually, in this way, food is wasted a lot. It also costs more. From childhood, children start liking various sauces and low-nutrition foods like pizza and burgers. Because of this, weight gain and other diseases start from an early age. The body does not grow properly.

To make food look more attractive, harmful artificial colours and chemicals are added unnecessarily. Eating foods like milk and sour fruits or milk and fish together can cause discomfort. In earlier times, care was taken to avoid this. In today's food culture and practices, there is a risk of unknowingly consuming such incompatible food items. For example, in wedding meals, items like *basundi* and *panipuri* are served together.





Think.

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What are the differences in the food culture in the past and today?

Jowar, wheat, bajra and rice are all different grains. Food items made from them are also different. But the use of all these is similar to our body. The starchy substances present in all these grains are useful to produce energy in our body. These starchy substances are called carbohydrates. Proteins are present in more proportion in different pulses and eggs. Proteins are essential for recovery from wear and tear and growth of the body. **The substances which are important for different needs of the body are called nutrients.**

All the food components are necessary for growth of the body, energy and good health.

- (1) **Carbohydrates** - Provides energy to the body. Carbohydrates are obtained from rice, wheat, jowar, bajra.
- (2) **Proteins** - Essential for growth and repair of the body. Proteins are found in pulses, milk, eggs, soybean and meat.
- (3) **Fats** - Produces energy and are essential for the health of the body. Fats are obtained from oil, ghee, butter.
- (4) **Vitamins** - Present in more proportion in fruits and vegetables. Helps in increasing immunity of the body against diseases.
- (5) **Minerals** - Useful in carrying out essential functions in the body. Minerals of iron and calcium make bones and teeth strong.
- (6) **Water** - Helps to remove unwanted and harmful substances out of the body after digestion of food, regulates the temperature of the body, keeps skin fresh, makes blood flow smoothly etc. Water is essential for all these activities.



Think.

Which are the sources of food that provide water to our body? What will happen if there is less water in the body?

© **Fibres** - These are not digested in our body but are important for maintaining the health of our digestive system as well as for the smooth passage of stools. Fibres are present in high proportion in green leafy vegetables and fruits. It is essential to include them in our diet for a healthy body.



◎ **Millets** – Millets are a type of small sized cereals. Jowar, bajra, *ragi* and *varai* are a few millets. Since 7,000 years ago, millets have been an important part of the human diet. We can eat them with minimal processing. Millets contain nutritious proteins and vitamins. Minerals proteins, carbohydrates, iron, magnesium and fibres are present in pulses.

Millets	Food items
Jowar, Bajra	<i>Bhakari, thalipith, upama, chakali, shev, papad</i>
<i>Ragi</i>	<i>Bhakari, biscuits, papad, kanji, ambil</i>
<i>Rajgira</i>	<i>Chikki, laddoo, khir, lahya</i>

Seasonal change and diet - The scripts called '**Vedas**', written by Indian sages in ancient times, are considered to be the oldest in the world. Out of which the script called '*Rigveda*' was written 3,500 years ago. The information written in the *Vedas* is based on very careful observations of nature and events in life, their interrelation, thoughtful reasoning, and conclusions drawn from those observations. The *Rigveda* contains information about the need to maintain balance between changes in nature and human life and the care that should be taken for it.

The seasons summer, monsoon and winter occur regularly one after the other. In each of these seasons, surrounding temperature, content of water vapour, intensity of sunlight and duration of daylight keep changing. The information about effects of these changes on our body is given in *Rigveda*.

The change from the end of one season to the beginning of another season happens slowly. This change takes place in fifteen days and during this period the effects like the digestion becoming slow, the skin getting dry, are seen. The immunity of the body also decreases. This affects our sleep. The information about the changes to be made in our diet in order to adapt with such changes, importance of applying oil to the body before taking bath, is mentioned in *Rigveda*. The relation between the changes taking place in nature, diet and daily routine is called '**Natural balance**'.

Find information about importance of a traditional bath in which oil is applied to the body before bathing (*abhyangsnan*) during Diwali, *tilgul* made during *Sankranti*, use of neem leaves and flowers on the day of *Gudhi Padwa* for good health.

Sometimes, due to insufficient food or by eating inappropriate food items, the body shows a deficiency of certain nutrients. The diseases caused due to this are called '**Deficiency diseases**'.



- **Let's find.**

The salt obtained from the seawater is used in many regions of Maharashtra. Many minerals are present in this salt obtained from seawater. Iodine is present in it in a small quantity.

Tribal people living in mountains use salt present in rocks. It is called rock salt. This salt lacks in iodine. Due to the deficiency of iodine, many people from this area suffers from disease Goitre. Eating iodized salt is the simple remedy on it.



Salt Pan



Goitre

- In childhood, while the body is growing a large amount of **vitamin 'D'** is required for the proper growth of bones. This vitamin 'D' is available in small proportions in the milk. On exposure to morning sunlight, this vitamin is prepared in our body under the skin in the lower layer. In the past, children commonly showed symptoms like deformity and weakness of the bones in limbs. This disease is called rickets. At that time, elders advised keeping the child in the morning sunlight instead of giving medicine. By doing this within a few days, the improvement was seen in the condition of the child's limbs.
- Due to deficiency of **vitamin 'C'**, skin becomes dry and bleeding of gums is seen. These are symptoms of scurvy. Vitamin 'C' is present in lemon, orange and amla in large proportions. If we include this in our diet, scurvy can be cured.
- Deficiency of **vitamin 'A'** causes poor vision in dim light, leading to night blindness. Eating foods like carrots, spinach, tomatoes, cabbage and papaya for a few days can help overcome this deficiency. Night blindness can be reduced.



The diseases caused due to deficiency of some nutrients, symptoms and diet for its prevention.

Name of disease	Reason	Symptoms	Preventive measures through diet
Night blindness	Deficiency of vitamin 'A'	Poor vision in dim light	Take milk, butter, eggs, egg yolk, mango, papaya, carrot etc.
Beriberi	Deficiency of vitamin 'B'	Fatigue or tiredness and weakness	Take milk, peas, millets and green vegetables etc.
Goitre	Deficiency of Iodine	Increase in size of thyroid gland.	Use of iodized salt for cooking.
Scurvy	Deficiency of vitamin 'C'	Bleeding gums	Take fruits like apple, orange, tomato, lemon etc.
Rickets	Deficiency of vitamin 'D'	Weakening of bones	Include milk and dairy products in your diet.
Weak bones	Deficiency of calcium and phosphorus	Frequent breaking of bones (Fracture)	Take milk and dairy products, eggs, meat and a vegetable rich diet.
Anaemia	Deficiency of iron	The person gets tired soon, looks pale and feels restless	Eat fruits like bananas, grapes, dates and vegetables like spinach.

Can we identify components of food? Try this.

(1) Test for starch -

- Keep some small samples of small pieces of potato, small pieces of chapati or bhakari, chickpeas, peanuts, butter and some milk.
- Add two drops of iodine indicator on each sample.
If the starch is present, the sample will show a blue colour on it, if absent, it will not show blue colour. This is an easy and useful test to identify the presence of starch in foods.

(2) Test for fats - Oily stains are seen on the paper, if we wrap Fritters or Shev in it. Those stains are because of fats present in it.

Take a small piece of some food item. Press it on a piece of paper. If paper is wet, let it dry. Observe paper after some time. **If you see an oily or translucent stain** on the paper, the food item contains fats in it. If the paper remains dry without any stains, it does not contain fats.

(3) Test for proteins - Take a paste of a food sample in a test tube. Add a few drops of 10% sodium hydroxide solution in it and then a few drops of 1% copper sulphate. When you shake the mixture well, you will see dark purple or blue colour in it. Then, the proteins are present. If colour does not change, there are no proteins in the foodstuff. If the test tube is not available then take a saucer used to drink tea or a plastic vessel to perform the test.



- **Introduction to Scientists -**

- **Dr. Coluthur Gopalan - The father of Indian Nutrition Science (1918 - 2019)**

Dr. Coluthur Gopalan was a leading nutritionist in India. Dr. Coluthur Gopalan has received Padmabhushan and many international awards. He studied the nutritional value of Indian food items and conducted fundamental research on malnutrition, deficiency of vitamins and health problems. He established the 'National Institute of Nutrition'. He wrote an important book on 'The nutritive values of Indian foods'. His work influenced the Mid-Day Meal Program in India.



- **Introduction to Scientists -**

- **Dr. Kamala Sohoni (1912 - 1998)**

In the field of Nutrition Science, Dr. Kamala Sohoni is a world-renowned name. She was the first Indian woman to receive a Ph.D. in biochemistry. She studied in depth about nutrients in Indian food items and their nutritive values. Based on that, the book written by Dr. Sohoni '*Ahargatha*' is well known. She especially studied proteins and vitamins in Indian foods. Fresh *neera* contains a high amount of vitamin C and mineral iron. She proved that fresh *neera* is highly nutritious and very beneficial for malnourished children and pregnant women. She was specially invited to work in world famous, Haffkins Laboratory in Cambridge University. She became the first woman director of the Institute of Science, Mumbai.



◎ **A Balanced Diet** - A balanced diet means **the diet, which provides all the essential nutrients required by the body** like carbohydrates, proteins, vitamins, minerals fats, water and fibres as per the need of the body.

➤ **Proper cooking skills for appropriate nutrition:** - If proper care is taken while cooking, then the nutritive values of food items are preserved properly.

- (1) Cut vegetables only after washing them.
- (2) Cook potatoes without peeling them.
- (3) Cut vegetables should be immediately cooked in a required amount of water. Do not use excess water for cooking.

How does food reach from the farm to our plate? Food reaches consumers from the farm. In the kitchen, it is transformed into tasty meals through various recipes. The food is made tasty while cooking it. Finally, the food reaches our plate and we enjoy eating it. The efforts of many people-farmers, workers, sellers and cooks- are behind it. Therefore, it is important to value food and respect it.



What We Have Learnt?

- The food gives us nutrition and energy for working, playing, studying and staying healthy. The food we regularly consume is called our diet.
- A diet based on the crops available and the climate of a particular region is called a Regional diet.
- What brings variety to our daily diet? One ingredient - many food items, as per seasons, needs, use of foodstuff, methods of preparation, regular food and food during festivals.
- The components, which are essential for growth of the body, energy production and to maintain a good health, are **nutrients**. Carbohydrates, proteins, fats, vitamins, minerals, water and fibres are main components of food. Millets, which are rich in all nutrients, should be an essential part of our diet.
- Sometimes, due to insufficient food or by eating inappropriate food items, the body shows a deficiency of certain nutrients. The diseases caused due to this are called '**deficiency diseases**'.
 - (1) Goitre: Due to deficiency of Iodine.
Remedy: Use of iodized salt.
 - (2) Rickets: Due to deficiency of Vitamin 'D'.
Remedy: Sitting in morning sunlight.
 - (3) Scurvy: Deficiency of vitamin 'C'.
Remedy: Use of citrus fruits in diet.
 - (4) Night blindness: Deficiency of vitamin 'A'.
Remedy: Include carrot, spinach, tomato, cabbage and papaya in diet.
- Cooking is an art of preparing tasty dishes using available ingredients through various methods.

Exercises

(1) Fill in the blanks.

- (1) The useful substances that our body get from food items are called
- (2) The substances which contain starch are called as
- (3) helps in removing waste substances produced in the body which are not needed by the body.
- (4) are necessary for the growth and repair of the body.
- (5) enhances the immunity of the body.



(2) Match the pair.

A	B	C
(1) Deficiency of vitamin 'D'	(a) Night blindness	(a) Include citrus fruits in diet
(2) Deficiency of vitamin 'C'	(b) Rickets	(b) Sitting in a morning sunlight
(3) Deficiency of vitamin 'A'	(c) Scurvy	(c) Include carrot, papaya in diet

(3) You are given a solution. How will you prove that it is iodine?

(4) Meena always likes to eat noodles, biscuits and bread. She does not like leafy vegetables, fruits and milk. Now she is suffering from stomach ache and constipation. Which changes she should make in her diet so that these problems will be minimized?

(5) Identify, Who Am I?

- (a) I give strength to the body to fight against diseases. I am present in fruits and vegetables.
- (b) I keep stomach clean. I am a part of vegetables and fruit peels.
- (c) I am the main source of energy. I am found in bhakari, *chapati* and rice.

(6) Make a list of different food items made from potatoes.

(7) What will happen if....

- (a) The food is heated again and again.
- (b) Fruit vegetables are used after peeling them.
- (c) Leafy vegetables are cut and then washed.
- (d) Vegetables are overcooked.
- (e) The water used for boiling vegetables is thrown away.

◎ Projects-

- (1) The packets of different food items are available in the market. The information about ingredients, their proportion in the food items is printed on the packet. Compare the information about components of food item on any two different packets. Determine which food item is more nutritious.
- (2) Find out information about nutritional values of millets.
- (3) Using millets make **My Nutritious Ladoo**, with the help of elders. Present it in class exhibition.



10

Into the Magical World of Magnets



After visiting the science exhibition, Nilu started going home. She was thinking about many experiments and funny things seen there. Nilu decided to make a funny thing she liked the most. What was that funny thing?



There was one small swing. One monkey made of cotton was kept on it. There was plastic plate on the table. In that plate, there were groundnut pods and guavas on one side and some eggs on the other side. If the plate was held so that the pods were in front of the monkey, the swing moved forward towards the plate. When egg side of the plate was brought closer, the swing moved backwards, and came to a stop there. Nilu tried this game four to five times. Without anyone touching it, the monkey comes towards the plate and when an unwanted object is brought near, it moves away ! “Why does this happen?”, Nilu asked her friend, who showed her this magical thing. He answered, “Because of magnet”.

Have you seen a magnet? What happens because of magnet?

Small decorative discs are available in the fair and toy shops. That small disc can be fixed anywhere on the iron surface and can be easily moved to a different position. Observe such disc carefully. You will see a blackish, flat piece similar to a coin attached to it from the backside. If that piece detaches from the disc, it does not stick to the iron surface. That black piece like a coin sticks to the iron. The objects, which are attracted towards iron, are called ‘**Magnets**’.



Things like, small drawing pins, small nails, iron fillings etc. are attracted towards magnets. If the iron article is very big or heavy, then the magnet gets attracted towards it.



Try this.

- Try to get a small magnet used in toys or a big magnet used in laboratories.
- What happens when magnet is taken near some objects from your home like different utensils, coins, cup and saucer, decorative articles, note down your observations.
- Go outside your home and take magnet near different parts of vehicles, dry soil and sand, observe what happens.
- Based on these observations, make a list of the objects, which are not attracted towards magnets. Those would be called non- magnetic substances. Then, what are the substances attracted towards the magnets are called?

There is attraction between magnets and substances made of iron. To make the shiny parts of rings of vehicle lights, door handles, nickel metal is used. The metals like nickel and cobalt are also attracted towards magnets. That means **iron, cobalt and nickel are magnetic substances.**



Think.

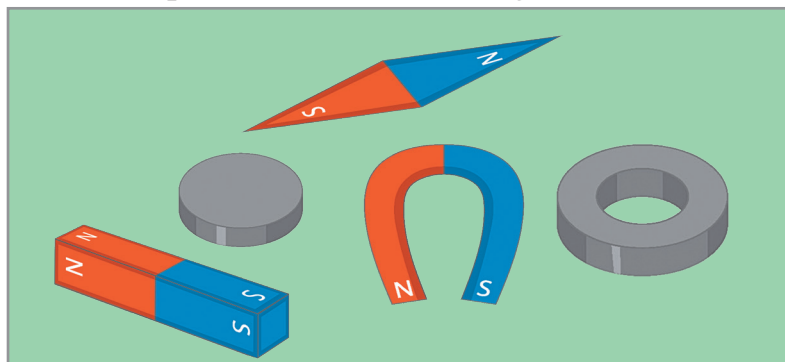
If dry black soil from a barren field is attracted to a magnet, what does it indicate? When and how did humans come to know about magnets?

Are there any uses of magnets other than making decorative discs that stick to iron doors and some toys?

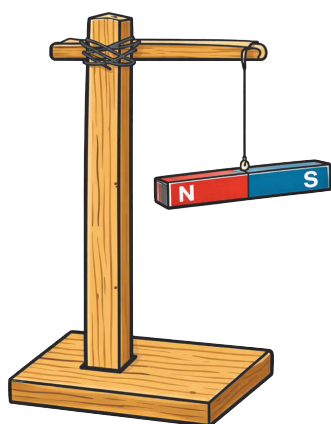
- You must have seen the pumps working on electricity. Small and large pumps are used to draw water from wells and to supply water to farms and cities. Strong magnets are necessary to make such powerful pumps.
- Homes and factories need electric supply. The machines produce electricity using magnets. These machines are called '**Electric generators**'.
- We can withdraw money from our bank account without visiting the bank. Machines for this are available at many places. These machines are called **ATM**. The card used to withdraw money has a thin magnetic strip containing the account holder's information.
- Large hospitals have machines (MRI) that can deeply examine the blood vessels, muscles and the functioning of internal organs without causing any injury to the body. This machine can only work using a magnet.
- Magnets are also used in electronic appliances like headphones, tape recorders and speakers.



Magnets of different sizes, shapes and strengths are required for different purposes. Before the techniques for making them were discovered, magnets made from iron rods or steel strips were used. Such magnets are used in laboratories.



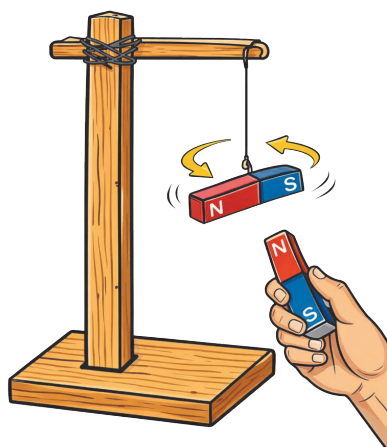
One end of a laboratory magnet is coloured or has a clearly visible coloured dot. This dot is used to indicate a special property of that end.



Take a bar magnet. Tie it with a thread so that it hangs freely in a horizontal position. Hang it with the help of a wooden stand. It will move for some time, then slowly becomes steady. Observe in which direction is its end with colour or dot pointing out. Push the magnet and shift its coloured end to another direction. The magnet will become stable in some time again. Now check in which direction that end points. Try this three to four times. What do you understand from this observation?

Every time that end gets stable in one direction only. That direction is north. It means that at that time the other end of the magnet is at the south. Hence, it is said that a freely suspended magnet always aligns itself in the north-south direction. The end, which points out in the north direction, is called the north pole of the magnet and the end, which points out in the south, is the south pole of the magnet.

Can the north-south position of a freely suspended magnet be changed without applying a force? Take another magnet in hand. Hold it at a certain distance from the end of the suspended magnet. Move the magnet in your hand slowly to the left and right one after the other.



What is the effect of this on a suspended magnet? Now repeat the same activity with the other end of the magnet in your hand near the suspended magnet. **What is the difference in both the observations?**

Instead of a magnet, take a nut bolt, iron cube and lock made of iron near the magnet. Now what do you observe? Why? Did you understand why a wooden stand is used for such experiments with magnets? Tell your classmates what you understood.





Try this.

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- Spread iron fillings or very small iron nails or pins on the paper.
- Take bar magnet horizontally near the objects spread on the paper.
- Lift the magnet and observe which part of the magnet attracts these objects more strongly.
- The force of the magnet, which attracts the magnetic substances, is concentrated in which part of the magnet?



Do You Know?

Nobody knows when and who discovered a magnet. The information about the stone, which gets stable in north-south direction when hung in air and attracts iron towards it, was given in Chinese scripts 2500 years ago. Later, similar information was also found in scripts from some other countries.

The story of the shepherd boy from Turkistan is famous. The shepherd used to take big flocks of goats and sheep to the mountains. To prevent the pointed tip of his stick from wearing out easily, an iron cap was fitted at its end. Some stones from Magnesia, Turkistan stick to this iron cap. There is a story about shepherds who noticed that when a long stone is hung, it remains aligned in the north-south direction.

Historians found a well-polished, long strip-like stone. 3500 years ago, those stones were used to find out directions. The iron ore called magnetite is found in many places. It is found in the soil near the earth's surface at some places. The scientists think that, at such places, reactions occurred due to lightening converted this ore into magnet. The magnetic properties are weak in such stones. These magnets are called natural magnets.

Many techniques were discovered later to make more powerful and big magnets. Magnets made from iron and steel are used at many places. Strong magnets are made from the mixture of aluminium, nickel and cobalt. Those magnets are called alnico magnets.

Factories make magnets using a mixture of a special soil used to make cup and soccer and fine metal powder. Such magnets are called ceramic magnets. These magnets, which are available in different shapes, are of low cost. So they are used for making decorative discs and toys. These magnets are manmade means artificial.

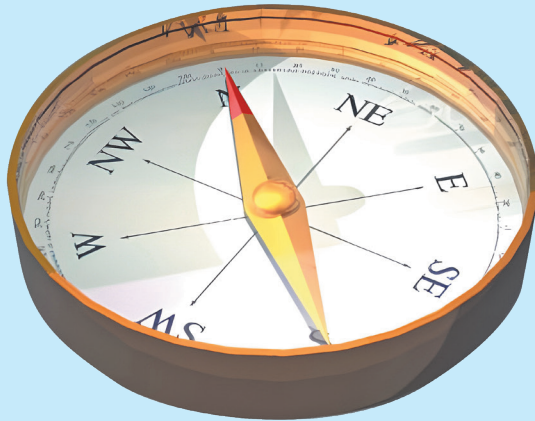


To find out directions while travelling in sea and desert, magnets were used for thousands of years. For that magnetic compass (mariner's compass) is used.



Think.

A magnetic needle that is fixed on support and free to rotate is known as magnetic compass, it is used to find out the directions. You made a magnetic compass using a small plastic box. Ramesh made the same compass using iron box. Which compass will show accurate direction? Why?



What We Have Learnt?

- The substances, which are attracted towards magnet, are called magnetic substances. Iron, cobalt and Nickel are magnetic substances.
- The substances, which are not attracted towards magnet, are called non-magnetic substances. For example - glass, plastic, wood etc.
- The part of the magnet with greater magnetic force are the poles of magnet. Magnet has two poles. The north and south poles of a magnet cannot be separated from each other.
- Magnets with different shapes are made artificially as per the need.
- Like poles of a magnet push each other away. That means like poles of a magnet show repulsion. And unlike poles show attraction.
- Magnets are used in many different devices.
- A magnetic compass is used to find out directions. A magnetic compass works on the principle that a suspended magnet always settles in north-south direction.



Exercises

(1) Think and choose the correct option.

- (1) Which of the following is a magnetic substance?
 (a) Copper (b) Iron (c) Aluminium (d) Silver
- (2) If a bar magnet is taken near iron fillings, then most of the iron fillings stick to of the magnet.
 (a) middle (b) all the parts equally
 (c) both the ends and middle (d) ends
- (3) A suspended magnet settles in direction of the magnet.
 (a) north - south (b) east- west (c) west- south (d) north-east
- (4) Out of the following, which poles of magnet show attraction?
 (a) N – S (b) S – S (c) N – N (d) S – N
 (1) Only option 'a' is correct (2) only option 'b' is correct
 (3) Option 'b' and 'c' are correct (4) option 'a' and 'd' are correct
- (5) A bar magnet is cut in three pieces  Which of the following is the correct position?
 (a)

N	S
---	---

S	N
---	---

S	N
---	---

 (b)

N

--

N

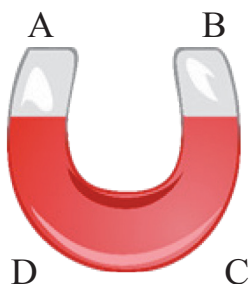
 (c)

N	S
---	---

N	S
---	---

N	S
---	---

 (d) None of the above
- (6) If the magnet shown below is moved above the iron fillings, then at which part most of the iron fillings will stick? Give a reason.
 (a) only A (b) only B (c) C and D (d) A and B



(2) Write whether the following statements are true or false. Correct the false statement.

(1) Stainless steel is a magnetic substance.

(2) Magnetite is a natural magnet.

(3) Identify whether I am magnetic or non- magnetic?



(4) There are a few alphabets in the boxes below. If you make a group of a few alphabets, you will find words related to magnet. A circle is shown around one such word. Find other words and write them in a notebook.

a	s	c	o	m	p	a	s	s
t	t	p	c	q	n	d	x	h
t	e	i	g	t	i	r	o	n
r	e	p	e	l	c	b	j	a
a	l	o	s	t	k	v	n	t
c	r	p	g	n	e	o	k	u
t	c	o	b	a	l	t	c	r
f	t	l	g	y	c	v	u	a
l	p	e	s	b	d	e	i	l
m	a	g	n	e	t	c	o	n



- (5) **Form questions in such a way that the following information will be used to answer them.**

The magnets have two poles north and south. Like poles repel each other. While unlike poles attract each other. The region around the magnet in which the magnetic force is effective is called the magnetic field. The magnets are made using iron, cobalt and nickel. The magnets are used to find out direction, to operate motors and generators, to produce sound in loudspeaker and headphones, in electrical appliances, in refrigerators etc. The magnets are used in waste management to separate magnetic material from the heaps of garbage. In computers, the magnetic strips are used to save information.

- (6) **This toy car is made up of iron. Using a magnet how will you make it move? Write the method and try it.**



- (7) Ramesh took a magnetic compass to an open field. It showed the north direction correctly. He came into a room with the same compass. There was one iron cupboard in one corner of the room. Will the compass show the exact direction in that room? Discuss it with your friends and try it.
- (8) You are given a magnet. The colour or dot is not marked as the pole. How can you identify poles of the magnet using another magnet?
- (9) Keep an iron nail on a table. Slowly bring it near the bar magnet from the distances of 50cm, 30cm, 10cm, 8cm. Observe what happens. What can you conclude about the effect of a magnet on an iron nail?

◎ Projects -

- (1) Make toys that can move using ceramic magnet.
- (2) Make a magnetic compass to identify directions.



11

Force and Pressure

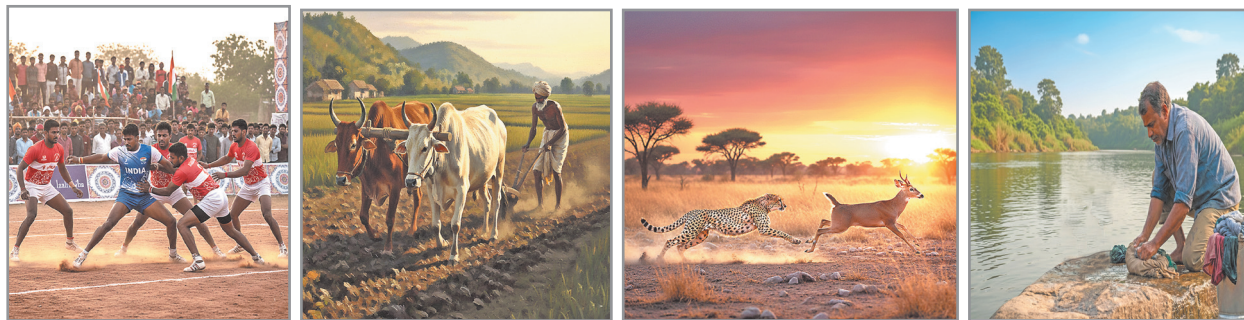


Everyone in the picture is performing some task. It seems to be applying sufficient force for that task. We apply force to push, pull, stop, throw, pick an object and to give pressure on it. We need to apply force while performing the following activities like lifting school bag, pressing light switch, opening compass box, cleaning etc. This effort is known as **‘Force’**. If force is applied on a stationary object, it changes its place. When an object keeps changing its position continuously, it is called a **‘Moving object’**. **A force has to be applied to make a stationary object move. A force is also needed to bring a moving object to rest.**



Types of forces -

☉ Muscular force -



Movement occurs with the help of bones and muscles in the body while performing different tasks, playing games and agricultural activities. **The force applied with the help of muscles is called Muscular force.** Like humans, animals also use muscular force.

☉ **Mechanical force** - The force applied by means of a machine is called **Mechanical force.** Even while working with some machines, muscular force is still required. Make a list of different machines performing different tasks at your home.



What are the above equipments used for?

☉ Gravitational force -



A cut kite, fruits from trees and a ball released from the hand fall to the ground. Throw eraser and a small piece of chalk in upward direction and observe it. Why do objects thrown in an upward direction come down again towards earth? Earth attracts all the objects around it, towards itself. This force is called **Earth's gravitational force**. Due to this force, the speed of an object thrown upwards decreases gradually and then the object comes down again towards earth. The gravitational force acts even on the stationary objects on the surface or ground.





Do You Know?

When we say gravitation, many people remember scientist Newton. However, about 600 years ago before Newton means around 950 years ago, the Indian mathematician Bhaskaracharya (II) wrote a book called *Siddhant Shiromani*. He has written in this book that the earth pulls objects towards itself. Bhaskaracharya did not use the word gravity, but he had already developed an idea and studied this force of attraction in that era.

Sir Isaac Newton was a renowned British scientist who lived about 350 years ago. He conducted many experiments in astronomy, mathematics, physics and made important discoveries in topics such as motion and gravity.

◎ Magnetic force -



Keep some pins, nails, pencils, pen, eraser and keys on the table. Which objects are attracted to a magnet when it is brought near them? It is observed that iron objects are attracted towards magnets. Force is needed to pull these objects. This force is exerted by the magnet. **Thus, the force exerted by a magnet is called magnetic force.**

Magnetic force is used in many appliances.



Think.

The refrigerator door opens only when pulled with a little extra force and sticks tightly when closed. Why does this happen?

◎ **Frictional force** - To make wooden furniture smooth, its surface is rubbed with rough sandpaper. For that sand paper or polish paper is used. Take two pieces of sand paper. Rub its rough surfaces on each other. Now take two pieces of smooth paper. Rub their surfaces on each other. Which paper surfaces have more friction?



We know that the speed of pushed balls, marbles and carrom coins goes on decreasing. When the coins move on the surface of the carrom, there is friction between the surface of carrom board and coins. It reduces the speed of coins. From this, we understand that friction produces a force that opposes motion. This is called **‘Frictional force’**.



Writing with a pencil and erasing it, both happen because of friction. Cycle, scooter and bus have breaks. The speed of the vehicles decreases on applying breaks. Is this useful or harmful for us?



Do You Know?

Immense impact of friction!

NASA is world famous Space Research Organization. This institute has made the spacecraft named as Columbia which can be used again and again for space missions. It was used many times. By the end of 1997, this spacecraft successfully carried out a 16-day space mission for many important tasks such as launching a satellite and conducting experiments in biology and the creation of new materials. Seven astronauts contributed to that success. Dr. Kalpana Chawla served as a mission specialist.



On 16th January 2003, Space Shuttle Columbia set out again on a new mission. With seven astronauts on board, the spacecraft traveled 1,067 lakh km in 16 days. It completed 252 orbits around the earth and carried out many experiments at a greater height. Kalpana Chawla was once again the head of one of the divisions in this mission.

After completing all the planned tasks of the mission, the journey back to earth began. On 1st February 2003, it re-entered earth's atmosphere at high speed. The spacecraft entered the atmosphere at tremendous speed and within a few seconds burnt like a meteor.

Rock pieces from space moving towards the earth at high speed burns up in the atmosphere before they reach the ground. We call this as meteor shower. Even if it is meteor or spacecraft, burning of it is due to friction with atmospheric air. The speed of meteor and a returning spacecraft is tremendous, therefore the friction is also tremendous. The heat produced by this friction is also very high. Many earlier missions were successful. Why did this crisis happen this time? During its flight, a small piece of its heat shield broke off. That small fault led to such a serious consequence.

Along with Dr. Kalpana Chawla, six other astronauts died when space shuttle Columbia disintegrated. This mishap happened because of the tremendous friction!



Try this.

Take one marble. Put it on the floor with the smooth surface. Strike it little with finger. How far did the marble go? Measure the distance. Now put the marble on the tile with rough surface. Strike it as before. Record how far the marble goes on the rough surface. Even though the marble and the force applied to push it are the same, why is the distance covered different?

Friction between rough surfaces is greater than the friction between smooth surfaces. To reduce the friction while machine wheels rotate, substances like lubricants and grease are used. As the frictional force decreases, the speed of machine wheels increases and wear and tear decreases.



◎ Electrostatic force -



Try this.

Make some small pieces of paper. Spread them on the table. Take a plastic comb or ruler from the compass box, rub it on dry hair and bring it near these pieces. Observe what happens. Do the same activity using inflated balloon instead of comb.

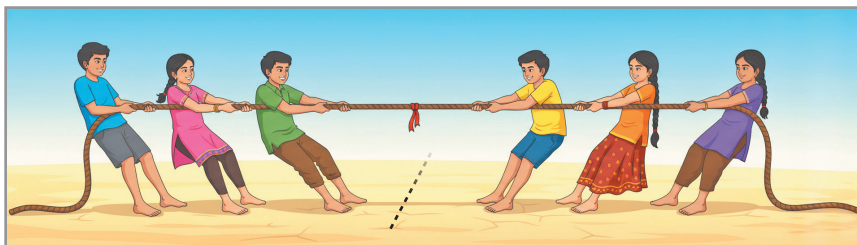
Due to friction, a temporary electric charge is produced on the rubbed surfaces of materials like glass, plastic, rubber and ebonite. This electric charge remains on that surface for some time. It does not flow away. Because of these static electric charges, light objects like paper pieces and threads are attracted. The force produced due to static electric charges is called '**Electrostatic force**'.



Do You Know?

In the rainy season, when we wear or remove nylon or terrycot clothes, we may hear a crackling sound and see small sparks. This happens due to static electricity.

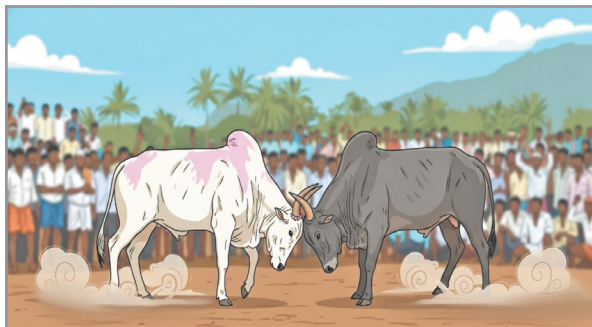
◎ **Unbalanced forces** - In a game of tug of war, even when both sides apply force, when does the rope not move to either side? When does one team win the match? At that time, are the forces applied by both sides equal?



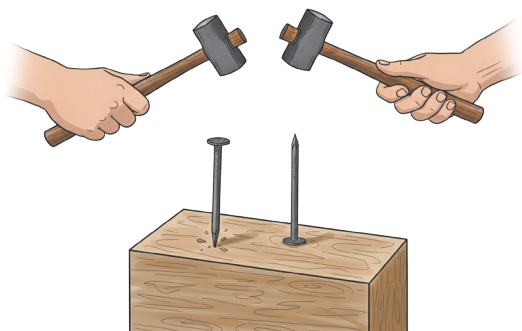
When forces acting in opposite directions are not equal, the effect of the greater force is seen. Forces acting in such situations are called '**Unbalanced Forces**'. Make a list of examples of unbalanced forces seen in day-to-day life.



© Balanced forces -



Puppies are pulling a piece of cloth in opposite directions. Sometimes the piece of cloth is pulled towards one puppy and sometimes towards the other puppy. Sometimes equal forces will act on the cloth in opposite directions. As a result, the combined effect of forces becomes zero. Therefore, the piece of cloth remains in a stable position. Such forces are called **Balanced forces**.



If the tip of a nail is placed on wood and the nail is struck, the effect of the applied force acts on a very small area. At that moment, the nail easily penetrates into the wood. If the blunt or flat end of the nail is placed on the wood and struck, will it go into the wood? When the tip of the nail is broad, the applied force is distributed over a larger area. Therefore, the nail does not penetrate into the wood. It is possible to determine how much force is applied on a unit

area. The force exerted on a unit area is called '**Pressure**'. The following formula is used to measure the pressure.
$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

Measurement of pressure is necessary at large water reservoirs, pumps and the air inside vehicle tyres. For that, the unit newton/metre² is used. Newton is the unit of force and metre² is the unit of area.

The unit newton/metre² is also known as 'pascal'. The units newton and pascal are named in the honour of those scientists.

At fairs, a performer stands on many sharp nails fixed close together on a board. Sometimes they even walk on it. Will those sharp nails not pierce his feet? What is the reason that the nails do not pierce his feet? Can the performer stand on just a single sharp nail on the board? What do you think?

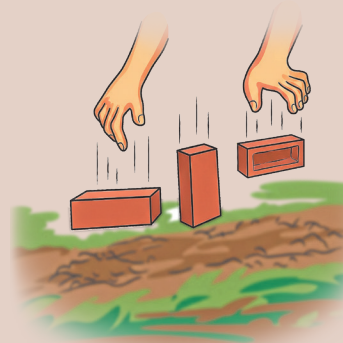




Try this.

Gently drop a brick into wet soil from a small height, as shown in the picture, in both vertical and horizontal positions. Observe the part of the brick that has sunk into the soil.

In which position did the brick sink deeper into the soil? When it sank less, was the contact area with the soil smaller or larger than before? Pressure exerted depends on the unit area. **The pressure is more if the area is less and the pressure is less if the area is more.**



☉ **Atmospheric pressure** - There is an envelope of air around the earth. It is called the atmosphere. The pressure exerted by the atmosphere on the surface of earth can be measured. As we go higher, the atmosphere becomes thinner, so the air pressure decreases. When there is a difference in air pressure between two places, air flows from the region of higher pressure to the region of lower pressure. Large storms also occur due to this.

When we drink water using a straw, we pull the air from the straw. As a result, the air pressure inside the straw decreases. Since the atmospheric pressure on the water surface is higher, the water is pushed into the straw.



Try this.

Take an empty plastic bottle. Open its lid and keep the bottle in warm water for some time. Due to this, some air from the bottle will move out. Then close the lid of bottle tightly and put it in cold water. Observe the bottle carefully. Discuss why this happens.



What We Have Learnt?

- The efforts taken to push or pull an object are called force.
- The force applied with the help of muscles is called muscular force.
- The force applied by means of a machine is called mechanical force.
- Earth attracts all the objects around it, towards itself. This force is called earth's gravitational force.
- The force exerted by a magnet is called magnetic force.
- Frictional force opposes motion. Due to friction, the speed decreases.
- The static electric charges develop on the substances like plastic, rubber and ebonite due to friction. The force produced due to such static charges is called electrostatic force.
- If two equal forces act on an object in opposite directions, the object remains at rest. This condition is called the balanced state of forces. These forces are called balanced forces.
- When the forces acting on an object are not equal, they are called unbalanced forces. In this case, the effect of the greater force is seen.
- The force acting on a unit area is called pressure.
- For the same applied force, pressure increases when the area of contact is smaller and decreases when the area is larger.
- The pressure exerted by the air is called atmospheric pressure.
- When there is a difference in atmospheric pressure between two places, wind flows and storms are formed.



Exercises

(1) Identify, which force am I?

- (a) I am used in different machines like sewing machines, coolers and vehicles.
- (b) All the objects thrown in the upward direction are attracted towards earth because of me.
- (c) Every movement in different games is possible because of me.
- (d) I am used in industries to lift iron scrap material.

(2) Find the correlation.

- (a) The coin struck on a carom board → frictional force
The fruits falling from the tree → -----
- (b) Area of contact increases → pressure decreases
Area of contact decreases → -----

(3) Write the following statements true or false. Correct the false statement.

- (a) Due to Earth's gravitational force, other planets stay in their orbits and revolve around the Sun.
 - (b) As we go higher above sea level, the air pressure increases.
 - (c) When frictional force decreases, the speed of the wheel of the machine increases.
 - (d) The unit of pressure is pascal.
- (4) Carefully observe a sewing machine while stitching clothes on it. Make a list of different forces used in it and write the role of each.
- (5) Write down the tasks that humans can perform by using the muscular force of animals.
- (6) Write down different tasks performed with the help of mechanical force in your surroundings.
- (7) Fruit can be easily cut with the sharp side of a knife, but it cannot be easily cut with the blunt side. Explain, why does this happen.
- (8) What will happen if grease or lubricant oil is not applied to a bicycle chain?
- (9) To prevent skidding on a smooth and wet floor, what precautionary measures can be taken?
- (10) Car tyres and shoe soles get worn out on using for a long duration. What can be the reason behind this?



(11) What will happen in the following situations. Guess...



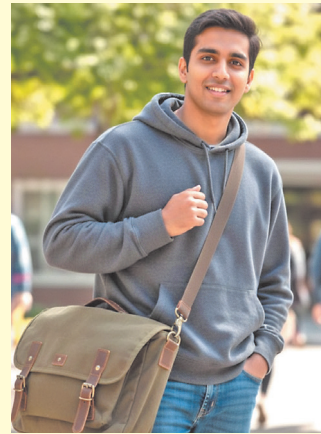
Walking on ice wearing such sandals.



Striking a pointed stone on a bat



A heavy bag with a broad strap on the shoulder.



A heavy bag with a narrow strap on the shoulder.

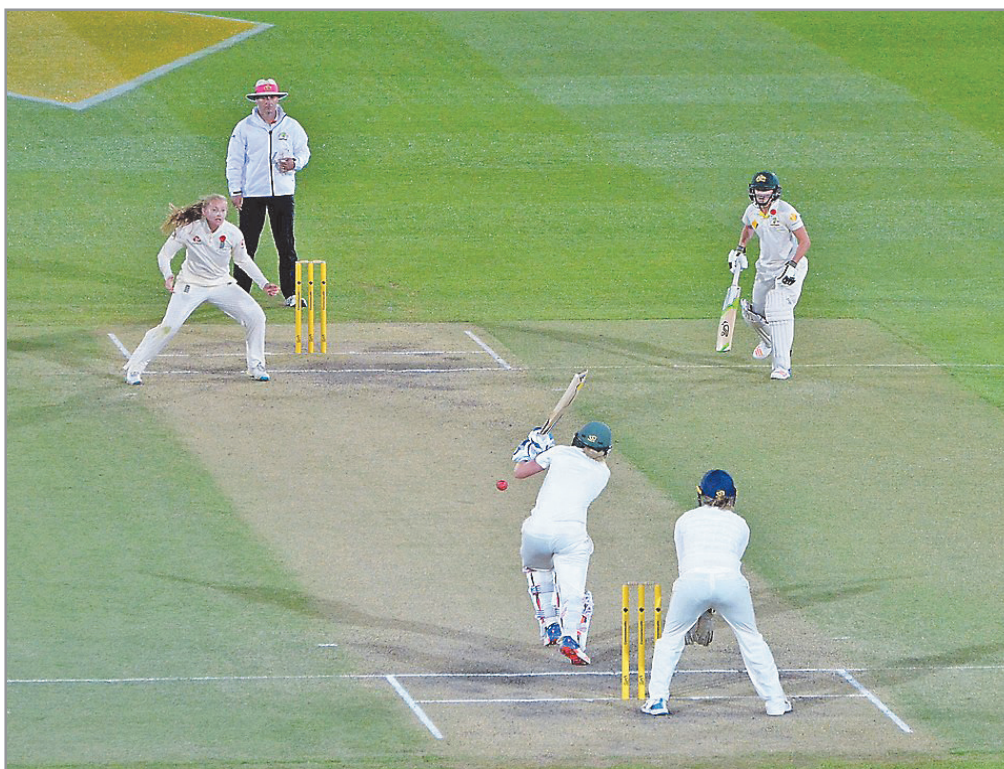
◎ Project -

Collect more information about Dr. Kalpana Chawla and collect pictures of her space missions. Present it in your class.



12

Motion and Types of Motion



You all love to play cricket, enjoy watching cricket matches. What do different players do in this game of cricket? Initially the ball is in the bowler's hand. There, the ball is at rest. The bowler runs up and bowls the ball to the batsman. Here, the position of the ball changes. When the batsman hits the ball with a bat, the ball goes in a different direction. Its position changes again. Sometimes, the ball goes into the wicket keeper's hands. There, the ball becomes steady in his hands. It means the ball is at rest when it is in the hand, otherwise, its position keeps changing.

When the position of an object keeps changing, the object is said to be in motion.



Think.

You are going for an outing by bus. You have kept your bag near your feet in the bus. Throughout the journey, your bag and the passenger next to you were in the same position in the bus. After some time, you reached your destination with your bag. During this journey, which objects were in motion? Which objects were stationary according to you? When you look out of the bus window, trees and houses along the road appear to move backwards. Tell, who all are in motion this time?



You and your bag, both were in the bus. The bag was in same place in the bus. Therefore, the bag did not change its position and it was steady according to you. What would the person watching from outside the bus think?

You reached your destination with your bag. This means the position of the bag has changed. Since the bus is in motion, the bag also gets the same motion. Whether an object is in motion or not is decided based on from where and how we observe it. One person may see an object as moving, while another may see it as steady.

To decide whether an object is in motion or not, we must observe it with respect to a steady object. Position of fixed object is called the **‘Reference point’**. To decide whether any object is at rest or in motion, a fixed reference point is needed.

Observe the objects around you and decide which of them are in motion. Which is the reference point for this? How will you decide which objects are stationary?



Think.

We feel that the trees and electric poles around us are at rest. However, the earth itself keeps rotating around its own axis continuously. It also keeps revolving around the sun. After knowing this, decide if you and everything on earth are at rest or moving.

◎ **Types of motion** - A moving object keeps changing its position continuously. If the position of an object keeps changing in a straight line, it is called **‘Linear motion’**. An object released from a height in downward direction, a fruit fallen from the tree is in motion in a straight line. That means they are in linear motion.

Give examples of linear motion around you. Is the motion of vehicles moving on a road and trains running on rails always linear?

A slingshot and a merry-go-round in a fair move along a circular path. Such motion is called **‘Circular Motion’**. Observe and note where you see circular motion around you.





Think.

Sometimes in our house, many ants gather around a piece of sweets, dead insect. At that time, some people spray salt water to drive them away. Then these ants start running in all directions randomly. Is their motion linear?



Observe.

While stitching clothes using a sewing machine, different parts of the machine keep moving. What kind of motion is seen in all these parts?



While stitching clothes using a sewing machine, the cloth moves continuously forward in a straight line. This shows **linear motion** of cloth. The motion of the wheel on one side of the sewing machine is **circular**. The needle of the machine moves up and down continuously. Observe carefully the movement of the foot pedal and the rod connecting it to the large wheel on the sewing machine. Is the movement at both of its ends the

same? The foot pedal moves up and down, but the end near the axis of the large wheel moves in a circular path.

The movement of the swing is somewhat different. It goes from one end to another and then back and forth again.

The motion of an object that moves continuously up and down or back and forth on the same path is called an '**Oscillatory motion**'. The musical instruments like *sitar*, *tambora* and *veena* have stretched strings. These strings vibrate when plucked. That motion is also an '**Oscillatory motion**'.



You must have seen butterflies flying around flowers in a garden. While flying, they move in different directions in a zigzag manner. Their motion is neither continuously straight nor circular. Thus, the motion of objects moving in different directions is called '**Random motion**'.

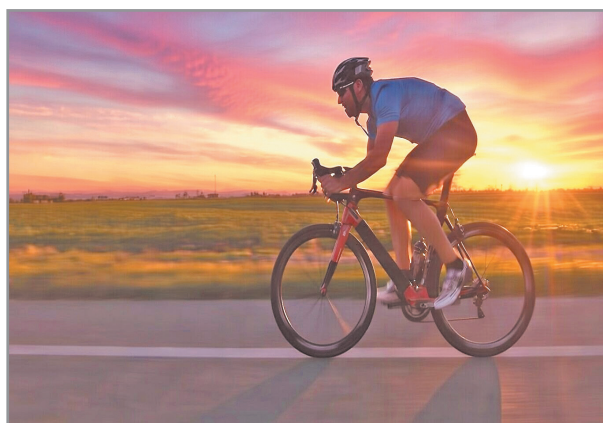
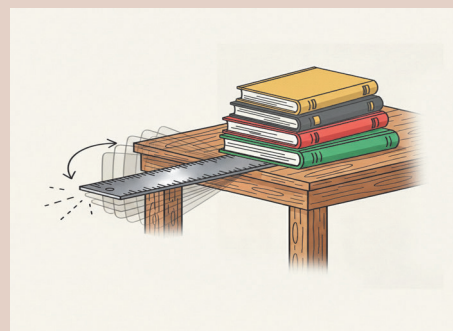
Random motion, circular motion and an oscillatory motion are not in one line. That means they are '**Nonlinear motions**'.





Try this.

Place a thin metal strip on a table so that half of it is on the table and half of it is outside the table. Place heavy objects like notebooks from your school bag or bricks on the part of the strip, which is on the table. Now gently push the part of the strip hanging outside the table downward (as shown in the figure). For some time, that part of the strip will keep vibrating. Observe movement of the strip. Decide what type of motion it has.



When the bicycle is in motion, identify the type of motion seen in its wheels, paddle and chain.

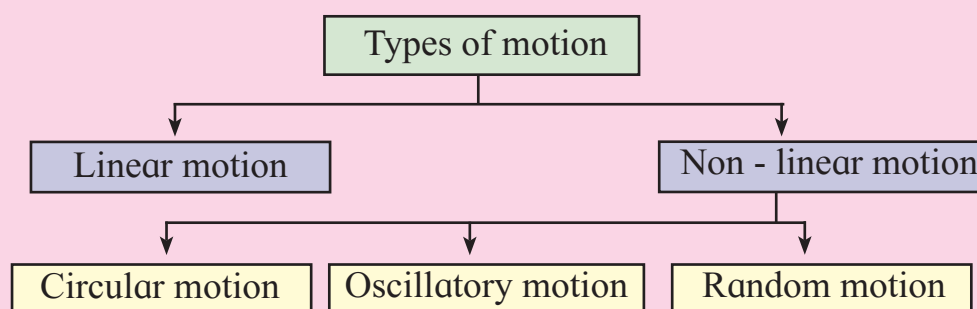


Observe.

Give examples from your surroundings where different types of motion are seen at the same time in one object.

What We Have Learnt?

- When the position of an object keeps changing, the object is said to be in motion.
- While observing a change in position, the observer's position and the reference point are important.
- A person inside the bus feels that the position of passengers and objects have not changed. However, a person outside the bus notices that the position of these object is changing.



- In some events, different types of motion are seen at the same time.



Exercises

(1) Classify the following into linear and non-linear motion.

- (1) A meteor falling from the sky.
- (2) A snake slithering on the ground.
- (3) A rocket launched from the ground into the sky.
- (4) Children running through the seated players while playing kho-kho.
- (5) A friend sliding down a slide.
- (6) An athlete jumps high after running a short distance.

(2) Write true or false. Correct the false statements.

- (1) An object going in a straight line is in oscillatory motion.
- (2) All the parts of a bicycle going along the road undergo linear motion.
- (3) The motion of a giant wheel at a fair is linear.
- (4) At the circus, a swinging act was performed at a height. In the end, the performers released the swing and jumped down onto the safety net below. In this entire act, the motion of performers is an oscillatory motion.
- (5) When a drilling machine starts drilling a hole in wood or a wall, both linear and circular motions can be observed.

(3) Answer in one sentence.

- (1) When do we say that an object is in motion?
- (2) What is the main difference between linear and nonlinear motion?
- (3) What is the motion of a child, sitting on a horse running on a straight road?
- (4) Which type of motion causes diaphragm of a drum to produce sound?

(4) You are on the playground. Write the different types of motions you observe there.

- (1) A boy is walking fast in a straight line, his hands are moving back and forth.
- (2) A girl is rotating her arms from the shoulder.
- (3) A boy is jumping high.
- (4) The motion of a girl skipping and her rope.

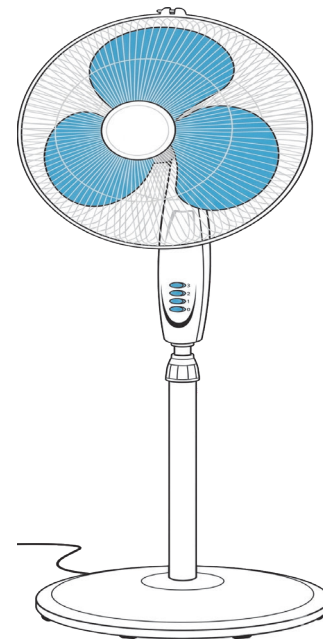
(5) Which types of motion are seen when a bird is flying in the air?



- (6) In the game shown in the picture below, which types of motions are seen in bicycle tyre and the girl?



- (7) 'Every object on the earth is in motion', is this statement true? Justify.
- (8) When a fan is rotating, which parts of the fan show which different types of motions?



◎ Project -

Go to a garden near your house. Observe the different play equipments there. List the types of motion seen in those play items.





In Karnataka, Odisha and Maharashtra, there are many hills of red rocks. A large area of red soil is seen around them. The red soil formed from these rocks in the hills is completely infertile for farming. Crops do not grow well in this soil. What is the use of such infertile soil?

This red colour of the soil and rocks is due to the minerals of iron present in them. By processing this soil, iron and steel can be obtained from it. Even after, meeting the needs of all the industries in the country, a large amount of minerals of iron, remains with us. Every year, many countries around the world buy lakhs of tonnes of minerals of iron from India and use it to produce steel. These countries have big steel making industries, but do not have minerals of iron. Industries run on the minerals we provide. Our country earns several crores of rupees every year from this trade. This trade has been going on for many years. It will continue for the next hundred or two hundred years, as we have large reserves of these minerals. This soil, though infertile for farming, is actually the country's wealth and a valuable asset.

The coastal region of Konkan and areas like Kolhapur and Ratnagiri, also have large hills of different types of red rocks and the soil formed from them. Mineral bauxite is present in this soil and rocks. Aluminium metal is obtained from it. Every year, our country export lakhs of tonnes of bauxite to other countries. Large hills of bauxite are also the country's wealth and asset! When the special properties, importance and uses of such different types of soil were not known, people considered it very insignificant and of no importance. From this, the proverb like 'मातीमोल होणे', this means 'to become worthless' originated. Now, such soil is becoming a valuable asset.

◎ **Soil** - The china clay found in the soil of Bihar and Kerala and *multani mati* in cosmetics found in Rajasthan are used in Industries. Decorative items and idols are made from clay called terracotta. In the past few years, people have started realizing that the soil deposits once considered worthless are actually the wealth of the nation. Humans have not created this wealth. **It is a gift given to us by nature.** That is why such wealth is called '**Gift of nature**'. Fertile black soil that helps crops grow well and the fertile soil formed from river deposits brought by floods, are also natural wealth.



We can easily notice that the soil and crops are not the same everywhere. Some fields have red soil, while some have black. Have you noticed that chilli is often grown in many fields with light whitish soil? Which crops grow well in fields with fertile black soil? Find this information.

Soil with different colours looks different and the texture of soil from different places is also different. Take some soil on your palm and rub it between your fingers to feel it. At some places, the soil is rough like sand or rangoli, while soil formed from river deposits is soft like flour. This is called soil texture. Based on the size of sand-like particles in soil and their proportion, soil can be classified as very coarse, moderately coarse and fine. Some other properties and uses of soil also depend on the texture of soil. Can the soil used for making bricks also be used for making idols? Which items made from terracotta, china clay and *shadu* clay have you seen? What is the colour of *Multani mati* and what is it used for?

For farming and construction, the ability of soil to retain moisture is an important property. The amount of decayed leaves, dung and sand-like particles in the soil determines how much water the soil can hold. This ability is called the ‘**Water-holding capacity**’ of the soil.



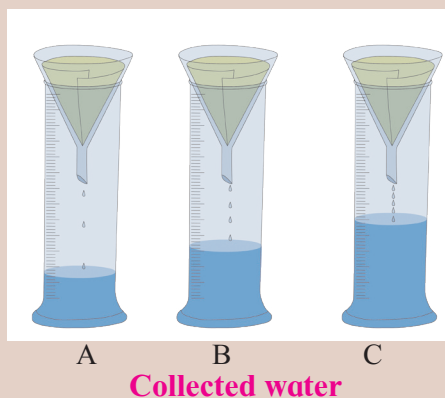
Think.

After tea is prepared, it is filtered, what remains in the strainer? If you press the remaining material in the strainer with a spoon, what happens?



Try this.

- Take three measuring cylinders, three glass funnels, filter papers and water.
- Take (A) clayey soil (B) sandy soil (C) sand each 10 grams or two spoons.
- Fix filter papers in glass funnels as shown in the figure.
- On one of these papers, pour (A) clayey soil on second (B) sandy soil and on third (C) sand.
- Pour 20 ml of water into each funnel and then check how much water remains in each measuring cylinder placed underneath. (If three measuring cylinders are not available at the same time, then perform the same procedure one after another for all three samples and record the observations.) What conclusion will you draw from this?



Besides soil, nature has given us many other types of resources. We often do not realize the importance of some of them and so they are used carelessly and excessively. To understand that it is a valuable resource, we must know its importance. We use water every day. Do we consider it a resource?



☉ **Water** - When we think of the uses of water, everyone remembers its use for drinking, farming and cleaning. **Water not only satisfies thirst but is also the basis of life.**

For what purpose water is used? For bathing, cooking, gardening and cleaning are common answers. Have you ever thought about how much water is required in large quantities to make things that we don't even notice?

From growing sugarcane to producing one kilogram of sugar, many liters of water are required. Think! How many tonnes of sugar are produced in a factory every day? How much water must be used for that? To make paper, wood pulp has to be processed. For that, a large amount of water is needed. Around 340 to 500 litres of water are required to make one kilogram of paper. The same is true for the production of various medicines also. Industrial production and production of essential goods for life is not possible without water. That is why water is a valuable natural resource. Rainwater, groundwater, springs, streams, lakes, rivers and seas are all sources of water.

Water is essential for proper functioning of cells in living organisms. The plants use water to prepare food. Water is needed by living organisms for digestion of food and for transporting nutrients in the body. Sweating helps to regulate the body temperature. Water is essential to throw out the excretory products in living organisms. Even though there is a large amount of water in the oceans on earth, only a small portion is suitable for drinking. In some places, water sources contain more salts, while in others they contain fewer salts. Rainwater does not contain dissolved minerals and salts. This water is collected in rivers, ponds and dams. Thus, the water collected on the surface of the earth is called '**Surface water**'.

Water that seeps into the ground goes deeper into the soil. This water reaches wells and bore wells. This water found below the ground is called '**Groundwater**'.

As water seeps into the ground, many different types of salts dissolve in it. Hence, water from some wells is salty. If certain salts are dissolved in this water, then soap does not form lather in it. Therefore, this water is called '**Hard water**' (i.e. water in which soap does not form lather). Clothes are not cleaned properly with this water. Water in which soap forms a lot of lather is called '**Soft water**'.

It is our responsibility to store water properly and use it carefully. To conserve water, we say '**Save water- Save life**'. Most of the places have scarcity of water. In such places, water has been stored using special methods since ancient times.

Which water sources in your area are known to you? Find information about them.





Do You Know?

In earlier times, tanks were used to store water. These tanks were built with stones on all four sides. They were usually large in breadth and depth. Such tanks are mainly found in old cities from earlier times. In some places, water from such tanks is still in use. In Rajasthan, stepwells known as '*Bawadi*' and in Gujarat, known as '*Vav*' are found. Because their walls are made of stone, the water remains preserved for a long time. Such systems are very useful in areas with water shortage.



Rainwater harvesting is a method of storing rainwater. Rainwater that falls on building rooftops and open grounds is collected and stored in suitable tanks. At some places, instead of storing this water in tanks, arrangements are made so that it seeps a little deeper into the ground. Due to this water released into the ground, the groundwater level increases. As a result, the water in nearby wells and bore wells also increases.



☉ **Marine wealth** - Fish is the main food for many people in the world. Large quantities of fish are obtained from the sea. In addition salt, various minerals, shells and marine plants are also obtained. Valuable metals are found in the sediments of the ocean floor.



This is also a marine wealth

The sand on some seashores contains special substances. That sand is used in various industries. All this marine wealth is a natural resource. Marine sediments are used in various ways for construction and for extracting minerals and metals. In India, the sands along the coasts of Kerala, Tamilnadu, Andhra Pradesh and Odisha contain deposits of valuable minerals.



In some places, deep under the sea and underground, there are deposits of mineral oil and natural gas. These are extracted using different machines. Fuel is obtained from them. That means oil and gas deposits are also natural resources.

Marine Wealth

Sr. No.	Types of marine resources	Wealth	Uses/ Properties
1	Marine biodiversity	Fishes, prawns, crabs, sea-shells	A major source of food, trade and nutrition
2	Minerals	Copper, iron and magnesium from the ocean floor	For factories and industries
3	Oil and Natural gas	Sources of fuel from the ocean floor	For energy production and transport
4	Aquatic plants	Marine algae, iodine	Used in the manufacture of medicines, cosmetics and food products
5	Useful substances	Common salt, some other salts	Food items and daily use



Do You Know?

In many countries, clear skies and sunny days are very rare. On the day when such sunlight appears, people there call it a 'sunny day', meaning a day of sunshine. On such days, people stop their daily work and rush to the seashore or open fields. People try their best to get as much sunlight on their bodies as possible. We receive plenty of sunlight in our country. Sunlight provides the body with heat and vitamin 'D'. In India, the climate is warm. Because we get plenty of sunlight for a long time, different types of crops and plants grow well.

Sunlight: A gift of nature.

Throughout the year, abundant sunlight is a gift given to us by nature. This is also a natural resource. The energy obtained from the sun is called '**Solar energy**'. Since ancient times, people have used the sun's heat to dry grains from fields, dry washed clothes and make salt in salt pans. In the past few years, electricity has been generated in many places with the help of sunlight. Agricultural pumps, as well as lights and fans in homes and many offices, run using this electricity. You may have seen such panel-like sheets that generate electricity in some farms and on the roofs of houses. They are called '**Solar panels**'. In many places, a large amount of electricity is generated using this method. Solar energy is environment-friendly, free and inexhaustible. That is why it is a very important source of energy. In the past few years, the use of devices like solar heaters to get hot water and solar cookers for cooking has been increasing.





Solar Panel

Get information about various devices that run on solar energy. Tell your friends what those devices are used for.

☉ Wind energy -

There is an envelope of air extending several kilometres around the earth. It contains oxygen, carbon dioxide, nitrogen and other components. Air is an essential resource for all living beings.

Some places are always windy. In such places, large windmills are fitted. Due to wind, the windmills rotate. Using this, electricity can be generated. Projects that produce large amount of electricity using many windmills are called '**Wind energy projects**'.



There is a large wind energy project in Maharashtra at '*Chalkewadi*' in Satara district. It is considered as one of the largest wind energy projects in Asia.

☉ **Forest wealth** - Many useful things are obtained from forests. Wood is useful for making furniture. The wood of certain trees is used for making paper, while some are used for medicines. In the last few years, forests have been cut on a large scale in all the countries for building new roads, new cities and factories. At that time, the consequences of deforestation were not considered. As a result, effects such as loss of habitats of many animals and reduced rainfall are becoming visible. Therefore, efforts to increase forests worldwide have begun.



Many products are obtained from forests such as fruits, *hirda*, *beheda*, *shikekai*, gum and medicinal plants. Medicinal extracts are prepared from leaves, flowers, roots and branches of trees. These are used to make tablets and syrups. Many plants like holy basil, *ashwagandha*, aloe vera, *amla*, *hirda* and *beheda* are used for medicinal purposes.



Do You Know?

In India, forests and vegetation are of great importance. In 1973, a movement has taken place to protect forests in India. To oppose deforestation, local women and activists, including Gaura Devi, hugged trees and said, 'First cut us before cutting the trees.' Therefore, this movement is called the 'Chipko Movement'. Sunderlal Bahuguna gave direction to this movement.



About 2500 years ago, a sage named *Charak* lived in India. He studied diseases in humans, their causes and the treatment using medicines prepared from plants throughout his life. From this, he developed a system of treatment. This system is called Ayurveda. Sage *Charak* is the founder of Ayurveda, meaning the one who developed this system. Even today, this system of treatment is widely used all over the world.

The script named '*Charak Samhita*', written by Sage *Charak*, provides detailed information about the properties of medicinal plants, their use in treating diseases, their cultivation and the proportions of different plants to be used while preparing various medicines.

Collect information about the medicinal plants found in your surroundings. Discuss it in class.

Fossil fuels - Many years ago, there were dense forests, wetlands, and vast oceans on the earth. During that time, layers of mud, sand and rocks gradually covered the remains of dead organisms. Over the time, they were buried deep inside the earth. Due to high temperature and pressure, over millions of years these remains transformed into coal, petroleum and natural gas. These are used as fuels for vehicles and industries. Therefore, they are called fossil fuels.



Fossil fuels are mainly of three types: coal, crude oil and natural gas. Coal was formed from remains of ancient plants. It is used as fuel for electricity generation and in industries. In some places, there are oil wells from where oil is obtained beneath the sea floor. We get petrol, diesel, kerosene and tar from crude oil. Petrol, diesel and natural gas are used as fuel for vehicles and for some machines. Natural gas is a mixture of methane and some other gases. It is used as fuel for cooking and electricity generation.



An oil well that extracts oil and gas beneath the sea

Such fuels take millions of years to form underground. The fuels currently used worldwide were formed on earth thousands of years ago. Due to the excessive use of such fuels, harmful substances are mixed in the atmosphere. Moreover, the reserves of oil available today will eventually be exhausted. Therefore, they should be used carefully.



Do You Know?

Due to fuels burning in vehicle engines, some harmful gases are produced. They are mixed in air along with smoke. In metro cities like Mumbai, Pune, Nagpur, special display boards are installed at traffic places to show the levels of such gases present in the air. These boards provide information about the levels of harmful gases in the air at those places, the air temperature and the amount of moisture in the air.

Which fuel-powered vehicles are used in your family and in surroundings?
Which type of fuel is used the most? Discuss.



Natural resources are of three types - renewable, non-renewable and sustainable. '**Renewable resources**' are produced again and again with the help of nature. Example- water, soil etc. '**Non-renewable resources**' means the resources available in limited quantity. It takes thousands of years for regeneration of non-renewable resources. Example- petrol, coal, natural gas etc. Sunlight, wind, waves of sea are never ending. They are always available in nature; such resources are called sustainable means resources that can last for a long time.

What We Have Learnt?

- There are many natural resources like soil, water, sea, sun, air, forests and fossil fuels.
- Water is important for living world. Rainwater, ground water, springs, streams, ponds, rivers and seas are sources of water.
- We get food, minerals and resources for medicine production from sea.
- We can obtain solar energy from sunlight and wind energy from wind.
- Forests are source of food, medicines, gum and many other useful items for our life.
- Fossil fuels are mainly of three types: coal, petrol/diesel and natural gas.
- Natural resources are of three types – renewable, non-renewable and sustainable.

Exercises

(1) Find the correct option and rewrite the statement.

- (1) _____ is more fertile for farming.
(a) Black soil (b) China clay (c) Red soil (d) *Multani mati*
- (2) _____ is fossil fuel.
(a) Sunlight (b) Wind (c) Petrol (d) Water
- (3) _____ is a sustainable source of energy.
(a) Coal (b) Petrol (c) Natural gas (d) Sun

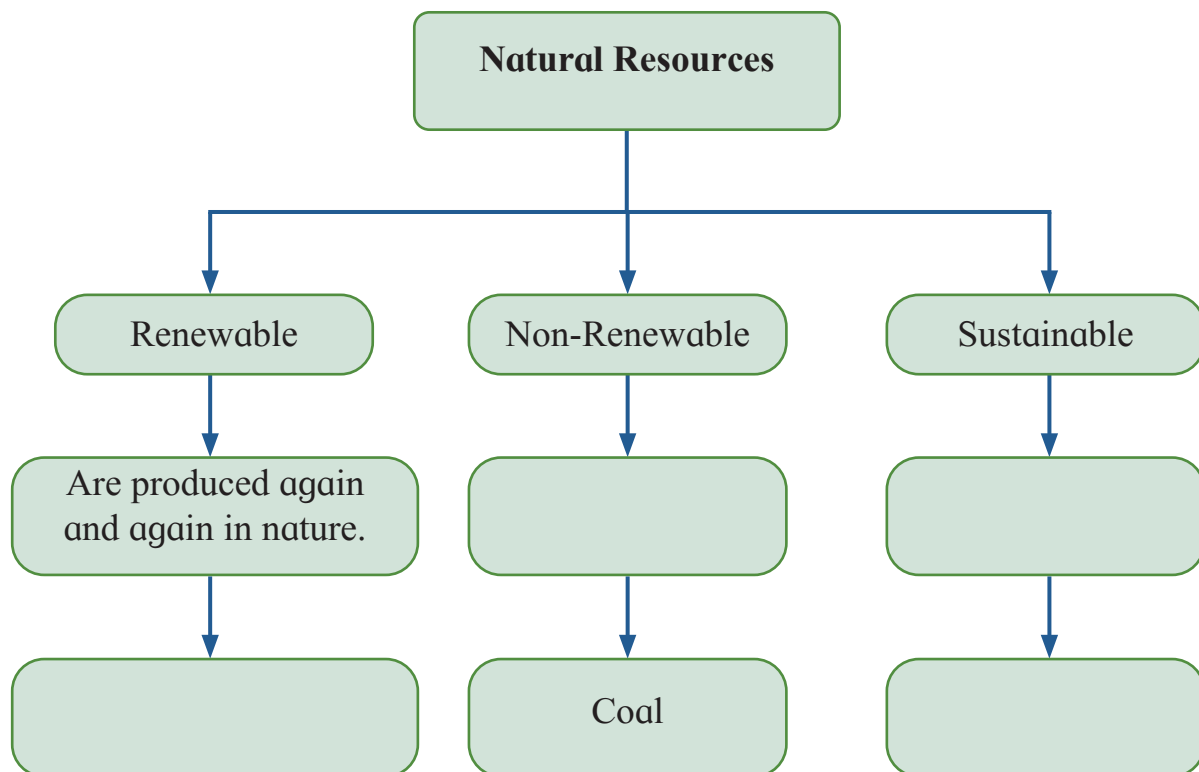


(2) Write whether the following statements are true or false. Give reason.

- (1) There is a lot of water available on land, so use it carelessly.
- (2) Renewable resources are produced again and again.
- (3) Petrol, Coal, Natural Gas are easily available to us.

(3) Match the pair.

Resources (Group A)	Characteristic (Group B)	Example (Group C)
(a) Fossil fuel	(i) Useful for agriculture	(1) Turmeric
(b) Solar energy	(ii) Useful for health	(2) Diesel
(c) Black soil	(iii) Non-renewable	(3) Solar cooker
(d) Medicinal plants	(iv) Sustainable resource	(4) Cotton

(4) Complete the flow chart.

(5) Give scientific reasons.

- (1) It is necessary to store rainwater.
- (2) Solar energy is called an inexhaustible energy source.
- (3) Fossil fuels should be used sparingly.

(6) Answer in short.

- (1) Write about the importance of water and ways to save water.
- (2) What is a natural resource?
- (3) Write in short about the benefits of solar energy and how to increase usage of it.
- (4) Explain in short about types of marine resources and their uses for humans.
- (7) Which type of energy will be beneficial for us in future? renewable or non-renewable, why?
- (8) What should be done to protect and take care of the trees and shrubs in the surroundings?
- (9) If fossil fuels are exhausted, what effects will it have on our daily life? List all the possible effects, you can think of.

☉ Projects -

- (1) Small solar panels are available for science projects. Using them, make some toys and equipments.
- (2) Collect information about 'Medicinal plants and their use' in your surroundings.
- (3) Collect information.
Make three groups of friends from your class. Name each group separately.
Diet group – Collect information about food obtained from sea.
Mineral group – Collect information about different minerals from sea.
Medicine group – Collect information about useful materials, used in medicine production obtained from sea.
Each group will present the information collected in the class.
- (4) Make some decorative and useful articles from clay.
- (5) We can collect different seeds from our home and neighbours. Seeds collected like this are kept in the mud ball and such dried ball is called seed ball. Make such seed balls with your friends. During rainy season, throw these seed balls around your school premises and in your neighborhood to help create a forest.



General Science - Standard Six

Practical

At the middle school level from std. six to eight, General Science subject has been included separately. With the aim of creating curiosity among students and developing experimental skills, the following list of sample experiments is given. Write the practical record using following points – Aim of the experiment, apparatus, diagram (wherever necessary), procedure, observations, conclusion/inference. It is necessary to conduct these experiments at the school level.

Sr. No.	Name of Experiments
1	Study the stages of the life cycle of mosquito with the help of a chart.
2	Measure the temperature of water using a thermometer.
3	Measure the volume of liquid using a measuring cylinder.
4	Measure weight of different objects using a spring balance.
5	Separating the components of a mixture by evaporation, filtration and magnetic separation methods.
6	Observe seeds of different types of plants and classify them.
7	Consider possible disasters in the school environment and study the remedies for them.
8	Study the change of states of water.
9	Determine the density of a substance by using formula.
10	Classify the objects as transparent, semi-transparent and opaque.
11	Study the laws of reflection light.
12	Identify types of forces.
13	Identify the existence of atmospheric pressure.
14	Study the properties of different samples of soil.



Handwriting practice area with 20 rows of dotted lines on a light blue background.



Hello Children!

If you feel uneasy about someone touching you inappropriately, you should not keep quiet. You must :

1. Not blame yourself.
2. Tell someone whom you trust.
3. You can also inform National Commission for Protection of Child Rights through the **POCSO e-box**.

When you get an unsafe touch, you may feel bad,
confused and helpless.
You need not feel “bad” because it’s not your fault.



Press This Button

POCSO e-box available at ncpcr@gov.in

If you are below 18 years of age, and are troubled or confused
or abused or in distress or know some other child who is...

*Call 1098...because some numbers are good!
They change lives!!!*



CHILDLINE 1098 - a national 24 hours toll free
emergency phone service for children in distress is an
initiative of CHILDLINE India Foundation supported
by Ministry of Women & Child Development.



Provide students age-appropriate guidance on recognizing and understanding
good touch and bad touch, ensuring their physical and emotional well-being.



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