1. The Nature of Science

The Nature of Science – Scope – The Nature of Knowledge

Over the course of human history, people have developed many interconnected and validated ideas about the physical, biological, psychological, and social worlds. Those ideas have enabled successive generations to achieve an increasingly comprehensive and reliable understanding of the human species and its environment. The means used to develop these ideas are particular ways of observing, thinking, experimenting, and validating. These ways represent a fundamental aspect of the nature of science and reflect how science tends to differ from other modes of knowing. Science presumes that the things and events in the universe occur in consistent patterns that are comprehensible through careful, systematic study.

Science also assumes that the universe is, a vast single system in which the basic rules are everywhere the same. Knowledge gained from studying one part of the universe is applicable to other parts. For instance, the same principles of motion and gravitation that explain the motion of falling objects on the surface of the earth also explain the motion of the moon and the planets.

Scientific Knowledge is Subject to Change

Science is a process of constructing knowledge. The process depends both on making careful observations of phenomena and on inventing theories for making sense out of those observations. Change in knowledge is inevitable because new observations may challenge prevailing theories.

Scientific Knowledge is Long-lasting

This appears to contradict what was told earlier. But the important fact here is, most scientific knowledge is durable. For example, in formulating the theory of relativity, Albert Einstein did not discard the Newtonian laws of motion but rather showed them to be only an approximation of limited application within a more general concept. Continuity and stability are as characteristic of science as change is, and certainty as prevalent as tentativeness. Hence, there will as many (or even more) uncertain things as things that we are certain of.

Science Cannot Provide Complete Answers to All Questions

There are many matters that cannot usefully be examined in a scientific way. There are, for instance, beliefs that-by their very nature-cannot be proved or disproved (such as the existence of supernatural powers and beings, or the true purposes of life).

Scientific Inquiry

Plato believed that only through the mind we can arrive at reason and truth. Science asks three basic questions. They are:

What is there? (E.g. What is in this stone? What is there in the Moon?)

How does it work? (E.g. How does air help plants to prepare their food?)
How did it come to be this way? (looking at a fossil or a stone).

This is scientific inquiry. Fundamentally, the various scientific disciplines are alike in their reliance on evidence, the use of hypothesis and theories, the kinds of logic used, and much more. Scientific inquiry is not easily described apart from the context of particular investigations. There simply is no fixed set of steps that scientists always follow, no one path that leads them unerringly to scientific knowledge. There are, however, certain features of science that give it a distinctive character as a mode of inquiry. Although those features are especially characteristic of the work of professional scientists, everyone can exercise them in thinking scientifically about many matters of interest in everyday life.

Science Demands Evidence

When a phenomenon is taken for scientific inquiry, theoretical proof of 'how it happens' or 'what is the truth' is not just enough. It needs tangible evidence. The validity of scientific claims is settled by referring to observations of phenomena. Hence, science concentrates on getting accurate data.

Science Is a Blend of Logic and Imagination

Scientific concepts do not emerge automatically from data or from any amount of analysis alone. The assumption has to be connected with conclusions through scientific arguments that conform to the principles of logical reasoning. Sometimes discoveries in science are made unexpectedly even by accident and often by leaps of imagination.

Science Explains and Predicts

The predictions may be about evidence from the past that has not yet been found or studied. A theory about the origins of human beings, for example, can be tested by new discoveries of human-like fossil remains. This approach is clearly necessary for reconstructing the events in the history of the earth or of the life forms on it. It is also necessary for the study of processes that usually occur very slowly, such as the building of mountains or the aging of stars.

Science Is a Complex Social Activity

Scientific work involves many individuals doing many different kinds of work and goes on to some degree in all nations of the world. Men and women of all ethnic and national backgrounds participate in science and its applications. These people—scientists and engineers, mathematicians, physicians, technicians, computer programmers, librarians, and others—may focus on scientific knowledge either for its own sake or for a particular practical purpose, and they may be concerned with data gathering, theory building, instrument building, or communicating.

2. How do Children Learn Science?

The essential feature of science is the spirit of enquiry and discovery and so it becomes the basis for science teaching. An understanding of science requires a definite to minimum of basic factual knowledge and vocabulary and some real experience of investigation coupled with a knowledge and understanding of the ways in which scientific methods are used. Science teaching must engage the children who are curious and question everything. It is understood from the nature of science that it is not just a body of knowledge but a process to develop knowledge. Therefore, science teaching must not be didactic. Often it is the scientist's discovery/invention that is highlighted in content and never the background how he/she arrived at that discovery/invention. The process how they arrived at it is crucial to develop conceptual understanding, inculcate the scientific method of enquiry so this process is to be highlighted/emphasized in the teaching process.

Science is a systematic, careful and continuous inquiry/investigation through, experimentation for verification on validation. Hence, the activities and experiments in the classroom must be designed to nurture and channel curiosity, ask questions, make observations and lead to an open argumentation that leads to evolve the acceptable, accurate solution/conclusion in a democratic way. It is vital that children are prepared through science teaching to construct knowledge and engaged in continuous enquiry to satisfy their innate curiosity. Science and technology is ever expanding/progressing by constant experimentation and verification on validation developing new theories, inventions or sometimes come up with improved version that explains more phenomena thus the quality of flexible attitude is to be fostered to be tolerant to accept others view or to critically appraise and assess it. Scientific concepts knowledge do not emerge automatically they are labour of love of some scientists or group of scientist's commitment to know the unknown. What science accepts as knowledge and recognize as knowledge is after validation, verification though experimentation. The children are to be encouraged to conduct their projects in a systematic and analytical way.

How do Children Learn Science?

Let us see an instance of how children learn science. One day, Ravi and Ramu wanted to fly a kite. They made a kite pasting a few sticks to a piece of paper taken from old newspapers. The tied some thread, went upstairs, observed the direction of the wind, and tried to fly it. But it did not fly. They measured and checked if the knot is alright before they tried it for the second time. Even then, the kite did not fly. They thought that the tail is too short, so they pasted some more pieces of paper to make it longer. This time the kite went up and up but then it came tumbling down. Now they had a clue. They shortened it a bit and then successfully flew the kite.

Observe the above incident carefully. How did the children learn the science behind 'how does a piece of paper transform into a kite and fly in the air?' You wonder whether children will be able to answer questions like: What happens if there is a change in the length or width or both? Why should the sticks be pasted in a certain way? What happens if the point where the thread is knotted changes? Is there a relation between the size of the kite and its tail? Why does not the kite fly in the direction opposite to the wind direction? What kind of thread should be used to fly a kite? Whey does not the kite fly if it is flown from ground instead of the top floor. We also have a doubt whether children will ever think of such things. When children try to fly a kite, they move forward by learning through trial and error and discussing with logical reasoning.

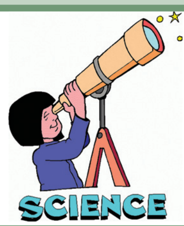
When the kite does not fly, they investigate the problem and come out with some assumptions (hypotheses) and consequently with some 'things to do' to solve the problem. Then they apply them, validate their assumptions and ultimately solve the problem. This is what we mean by thinking scientifically. We call it the Scientific Method. This is the underlying principle of science.

Children by nature have very close relations with their surroundings. They analyze their experiences with the surroundings from their own angle. At upper primary stage meticulous observation, creative solutions to problems and logical reasoning start blossoming in the child, so the objective of school should be to channelize these competencies properly and guide them to learn science.

Everything in the world around us is bound by some principles and laws. Identifying them is the prime objective of science. To know this, questions like Why? What? How? Etc., must be asked. Science is in every work like riding a bicycle, playing cricket, throwing stones to fell fruits, and cooking. Children understand the principles and laws hidden in them in their own way. They generalize in their own style. This demonstrates the need to give a lot of importance to 'learning by doing' in the teaching learning activities developed to teach science. Children learn everything by keen observation and trial and error method. Pedagogically, we call them process skills. Children never do a thing presuming that there is an underlying principle in the work they do which is called science. This means, they give importance to process rather than the product. Learning science depends a lot on this key factor. A scientist does not work to find solutions to a specified problem. New inventions/discoveries are made or new problems arise as s/he goes on exploring. This is done naturally and creatively without any pressure or obligation.

Chapter 1

WHAT IS SCIENCE



It is amazing to think of the facilities available today when compare with primitive man. Computers, mobile phones, internet, space shuttles, robotics, hybrid food grains, medicines, etc are all the results of ideas which originated in some human brains. They are all the people who think differently to observe and understand the nature in a specific way. Let us understand how they think and what they do.

What is science?

Science is the concerted human effort to understand or to understand better, the history of the natural world and how the natural world works, with observable physical evidence as the basis of that understanding.It is done through observation of natural phenomena, and/or through experimentation that tries to simulate natural processes under controlled conditions. Science is a process of thinking.

Science is an organized study of knowledge which is based on experimentation. Science is a tool for searching truths of nature. Science is the way of exploring the world.

Questioning is the primary or fundamental step in scientific thinking. There are so many things around us which sprout doubts in our minds. Ofcourse they may be problems. Let us observe the following experiences, you too add your observations to enrich the list.

1. Why leaves fall from the tree when they turn in yellow?
2. How ants identify sweets kept in a tin?
3. Why can not we see stars during day time?
4. Pickles do not spoil but sambar gets spoilt, why?
5. Farmers are afraid of unseasonal rains and uncontrolled pests. How to solve these problems?
6. Why diseases occur and how to prevent and cure?

Consider some examples. An ecologist observing the territorial behaviors of blue birds and a geologist examining the distribution of fossils in an outcrop are both scientists making observations in order to find patterns in natural phenomena. They just do it outdoors and thus enlighten the general public. An astrophysicist photographing distant galaxies and a climatologist shifting data from weather balloons similarly are also scientists making observations, but in more discrete settings.

The examples above are of observational science. There is also experimental science. A chemist observing the rates of one chemical reaction at a variety of temperatures and a nuclear physicist recording the results of angular momentum of a particular particle in the circular path are both scientists performing experiments to discover consistent patterns emerge. A biologist observing the reaction of a particular tissue to various stimulants is likewise experimenting to find patterns of behavior. These folks usually do their work in labs and wear impressive white lab coats.

The critical commonality is that all these people are making and recording observations of nature, or of simulations of nature, in order to learn more about how nature, in the broadest sense, works. We'll see below that one of their main goals is to show that old ideas (the ideas of scientists a century ago or perhaps just a year ago) are wrong and that, instead, new ideas to explain nature in a better way.

The word science comes from the Latin word *"scientia"*, meaning knowledge.

What does that really mean? Science refers to a system of acquiring knowledge. This system uses observation and experimentation to describe and explain natural phenomena. The term science also refers to the organized body of knowledge people have gained using that system. Less formally, the word science often describes any systematic field of study or the knowledge gained from it.

Why do science?

The individual perspective

Why are all these people described above doing? what they are doing? In most cases, they're collecting information to test new ideas or to disprove old ones. Scientists become famous for discovering new things that change how we think about nature, whether the discovery is a new species of dinosaur or a new way in which atoms bond. Many scientists find their greatest joy in a previously unknown fact (a discovery) that explains some problems previously not explained, or that overturns some previously accepted idea.

The Societal Perspective

If the ideas above said, explain why individuals do science, one might still wonder why societies and nations pay those individuals to do science. Why does a society devote some of its resources to this business of developing new knowledge about the natural world, or what has motivated these scientists to devote their lives to develop this new knowledge?

One realm of answers lies in the desire to improve people's lives. Geneticists trying to understand how certain conditions are passed from generation to generation and biologists tracing the pathways by which diseases are transmitted are clearly seeking information improve the lives of ordinary people. Earth scientists developing better models for the prediction of weather or for the prediction of earthquakes, landslides, and volcanic eruptions etc are likewise seeking knowledge that can help avoid the hardships that have plagued humanity for centuries. Any society concerned about the welfare of its people, which is at the least any democratic society should do, will support efforts like these to better people's lives.

Another realm of answers lies in a society's desires for economic development. Many earth scientists devote their work to finding more efficient or more effective ways to discover or recover natural resources like petroleum and ores. Plant scientists seeking strains or species of fruiting plants for crops are ultimately working to increase the agricultural output that nutritionally and literally enriches nations. Chemists developing new chemical substances with potential technological applications and physicists developing new phenomena like superconductivity are likewise developing knowledge that may spur economic development. In a world where nations increasingly view themselves as caught up in economic competition, support of such science is nothing less than an investment in the economic future.

Lastly, societies support science because of simple curiosity and because of the satisfaction and enlightenment that come from knowledge of the world around us.

Science and Change

If scientists are constantly trying to make new discoveries or to develop new concepts and theories, then the body of knowledge produced by science should undergo constant change. Such change progress towards a better understanding of nature. It is achieved by constantly questioning whether our current ideas are correct or not

The result is that theories come and go, or atleast modified through time, as old ideas are questioned and new evidence is discovered. In the words of Karl Popper, "Science is a history of corrected mistakes", and even Albert Einstein remarked of himself "That fellow Einstein . . . every year retracts what he wrote the year before". Many scientists have remarked that they would like to return to life in a few centuries to see what new knowledge and new ideas have been developed by then - and to see which of their own century's ideas have been discarded.

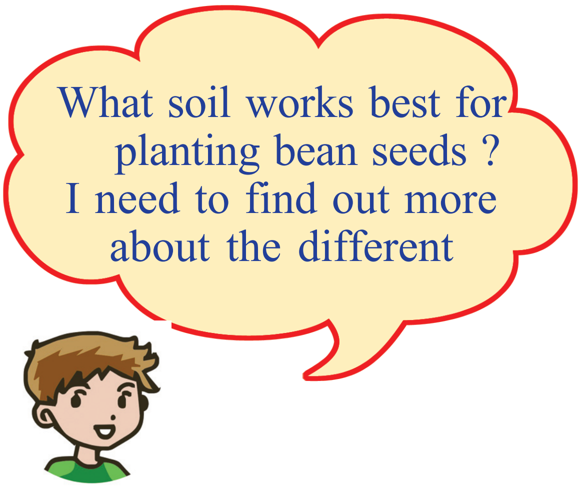
Scientists observe the nature and its laws. They discover the secrets of nature. Based on these discoveries and inventions different innovations take place. Scientists follow a specific way for their innovations. The way that they follow is called *'scientific method'*. Let us find out how they follow

How scientists work - Scientific Method

Planning an investigation

How do scientists answer a question or solve a problem they have identified? They use organized ways called **scientific methods** to plan and conduct a study. They use science process skills to help them gather, organize, analyze, and present their information.

Aravind is using this scientific method for experimenting to find an answer to his question. You can use these steps, too.



Step 1 Observe, and ask questions.

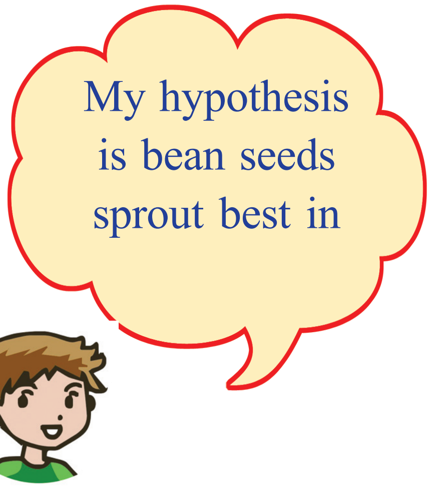
- Use your senses to make observations.
- Record **one** question that you would like to answer.
- Write down what you already know about the topic of your question.
- Decide what other information you need.
- Do research to find more information about your topic.

Step 2 Form a Hypothesis.

- Write a possible answer, or hypothesis, to your question.

  A **hypothesis** is a possible answer that can be tested.

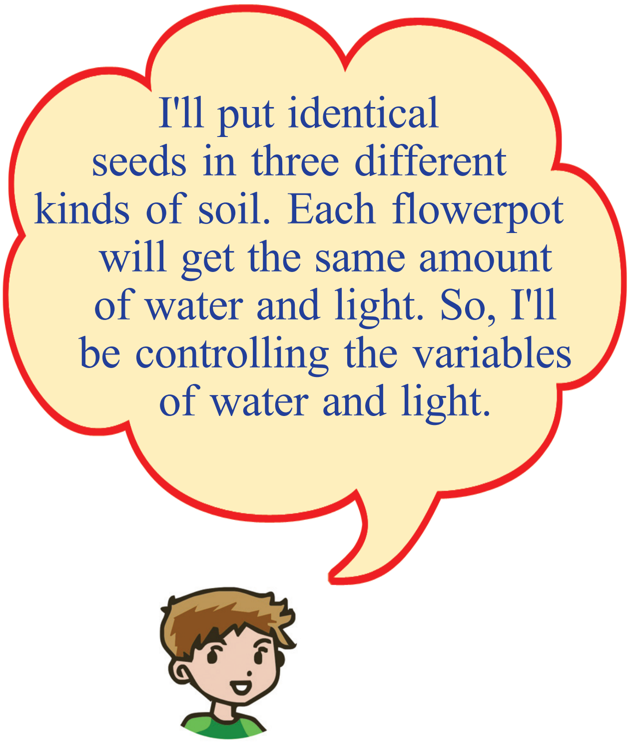
- Write your hypothesis in a complete sentence.



Step 3 Plan an experiment.

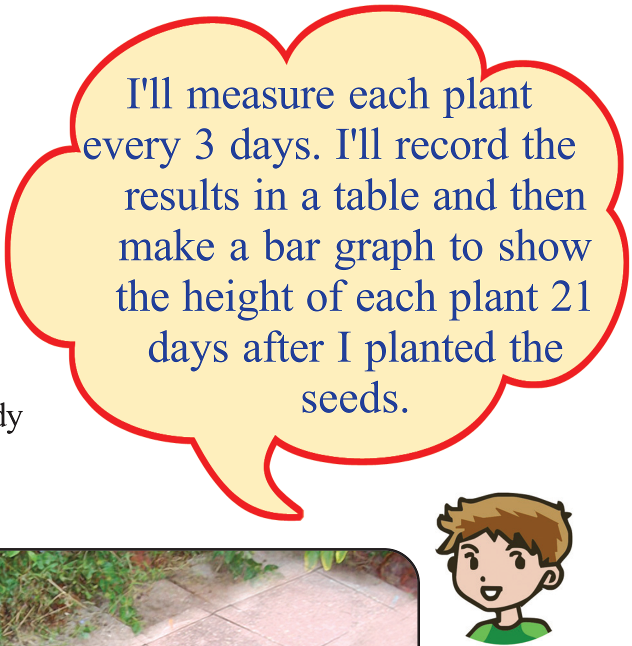
- Decide how to conduct a fair test of your hypothesis by controlling variables.

  Variables are factors that can affect the outcome of the investigation.
- Write down the steps you will follow to do your test.
- List the equipment you will need.
- Decide how you will gather and record your data



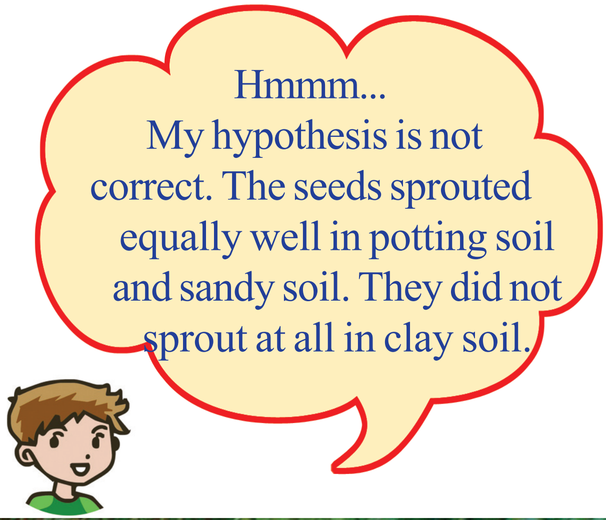
Step 4 Conduct the experiment.

- Follow the steps you have written.
- Observe and measure carefully.
- Record everything that happens.
- Organize your data so that you can study it carefully.



Step 5 Draw conclusions and communicate results.

- Analyze the data you gathered.
- Make charts, tables, or graphs to show your data.
- Write a conclusion. Describe the evidence you used to determine whether your test supported your hypothesis.
- Decide whether your hypothesis is correct or not.



Investigate Further

If your hypothesis is correct…

You may want to pose another question about your topic that you can test.

If your hypothesis is incorrect…

You may want to form another hypothesis and do a test of a different variable.

Do you think Aravind's new hypothesis is correct? Plan and conduct a test to find out!

Using science process skills

When scientists try to find an answer to a question or do an experiment, they use thinking tools called process skills. You use many of the process skills whenever you speak, listen, read, write, or think.

Think about how these students use process skills to help them answer questions, do experiments, and investigate the world around them.

What Saketh plans to investigate?

Saketh collects seashells on his visit to the beach. He wants to make collections of shells that are alike in some way. He looks for shells of different sizes and shapes.

How Saketh uses process skills

He **observes** the shells and **compares** their sizes, shapes, and colours. He **classifies** the shells first into groups based on their sizes and then into groups based on their shapes.

Process Skills

Observe – use the senses to learn about objects and events.

Compare – identify characteristics of things or events to find out how they are alike and different.

Classify – group or organize objects or events in categories base on specific characteristics.

What Charitha plans to investigate

Charitha is interested in learning what makes the size and shape of a rock change. She plans an experiment to find out whether sand rubbing against a rock will cause pieces of the rock to flake off and change the size or shape of the rock.

How Charitha uses process skills

She collects three rocks, **measures** their masses, and puts the rocks in a jar with sand and water. She shakes the rocks every day for a week.

Then he measures and **records** the mass of the rocks, the sand, and the container. She interprets her data and concludes that rocks are broken down when sand rubs against them.

Process Skills

Measure – Compare and attribute of an object, such as mass, length, or capacity to a unit of measure, such as gram, centimetre, or litre. Gather, Record, Display, and Interpret Data

- Gather data by making observations that will be useful for inferences or predictions.
- Record data by writing down the observations in a table, graph, or notebook.
- Display data by making tables, charts, or graphs.
- Interpret data by drawing conclusions about what the data shows.

What Aravind plans to investigate

Aravind wants to find out how the light switch in his bedroom works. He uses batteries, a flashlight bulb, a bulb holder, thumbtacks, and a paper clip to help him.

How Aravind uses process skills

He decides to **use a model** of the switch and the wires in the wall.

He **predicts** that the bulb that the bulb, wires, and batteries have to be connected to make the bulb light.

He **infers** that moving paper clip interrupts the flow of electricity and turns off the light. Aravind's model verifies his prediction and inference.

Process Skills

Use a Model : make a representation to help you understand an idea, an object, or an event, such as how something works.

Predict : form an idea of an expected outcome, based on observations or experience.

Infer : use logical reasoning to explain events and draw conclusions based on observations.

What Swetha plans to investigate

Swetha wants to know what brand of paper towel absorbs the most water. She plans a test to find out how much water different brands of paper towels absorb. She can then tell her father which brand is the best one to buy.

How Swetha uses process skills

She chooses three brands of paper towels. She **hypothesizes** that one brand will absorb more water than the others. She **plans and conducts an experiment** to test her hypothesis, using the following steps:

- Pour 1 litre of water into each of three beakers.
- Put a towel from each of the three brands into a different beaker for 10 seconds.
- Pull the towel out of the water, and let it drain back into the beaker for 5 seconds.
- Measure the amount of water left in each beaker.

Swetha **controls variables** by making sure each beaker contains exactly the same amount of water and by timing each step in her experiment exactly.

Process Skills

Hypothesize – make a statement about an expected outcome.

Plan and Conduct Experiment – identify and perform the steps necessary to test a hypothesis, using appropriate tools, recording and analyzing the data collected.

Control Variables – identify and control factors that affect the outcome of an experiment so that only one variable in a test.

Fig

Reading to learn

Scientists use reading, writing, and numbers in their work. They read to find out everything about a topic they are investigating. So it is important that scientists know the meaning of science vocabulary and that they understand what they read. Use the following strategies to help you become a good science readers.

Before Reading

- Read the Find Out statement to help you know what to look for as you read.
- **Think:** I need to find out what the parts of an ecosystem are and how they are organized.
- Look at the **Vocabulary** words.
- Be sure that you can pronounce each word.
- Look up each word in the Glossary.
- Say the definition to yourself. Use the word in a sentence to show its meaning.
- Read the title of the secion.
- **Think:** I need to know what an ecosystem is. I need to read to find out what the parts of an econosystem are. The heading Different Econosystem gives me a clue that an ecosystem may have both living and nonliving parts.

Let us observe the following table of different species

Flora and Fauna	Name of the species
Plants	Orchids species,sandalwood tree,cycas, medicinal plants, Rauvolfia serpentine etc.
Animals	Leopard, Indian Lion,Indian Wolf, Red Fox, Red Panda,Tiger, Desert Cat, Hyena etc. Gharial, Tortoise, python, Green sea turtle etc. Peacock, Great Indian bustard, Pelican, Great Indian horned bill etc. Golden monkey, Lion tailed macaque, Nilgiri Languor, Loris

Endemic Species

Observe the pictures and identify the animals. Also try to find out where these can be found?

You may find that these animals are specifically found in certain regions of the world.

You are also aware of the fact that many plants and animals are widely distributed throughout the world. But some species of plants and animals are found restricted to some areas only. Plants or animal species found restricted to a particular area of a country are called **Endemic Species.**

- Name an Endemic Species of our State?
- You may notice that kangaroo is endemic to Australia and Kiwi to New Zealand. Can you tell which among the above pictures represent an endemic species of India?

Name some other endemic species of India.

You can take help of books from your school library or internet.

During reading

Find the main idea in the first paragraph.

- Groups of living things and their environment make up an ecosystem.

Find **details** in the next paragraph that support the main idea.

- Some ecosystems have only a few living things.
- Environment that have more space, food, and shelter have many living things.
- Plants and animals in an ecosystem can meet all their basic needs in their ecosystem.

Check your understanding of what you have read.

- Answer the question at the end of the section.
- If you are not sure of the answers, reread the section and look for the answer to the question.

After Reading:

Summarize what you have read.

- Think about what you have already learned about ecosystems and interactions.
- **Ask yourself:** What kind of system is an ecosystem? What interactions occur in an ecosystem?

Study the photographs and illustrations.

- Read the captions and any labels.
- Think: What kind of ecosystem is shown in the photographs?

What are the nonliving parts of the ecosystem?

What living parts of the ecosystem are sown?

Reading about science helps you understand the conclusions you have made based on your investigations.

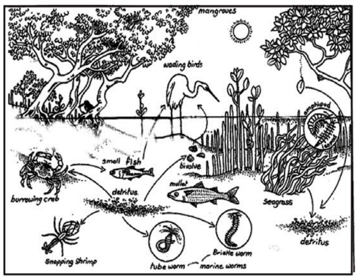
Biotic Components

Producers - magrrove, spirogyra, euglena, oscilatoria, blue green algae, ulothrix, etc.

Cosumers - shrimp, crab, hydra, protozoans, mussel, snails, turtle, daphnia, brittle Word, tube Worm, etc.

Decomposers - Detritus feeding bacteria, etc.

Abiotic components - Salt and fresh water, Air, sunlight, soil, etc.



Food web in Coringa Ecosystem

Do you know? There are over 1000 organisms living on our skin. In the chapter on microorganisms you have already seen the pictures of some of them. The biotic community consists of bacteria, fungi and small arthropods etc. The abiotic factors are dead skin cells, water, salts and oil of our sweat, air etc.

We have studied that

A living community cannot live in isolation. It lives in an environment which supplies its material and energy requirements and provides other living conditions. The living community, together with the physical environment forms an interacting system called the Ecosystem. An ecosystem can be natural or artificial, temporary or permanent.

A large grassland or a forest, a small tract in a forest or a single log, an edge of a pond, a village, an aquarium or a manned spaceship can all be regarded as ecosystem. An ecosystem can thus be defined as a functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment.

(Brochure of CoP-11, Biodiversity Conference, Hyderabad, 1-19, Oct, 2012)

THE DESERT ECOSYSTEM

The desert occupy about 17% of the land and occur in the regions with an average rainfall of less than 23cms. Due to extremes of temperature, the species composition of desert ecosystem much varied and typical. The various components of a desert ecosystem.

Writing to communicate

Writing about what you are learning helps you connect the new ideas to what you already know. Scientists write about what they learn in their research and investigations to help others understand the work they have done. As you work like a scientist, you will use the following kinds of writing to describe what you are doing learning.

In informative writing: you may

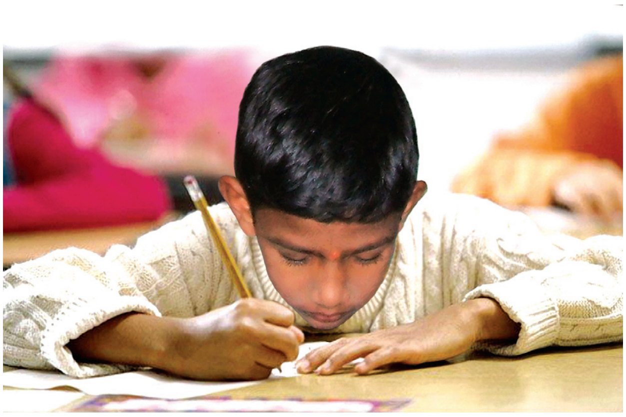
- Describe your observations, inferences, and conclusions.
- Tell how to do an experiment.

In narrative writing: you may

- Describe something, give examples, or tell a story.

In expressive writing: you may

- Write letters, poems, or songs.



In persuasive writing: you may

- Write letters about important issues in science.
- Writing about what you have learned in science helps others understand your thinking.

Measuring

Scientists make accurate measurements as they gather data. They use different measuring instruments, such as thermometer clocks, timers, rules, a spring scale, and balance, and they use beakers and other containers to measure liquids.

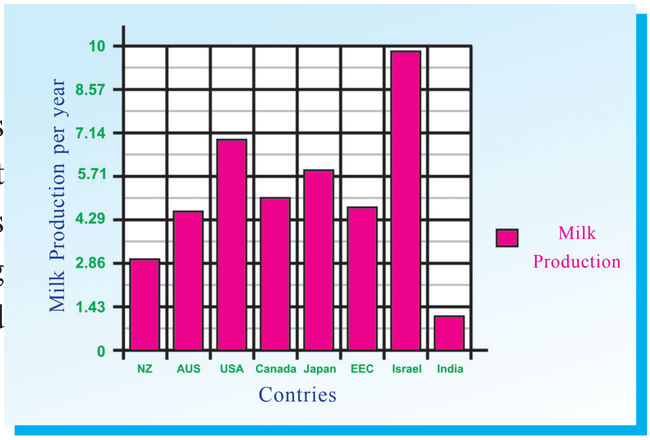
Using numbers

Scientists use numbers when they collect and display their data. Understanding numbers and using them to show the results of investigations are important skills that a scientist must have.

As you work like a scientist, you will use numbers in the following ways.

Interpreting Data

Scientists collect, organize, display, and interpret data as they do investigations. Scientists choosed a way to display data that helps others understand what they have learned.



Tables, charts, and graphs are good ways to display data so that it can be interpreted by others.

Using Number Sense

Scientists must understand what the numbers they use represent. They compare and order numbers, compute with numbers shown on graphs, and read the scales on thermometers, measuring cups, beakers, and other tools.

Good scientists apply their math skills to help them display and interpret the data they collect.

In your school laboratary you will have many opportunities to work like a scientist.

An exciting year of discovery lies ahead!

Safety in science

Doing investigations in science can be fun, but you need to be sure you do them safely. Here are some rules to follow.

1. **Think ahead :** Study the steps of the investigation so you know what to expect. If you have any questions, ask your teacher. Be sure you understand any safety symbols that are shown.

2. **Be neat :** Keep you work area clean. If you have long hair, pull it back so it doesn't get in the way. Roll or push up long sleeves to keep them away from your experiment.
3. **Oops!:** If you should spill or break something or get cut, tell your teacher right away.
4. **Watch your eyes:** Wear safety goggles anytime you are directed to do so. If you get anything fall in your eyes, tell your teacher immediatly.
5. **Yuck! :** Never eat or drink anything during a science activity unless you are told to so by your teacher.
6. **Protect yourself from shocks :** Be especially careful while using an electrical appliance. Be sure that electric cords are in a safe place where you can't trip over them. Don't ever pull a plug out an outlet by pulling on the cord.
7. **Keep it clean:** Always clean up when you have finished. Put everything away and wipe your work area. Wash your hands.

The secrete of inventions and discoveries only lies in identifying the problem. The earth revolves around the sun even before the discovery of Helio centric theory by Copernicus. In the same way the things used to fell down on earth even before Newton's investigations. The meaning behind that were those people thought beyond the common man in identifying the problems. They thought and observe in unique way. We know that necessity is mother of invention, when people needed a mean to travel fast from place to another place discovered vehicles. In the same way to travel more fast we invented supersonic jet planes and even space craft's (to learn more about the development of science go through the book History of science written by F. Cojori).

There is a sequential order in discovering things. Let us observe how your mother cooks, you also can observe how a cycle mechanic repairs a cycle, try to observe how farmer ploughs his field. You will find a systematized pattern in all these things.

Write what you observe about these patterns and discuss in groups.

How do birds and ants find their way home? How trees shed leaves in a particular season? Likewise many more questions might have sprouting in your brain. Try to answer them in your own way. For this you need to follow a sequential order please go through the following…

- Identifying problem - Let us identify any problems from your surroundings
  Ex: The bulb did not lit in the room.
- Making hypothesis - List out different solutions which your think for the identifying problem.
  Ex: De filament, fuse failure, switch problem, wire problem.
- Collecting information- To solve the identifying problem collect material, apparatus, Information, persons.
  Ex: Collect material like tester, screwdriver, wooden scale, wires, insulation tape, table and blade.
- Data analysis - Arrange the collected data or information to conduct experiment.
- Experimentation - To prove selecting hypothesis conduct experiment.
  Ex: Observe filament of the bulb.
- Result analysis - Analyzing the results to find out the solution for the problem based on the results you need to select another hypothesis to prove.
  Ex: Filament of the bulb is good in condition so we need to observe fuse.
- Generalisation - Based on the experiment and its results explain the solution for the problem.
  Ex: Fuse is damaged so the bulb not glow, so we need to replace the fuse.

This is the way to find out solutions for the problems in a scientific way. You may also select such problems and find out your own solutions.

Branches of Science

Science studies various things in nature. While one branch studies plants, another branch studies animals. Let us see some of the branches of science and their field of study. You can also collect some information on this.

S.No	Branch of Science	Field of Study
1	Physics	Physical features of materials like motion, time, gravitation, etc.
2	Chemistry	Structure of materials, properties, reactions, etc.
3	Botany	Structure of plants, growth, diseases, etc.
4	Zoology	Structure of various animals, habits, habitat, classification, etc.
5	Astronomy	Sun, moon, stars, planets
6	Geology	Structure of the Earth, history, minerals, rocks, etc.
7	Agronomy	Cultivating crops, management of land and water resources, etc.
8	Anatomy	Structure / framework of various living organisms, functioning , etc.
9	Anthropology	Life styles/cultures of ancient and modern human beings, etc.
10	Microbiology	Bacteria, virus, etc.
11	Biotechnology	Matters related to genes, hybrid seeds, production of drugs, etc.
12	Entomology	Characteristics of insects, uses, etc.
13	Ornithology	Birds, their ways of living, migration, etc.
14	Psychology	Behaviour of living things, mental state, etc.
15	Seismology	About earthquakes
16	Taxonomy	Classifying living things in animal and plant kingdom in to groups, etc.
17	Paleontology	About plant animal fossils, etc.
18	Ecology	Environment system, etc.
19	Pathology	Various diseases, reasons for diseases, etc.
20	Meteorology	Physical and chemical dynamics of atmosphere, the Earth, oceans, their effects, etc.