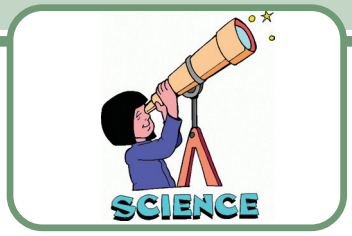
Chapter

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.

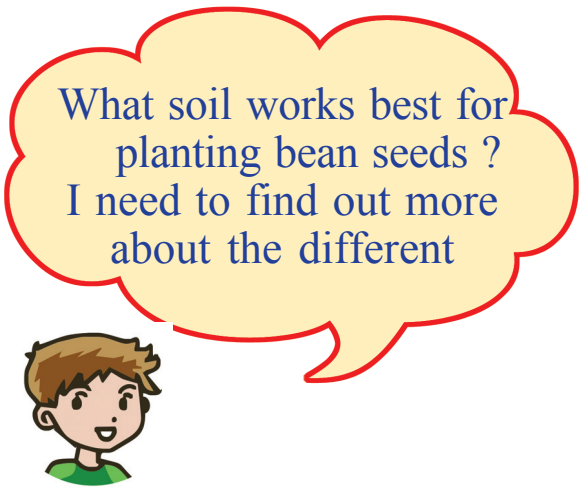
Scientists observe the nature and its laws. They discover the secrets of nature. Based on these discoveries and inventions different innovations take place. Scientists follow a specific way for their innovations. The way that they follow is called *'scientific method'*. Let us find out how they follow

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.

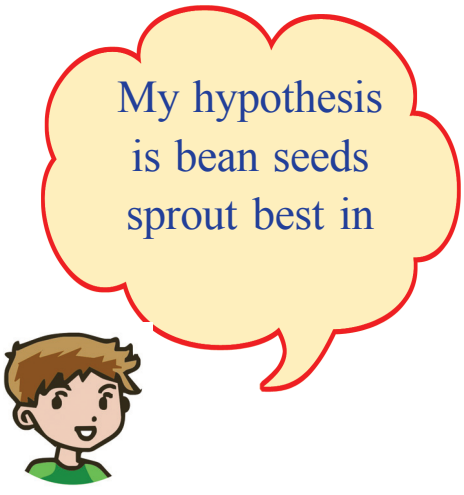
- Use your senses to make observations.
- Record **one** question that you would like to answer.
- Write down what you already know about the topic of your question.
- Decide what other information you need.
- Do research to find more information about your topic.

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

I'll put identical seeds in three different kinds of soil. Each flowerpot will get the same amount of water and light. So, I'll be controlling the variables of water and light.

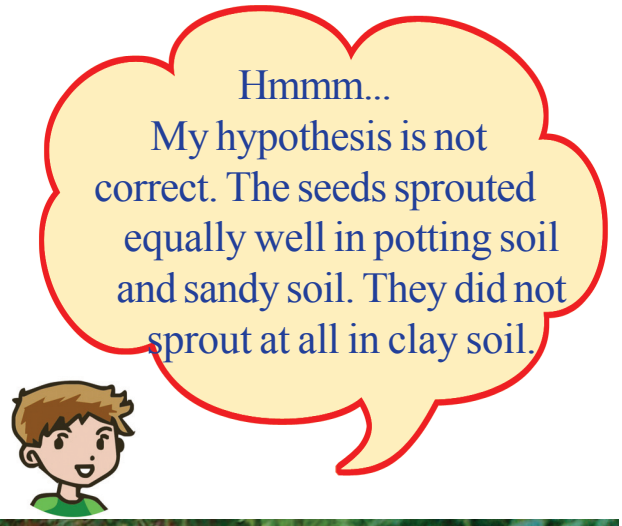
Step 4 Conduct the experiment.

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

I'll measure each plant every 3 days. I'll record the results in a table and then make a bar graph to show the height of each plant 21 days after I planted the seeds.

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.

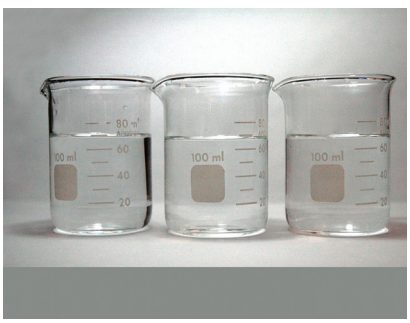
Swetha **controls variables** by making sure each beaker contains exactly the same amount of water and by timing each step in her experiment exactly.

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.