
Phenomenal
SCIENCE
6
STUDENT BOOK
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Pearson

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Content Table

Unit 1

How do science and technology make our lives easier?

Science and Technology

Science and technology are constantly advancing. New designs in the fields of medicine, communications, and engineering help us to achieve things that were once impossible. **Scientists**, just like **engineers**, use methods and processes to come up with solutions to problems or to answer questions. The **scientific method** and the **design process** may be different, but both require research to learn all the necessary information about what is being studied or developed.

Approaching problems using the scientific method begins with a question that needs to be answered and involves **experimentation** and **observation**. The scientific method can vary, depending on the question being asked, but it always has the same underlying mission: to discover the cause and effect of something through asking questions, gathering information, and examining it to try to find a logical answer.

The design process often involves designing a product, program, or process to accomplish a specific task based on certain **criteria**. After defining a problem, research is carried out to determine what is needed and ideas are formed to find a solution. A project often requires building something and **testing** it before completing a final design. Engineers often need to repeat certain steps in the design process before they can find an adequate solution to a problem. This process of repetition is called **iteration**.

Word Box

scientists
engineers
scientific method
design process
experimentation
observation
criteria
testing
iteration

1. **Check (✓) the sentences that are true and cross out (×) the sentences that are false.**
   1. Scientists and engineers use the same process to study and develop ideas and theories. ☐
   2. The scientific method often involves designing a product to help solve an unanswered question. ☐
   3. After a designer tests a product, they are ready to present the final design. ☐

2. **In pairs, discuss what technology you use and how often you use it.**

What is the design process?

Word Box
designers

Define the Problem

The first stage in the design process is to ask *what* the problem or the need is, *who* has the problem or need, and *why* it is important to solve it.

Designers and engineers need to know what technology already exists for the product, program, or process and decide if they want to improve it or create something new. They may carry out research on the internet or read scientific or technological journals. Sometimes, companies will interview people or send out surveys, or questionnaires, to learn people's opinions of a product, program, or process and how it can be improved.

1. **Read the text again and answer the questions for the design in the picture.**

1 What? _____

2 Who? _____

3 Why? _____

Do Research

Researching ideas for a new product, program, or process can take a long time, and it can involve a lot of ideas from a lot of different sources. To carry out useful research, designers and engineers have to be organized so that they can record all their research and ideas without losing important information.

Designers and engineers record information in design notebooks, either handwritten or typed. Information might include sketches and notes. Mind maps are a great visual way of recording ideas and developing them from a central theme. Mind maps can be useful at any stage in the design process.

2. **In pairs, research the different types of computer mice. Use a mind map to record your research. Then discuss which mouse you think is the best and why.**

Develop Possible Solutions

There is not always just one solution to a problem. If a designer or an engineer focuses on just one idea, there is a high possibility that he or she will miss the opportunity to develop an even better one.

Word Box

brainstorming
ideation
pros and cons

At this stage in the design process, therefore, a good designer or engineer will participate in **brainstorming** sessions to come up with multiple solutions to the same problem. This process is called **ideation**, and may also involve sketching the ideas and examining existing solutions to determine which solution is the best.

Also, when deciding on the one solution to later develop, it is important to consider certain points that may affect the success of the product, program, or process.

- How much will it cost to make the product or develop the program or process?
- Are the materials needed readily available?
- Are the necessary skills and resources readily available?
- How long will it take to make the product or develop the program or process?
- Is the product safe? Is the program or process efficient?

3. **In groups, identify the problem shown in the picture and then brainstorm possible solutions.**

Choose One Solution

In order to weigh the different possible solutions, designers and engineers can use different tools. A list of **pros and cons** is helpful to visualize the options. Another tool is a decision-making matrix. This is a table that details the factors you need to consider in the columns and the possible alternatives or solutions in the rows. By giving a score to each criteria/solution, designers and engineers can make a good decision about which solution will work best.

4. **In your notebook, list the pros and cons for one of the ideas from the brainstorming session in Activity 3.**

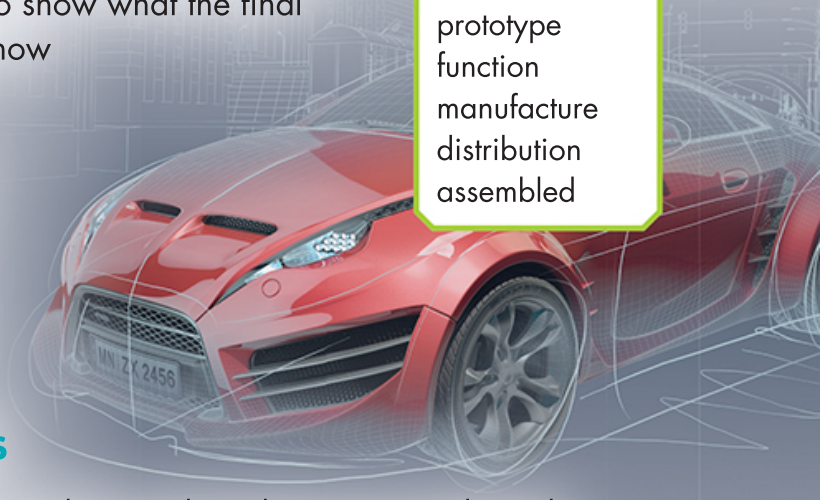
Make Models and Prototypes

Constructing a **model** of a product is an important step in the design process. A model is a **representation** of a final product, often on a smaller **scale** and using cheaper materials. Its purpose is to show what the final product will look like and give people an idea of how it will be constructed.

A **prototype** is a working representation of something, which is designed to test a product's **function** and detect any problems. In addition to showing how a product will look, it may include software or mechanical features to test the product's functionality.

Word Box

model
representation
scale
prototype
function
manufacture
distribution
assembled



Communicate and Evaluate Results

It is important that designers and engineers document their work as they progress through the design process. They should include problems encountered along the way and the steps taken to solve them. This information will be shared with people who will repeat the tests, with people who will offer further advice on how to improve it, and with people involved in the **manufacture** or **distribution** of the product.

There are different ways for designers and engineers to present their work. Depending on the solution they are working on, they may need to list materials, the tools needed to manufacture parts, and detailed instructions on how parts need to be **assembled**. Tables and charts or graphs are helpful ways of presenting information in a clear, visual manner.

Evaluation is the final stage of the design process, but it may mean repeating previous steps to redesign the product, program, or process. There may be questions that still need answering or design flaws that need to be corrected.

Put the pictures in the correct order to show the steps for creating a prototype.

6. **In pairs, discuss the different stages represented in Activity 5.**

Lesson 2

What areas do scientists study?

The Scientific Method

Science covers a very broad area—everything from medicine to energy resources to the latest software on your smartphone. The scientific method involves a process of different activities, from hypothesizing to making predictions to carrying out experiments or observations.

A **hypothesis** is a **speculation**, or assumption, based on knowledge we gather while we look for answers to questions.

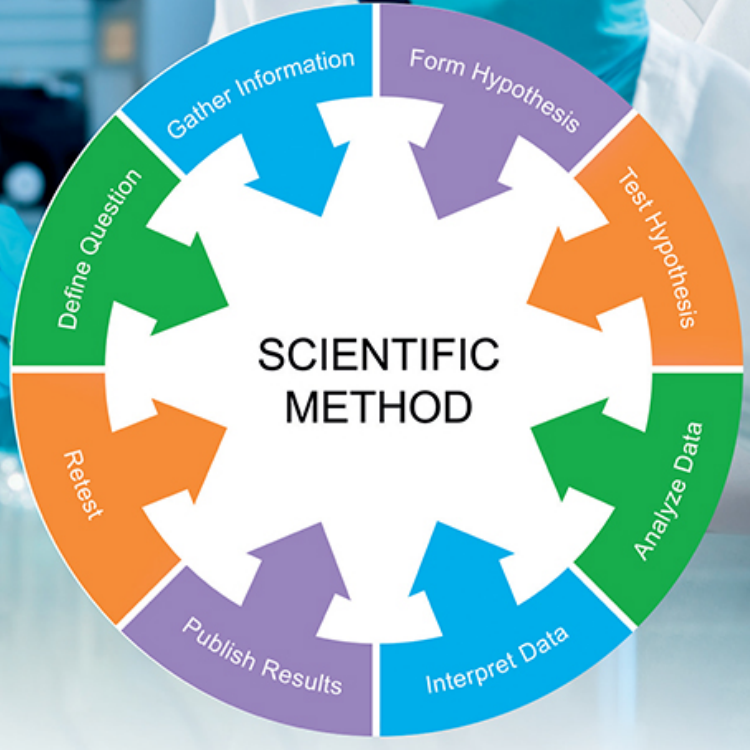
The scientific method usually has from six to eight steps:

- asking or defining questions
- gathering information by doing **research**
- proposing a hypothesis
- experimenting and testing the hypothesis
- recording observations
- analyzing and interpreting **data**
- concluding and publishing results
- retesting, if needed

Scientists, designers, and engineers often work together. They use their combined knowledge to discover existing problems and develop new ways to solve them.

Word Box

hypothesis
speculation
research
data



1. **Think about the 2020 COVID-19 situation. In groups, list and explain the application of the scientific method to find a vaccine or cure for it.**

2. **In pairs, research different kinds of scientists and what their jobs involve.**

Environmental Scientists and Biologists

Word Box

environmental scientists
samples
threats
damage
machinery
specialize
biologist
nutritionists

One of the biggest problems facing the world is damage to the environment, most of which is caused by humans. Industrial processes have a huge impact on the environment, causing pollution of land, air, and water. **Environmental scientists** collect and study **samples** of air, soil, water, food, and other materials so that they can understand the **threats** facing the environment and devise ways to control or stop further **damage**. For example, they can study new ways of producing energy using natural resources, improve **machinery** for manufacturing processes, or research new ways to protect wildlife in their natural habitat.

Scientists **specialize** in different areas of science. A **biologist** studies living things. But there are different types of biologists, and each one has different problems to research and solve. There are plant biologists, animal biologists, and human biologists. The study of plants, animals, and microorganisms can help scientists develop new vaccines and medicines to protect humans from disease. Sports scientists and **nutritionists** study the human body. By understanding how the body works, they can develop products and equipment to improve a person's performance and health.

3. Match the sentence halves.

1	A biologist can study…	a	the human body.
2	Environmental scientists…	b	humans, plants, or animals.
3	Sports scientists study…	c	improve a person's life.
4	New products and equipment…	d	collect and study samples of different materials.

4. Describe situations in which an environmental scientist, a plant biologist, an animal biologist, and a human biologist might be involved.

1 environmental scientist: _____

_____

2 plant biologist: _____

_____

3 animal biologist: _____

_____

4 human biologist: _____

_____

Chemists and Physicists

Word Box
chemistry
physics

Chemists study the composition and properties of matter, which makes up everything in the world. They also work to develop new forms of medicine. The field of **chemistry** is closely related to other sciences such as geology (composition of Earth's components) and ecology (how pollutants affect our environment). Chemists use their knowledge to help solve problems connected to sustainable energy, food production, environmental health, and even materials for clothing and cosmetics.

Physics is the study of how matter moves. Physicists study energy and forces from the smallest atoms to the universe. Physicists use their knowledge to solve everyday problems and help improve technology and invent new ways to make our lives simpler. They work at developing new technologies and solving engineering problems in transportation, architecture, computer and laser technology, medical equipment, and everyday objects that most of us probably take for granted.

5. Label the scientists according to their specialized area.

1 _____ 2 _____ 3 _____

6. Write B (biology), C (chemistry), or P (physics) next to the descriptions of research.

1 skin cream for people who suffer from eczema _____

2 high-speed train that travels through tunnels linking islands to the mainland in Europe _____

3 breakfast bar that contains the daily requirement of vitamins for a healthy diet _____

4 vaccine to protect the public from respiratory diseases _____

5 new form of fuel from renewable energy resources designed to reduce pollution _____

Lesson 3

How does technology help us solve problems?

Using Technology

Word Box
mimicking

By studying the world around us, scientists and engineers are able to create amazing inventions. Airplanes are engineered using technology based on the movement and muscular and skeletal systems of birds, for example. There are machines modeled on the structure and movement of fish, so that they function better underwater. Robots modeled after animals can even help scientists learn about how different species communicate by **mimicking**, or imitating closely, their actions and behavior.

New technology means that we can communicate with others, do business, and complete projects and transactions electronically. This means that we can interact with people and businesses across continents as if we are in the same room. We also have access to a virtual library of global knowledge and different types of entertainment through the internet.

The Sky Whale passenger aircraft concept designed by Oscar Viñals mimics the body of the beluga whale.

The shape of the Japanese Shinkansen high-speed train's front mimics the kingfisher's beak.

The combat drone's design mimics the bat's body.

The design of the McLaren P1™ is based on the aerodynamics of the sailfish.

1. **Circle the correct option to complete the sentences.**
   1 Engineers use technology to mimic the behavior of **birds** / **fish** in aircraft designs.
   2 By studying the movement of **machines** / **sea creatures**, scientists and engineers can improve how vehicles travel underwater.
2. **Choose one of the objects in the pictures above and explain why scientists or engineers decided to use the animal as a model.**
3. **In pairs, discuss other products that were designed with inspiration from nature.**

Technology and the Human Body

Scientists study the human body to help engineers develop new technology that can provide physical help for people in need. False limbs, called **prosthetics**, can replace missing limbs. The first prosthetic limbs weren't very flexible or capable of movement. However, new technology has helped prosthetics to function more like natural body parts. They are capable of intricate movements due to advances in robotic technology. They can even be controlled by **impulses** sent directly from the brain.

Word Box

prosthetics
impulses
nanorobotics
nanotechnology
nanobots

prosthetic leg

Nanorobotics is a technology currently being developed, which involves microscopic robots performing medical tasks inside the human body. It is believed that, through **nanotechnology**, we will be able to inject these **nanobots** into the blood stream. Scientists believe they will one day be used to identify specific diseases, kill cancer cells, and carry life-saving medicine more quickly to specific parts of the human body.

prosthetic hand

4. Write T (true) F (false).

1 Prosthetics are designed to replace missing organs in the body. _____
2 Prosthetics in the past had less functionality than they do now. _____
3 Modern prosthetics have been made possible through the use of robotics. _____
4 Nanobots are drones designed to deliver medical supplies. _____
5 Nanobots can now perform microscopic surgery inside the human body. _____

5. List three examples of how modern prosthetics can help people in ways older prosthetics couldn't.

1 _____
2 _____
3 _____

6. In pairs, discuss what might be possible through nanotechnology in the future.