

Scientific and Technical Texts

1 GETTING THE IDEA

Two important types of nonfiction writing are scientific and technical texts. A **scientific text** is an article, textbook, or experiment related to a scientific concept or topic. **Technical texts** provide detailed information on a specific topic. Technical texts often explain how something works or how to do something. User manuals, how-to guides, instructions, and cookbooks are examples.

Structure

Like most nonfiction texts, scientific and technical texts contain a lot of information. Authors use different text structures to organize the facts and details in a way that helps the reader understand, follow, and remember the information.

A **sequential structure** (also called **chronological order**) presents ideas and concepts in the order in which they happen or should be done. Authors often use time-order words, such as *first*, *next*, *before*, and *after*, and transitions, such as *during*, *while*, and *finally* to indicate the order of events. Alternately, they may use numbered steps to explain a **process**. When a text explains a procedure or gives instructions, it is important to follow the steps in order.

Underline the time-order words and transitions in this example.

The first stage in a butterfly's life cycle is the egg. The next stage is the larva stage. During this stage, the butterfly is shaped like a worm; it eats and grows a lot. The third stage is the pupa stage. The pupa creates a hard shell called a cocoon. While in the cocoon, it grows wings and other body parts. Finally, the adult emerges from the cocoon as a full-grown butterfly.

A **whole-to-part structure** begins with a main idea—the “whole.” Facts and details, the “parts,” explain and support the main idea or concept. This structure is also called **general to specific**. A **part-to-whole structure** is the reverse of a whole-to-part structure.

Circle the “whole” and underline the “parts” in the following sample.

A computer has many parts. The processor is the brain. A monitor displays information. The mouse and keyboard let the user communicate with the computer. The power source provides the energy to keep it all running.

A **spatial structure** describes things in terms of where they are located or the space they occupy. It uses location words such as *above*, *bottom*, *front*, *back*, *east*, and *southwest*. A user manual or science textbook may use this type of structure.

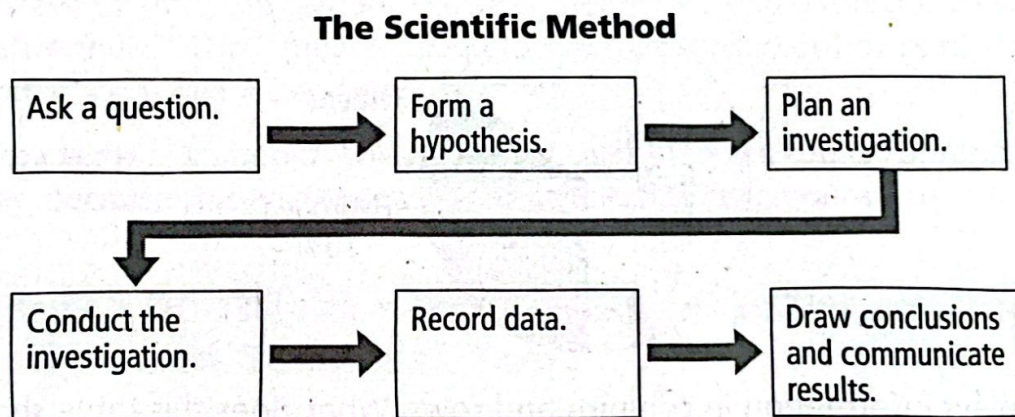
Circle the location words in the following paragraph.

Earth's layers of soil become harder the farther they are from the surface. The surface layer is made up of humus, which is soil with organic material. The next layer is topsoil. Under the topsoil is the subsoil. Below the subsoil is bedrock, which is made up of large, hard pieces of rock.

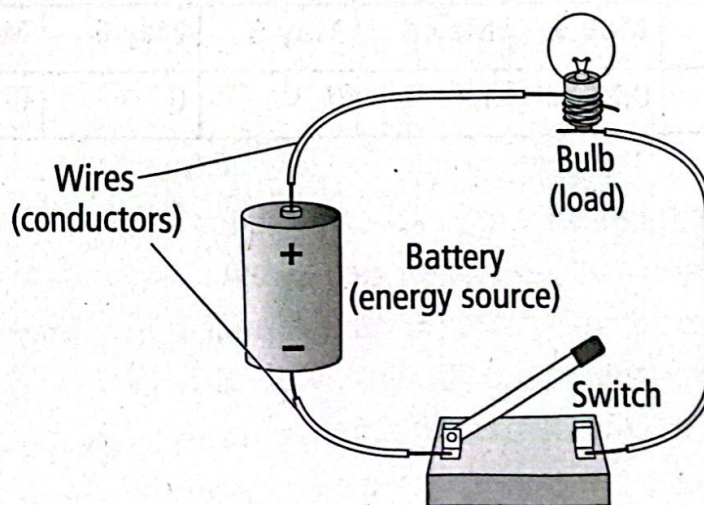
Graphic Features

A **graphic feature** is an image that helps readers visualize information. Some graphic features help explain complex information in the text. Others, such as graphs and tables, give new information in a compact way. Scientific and technical texts use a variety of graphic features. Some common graphics are listed below.

A **flowchart** shows the steps in a process using lines or arrows to connect the steps. This flowchart shows the flow of the scientific method.

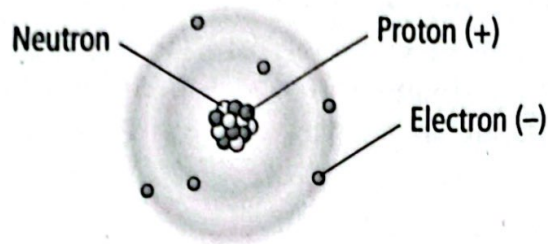


A **diagram** is a drawing that shows the parts of something or how something works. What parts of an electrical circuit does this diagram illustrate?



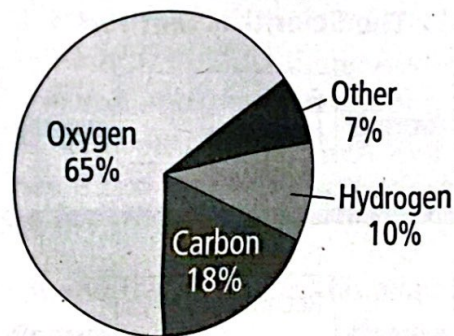
A **model** is a picture or an object that represents a real-life object. The real-life object is usually something too big, small, far away, hidden, or otherwise hard to see. Models that are images, such as this model of a carbon atom, help readers see and examine something that is not normally seen.

Carbon Atom



A **graph** often uses bars or lines to compare or contrast statistics or facts. A **pie chart**, or **circle graph**, quickly shows the parts of a whole. This pie chart shows the distribution of elements in the human body. The segments of a pie chart are colored or shown in different shades to help readers visualize the parts.

Distribution of Elements in the Human Body



A **table** displays information in columns and rows. What does this table show?

Rainfall from May 2–8							
	May 2	May 3	May 4	May 5	May 6	May 7	May 8
Rain (in inches)	0	0.25	1.1	0	0	0	0.4

Author's Purpose and Point of View

An author's **purpose**, or reason, for writing a scientific or technical text is mainly to give information about a topic or explain an experiment or concept. For that reason, most authors approach the topic in an objective way and maintain a neutral tone. However, in some scientific texts, authors may want to persuade readers to try or believe something. For example, a scientist writing an article about his or her experiment may be trying to convince readers that the findings are valid.

Although scientific and technical texts are usually objective and based on known facts, they may contain examples of speculation. **Speculation** is a guess about something that is not currently known. A speculation is usually based on some facts or logic, but it has not yet been tested. For example, many scientists speculate that there are undiscovered forms of life in deep ocean trenches. Though this idea is based on logic and probability, it will remain a speculation until more evidence is uncovered to support or disprove it.

Symbols and Key Terms

Scientific and technical texts may contain symbols and key terms.

- A **symbol** is a picture or letter that represents a word or idea. In the expression -4°F , the symbol $-$ means "negative" and the letter F stands for "Fahrenheit." The $^{\circ}$ means "degrees." When spelled out or read aloud, -4°F means "negative 4 degrees Fahrenheit."
- A **key term** is an important word that relates to the topic. *Fahrenheit* is a key term because it is a science word that tells about temperature.

Language Spotlight • Domain-Specific Vocabulary: Scientific and Technical Texts

Scientific and technical texts contain **domain-specific vocabulary** that has precise meanings for its domain, or area of study. Sometimes a word has a common meaning that is different from its scientific or technical meaning. The word energy has a specific meaning in physics, as in the paragraph below. Find other words in the paragraph that are domain specific and circle them. If necessary, use a dictionary to clarify their meaning.

A rock resting on a hill might not look energetic, but it is. In physics, energy means "the ability to do work." The rock at rest has potential energy, or stored energy. It remains at rest until a force, such as gravity or a push or pull, acts against it. As the rock rolls down the hill, the potential energy becomes kinetic energy, the energy of motion. The rolling rock gains speed and kinetic energy until another force stops it.

Read the passage.

Ben's Fruit Freshness Experiment

A student named Ben wanted to find out more about ways to keep fruit fresh. He knew that foods are often wrapped in plastic wrap to keep air from reaching the food and making it spoil. He also knew that many foods are refrigerated to keep them fresh. So he formed a hypothesis: Will wrapping a fruit in plastic wrap keep it fresher than refrigerating it or doing nothing at all? Then he did the following experiment to test his hypothesis.

Materials

Ben gathered these materials.

- three strawberries, same size and freshness
- 12"x12" sheet of plastic wrap
- three paper plates
- hand lens (optional)

Procedure

This is the procedure Ben followed.

First, Ben examined the three strawberries to verify that they were approximately the same size and level of freshness. Next, he put one strawberry on a plate and placed it in the refrigerator. Third, Ben wrapped a different strawberry in plastic wrap, put it on a plate, and placed it on a counter out of direct sunlight. Then, he put a third strawberry on a paper plate and placed it next to the one in plastic wrap. Ben did not do anything to this strawberry so he could make a valid comparison between the methods he was testing.

For four consecutive days, Ben used a hand lens to observe each strawberry at the same time each day. He noted its color, shape, freshness, and amount of mold and rot.

Observations and Data

Each day Ben recorded his observations in the following table.

	Refrigerator	Plastic Wrap	Doing Nothing
Day 1	unchanged, fresh	unchanged, fresh	unchanged, fresh
Day 2	unchanged, fresh	slightly darker color, fresh	darker color, one spot of mold
Day 3	slightly darker color, fresh	darker color, a little bit of mold	half covered in mold
Day 4	darker color, a little bit of mold	half covered in mold	mostly covered in mold

Conclusion

Ben wrote a conclusion for his experiment.

Refrigeration kept a strawberry freshest for the longest time, with plastic wrap being less effective than refrigeration and more effective than doing nothing at all. Therefore, the results of this experiment did not support the hypothesis that plastic wrap would keep a fruit fresher than refrigeration or doing nothing.

Answer the following questions.

- 1 Why did Ben choose to use a table instead of a pie chart or graph to record his observations?

Write your answer on the lines provided.

Hint Remember what each type of graphic feature is used for. What type of information is Ben gathering and recording?

- 2 The following steps from the procedure are out of order. Write a 1, 2, 3, or 4 next to each statement to show the correct order.

- ☐ Refrigerate one strawberry.
- ☐ Wrap a strawberry in plastic wrap and put it on a plate, put another strawberry on a paper plate, and place both strawberries on a counter.
- ☐ Observe the strawberries for four days.
- ☐ Examine three fresh strawberries.

Hint Look for time-order words and transitions in the "Procedure" section. What order do these words signal?

3

Why did Ben include a strawberry that he did not wrap or put in a refrigerator?

- A. to find out whether mold grows on strawberries
- B. to make a valid comparison between the methods
- C. to include more observations in his table
- D. to practice using a hand lens

Hint

Reread Ben's hypothesis. What was Ben trying to prove? He needed information about strawberries under three different conditions.

4

What was the purpose for writing about Ben's experiment?

- A. to inform
- B. to persuade
- C. to speculate
- D. to entertain

Hint

The way the information is presented is objective and has a neutral tone. What do these characteristics show about the author's purpose?

Use the Reading Guide to help you understand the passage.

Profile in Science: Kavita Shukla

Reading Guide

What is the usual purpose for writing and reading scientific texts? How does the author demonstrate that purpose throughout this passage?

What are some domain-specific words in this passage? Look for context clues to help you determine the meaning of these words.

Why does the author include information on how fruits ripen and rot?

How often do Americans throw away bananas because they are too mushy? Or toss apples that have soft brown spots? The answer is quite often. In the United States, approximately 20 percent of all produce is lost because of spoilage.

A young scientist and inventor named Kavita Shukla is trying to change that. Her story begins with a trip to India to visit to her grandmother when she was twelve years old. During her visit, Shukla accidentally swallowed tap water that was filled with dangerous bacteria. Her grandmother quickly gave her seeds from an herb called fenugreek. The herb worked, and Shukla did not get sick.

When Shukla returned home to Maryland, she thought about the antibacterial properties of fenugreek. Fenugreek is used to flavor Indian cooking, but people in the Middle East and India have used it as a home remedy for stomach ailments. It is known to kill certain bacteria that make people sick. This made Shukla wonder about other ways fenugreek could be used.

How Fruits Ripen . . . and Rot

Shukla found some rotting strawberries in her refrigerator. That got her thinking about the role of bacteria and other microbes in spoilage.

Shukla knew these facts about how fruits ripen and rot: Many fruits, such as bananas, are picked before they are ripe. After a fruit is picked, it continues the functions of the living plant for a time. One of these functions is taking in oxygen and giving off carbon dioxide. The oxygen can trigger the ripening process. The process of taking in oxygen produces a natural plant hormone called ethylene. Ethylene causes the starch in an unripe fruit to change to sugar, making the fruit softer. Ethylene also makes many fruits change color, such as when a banana turns from green to yellow. When most of the starch has changed to sugar, the fruit is ripe.

Reading Guide

What events are described in this passage? Which key words can you use to figure out their sequence?

What text structure is used in the excerpt from the patent? Look for transitions and time-order words.

Shukla received the patent from the U.S. government. The patent gave her the exclusive rights to her invention. What is the author's purpose for writing the excerpt?

The ethylene continues acting on the fruit even after the fruit is completely ripe. At this point, the ripening becomes rotting. As a fruit rots, it becomes soggy. This moisture and the sugar from the ripened fruit provide ideal growing conditions for bacteria, mold, fungus, and other microbes. Some microbes occur naturally on the fruit's skin; others are picked up during harvesting and shipping. The microbes feed on the fruit, which fuels their growth and causes the fruit to decay.

In a partially ripe fruit, stress or injury also triggers the production of ethylene. That is why an area on a fruit that is cut ripens more quickly than the rest of the fruit. A cut lets in oxygen, which hastens the action of the ethylene. It also lets microbes enter the fruit in the same way that a cut in your skin allows bacteria to enter your body. Once the microbes get into the fruit, they begin to feed on it. That causes the area around the cut to get softer sooner.

Shukla Starts Experimenting

Like every good scientist, Shukla began with a question: Can fenugreek be used to preserve foods? Then she tested her hypothesis. Shukla did not find the answer on her first test. For two years, she tried using different amounts of fenugreek on fruits and tested various ways to apply it. Ultimately, Shukla's final answer was described in the patent she received:

A fenugreek extract was prepared by grinding 10 g of fenugreek seeds and soaking the resulting powder in 100 mL of water. A soft sheet of paper was soaked in the resulting solution for two hours, and the sheet was then dried overnight. One strawberry was wrapped in the fenugreek-treated paper and kept in an incubator at 25°C for 120 hours. A different strawberry was wrapped in soft paper soaked in distilled water and dried overnight. This sample was also placed in an incubator at 25°C for 120 hours.

Observations every twelve hours showed that the strawberry wrapped in the water-soaked paper showed significant signs of spoilage after twenty-four hours while the strawberry soaked in the fenugreek-coated paper showed no signs of spoilage until after 120 hours or a longer period of time. Signs of spoilage included growth of bacteria and fungi on the surface of the fruit and loss of natural, fresh color of the fruit.

From US Patent 6372220: Fenugreek impregnated material for the preservation of perishable substances. Inventor: Kavita Shukla

Reading Guide

What effect does fenugreek have on fruits?

How do the subheads help you understand the content of each section?

The results of Shukla's experiments showed that the fenugreek on the paper doesn't affect the ripening process of a fruit. The ripening process is controlled by how much ethylene the fruit produces. What the fenugreek does affect is the presence and growth of microbes.

Shukla's experiments showed that the fenugreek killed or slowed the growth of many microbes that live on the surface of a fruit. Because there are fewer microbes acting on the fruit, the fruit rots more slowly.

The Future Is Fresh

Shukla received her patent for the fenugreek paper in 2002, when she was just sixteen. Today, she heads a company that produces the product, now called FreshPaper.

FreshPaper is inexpensive and easy to produce. Shukla believes that it will have wider applications in developing countries, which have limited access to refrigeration to keep produce fresh. She also thinks that the use of FreshPaper will reduce the estimated 1.3 billion tons of food that are lost to spoilage each year.

Shukla encourages everyone she meets to think about simple ideas. She says that people should never discount their own ideas no matter how basic they might seem. "Simple ideas," Shukla says, "are the ones that have the power to change things."

Answer the following questions.

1 Which structure does this passage **mainly** use to present information?

- A. whole-to-part
- B. part-to-whole
- C. spatial
- D. sequential

2 What was the author's purpose for including the excerpt from Shukla's patent? What do you learn from the excerpt that you do not learn from the main text?

Write your answer on the lines below.

3 The following question has two parts. First, answer Part A. Then, answer Part B.

Part A

Which is the **best** definition for the word microbe?

- A. insects that feed on fruit
- B. tiny living things
- C. small pieces of fruit
- D. insects that feed on other insects

Part B

Which evidence from the passage supports the answer to Part A? Choose **all** that apply.

- A. sugar from the ripened fruit
- B. ideal growing conditions
- C. occur naturally on the fruit's skin
- D. picked up during harvesting
- E. feed on the fruit
- F. lets in oxygen

4 Which sentence from the passage is an example of speculation?

- A. When Shukla returned home to Maryland, she thought about the antibacterial properties of fenugreek.
- B. That got her thinking about the role of bacteria and other microbes in spoilage.
- C. She also thinks that the use of FreshPaper will reduce the estimated 1.3 billion tons of food that are lost to spoilage each year.
- D. Shukla encourages everyone she meets to think about simple ideas.

5 Read the paragraph from the passage.

A fenugreek extract was prepared by grinding 10 g of fenugreek seeds and soaking the resulting powder in 100 mL of water. A soft sheet of paper was soaked in the resulting solution for two hours, and the sheet was then dried overnight. One strawberry was wrapped in the fenugreek-treated paper and kept in an incubator at 25°C for 120 hours.

Choose one symbol from the paragraph and explain what it stands for.
