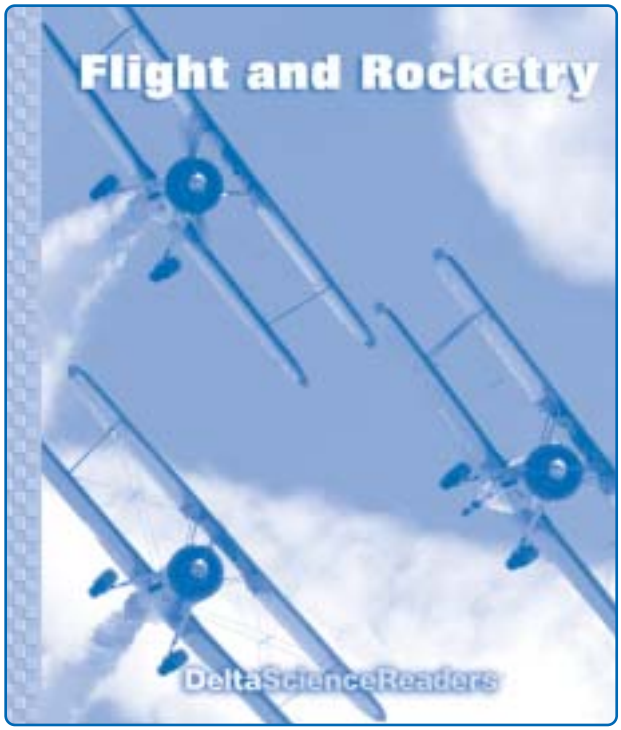
DELTA SCIENCE READER

Flight and Rocketry



Delta Science Readers *are nonfiction student books that provide science background and support the experiences of hands-on activities. Every* ***Delta Science Reader*** *has three main sections: Think About . . . , People in Science, and Did You Know?*

Be sure to preview the reader Overview Chart on page 4, the reader itself, and the teaching suggestions on the following pages. This information will help you determine how to plan your schedule for reader selections and activity sessions.

Reading for information is a key literacy skill. Use the following ideas as appropriate for your teaching style and the needs of your students. The After Reading section includes an assessment and writing links.

OVERVIEW

In the Delta Science Reader *Flight and Rocketry,* students read about the two types of flight—gliding flight and true flight. They learn about both lighter-than-air flight and heavier-than-air flight and about different types of flying machines, from parachutes and airships to jets and spacecraft. They find out about the forces at work in flight and how Bernoulli's principle explains lift. They are also introduced to the Wright brothers, who made the airplane that flew the first powered, controlled flight. Finally, students learn about milestones in the history of flight.

Students will

- read about gliding flight, true flight, flying vehicles, and rocketry
- identify the forces in flight—weight, lift, thrust, and drag—and how they act on an object in flight
- read about the history of flight
- examine nonfiction text elements such as table of contents, headings, and glossary
- interpret photographs and diagrams to answer questions
- complete a KWL chart

READING IN THE CONTENT AREA SKILLS

- Compare and contrast gliding flight and true flight
- Identify causes and effects related to the four forces involved in flight
- Draw conclusions about the forces that act on an airplane
- Identify main ideas and supporting details in text passages
- Describe the steps in the process by which a jet engine creates thrust
- Demonstrate critical thinking
- Interpret graphic devices
- Summarize and paraphrase

NONFICTION TEXT ELEMENTS

Flight and Rocketry includes a table of contents, headings, photographs, illustrations, captions, boldfaced terms, labels, diagrams, a chart, and a glossary.

CONTENT VOCABULARY

The following terms are introduced in context and defined in the glossary: *aerodynamics, aeronautics, airfoil, airship, Bernoulli's principle, controls, drag, friction, glider, gliding flight, gravity, helicopter, hot-air balloon, jet engine, lift, parachute, pressure, propeller, propulsion, rocket, rocketry, rotor, stability, thrust, true flight, weight.*

BEFORE READING

Build Background

Access students' prior knowledge of flight and rocketry by displaying and discussing the cover. Ask, *Do these planes look like modern planes or planes from long ago?* (planes from long ago) *How are they different from modern planes?* (They have two pairs of wings, one above the other.) *Where might you see planes like these today?* (Accept reasonable responses, such as at an air show or in a museum.) Invite students to share their experiences of flying in airplanes.

Read the title aloud, and invite students to share what they know about the topic from their personal experiences and hands-on explorations in science. To stimulate discussion, ask questions such as these: *What are the names of some types of aircraft? What do you know about how they work? What makes them able to fly? What kinds of forces do you think act on an airplane?*

Begin a group KWL chart by recording facts students know about flight and rocketry in the K column and questions they have about the topic in the W column. You may want students to copy the KWL chart so they can maintain their own charts as they read.

K What I Know	W What I Want to Know	L What I Learned	+ What I Want to Explore Further

Preview the Book

Explain that when students preview nonfiction, they should look at the title, the table of contents, headings, boldfaced words, photographs, illustrations, charts, graphics, and captions.

Then preview the book with students. Call attention to the various nonfiction text elements and explain how they can help students understand and organize what they read. Ask questions such as these: *How do the headings help you predict what you will read about? What do you see in this picture? How do you think it will help you understand the text?* Explain that the words in boldface type are important words related to flight and rocketry. Point out that these

words are defined in the glossary. Choose one word and have students find its definition in the glossary.

Preview the Vocabulary

You may wish to preview some of the vocabulary words before reading, rather than waiting to introduce them in the context of the book. Possibilities include creating a word wall, vocabulary cards, sentence strips, or a concept web.

For example, have students categorize words. List words from the glossary that can be grouped in different ways, such as *controls, drag, lift, propeller, rotor, thrust,* and *weight.* After helping students define the words, ask, *Into what groups can we put these words? What would be a good name for each category?* (Forces—drag, lift, thrust, weight; Aircraft Parts—controls, propeller, rotor)

Set a Purpose

Discuss with students what they might expect to find out from the book, based on their preview. Encourage them to use the questions on the KWL chart to set an overall purpose for reading.

GUIDE THE READING

Preview the book yourself to determine the amount of guidance you will need to give for each section. Depending on your schedule and the needs of your class, you may wish to consider the following options:

- **Whole Group Reading** Read the book aloud with a group or the whole class. Encourage students to ask questions and make comments. Pause as necessary to clarify and assess understanding.

- **Shared Reading** Have students work in pairs or small groups to read the book together. Ask students to pause after each text section. Clarify as needed and discuss any questions that arise or have been answered.

- **Independent Reading** Some students may be ready to read independently. Have them rejoin the class for discussion of the book. Check understanding by asking students to explain in their own words what they have read.

Tips for Reading

- If you spread out the reading over several days, begin each session by reviewing the previous day's reading and previewing what will be read in the upcoming session.

- Begin each text section by reading or having a volunteer read aloud the heading. Have students examine any illustrations or graphics and read accompanying captions and labels. Discuss what students expect to learn, based on the heading, illustrations, and captions.

- Help students locate context clues to the meanings of words in boldface type. Remind them that these words are defined in the glossary. Provide help with words that may be difficult to pronounce.

- As appropriate, model reading strategies students may find helpful for nonfiction: adjust reading rate, ask questions, paraphrase, reread, visualize.

Think About . . . (pages 2–13)

Pages 2, 3 *What Is Flight?*

- Read the introduction with students. Have them look at the photographs on page 2. Ask, *What do you see?* (maple tree seeds, a lizard) *Why do you think these appear on a page about gliding flight?* (They are things that glide.) Then have students read to learn about gliding flight.

- Check comprehension by asking, *What is the difference between gliding flight and true flight?* (No power is used in gliding flight; true flight uses some kind of power.) *What kinds of things glide?* (plant seeds, birds, and some fish, frogs, lizards, snakes, and mammals)

- Have students read the first paragraph on page 3. Ask, *What is the main idea—the most important point—you learned about birds, insects, and bats in this paragraph?* (They are the only true animal flyers.) *What detail supports this main idea?* (They fly by using muscle power to flap their wings.)

- Have students finish reading the page and study the diagram to learn about the scientific principle behind true flight. Ask students to explain Bernoulli's principle in their own words. (Fast-moving air has less pressure than slow-moving air.) Help students identify cause-effect relationships by asking, *What effect does this have on a wing?* (Fast-moving air above a wing has a weak force. The slower-moving air under the wing has a strong force. The strong force pushes upward more than the weak force pushes downward, so the wing lifts up.)

- Reinforce students' awareness of two of the forces involved in flight. Ask, *What is the name of the force that pushes a bird or other object forward?* (thrust) *What is the force that pushes an object up?* (lift)

- If necessary, provide help with the pronunciation of *Bernoulli* (bur-NOO-lee).

Page 4 *Trying to Fly*

- Have students read the introduction to "Trying to Fly." Invite students to share what they know about parachutes. Then have them read page 4. Ask, *Is jumping from a high place with a parachute true flight? What is it?* (No, it is gliding flight.)

- Discuss the forces that are involved in a parachute jump. Ask, *What force pulls a person using a parachute toward Earth?* (gravity) *What force slows a parachute down?* (friction) *How is a parachutist able to land safely?* (When the force of friction equals the force of gravity, the person's rate of fall is slowed to a safe speed.)

- If necessary, provide help with the pronunciation of *André-Jacques Garnerin* (AHN-dray ZHAHK gar-neh-REHN).

Further Facts

- Both the Chinese and Japanese used kites for military purposes. Kites carried observers aloft to spy on the enemy and were also used to carry fighters into or out of cities under attack.

- Around 1485 Leonardo da Vinci sketched a design for a pyramid-shaped parachute in his notebook. Some years earlier, an unknown Italian engineer made a sketch of a cone-shaped parachute, probably to be made of cloth.

- Garnerin's first parachute jump, in Paris in 1797, was from a height of 1,000 m (3,280 ft). In 1802 he jumped from a height of 2,440 (8,000 ft) over England.

- In 1798 Garnerin's wife, Genevieve Labrosse, became the first woman to successfully parachute, from a balloon.

- The highest parachute jump ever took place on August 16, 1960, when Joe Kittinger of the U.S. Air Force jumped from a balloon at 31,333 meters (almost 20 mi). He was in freefall for $4^1/_2$ minutes and reached 320 m/sec (714 mph), faster than the speed of sound.

Page 5 *Lighter-Than-Air Flight*

- Read the introduction to "Lighter-Than-Air Flight" with students. Have students look at the photographs and read the captions. Invite students who have seen hot-air balloons or blimps to describe them. Ask questions such as these: *Was the balloon or blimp quiet or noisy? Did it move quickly or slowly?*

- After students read the section on hot-air balloons, assess comprehension by having students describe the cause-effect chain of events that enables a hot-air balloon to fly. (The air inside the balloon is heated. This causes the air to expand and become less dense. The balloon displaces the colder, denser air. As a result, the balloon rises into the air.)

- Have students read the caption of the hot-air balloon photograph. Explain that at different levels above the ground, the wind blows in different directions. The balloon pilot changes direction by causing the balloon to go up or down in order to find a wind current blowing in the right direction. Ask, *How do you think the pilot causes the balloon to go up?* (by making the air in the balloon hotter) *How would the pilot make the balloon go down?* (by letting the air in the balloon cool off)

- Before students read the section on airships, ask whether anyone has ever released a helium-filled balloon into the air, accidentally or on purpose. Encourage volunteers to tell what happened. Then have students read the text and look at the photograph. Explain that the pilot and passengers ride in a cabin under the body of the airship. Ask, *What makes an airship lighter than air?* (the gas inside the balloon, which is lighter than the gases that make up air) Return to the earlier discussion of released balloons and ask students what caused the balloon to float and then soar upward when it was released. (It was filled with a gas that was lighter than air.)

- After students view the photograph and read the caption, ask, *Why do you think airships are used to film sporting events?* If necessary, explain that their slow, steady movement and ability to hover make them good platforms for television cameras.

- Students may be interested to know that the first airships were called dirigibles (or dirigible balloons), from the French word diriger, "to steer." Giffard's dirigible was nonrigid; it held its shape only when filled with gas. The first rigid airship—which had a hull of aluminum sheeting—was built in Germany in 1897. More sophisticated rigid airships were developed by a German count, Ferdinand von Zeppelin; they were called zeppelins after him.

- If necessary, provide help with the pronunciation of *Montgolfier* (mon-gol-fee-YAY), *Henri Giffard* (on-REE jih-FARD), *hydrogen* (HI-druh-jen), and *helium* (HE-lee-um).

Further Facts

- The Montgolfiers' first balloon traveled more than 2.4 km ($1^1/_2$ mi). The first humans who flew in a Montgolfier balloon burned wool and straw to keep the air in the balloon hot.

- Anchored observation balloons were used by both sides during the American Civil War and World War I. During World War II, balloons were anchored over British cities to prevent airplanes from conducting low-level bombing raids.

- High-level balloon flights have been used to collect information on the upper atmosphere. Weather balloons gather essential upper-air data needed to forecast the weather. These instruments are launched twice a day at 1,100 sites around the world.

- Helium replaced hydrogen in airships because of hydrogen's extreme flammability, which caused many fatal airship disasters. Helium does not burn.

- Before advances in heavier-than-air flight, German airships—the equivalent of airborne luxury ocean liners—made regular transatlantic passenger flights between Europe and the United States.

- The largest aircraft ever to fly was the German passenger airship *Hindenburg*. It was 245 m (804 ft) long and 41 m (135 ft) in diameter. The ship was beginning its second season of transatlantic voyages when it was destroyed in a tragic fire in May 1937 during the landing at Lakehurst, New Jersey.

Page 6 *Heavier-Than-Air Flight*

- After students read the title and the introduction on page 6, ask them what problems inventors had to solve in order to

achieve heavier-than-air flight. (Students should mention the problem of overcoming gravity.) Then ask what they know about the Wright brothers. Call on volunteers to share any information they have. Then have students read page 6, look at the photographs, and read the captions.

- Assess understanding by having students summarize the events that led to the invention of the airplane. (George Cayley experimented with kites until he made one that could carry a person. Otto Lilienthal studied how birds flew and improved on glider designs. Felix du Temple built an aircraft with power, but it could not be controlled. The Wright brothers added an engine to a glider and made the first successful powered flight.)

- If necessary, provide help with the pronunciation of *Lilienthal* (LEE-lyen-tol) and *Felix du Temple* (FEE-liks dyoo-TOMPL).

Page 7 *Forces in Flight*

- Before students read page 7, have them study the diagram and read the labels and caption. Review the forces they have already read about. Ask, *What is thrust?* (the force that moves an object forward) *What is lift?* (the force that pushes an object up) You may wish to review Bernoulli's principle. Then guide students to interpret the diagram. Ask, *How do the arrows help you understand the forces that are acting on the airplane?* (The arrows show the direction of the force.) *By looking at the diagram, what can you tell about drag?* (It is the opposite of thrust; it pushes an object backward.) *What can you tell about weight from the diagram?* (It is the opposite of lift; it pulls an object downward.) Explain that they will learn more about these four forces when they read the text.

- After students read, have them explain the cause-and-effect relationships related to the four forces. Ask, *What causes weight?* (the force of gravity pulling down on an object) *What things affect lift?* (the shape and angle of the wing, the speed of the plane, and the speed of the air around the plane) *What causes thrust?* (Air pushed back by the propeller creates an opposite force—the thrust that pushes the plane forward.) *What causes drag?* (friction between the air and the surface of the plane) *What has to happen in order for a plane to fly?* (Thrust and lift have to be stronger than drag and weight.) Encourage students to predict what would happen if all four forces were equal. (The plane would not move.)

- You may wish to tell students that the word *aerodynamics* is a combination of the Greek words *aero,* "air," and *dynamikos,* "power."

- If necessary, provide help with the pronunciation of *aerodynamics* (air-o-di-NAM-iks).

Page 8 *Structure of Airplanes*

- Before students read page 8, have them look at the photographs of planes and name as many different parts of each plane as they can. Ask students to tell one major difference between the two planes. (The older type of plane has two pairs of wings.) Then have them read to learn about the structure of planes.

- You may wish to tell students that the word *aeronautics* is a combination of the Greek words *aero,* "air," and *nautes,* "sailor" (from *naus,* "ship"). Ask students what other words they know that contain the root *naut*. Students may mention *astronaut*. Translate this for them as "star sailor."

- Ask, *Why do you think the first airplanes were built with lightweight materials?* (People thought planes had to be light in order to fly.) *What advantages does metal have over wood, bamboo, and cloth?* (Metal is stronger and harder to damage.) *Why do planes with just one pair of wings have less drag than planes with two*

pairs? (There is less surface area so there is less friction, which causes drag.) Can students think of any advantages of having two pairs of wings? (twice as much lift)

- If necessary, provide help with the pronunciation of *aeronautics* (air-uh-NOT-iks).

Page 9 *Controlling an Airplane*

- Have students read page 9 to learn about airplane controls. Encourage them to look back and forth at the diagrams as they read the text. After reading, have students summarize each type of control and what it does. (ailerons—flaps on the wings that are raised or lowered to raise or lower a wing and make a plane bank or roll; elevators—flaps on the flat part of the tail that move up or down to raise or lower the plane's nose and make it go up or down; rudder—flap on the plane's tail that can be turned to make the plane's nose turn right or left) Ask, *How does a pilot control the ailerons and elevators?* (with a U-shaped steering wheel called a yoke) *How does a pilot control the rudder?* (with foot pedals)

- Invite students to draw conclusions about the abilities a pilot needs in order to control a plane. (Accept reasonable responses.) If necessary, point out that a pilot needs to be well coordinated in order to manage several different controls at the same time.

- If necessary, provide help with the pronunciation of *ailerons* (AY-luh-ronz).

Pages 10, 11 *Jet Aircraft*

- Have students read the text about jet aircraft on page 10 and examine the diagram. Have students summarize the steps in the process by which a jet engine creates thrust. (First, the engine draws in air through a front vent. Next, it compresses the air. Then it mixes the air with fuel and burns it. Finally, it pushes the exhaust gases out through a back vent at a high rate of speed.) Then have students take turns pointing to and naming each part of the jet engine shown in the diagram and telling what the part does.

- Ask, *How is this type of propulsion different from that of a propeller-driven plane?* (A propeller spins and pushes air back; it doesn't compress air or burn fuel to create thrust.)

- Have students read the text on page 11 and look at the photographs and captions in order to learn about three other types of jet engines. After students finish reading, have them rank the engines in order from slowest to fastest. (turboprop, turbofan, turbojet, ramjet) Then guide them to compare and contrast the four types of jet engines. Ask, for example, *How are the turboprop and turbofan different from a turbojet?* (They have propellers; the turbojet doesn't.) *How is a ramjet engine different from the other three?* (It does not have a compressor or turbine.)

Page 12 *Helicopters*

- Have students read the text on page 12 to learn about helicopters. After they read, encourage volunteers to tell their first reaction to the sketch from Leonardo da Vinci's notebook and the information about his idea for a machine like a modern helicopter. Tell them that da Vinci had many other ideas for devices that could not be built because the technology did not yet exist.

- Ask, *What lets a helicopter rise into the air?* (A rotor on the roof of the helicopter spins and creates lift.) *What does the tail rotor do?* (It lets the helicopter rotate left or right.) *Why does a pilot need to use both hands and both feet to control a helicopter?* (One hand control moves the helicopter in different directions; the other makes it go up or down. Foot pedals control the tail rotor.)

- Have students explain in their own words what makes a helicopter more useful in

some ways than an airplane. (It can fly straight up or down, fly backward, and hover, so it can get to places airplanes can't reach.)

- You may wish to tell students about the Harrier jet, the only airplane that can take off and land vertically. The plane's engines are positioned to produce upward thrust. After a safe height is reached, the engine nozzles rotate to provide forward thrust, and the plane switches to horizontal flight.

- If necessary, provide help with the pronunciation of *Leonardo da Vinci* (lee-uh-NAR-do duh-VIN-chee).

Page 13 *Rockets*

- Have students read the text about rockets on page 13. Assess comprehension by having students describe how a rocket engine works. (The engine burns fuel in a chamber with an open end. The hot gases expand and push out the open end. This creates thrust in the opposite direction.) Ask, *Why must a rocket engine be able to work without drawing in air from the outside, as a jet engine does?* (There is no air in space.)

- Ask, *What is the main difference between solid fuel and liquid fuel rockets?* (A solid fuel rocket can't be controlled or turned off; it runs until the fuel is used up. A liquid fuel rocket can be controlled; liquid fuel also gives more energy than solid fuel.)

Further Facts

- Gunpowder was invented by the Chinese during the eighth century C.E. Around 1050, the Chinese began making elaborate fireworks. Different chemicals were added to gunpowder to create a wide variety of colors and special effects.

- Robert H. Goddard is known as the father of modern rocket propulsion. In 1920 he outlined the possibility of a rocket reaching the moon and exploding a load of flash powder there to mark its arrival. Goddard's proposal was ridiculed. Fortunately, he persevered in solving engineering problems. A U.S. rocket landed on the moon in 1962 (17 years after Goddard's death).

People in Science (page 14)

The Wright Brothers

- Review with students what they learned about the Wright brothers on page 6. Then have them read page 14 to discover more about these pioneers of flight.

- After students read, ask them what was the most surprising or interesting thing they learned about Wilbur and Orville Wright. Point out the years of work involving much trial and error that the men devoted to fulfilling their dream. Encourage students to discuss what personal qualities made the brothers successful in the end. (Students may suggest that the brothers read and studied a lot, were focused on their goal, hard working, intelligent, not easily discouraged, skilled at design, determined, and daring.)

Further Facts

- Wilbur Wright (1867–1912) was born on a farm near Millville, Indiana, and his brother Orville (1871–1948) was born in Dayton, Ohio. Their father was a minister who encouraged his children to be independent and creative. The family home had two libraries, which contributed to the brothers' love of reading.

- Wilbur and Orville were the only members of their family who did not attend college. Instead, they became self-taught engineers and inventors who read extensively and learned from experts in aeronautics.

- At the Wright Cycle Co., the brothers not only repaired bicycles but designed and manufactured new ones. Among their

cycling innovations were a self-oiling hub and self-tightening pedals.

- In 1908 Wilbur carried aloft the first U.S. airplane passenger—the brothers' mechanic, Charles Furnas.

Did You Know? (page 15)

About the History of Flight

- Have students read the text and the chart on page 15 to discover milestones in the history of flight. Point out that a chart such as this presents information in a way that is easy to read. Invite students to offer their opinions about which of these events helped change our lives the most.

- After reading, ask students what events they think should be added to the chart. Ask them to give reasons for their opinions. Encourage students to do online research on any of the "firsts" listed in the chart that interest them.

- You may wish to provide more information about the myth of Daedalus and Icarus. Tell students that according to the legend, Daedalus was an architect and sculptor who created the famous Labyrinth and other works for King Minos of Crete. He fell out of favor with Minos and was imprisoned with his son, Icarus, in a high tower. Daedalus created wings so that they could fly from the tower. He successfully escaped to Sicily, but Icarus flew too close to the sun. His wings melted, and he fell into the sea and drowned.

- If necessary, provide help with the pronunciation of *Daedalus* (DED-uh-luhss), *Icarus* (IK-uh-ruhss), *Yeager* (YAY-gur), *Sputnik* (SPUT-nik), and *Yuri Gagarin* (YOO-ree guh-GAR-in).

Further Facts

The myth of Daedalus and Icarus is not the only Greek myth that involves flying and winged creatures.

- Hermes, god of commerce and the messenger of the gods, wore winged sandals and a winged cap.

- Pegasus, a winged horse formed when Perseus cut off Medusa's head, was the horse of the Muses and eventually became the carrier of Zeus's thunderbolts.

- Harpies were monsters whose bodies were half woman, half bird.

AFTER READING

Summarize

Complete the KWL chart you began with students before reading by asking them to share the answers to their questions. Call on volunteers to retell each text section. Then have students use the information in the KWL chart to write brief summary statements.

Discuss with students how using the KWL strategy helped them understand and appreciate the book. Encourage them to share any other reading strategies that helped them understand what they read.

Direct attention to the fourth column in the chart and ask: *What questions do you still have about flight and rocketry? What would you like to explore further?* Record students' responses. Then ask, *Where do you think you might be able to find this information?* (Students might mention an encyclopedia, science books, and the Internet.) Encourage students to conduct further research.

Review/Assess

Use the questions that follow as the basis for a discussion of the book or for a written or oral assessment.

1. Name and describe the two types of flight. (The two types of flight are gliding flight, in which something floats through the air without using power, and true flight, in which power is used to make something fly.)

2. What are the four forces that act on a moving airplane, and how does each act? (weight—pulls down; lift—pushes up; thrust—moves an object forward; drag—slows down a flying object)

3. What are the three basic controls a pilot uses to make a plane change direction? What does each control do? (Ailerons are movable flaps on the wings that can be raised or lowered to raise or lower the wings and make the plane turn. Elevators are movable flaps on the flat part of the tail that move up or down to make the plane's nose go up or down. The rudder is a movable flap on the plane's tail that can be turned to make the plane's nose turn right or left.)

4. How do jet engines and rocket engines create thrust? (A jet engine draws air in through a front vent, compresses it, mixes it with fuel, and burns it. Then it pushes the exhaust gases out at high speed through a rear vent. A rocket engine burns solid or liquid fuel inside a chamber with one open end; the hot gases rush out the opening, causing thrust.)

Writing Links/Critical Thinking

Present the following as writing assignments.

1. It has been said that the invention of the airplane made the world get smaller. Explain what this means. (Accept reasonable responses, such as that the speed of airplanes made travel and transportation of goods faster than by land or ship.)

2. Describe how each new invention in the history of flight led to the next invention. (Responses should mention that once lighter-than-air flight and gliders had been invented, the next step was finding a way to add power and to control the flight. This led to the invention of the airplane. After propeller-driven planes were invented, people looked for ways to make them faster, which led to the jet engine. This, in turn, led to rockets and space flight.)

Science Journals: You may wish to have students keep the writing activities related to the Delta Science Reader in their science journals.

References and Resources

For trade book suggestions and Internet sites, see the References and Resources section of this teacher's guide.