SC.5.N.1.6 Recognize and explain the difference between personal opinion/interpretation and verified observation. **SC.5.N.2.1** … science is grounded in empirical observations that are testable; explanation must always be linked with evidence. **SC.5.N.2.2** … when scientific investigations are carried out, the evidence produced by those investigations should be replicable by others.

LESSON 1

ESSENTIAL **QUESTION**

What Is Science?

Engage Your Brain

Find one answer to the following question in this lesson and write it here.

What are some science skills you could use when studying fish in an aquarium?

_____

_____

_____

ACTIVE READING

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

_____

_____

_____

_____

Use Headings

Active readers preview headings and use them to pose questions that set purposes for reading. Reading with a purpose helps active readers focus on understanding what they read in order to fulfill the purpose.

(bkgd) ©Frans Lemmens/Getty Images

What All Scientists Do

Digging up fossils. Peering through telescopes. Mixing chemicals in a lab. Using computers to make weather predictions. These are only a few of the things scientists do.

ACTIVE READING As you read these two pages, turn the heading into a question in your mind, and underline sentences that answer the question.

Does solving puzzles and searching for buried treasures sound like fun? If so, you might like being a paleontologist. Paleontologists are scientists who study the history of life on Earth. Like all scientists, they try to explain how and why things in the natural world happen. They answer questions by doing investigations. An **investigation** is a procedure carried out to carefully observe, study, or test something in order to learn more about it.

In addition to knowing a lot about living things of the past, paleontologists have to use many skills. In fact, all scientists use these skills. All scientists **observe**, or use their five senses to collect information. And all scientists **compare**, finding ways objects and events are similar and different.

Observe

Write one observation you could make about the fossil.

_____

_____

Paleontologists use fossils to answer questions such as, "What was Earth's environment like in the past?"

Paleontologists also work in labs, cleaning and studying fossils.

This paleontologist needs to observe the landscape to predict where fossils might be hidden. Once he finds the fossils, he compares them to fossils found in other parts of the world.

Paleontology is just one branch of science. **Science** is the study of the natural world and involves making observations and performing investigations. Scientists learn by thinking critically about the results of their investigations.

Compare

Observe these two skulls. List two ways they are and two ways they are different.

Similarities	Differences

Prove It!

Rotten Meat turns into Maggots!

In the 1600s, there were not many ways to keep meat fresh. Rotting meat quickly filled with squirming, worm-like maggots. Yuck! Where did the maggots come from?

ACTIVE READING On these two pages, circle the examples of evidence.

▶ **Draw a large *X* through the explanation that was shown *not* to be true.**

Travel back in time to the 1660s. Most people think flies, worms, and mice come from nonliving objects and rotting food. As evidence, or proof, they show how a dead animal's body soon becomes loaded with squirming maggots.

To a scientist, **evidence** is information collected during a scientific investigation. Some evidence, such as seeing a fossil dinosaur skull, is direct evidence that the dinosaur existed. Evidence can be indirect, such as finding a fossil footprint of a dinosaur.

Meet Dr. Francesco Redi, a scientist in Italy. A book Dr. Redi reads leads him to think maggots come from the eggs of flies. Redi **plans and conducts investigations** to gather evidence. He

The meat in the open jar soon became "wormy," while the meat in the sealed jar did not.

Redi placed fresh meat in two jars. He covered one jar and left the other jar uncovered.

traps some maggots inside jars with pieces of meat. He watches the maggots turn into adult flies. He observes adult flies laying eggs and more maggots come out of these eggs.

Redi then sets up an experiment. He places meat in several jars. Some jars are sealed and others are left open to the air. Redi observes that only the meat in jars he left open have maggots.

Redi experiments many times over. He tries dead fish, frogs, and snakes. All the evidence supports his claim: Living insects can only come from other living insects.

▶ Fill in the blanks in this sequence graphic organizer.

Make observations and ask _____.

↓

Plan and conduct _____.

↓

Use _____ to make claims.

Maggots Hatch from eggs that flies lay.

A Sticky Trap

Humans are too big to get stuck in a spider's web. But there are some sticky traps you need to avoid when thinking like a scientist.

ACTIVE READING As you read these two pages, turn the main heading into a question in your mind. Then underline sentences that answer the question.

▶ Look at the words in the spider web below. Star the things you *should* use to draw conclusions properly. Cross out the others.

Opinions

Favorites

Observations

Inferences

Evidence

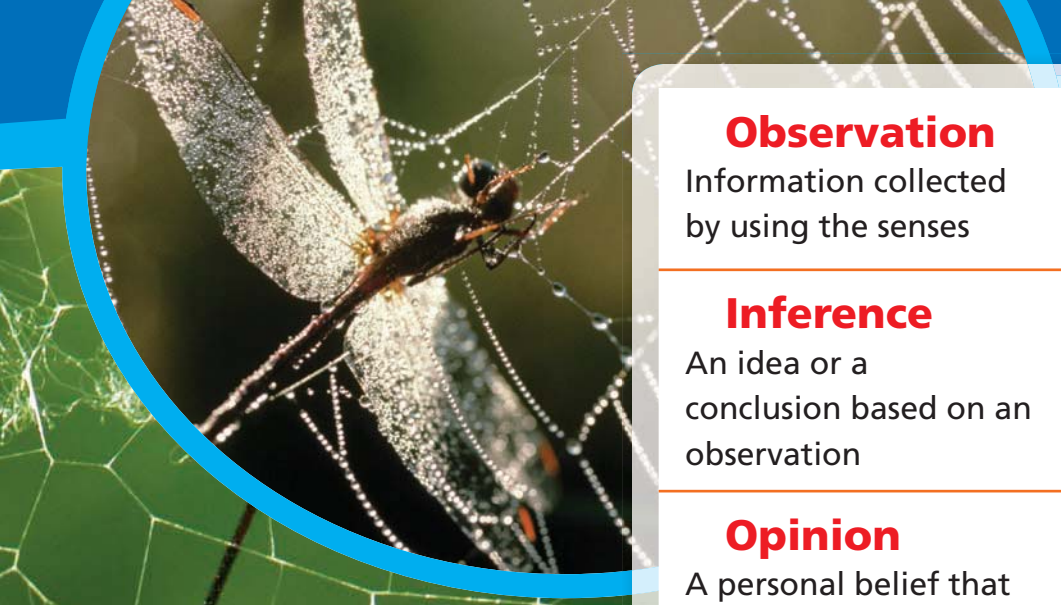
Feelings

How to Draw Conclusions

Scientists **draw conclusions** from the results of their investigations. Any conclusion must be backed up with evidence. Other scientists judge the conclusion based on how much evidence is given. They also judge how well the evidence supports the conclusion.

Don't jump to conclusions too quickly. That's a sticky trap in science! As Dr. Redi did, repeat your investigations. Think about what you can **infer** from your observations. And then—only then—draw your conclusions.

Suppose you spend a week observing spiders. You might conclude that all spiders build webs to catch their food. This may be true of the spiders you observed, but it's not true of all spiders. Some spiders, such as wolf spiders, hunt for their prey instead.



Observation Information collected by using the senses	The insect is stuck in the spider web.
Inference An idea or a conclusion based on an observation	A spider is going to use the bug for food later.
Opinion A personal belief that does not need proof	Spiders are really gross!

Opinion or Evidence?

An **opinion** is a belief or judgment. It doesn't have to be proved, or backed up with evidence. It might be your opinion that spiders are gross and disgusting. Others may disagree, but you are welcome to stick with your opinion!

Personal feelings and opinions should not affect how you do investigations. Nor should they affect your conclusions. It's hard to do, but science is about keeping an open mind. For example, don't ignore evidence just because you don't like what it means.

▶ **Write one observation, one inference, and one opinion about what you see in the photo.**

Observation	
Inference	
Opinion	

Why It Matters

Knowledge Grows

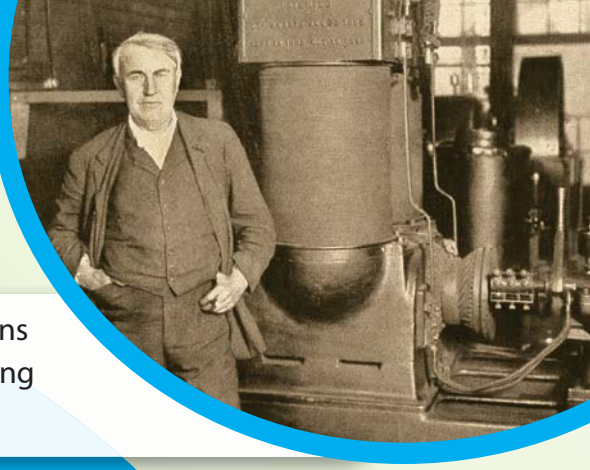
How is a man investigating electricity and wires almost 300 years ago connected to the latest video game release?

Stephen Gray, a scientist born in 1666, was working at home when he discovered that electrical energy could move along a short metal wire. Gray carried his materials to friends' homes. He showed them how the materials worked and, together, they made the wire longer and longer.

Today there are so many ways for scientists to **communicate**, or share, the results of investigations. When scientists communicate clearly, others can repeat their investigations. They can compare their results with those of others. They can expand on one another's ideas. In these ways, scientific knowledge grows.

Communicate

List several ways you can communicate.



1729 Stephen Gray shows that electrical energy can be carried through a wire.

1882 Thomas Edison opens the first electricity generating station.

Knowledge grows when it is communicated. Each science discovery leads to new questions. More is learned and new things are invented.

The first video game was invented in 1958. The inventor was a scientist named William Higinbotham. The reason? To make Visitor's Day at his lab more interesting for the public! Hundreds of people lined up to play the game.

Take a look at the timeline. The science behind Higinbotham's game goes back hundreds of years or more.

1947 The transistor, needed to make radios and computers, is invented.

1953 The first computer is sold.

1958 William Higinbotham invents the first video game.

1967 First handheld calculator invented.

1971 First coin-operated arcade video games in use.

The first arcade games were not very complex.

1972 The first home video game systems are sold.

1977 The first handheld video games are sold.

2015 Video games are quickly moving from systems to cloud-based apps.

The video games of today are fast, complex, and interactive.

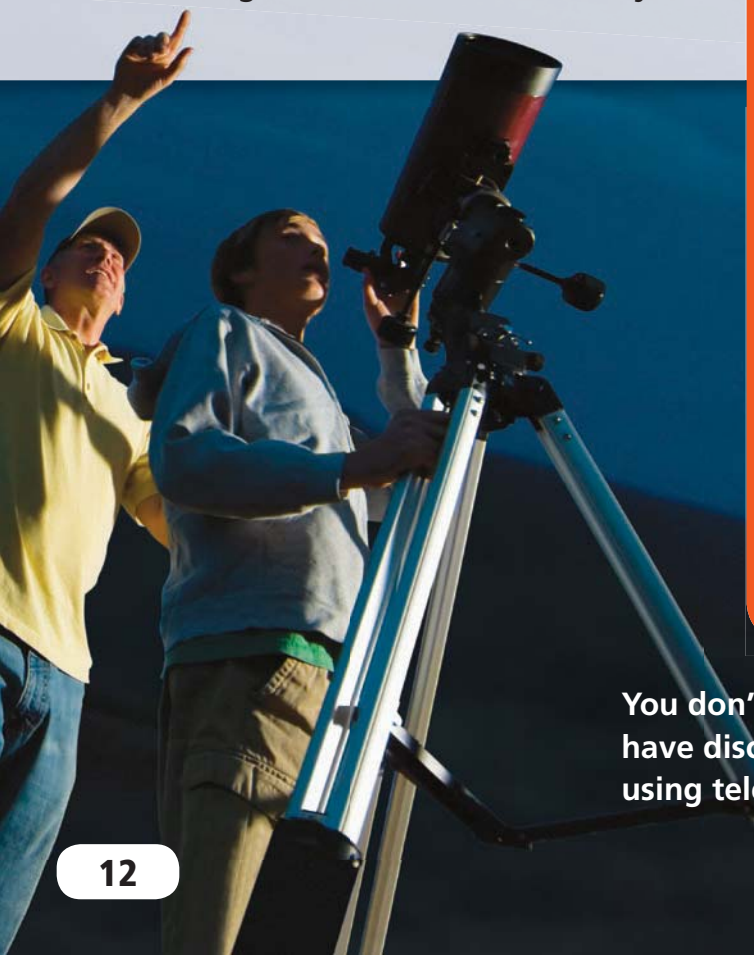
Meet Scientists

There are more people working as scientists today than ever before in history. Yet, there are plenty of unanswered questions left for you to answer!

ACTIVE READING As you read these two pages, underline what each type of scientist studies.

Astronomer

Astronomers ask questions about how the universe works. Because novas, black holes, and galaxies are so far away, they use time/space relationships to investigate them. For example, astronomers measure space distances in units called light-years. That's how far light can travel in one Earth year.



You don't have to be a pro to do astronomy. People have discovered many comets and exploding stars using telescopes in their back yards!

DO THE MATH

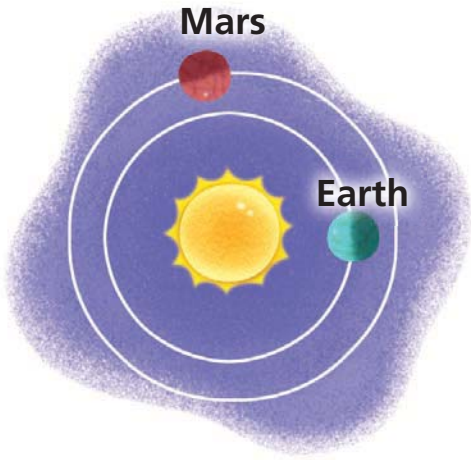
Use Fractions

Earth and Mars travel around the sun. Each time Earth makes one complete trip, Mars makes about $\frac{1}{2}$ of its trip.

1. How many trips does Earth make around the sun in the time it takes Mars to make one trip?

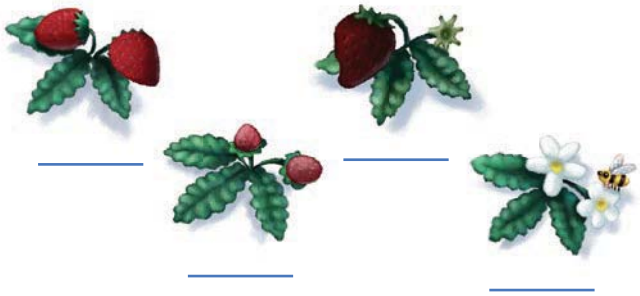
_____

2. In the drawing below, put an *X* where Mars will be after Earth completes five trips around the sun.



Order

When you order, you place objects or events one after another in the correct sequence. Write the numbers *1*, *2*, *3*, and *4* to show the order of the images below.



Botanist

Botanists investigate questions about plants. For example, some botanists study how environmental conditions affect a plant's life cycle.

Taxonomist

Taxonomists are scientists who identify types of living things and classify them by how they are related. When you classify, you organize objects or events into categories based on specific characteristics.

Classify

Look at the butterflies on this page. What are some ways you could classify them?

Sum It Up »

Read the summary, and fill in the missing words.

The goal of a scientist is to understand the natural world. To do this, a scientist plans and conducts 1. _____ .

Scientists use the 2. _____ they gather to draw 3. _____ .

A good scientist does not let his or her personal beliefs, or 4. _____, influence his or her study.

There are many important skills that scientists use. For example, when scientists 5. _____ , they use their observations and prior knowledge to determine what is happening.

Read each of the statements below. Write the science skill that each student used.

6. Angela made a list of how the two planets were alike.

_____

7. Krystal sorted the rocks into five groups based on their color.

_____

8. Robbie explained the results of his investigation to his classmates.

_____

9. Dmitri noted how the feathers looked and felt.

_____

10. Juan organized the steps of the process from first to last.

_____

Brain Check

Name _____

Vocabulary Review

1 **Draw a line from each term to its definition or description.**

1. evidence*	A. the study of the natural worldthrough investigation
2. inference	B. collecting information by using the senses
3. classify	C. an idea or conclusion based on an observation
4. investigation*	D. facts and information collected over time
5. knowledge	E. to put things into groups
6. opinion*	F. to arrange things by when they happened or by their size
7. observing	G. the sharing of information
8. communication	H. the observations and information that support a claim
9. science*	I. the process of studying or testing something to learn more about it
10. order	J. a belief or a judgment

*Key Lesson Vocabulary

Apply Concepts

2 Compare these two birds. List how they look similar and different.

Similarities:

_____

_____

Differences:

_____

_____

3 Suppose someone tells you they saw a bird never before seen in your state. What kinds of evidence would you ask for?

_____

_____

_____

4 What, in your opinion, is the scariest animal on Earth? How should this affect your investigations?

_____

_____

_____

_____

5 One morning you see an outdoor garbage can tipped over. Plastic bags are torn open. What could you infer?

_____

_____

_____

Take It Home! See *ScienceSaurus*® for more information about scientific investigations