SPECTRUM®

# Science

GRADE 7


## Focused Practice to Support Science Literacy

- Introduction to scientific research
- Natural, earth, life, and applied science lessons
- Research extension activities
- Key word definitions
- Answer key

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# Lesson 1.1 Keys to Unlocking the World

**discipline:** an area of knowledge or study

**unreliable:** can't be trusted or depended on

**formulas:** mathematical equations expressed in symbols

**velocity:** speed, or the distance traveled in a set amount of time

**statistics:** math that deals with the collection, organization, and analysis of numerical facts

Like other areas of modern life, computers have become one of the most widely used tools in every scientific discipline. A good scientist must know how to use a word processing program, the Internet, and any software that helps his or her research.

The scientific method:
1. Ask a question.
2. Form a hypothesis.
3. Design and conduct an experiment.
4. Draw conclusions based on the results.
5. Share the details and results of the experiment with other scientists.

*What skills do you need to be a good scientist?*

Science begins with curiosity. Taking an interest in the world around you and asking questions about how and why things happen is just the first step, though. Scientists depend on a wide range of skills and tools to help them investigate and discover the answers.

As a scientist, you'll need to know how to use certain tools. Whether it's a scale, a microscope, a laser, or a Bunsen burner, you need to be familiar with each tool's function and how it's used safely. Laboratories can be places for discovery, but they can also be places of danger. Being careful, precise, and safe are a scientist's top priorities in the lab.

The specific tools scientists use each day depend on which scientific **discipline** they're involved in and the kind of research they're doing. However, certain skills are used nearly every day in every kind of science.

One of the most basic skills is careful observation. Observation is the key to all good scientific research. Whether you're conducting experiments, studying animals in the wild, or digging through the ground in search of ancient bones, you need to observe everything closely and take detailed notes. An event that seems minor or unimportant when it happens may turn out to be the reason an experiment fails or succeeds. If you don't bother to record the event—or even notice it—then your research will be incomplete and your results will be **unreliable**.

Another important skill used by all scientists is math. Physicists and chemists, for example, need to be familiar with a wide variety of mathematical **formulas**. Sometimes, they're easy—**velocity** is distance divided by time, or $v = d/t$. Sometimes, they're more complex—the surface area of a sphere is four times pi times the radius squared, or $s = 4\pi r^2$.

Other scientists, like biologists and ecologists, commonly use **statistics** to study and compare the data they recorded while making observations.

A scientist must be skilled in language and communication, as well. Remember, science is an ongoing process that depends on sharing research and results. Each new discovery builds on the discoveries made by scientists in the past and adds to the collective body of scientific knowledge. If you can't communicate well, how will you be able to explain to other scientists the amazing discoveries you've made?

NAME _____

Circle the letter of the best answer to the question below.

**1.** Certain skills are important to every scientist. Which of the following is not one of them?

**a.** typing on a keyboard

**b.** performing mathematical calculations

**c.** using a microscope

**d.** communicating

Write your answers on the lines below.

**2.** Why is careful observation such an important part of being a scientist?

_____

**3.** Imagine that you develop a hypothesis and design an experiment, but your experiment shows that your hypothesis is incorrect. Should you still publish the results of your experiment? Why or why not?

_____

_____

_____

**4.** The word *interdisciplinary* means "involving more than one field of knowledge or study." Explain why a good scientist needs to have interdisciplinary skills.

_____

_____

_____

## What's Next?

The latest and most up-to-date scientific research isn't usually found in books. Scientific magazines, called *journals*, are often the first place scientists publish their research and results. This way, other scientists around the world can review the methods that were used and draw conclusions about how reliable the results are. Though you probably will not find scientific journals at your local bookstore, you will find magazines that describe some of the latest scientific discoveries and news.

# Lesson 1.2 The Human Hobbits

***Homo sapiens:*** the species to which modern human beings belong; characterized by a large brain, language, reasoning, and the ability to walk on two legs

**microcephaly:** abnormally small head and brain

There were other interesting findings in the cave where the skull was discovered. Scientists found evidence of fire, as well as tools that would have been used by someone the size of the hobbit. The dates of these artifacts matched the dates that hobbits would have lived. The use of tools and fire indicated that *Homo floresiensis* was capable of problem solving—skills that would have seemed too advanced for the size of its brain.

*How small were the early ancestors of human beings?*

If you've ever read any books by J. R. R. Tolkien or seen the movies based on his books, then you've probably heard of hobbits—small, round, human-like creatures with pointy ears. The hobbit was born in Tolkien's imagination and has no resemblance to any actual living being, past or present. That is, at least, until a few years ago.

In 2004, researchers found the remains of a small relative of human beings in a cave on the Indonesian island of Flores. At first, they believed it belonged to a child. When they examined it further, though, they saw that there was too much wear on the teeth for it to have been a child. Other features of the skull made the scientists think that it was several million years old. It had a sloping forehead, unlike modern human beings, as well as thick eyebrow ridges and a small chin. They believed the skull belonged to a 30-year-old female who was about 3 feet 4 inches tall and weighed 55 pounds—about the size of a modern four year old. Her brain would have been about one-quarter the size of a modern adult brain.

The biggest surprise came when the scientists dated the remains to only about 18,000 years old. This small species of human existed at the same time as ***Homo sapiens***, the species that modern human beings belong to. Until the discovery of *Homo floresiensis*—or "the hobbit," as it was nicknamed—it was believed that all other species of early human beings were extinct by the time *Homo sapiens* walked the planet.

There has been much controversy since the discovery. Some scientists believe that the hobbit isn't a separate species of human being. Instead, they think that the specimen that was discovered had **microcephaly**. The remains of seven more individuals have been found on Flores, though, and they are all the same size. It would be odd for so many people in a small area to have had the same condition. This supports the idea that the hobbits are actually a separate species.

Early in 2007, skull casts were done of modern human beings with microcephaly. These casts were compared with the ancient remains. The researchers who conducted the study felt sure that the hobbits did not have this condition. As research in Flores continues, scientists on both sides of the debate hope to find evidence that supports their theories.

NAME _____

Write your answers on the lines below.

**1.** How was *Homo floresiensis* different in appearance from *Homo sapiens*?

_____

_____

**2.** Why were researchers surprised to find out how old the remains of the hobbit were?

_____

_____

**3.** Why did scientists first believe that the skull they found belonged to a child? Why did they change their opinions?

_____

_____

**4.** Why was the scientists' discovery of tools and fire in the cave where the hobbit was found significant?

_____

_____

**5.** Using the selection to illustrate your point, explain why it is necessary for scientists to be open minded and to be willing to adjust their beliefs as new information becomes available.

_____

_____

_____

**6.** Why did scientists make skull casts of modern individuals with microcephaly?

_____

**7.** In your opinion, is *Homo floresiensis* a separate human species? Why or why not?

_____

_____

# Lesson 1.3 Searching for Our Ancestors

**anthropology:** the study of human life and culture

**archaeology:** the study of human life and cultures of the past, using fossils and artifacts

**hominid:** the biological family that includes human beings and primates, in both present and extinct forms

Mary Leakey was a shy but careful scientist. Louis Leakey's outgoing personality, however, helped interest others in their work and to raise funds that allowed them to continue their research.

Richard Leakey (Louis and Mary's son), his wife Meave, and daughter Louise have all carried on the family tradition and are respected paleontologists.

Louis Leakey was fascinated by the study of primates. He helped primatologist Jane Goodall get her start and begin her long-term observation of wild chimpanzees. He also assisted other scientists, such as Dian Fossey, establish studies of primates.

*Why were the contributions of the Leakeys so important to the study of early humanity?*

Louis Leakey grew up in British East Africa in the early 1900s. He discovered his first fossils as an adolescent, which led to his lifelong passion for **anthropology** and **archaeology**.

Before Louis began his career, it was widely believed that the earliest human beings had lived in Asia. Louis was able to convince the scientific community that the first human beings evolved in Africa instead. As a result, other scientists refocused their attentions on Africa.

In the 1920s, Louis began leading expeditions to Olduvai River Gorge in modern-day Tanzania. There, he found animal fossils, as well as Stone Age tools. In 1948, he and his wife, Mary, made one of their most important finds—a skull they dated at 20 million years old. The Leakeys believed the skull to belong to an early human ancestor. The skull is not considered by modern experts to be a direct human ancestor, but it is still an important piece of the puzzle of human origins.

Many of the Leakeys' significant finds are attributed to Mary Leakey. Mary was a talented archaeologist at a time when few women had careers in science. In 1959, she found a **hominid** skull that she and Louis dated at 1.75 million years old. The oldest human remains found in Asia were only several thousand years old, so this supported the theory of Africa as the "cradle of humanity." A couple of years later, Mary found another skull of an ancient human ancestor. It was unearthed in the same area as some stone tools. The Leakeys concluded that *Homo habilis*, or "handy man," had been the first tool maker.

Mary's most important discovery came after the death of her husband. She and her team found a series of hominid footprints preserved in volcanic ash. Finding footprints might not seem very significant, but it gave the team an important piece of information. The footprints matched fossils found in the same area that were between 2.9 and 3.5 million years old. The footprints showed that the *Australopithecus afarensis*, an early ancestor of modern-day human beings, was able to walk upright.

Some of early human history is still a mystery to us today. Much of what we do know, though, is a result of the many years the Leakeys spent digging in the African dirt, searching for clues to our ancient past.

NAME _____

Circle the letter of the best answer to the question below.

**1.** Louis Leakey's belief that Africa was the "cradle of humanity" was

**a.** supported by most of the scientific community of the 1920s.

**b.** supported by the findings of ancient animal fossils.

**c.** supported by the findings of human ancestors that were older than those found in Asia.

**d.** not supported by any of the Leakeys' findings.

Write your answers on the lines below.

**2.** How did *Homo habilis* get its name?

_____

**3.** Why were Louis and Mary a well-paired scientific team?

_____

_____

**4.** Using Louis Leakey as an example, explain how personality can play a role in one's success as a scientist.

_____

_____

**5.** Explain the importance of Mary Leakey's discovery of hominid footprints in volcanic ash.

_____

_____

**6.** How did Mary determine what kind of footprints she had found? Do you think this was a reliable method?

_____

_____

## Unifying Concepts and Processes

Why do you think Louis was interested in helping to promote the study of primates?

_____

# Lesson 1.4 Vanishing Nature

**extinct:** no longer living or existing

**salinity:** degree of saltiness

**invasive species:** a species of plant or animal that is not native to an area; its introduction often causes changes to the existing populations of plants and animals

Species do not always remain on the list of extinct creatures forever. Occasionally, scientists will find new evidence of a plant or an animal that was thought for years to be extinct, such as the painted frog.

According to the Red List of Threatened Species, published by the World Conservation Union, nearly 16,000 species are currently threatened with extinction.

*What causes plants and animals to become extinct?*

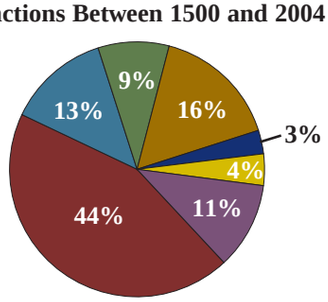
When you think about species that have become **extinct**, you might picture dinosaurs or other prehistoric animals that are known only through fossil remains. It is not uncommon for plants and animals to have become extinct throughout Earth's history. However, the rates of extinction in the last 500 years may be 50 to 100 times their average rate throughout history.

A plant or animal is considered extinct when there has been a serious search for it over a period of time and no recent evidence can be found. By examining fossils, paleontologists have determined that there have been about five mass extinctions in history. Each one seems to be linked to changes in Earth's environment. For example, ice ages, changes in the **salinity** of Earth's oceans, and a change in sea levels have all been responsible for large numbers of species disappearing in a relatively short time. The largest extinction is believed to have taken place at the end of the Permian period, about 250 million years ago. Changes in sea level and ocean salinity caused the extinction of about 96 percent of marine animals and 77 percent of land animals.

During the last five centuries, human beings and human activity have been the main cause of rising rates of extinction. When land is cleared for development or for use in agriculture, animals lose their habitats and sometimes their lives. The pollution produced by industry, mining, and the burning of fossil fuels has also had a negative effect on plant and animal populations.

The greatest threat appears to have been the introduction of alien or **invasive species**. This can happen intentionally, as when a new crop is introduced to an area where it doesn't naturally grow. It can also happen accidentally, as when an animal or insect travels in a boat or plane's cargo from one side of the world to another. The round goby, for example, is a fish native to the Black and Caspian seas that was introduced into the Great Lakes though ships' ballast water.

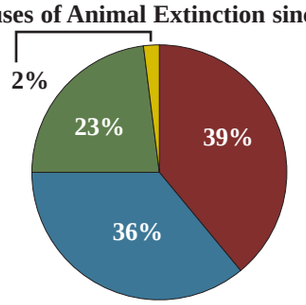
**Extinctions Between 1500 and 2004**




- Invertebrates
- Plants
- Fish
- Mammals
- Birds
- Amphibians
- Reptiles

Total = 844 known species

**Causes of Animal Extinction since 1600**




- Introduction of Invasive Species
- Habitat Destruction
- Hunting and Other Types of Intentional Killing
- Other Causes

NAME _____

Using the charts, write **true** or **false** next to each statement below.

**1.** _____ Habitat destruction is the leading cause of animal extinction since 1600.

**2.** _____ To determine the number of mammals that have become extinct since 1500, you would find 9% of 844.

**3.** _____ Hunting is the cause of more than one-third of animal extinctions.

**4.** _____ Vertebrates and invertebrates have become extinct in nearly equal numbers.

Write your answers on the lines below.

**5.** How do scientists determine that a species has become extinct?

_____

**6.** Give two examples of causes of mass extinctions in Earth's history.

_____

**7.** Why might a plant or an animal be removed from the list of extinct organisms?

_____

**8.** What method do scientists use to trace plant and animal extinctions through Earth's history?

_____

**9.** The introduction of an invasive species can obviously present a threat to local species of plants and animals. Can you think of a time when introducing an alien species might benefit local plants or animals?

_____

_____

**10.** According to the pie chart, what category of organism has had the greatest number of extinctions? Why do you think this is?

_____

_____

## What's Next?

Do some research online or at the library to learn more about species of plants and animals that are currently threatened with extinction. What is being done to protect them?

# Lesson 1.5 Lab Notes

**solution:** an equally distributed mixture of two or more substances

**slurry ice:** a mixture of ice, water, and salt that is used to cool substances below water's normal freezing point

*Did the student use good scientific methods during this experiment?*

**Objective:** I know that pure water freezes at 0ºC, so I want to see how adding different substances to water changes the freezing point. I will measure the freezing point of pure water, water mixed with salt, water mixed with sugar, and water mixed with alcohol.

**Hypothesis:** The saltwater **solution** will have the lowest freezing point.

**Details of the Experiment:** First, I made my solutions. I poured one cup of water into Beaker 1 and set it aside. I poured one cup of water into Beaker 2 and then added one tablespoon of salt, stirring the solution until the salt was completely dissolved. I poured one cup of water into Beaker 3 and then added one tablespoon of sugar, again stirring the solution until the sugar was completely dissolved. I poured one cup of 40 percent isopropyl alcohol—the other 60 percent is pure water—into Beaker 4.

Next, I made a mixture of **slurry ice** in a large bowl by combining water, ice, and salt. I placed Beaker 1 into the slurry ice mixture and began stirring the pure water with a thermometer. I made sure the thermometer didn't touch the bottom of the beaker as I stirred. As soon as ice crystals began forming on the water in the beaker, I read the temperature on the thermometer and recorded the result. I repeated this procedure for the other three solutions.

**Results:** Freezing point of Beaker 1 (plain water): -0.5ºC
Freezing point of Beaker 2 (saltwater solution): -4.5ºC
Freezing point of Beaker 3 (sugar water solution): -4.5ºC
Freezing point of Beaker 4 (40% isopropyl alcohol): -17.5ºC

**Conclusion:** My hypothesis was not correct. A solution of alcohol and water will have the lowest freezing point.

**Comments:** I was surprised to see that both the sugar and salt solutions had the same freezing point. I also thought that alcohol, which is a liquid, would affect the freezing point less than a solid, like salt or sugar, would.

NAME _____

Circle the letter of the best answer to the question below.

**1.** What were the variables in this experiment?

**a.** the solutions

**b.** the freezing points

**c.** the beakers

**d.** the water

Write your answers on the lines below.

**2.** Write another hypothesis that could have been tested by this experiment.

_____

**3.** Why was it important not to let the thermometer rest on the bottom of the beaker?

_____

**4.** This student's experiment had an additional variable that made the conclusion unreliable. What was the additional variable, and how did it affect the experiment? [Hint: There are 16 tablespoons in a cup, so one tablespoon is 6.25 percent of one cup.]

_____

_____

**5.** Salt is often spread on roads during winter to prevent ice from forming. Do you think sugar would work as well? Explain your answer.

_____

_____

## What's Next?

Do you think the boiling point of water would be affected in a similar way? Design an experiment similar to the one described in the selection, making sure you have an adult to help you. You'll also need to purchase or make a thermometer that attaches to the side of a container—you don't want to hold the thermometer in the boiling water! Heat each solution just until it begins to boil, and then record the temperature.