

Objectives

After this lesson, students will be able to

J.1.4.1 Describe features found on the moon's surface.

J.1.4.2 Identify some characteristics of the moon.

J.1.4.3 Explain how the moon formed.

Target Reading Skill

Identifying Main Ideas Explain that identifying main ideas and details helps students sort the facts from the information into groups. Each group can have a main topic, subtopics, and details.

Answers

Possible answers:

Detail: Dark, flat areas called maria, which formed from huge lava flows

Detail: Large, round pits called craters, which were caused by the impact of meteoroids

Detail: Highlands, or mountains, which cover much of the moon's surface

All in One Teaching Resources

- [Transparency J12](#)

Preteach

Build Background Knowledge

L2

Impact Craters

Hold up a rock. Tell students to suppose that the rock is as large as a building and is traveling through space. Ask them to picture the rock falling through Earth's atmosphere and landing in an open desert. Ask: **What do you think would happen?** (Possible answer: The rock would leave a large depression in the desert sand or explode on impact.)

Reading Preview

Key Concepts

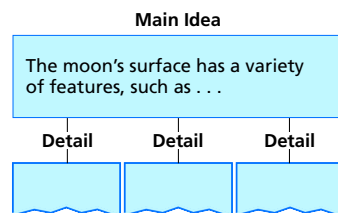
- What features are found on the moon's surface?
- What are some characteristics of the moon?
- How did the moon form?

Key Terms

- telescope
- maria
- craters
- meteoroids

Target Reading Skill

Identifying Main Ideas As you read "The Moon's Surface," write the main idea—the biggest or most important idea—in a graphic organizer like the one below. Then write three supporting details that further explain the main idea.



Lab Zone

Discover Activity

Why Do Craters Look Different From Each Other?

The moon's surface has pits in it, called craters.

1. Put on your goggles. Fill a large plastic basin to a depth of 2 cm with sand.
2. Drop marbles of different masses from about 20 cm high. Take the marbles out and view the craters they created.
3. Predict what will happen if you drop marbles from a higher point. Smooth out the sand. Now drop marbles of different masses from about 50 cm high.
4. Take the marbles out and view the craters they left.

Think It Over

Developing Hypotheses In which step do you think the marbles were moving faster when they hit the sand? If objects hitting the moon caused craters, how did the speeds of the objects affect the sizes of the craters? How did the masses of the objects affect the sizes of the craters?



For thousands of years, people could see shapes on the surface of the moon, but didn't know what caused them. The ancient Greeks thought that the moon was perfectly smooth. It was not until about 400 years ago that scientists could study the moon more closely.

In 1609, the Italian scientist Galileo Galilei heard about a **telescope**, a device built to observe distant objects by making them appear closer. Galileo soon made his own telescope by putting two lenses in a wooden tube. The lenses focused the light coming through the tube, making distant objects seem closer. When Galileo pointed his telescope at the moon, he was able to see much more detail than anyone had ever seen before. What Galileo saw astounded him. Instead of the perfect sphere imagined by the Greeks, he saw that the moon has an irregular surface with a variety of remarkable features.

- ◀ Galileo used a telescope to help make this drawing of the moon.

Lab Zone

Discover Activity

Skills Focus Developing hypotheses L2

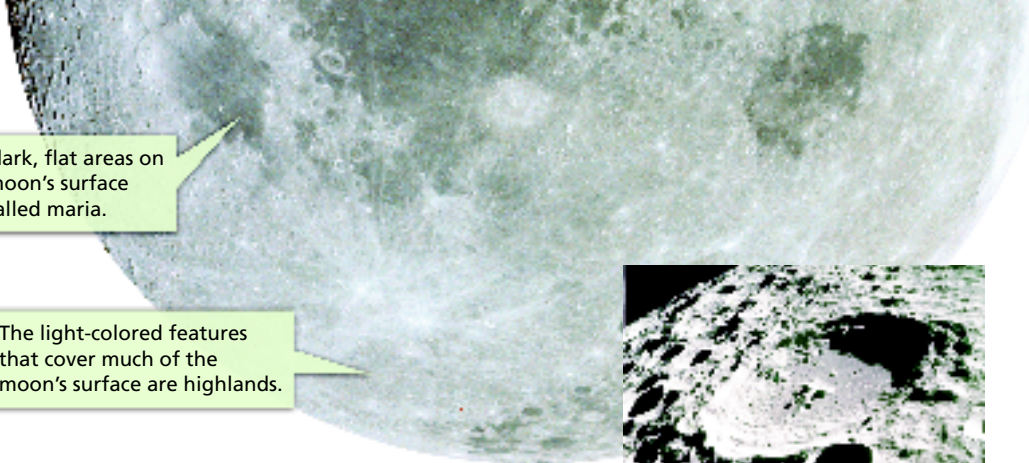
Materials plastic basin or mixing bowl about 25 cm across, sand, 3 marbles of different masses, meter stick

Time 20 minutes

Tips After Step 2, have students measure the depth and diameter of the craters.

Expected Outcome The size of the craters will increase with mass and with height.

Think It Over The marbles are moving faster in Step 3. The more massive the impacting object or the faster it hits, the larger the resulting crater will be.



The dark, flat areas on the moon's surface are called maria.

The light-colored features that cover much of the moon's surface are highlands.

The Moon's Surface

Recent photos of the moon show much more detail than Galileo could see with his telescope. **Features on the moon's surface include maria, craters, and highlands.**

Maria The moon's surface has dark, flat areas, which Galileo called **maria** (MAH ree uh), the Latin word for "seas." Galileo incorrectly thought that the maria were oceans. The maria are actually hardened rock formed from huge lava flows that occurred between 3 and 4 billion years ago.

Craters Galileo saw that the moon's surface is marked by large round pits called **craters**. Some craters are hundreds of kilometers across. For a long time, many scientists mistakenly thought that these craters had been made by volcanoes. Scientists now know that these craters were caused by the impacts of **meteoroids**, chunks of rock or dust from space.

The maria have few craters compared to surrounding areas. This means that most of the moon's craters formed from impacts early in its history, before the maria formed. On Earth, such ancient craters have disappeared. They were worn away over time by water, wind, and other forces. But since the moon has no liquid water or atmosphere, its surface has changed little for billions of years.

Highlands Galileo correctly inferred that some of the light-colored features he saw on the moon's surface were highlands, or mountains. The peaks of the lunar highlands and the rims of the craters cast dark shadows, which Galileo could see. The rugged lunar highlands cover much of the moon's surface.



What are maria?

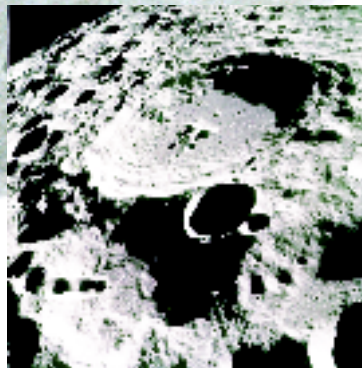


FIGURE 18

The Moon's Surface

The moon's surface is covered by craters, maria, and highlands. Craters on the moon formed from the impact of meteoroids. Most large craters are named after famous scientists or philosophers.

Observing What are the light regions in the top photograph called?

Go Online

SCILINKS™

For: Links on Earth's moon
Visit: www.SciLinks.org
Web Code: scn-0614

Instruct

Go Online
SCILINKS™

For: Links on Earth's moon
Visit: www.SciLinks.org
Web Code: scn-0614

Download a worksheet that will guide students' review of Internet resources on Earth's moon.

The Moon's Surface

Teach Key Concepts

L2

Features on the Moon

Focus Tell students that when they observe a full moon, they can see light and dark areas.

Teach Explain that these areas are caused by maria and highlands. Ask: **Which moon features are linked to ancient volcanic activity?** (*Maria*) **What are highlands?** (*Mountains on the moon*) **What causes craters?** (*The impacts of meteoroids, which are chunks of rock or dust from space*)

Apply Tell students that a crater on the far side of the moon called the South Pole-Aitken Basin is the largest and deepest impact crater known in the solar system—2600 km in diameter and 12 km deep. **learning modality: visual**

Independent Practice

L2

All in One Teaching Resources

- [Guided Reading and Study Worksheet: Earth's Moon](#)



Student Edition on Audio CD

Differentiated Instruction

Less Proficient Readers

L1

Relating Text and Visuals Some students may need extra help using the text to identify the features in Figure 18. Choose one of the features in the figure, and have a volunteer read its description

from the text. Then ask: **Is the Sea of Tranquility on the moon really an ocean?** (*No*) **What is it?** (*It is one of the maria, or dark, flat regions on the moon's surface.*) Repeat this process for the other labeled features. **learning modality: visual**

Monitor Progress

L1

Oral Presentation Call on students at random to describe the features of the moon and how they formed.

Answers

Figure 18 Highlands



Dark, flat areas on the moon's surface

Characteristics of the Moon

Teach Key Concepts

L2

Moon Properties

Focus Remind students that Earth has an atmosphere, a comfortable temperature range, and water in three states—liquid, gas, and solid.

Teach Ask: **How does the moon's diameter compare to Earth's?** (*The moon is about one-fourth Earth's diameter.*) **Why do temperatures on the moon vary so much?** (*The moon has no atmosphere.*) **In which state of matter would you likely find water on the moon?** (*Solid*)

Apply Have students relate the characteristics of the moon to the challenge of building a viable moon colony. **learning modality: verbal**

The Origin of the Moon

Teach Key Concepts

L2

How the Moon Formed

Focus Have students examine Figure 21.

Teach Have students use the diagram to summarize the collision-ring theory.

Apply Ask: **What evidence do you think might be used to support a theory that the moon was formed from material from Earth's outer layers?** (*The moon's average density is similar to the density of Earth's outer layers.*) **learning modality: verbal**

All in One Teaching Resources

- [Transparency J13](#)



FIGURE 19

The Moon's Size

The diameter of the moon is a little less than the distance across the contiguous United States.

Calculating What is the ratio of the moon's diameter to the distance between Earth and the moon?

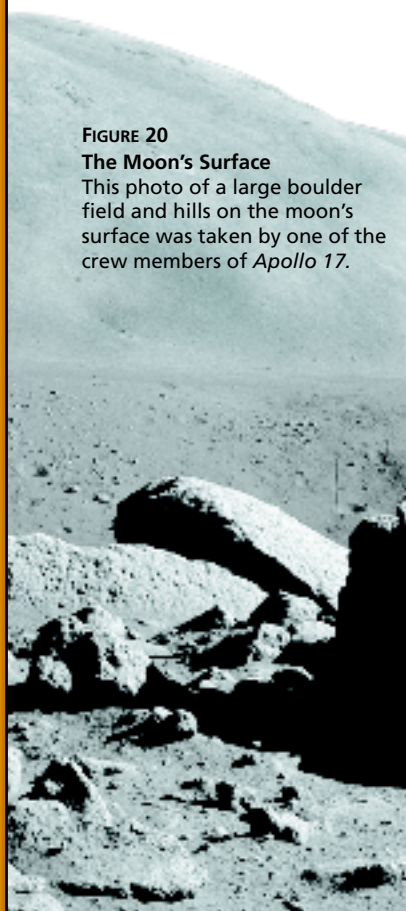


FIGURE 20

The Moon's Surface

This photo of a large boulder field and hills on the moon's surface was taken by one of the crew members of Apollo 17.

Characteristics of the Moon

Would you want to take a vacation on the moon? At an average distance of about 384,000 kilometers (about 30 times Earth's diameter), the moon is Earth's closest neighbor in space. Despite its proximity, the moon is very different from Earth. **The moon is dry and airless. Compared to Earth, the moon is small and has large variations in its surface temperature.** If you visited the moon, you would need to wear a bulky space suit to provide air to breathe, protect against sunburn, and to keep you at a comfortable temperature.

Size and Density The moon is 3,476 kilometers in diameter, a little less than the distance across the United States. This is about one-fourth Earth's diameter. However, the moon has only one-eightieth as much mass as Earth. Though Earth has a very dense core, its outer layers are less dense. The moon's average density is similar to the density of Earth's outer layers.

Temperature and Atmosphere On the moon's surface, temperatures range from a torrid 130°C in direct sunlight to a frigid 2180°C at night. Temperatures on the moon vary so much because it has no atmosphere. The moon's surface gravity is so weak that gases can easily escape into space.

Water The moon has no liquid water. However, there is evidence that there may be large patches of ice near the moon's poles. Some areas are shielded from sunlight by crater walls. Temperatures in these regions are so low that ice there would remain frozen. If a colony were built on the moon in the future, any such water would be very valuable. It would be very expensive to transport large amounts of water to the moon from Earth.



Where on the moon is there evidence of the existence of ice?

Answers
Figure 19 3,476:384,000, or about 1:110


Near the poles



The collision-ring theory

The Origin of the Moon

People have long wondered how the moon formed. Scientists have suggested many possible theories. For example, was the moon formed elsewhere in the solar system and captured by Earth's gravity as it came near? Was the moon formed near Earth at the same time that Earth formed? Scientists have found reasons to reject these ideas.

The theory of the moon's origin that seems to best fit the evidence is called the collision-ring theory. It is illustrated in Figure 21. About 4.5 billion years ago, when Earth was very young, the solar system was full of rocky debris. Some of this debris was the size of small planets. **Scientists theorize that a planet-sized object collided with Earth to form the moon.** Material from the object and Earth's outer layers was ejected into orbit around Earth, where it formed a ring. Gravity caused this material to combine to form the moon.



What theory best explains the moon's origin?

FIGURE 21
Formation of the Moon

According to the collision-ring theory, the moon formed early in Earth's history when a planet-sized object struck Earth. The resulting debris formed the moon.



Earth, Moon, and Sun

Video Preview

▶ Video Field Trip

Video Assessment


Discovery
CHANNEL
SCHOOL
Video
Field Trip

Earth, Moon, and Sun

Show the Video Field Trip to let students consider the various theories about the origin of Earth's moon. Discussion question: **What is the most widely accepted theory of the moon's origin?** (*The collision-ring, or impact, theory*)

Section 4 Assessment

Target Reading Skill Identifying Main Ideas Use your graphic organizer to help you answer Question 1 below.

Reviewing Key Concepts

- a. Identifying** Name three major features of the moon's surface.
b. Explaining How did the moon's craters form?
c. Relating Cause and Effect Why is the moon's surface much more heavily cratered than Earth's surface?
- a. Describing** Describe the range of temperatures on the moon.
b. Comparing and Contrasting Compare Earth and the moon in terms of size and surface gravity.

- Relating Cause and Effect** What is the relationship between the moon's surface gravity, lack of an atmosphere, and temperature range?
- a. Describing** What was the solar system like when the moon formed?
b. Sequencing Explain the various stages in the formation of the moon.



At Home Activity

Moonwatching With an adult, observe the moon a few days after the first-quarter phase. Make a sketch of the features you see. Label the maria, craters, and highlands.



At-Home Activity

Moonwatching If weather conditions or light pollution prevent viewing the moon in the night sky, suggest that students visit NASA Web sites with a family member to view photographs of the moon.

L1


Chapter Project

Keep Students on Track Check that students are looking for patterns in their data. Encourage them to compare changes noticeable in one evening and changes over the course of the project. Provide moon maps and charts, and suggest that they look for surface features with binoculars. The elevated walls of craters are most visible during the crescent and quarter phases.

Assess

Reviewing Key Concepts

- a.** Craters, maria, and highlands
b. Meteoroid impacts
c. Water, wind, and other forces wore away craters on Earth. There is no wind or liquid water on the moon.
- a.** 130°C to -180°C
b. The moon is one-fourth the diameter of Earth. The moon's surface gravity is much weaker than Earth's.
c. The moon's weak surface gravity allows gases to escape into space, so the moon has no atmosphere, resulting in widely varying surface temperatures.
- a.** It was full of rocky debris.
b. A planet-sized object collided with Earth. Material was ejected into orbit around Earth and formed a ring. Gravity caused this material to combine into the moon.

Reteach

Have students compare and contrast the properties of the moon and Earth.

L1

All in One Teaching Resources

- [Section Summary: Earth's Moon](#)
- [Review and Reinforce: Earth's Moon](#)
- [Enrich: Earth's Moon](#)