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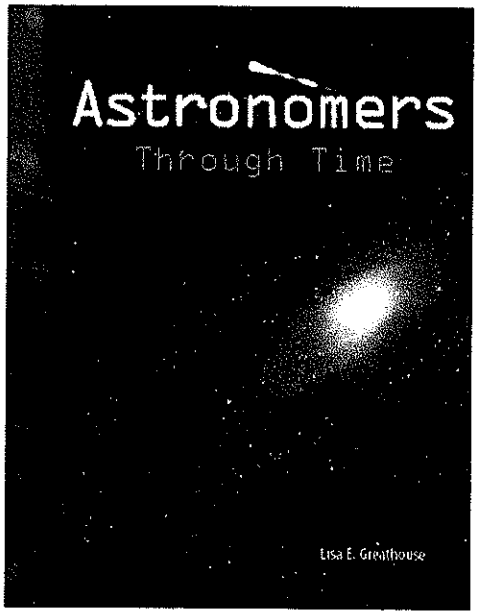
Science Readers

Lesson Plans for

Astronomers Through Time



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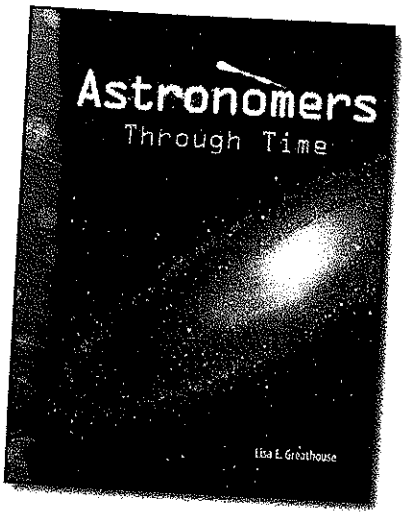
Astronomers Through Time Reader



Learning Objectives

Students will make inferences about information encountered in text. (Nonfiction Reading Objective)

Students will write answers to anticipated questions. (Writing Objective)

Students will explore concepts related to the solar system. (Science Content Objective)

Materials

- whiteboard/chalkboard
- wipe-off markers/chalk
- paper and pencils
- *Massive Planets* transparency
- *Massive Planets* activity sheet (page 152)
- *Not Within Walking Distance* activity sheet (page 153)
- *A Bright Idea* activity sheet (page 154)
- materials for Lab (page 140)
- *Reader Quiz* (page 155)

Before Reading

Complete the Introductory Activity (page 136) with the whole class. Then divide the students into ability-based reading groups. The students who read this book should be reading below level.

Begin the lesson by telling students that people have been curious about the solar system for thousands of years. Ask the students why they think people are so curious about it. What has their curiosity driven them to do?

Explain to the students that they have just made inferences about the curiosity people have about the solar system. Tell them that **making inferences** involves using information we know and have learned about a subject to draw conclusions. For example, they may have inferred that since people are curious about the solar system, some people have taken the time to study and research to learn more about it.

Display the reader *Astronomers Through Time* and tell students that they will make further inferences as they read the text.

Review new vocabulary with the students. Words such as **astronomer**, **constellation**, **observatory**, and **telescope** may interfere with the reading of struggling readers, so be sure to spend time introducing these words and defining them. Encourage discussion of the topic of astronomy and use the new vocabulary words in sentences related to the topic.

During Reading

Divide students into pairs to read the text. You may choose to have students read sections of the book or have them read the entire text. If having pairs of students read only portions of the book, be sure to allow time after reading for all pairs of students to share what they read in order to inform the others in the group.

As astronomers discovered more about the planets in the solar system, they were able to measure their size, mass, and distance from the sun. Reread pages 18–19 about Newton's idea relating gravity to the planets' orbits.

Display the *Massive Planets* transparency. Have students compare the sizes of the planets. If they were to guess, which planets do they think have the greatest mass? Explain that a planet's size and mass affect the pull of gravity on its surface.

Distribute *Massive Planets* (page 152) to students. Read the information and consider the question. What do the students hypothesize? Allow them time to complete the activity sheet. What did the students discover? Challenge students to write each planet's mass in standard form.

After Reading

After reading, ask the following questions:

- On pages 6 and 7, the author discusses the first woman astronomer. Do you think there are more men than women astronomers? Why do you think the author emphasizes the first woman in this field?
- Why do you think math and science classes are recommended for people who want to become astronomers?
- How do you think people responded when Copernicus said the earth was not the center of the universe? Why?
- Why do you think the church felt so strongly about their beliefs about the sun and planets revolving around the earth?
- Galileo served a prison sentence because of his beliefs. What does that tell you about Galileo as a person?

Explain to the students that their answers to the previous questions involved making inferences. They learned new information and then drew conclusions.

Next, tell students that they will be asked to write about what they learned to others who do not know much about astronomers. Tell students that an effective way to explain things is to anticipate the questions of others.

After Reading *(cont.)*

Ask students what they think others might like to know about astronomers. For example:

- What does an astronomer do?
- What things have astronomers discovered?
- Is there still more to learn about planets and space?

Tell students that these kinds of questions can guide them as they write to explain the topic to others. Have students work in pairs to brainstorm questions people might have and then have students work independently to write informational pieces addressing these questions.

The distances between celestial bodies can be deceiving when looking at pictures of the solar system (such as the one shown in the transparency). Ask the students to share the farthest they have traveled and how long the journey lasted. How would this compare if they were to travel to Mars?

Reread pages 24 and 25 about light years. Help students calculate the distance they traveled in light years. For example, if the farthest a student traveled is 2,000 km, that trip was one five-billionth of a light year. If the student went there and back two and a half billion more times, he or she would finally have traveled just one light year. Practice similar calculations.

Then distribute *Not Within Walking Distance* (page 153) to students. If needed, help them work through the calculations together. Practice reading these numbers.

The idea that the sun is the center of the solar system is accepted now, but long ago, people were put to death for saying this. Reread pages 12 to 15 about Galileo Galilei and his notion that the sun was the center of the solar system. How have people's attitudes since then changed?

Distribute *A Bright Idea* on page (154) to students. Read the information about Galileo and his opposition, and the data in the chart. Allow students time to complete the activity sheet with a partner. They may then share their answers. As a class, write a one-sentence summary to explain what it means to say that the sun is the center of the solar system.

A short *Reader Quiz* is provided (page 155). Use this to assess your students' understanding of the reader.

Finally, gather the students back together in a whole group to have them complete the lab activity (pages 139–140) and the Concluding Activity (page 137).

Massive Planets

Each of the planets has its own diameter (measure across) and mass (amount of matter). These measurements affect the gravity on each planet. Think: Are the widest planets also the most massive?

Directions: Compare the diameters and masses of each of the planets. Order them from least to greatest for each measure. Compare the lists. Answer the question.

Planet	Diameter (km)
Mercury	4,879
Venus	12,104
Earth	12,756
Mars	6,794
Jupiter	142,984
Saturn	120,536
Uranus	51,118
Neptune	49,528

Planet	Mass (10^{24} kg)
Mercury	0.330
Venus	4.870
Earth	5.970
Mars	0.642
Jupiter	1,899.000
Saturn	568.000
Uranus	86.800
Neptune	102.000

Planets in order by diameter

1.

2.

3.

4.

5.

6.

7.

8.

Planets in order by mass

1.

2.

3.

4.

5.

6.

7.

8

Can a planet's mass be estimated based on its size? Explain.

Not Within Walking Distance

Astronomers measure distances of far away stars and galaxies in light years (ly). A light year measures length. It is equal to about 10 trillion kilometers. The sun's light takes about 8.31 minutes to reach Earth. This is much less than one year! Margaret Geller estimates the Great Wall to be 500 million light years away. How many kilometers is this?

To calculate this in kilometers, multiply the number of light years by 10 trillion kilometers.

500,000,000 x 10,000,000,000,000 = 5,000,000,000,000,000,000,000

Use the place value chart to read the number.

#	Septillions	Sextillions	Quintillions	Quadrillions	Trillions	Billions	Millions	Thousands	Units
Ex.		5	000	000	000	000	000	000	000
1									
2									
3									
4									

So the Great Wall is 5 sextillion kilometers away!

Directions: Use multiplication and the place value chart to calculate these distances in kilometers.

1. The distance from our sun to the next nearest star, Proxima Centauri, is 4.21 light years. How many kilometers is this?

2. The distance from our sun to our galaxy's center is about 26,000 light years. How many kilometers is this?

3. The diameter of the Milky Way Galaxy is about 100,000 light years. How many kilometers is this?

4. The galaxy is surrounded by a large cluster estimated to be 300,000 light years in diameter. How many kilometers is this?

5. One of Geller's maps spanned 500 million light years. If there were 1,000 galaxies in this span, about how many light years apart was each galaxy?

6. If the sun's light takes 8.31 minutes to reach Earth, is this more or less than a light year?

A Bright Idea

Galileo Galilei used his own telescope to study the stars. One of these stars was the Sun. He noticed dark spots that appeared and seemed to move on the sun. This led Galileo to believe the spots were on the sun's surface, and that the sun rotated.

A German mathematician, Christoph Scheiner, suggested the dark spots were objects that revolved around the sun. This explanation helped preserve the idea that all objects in the skies were pure or perfect, a belief of the church.

Today we know the sun spots are magnetic storms. Galileo's scientific study led him to the correct conclusion.

Directions: Use the information above and what you read in *Astronomers Through Time* to answer the questions.

1. First Nicholas Copernicus and then Galileo Galilei said the Sun was the center of our solar system. Before this, people believed the Earth was the center of the solar system. Think about what causes day and night. Draw how these two ideas differ to show how day and night happen.

   People five hundred years ago believed the Earth was the center of the solar system. Day and night would be caused like this.

   Now people know the Sun is the center of the solar system. Day and night are caused like this.

2. How were Galileo's ideas proven true?
3. How many years passed between the time Galileo was charged with a crime and when the church cleared Galileo of these charges?
4. The Sun is very hot. Why doesn't the Earth melt?
5. If the Sun has 99.8 percent of the mass in the solar system, what has the other .2 percent?
6. The Earth's diameter is 12,756 km. What is diameter of the Sun?
7. People can say that the sunlight here now left the Sun 8.31 minutes ago. What does this mean?

Reader Quiz

Directions: Use what you learned from reading *Astronomers Through Time* to choose the best answer for each question.

1. Today's astronomers need to know about which subjects?
   a. math
   b. science
   c. writing
   d. all of these

2. How has astronomy changed the way people view the universe?
   a. People no longer believe the Earth is at the center of the universe.
   b. Constellations are still useful to help a person find his way.
   c. People realize all the planets have been discovered.
   d. People believe they are the only living beings in the universe.

3. How did Galileo's interest in astronomy help people learn more about the solar system?
   a. He invented the telescope.
   b. He wrote his discoveries down.
   c. He studied and shared information about moons, stars, the sun and other objects.
   d. He helped people understand that the sun is at the center of the solar system.

4. How are Sir Isaac Newton's ideas applied to astronomy?
   a. Gravity is what keeps the planets in orbit.
   b. His study of the universe helped him create a new branch of mathematics.
   c. His study of philosophy is used by scientists studying possible other life forms.
   d. Newton's ideas do not apply to astronomy.

5. How are Carl Sagan's ideas different from astronomers before him?
   a. Sagan only studied the planets.
   b. Sagan included colorful images in his books about the solar system.
   c. Sagan's way of sharing information about the solar system interested other people.
   d. Sagan believed aliens can read his words.

6. Of the astronomers you read about in *Astronomers Through Time*, which would you nominate for a "Star Astronomer Award"? Use details and examples from the book to explain your answer.

Astronomers Through Time Answer Key

Massive Planets

Planets in order by size: 1. Mercury; 2. Mars; 3. Venus; 4. Earth; 5. Neptune; 6. Uranus; 7. Saturn; 8. Jupiter

Planets in order by mass: 1. Mercury; 2. Mars; 3. Venus; 4. Earth; 5. Uranus; 6. Neptune; 7. Saturn; 8. Jupiter

Answer: No. Uranus has a larger diameter than Neptune, but less mass.

Not Within Walking Distance

1. 421,000,000,000,000
2. 260,000,000,000,000,000
3. 1,000,000,000,000,000,000
4. 3,000,000,000,000,000,000
5. 500,000 light years
6. less

A Bright Idea

1. Check students' illustrations. One should show the Sun revolving around the Earth. The second should show the Earth rotating to make day and night.
2. He used science and careful records to prove his ideas.
3. 359 years (1992 – 1633)
4. The Earth is far enough away from the Sun so that the heat does not burn the planet.
5. The planets and other objects in the solar system make up the other .2 percent.
6. 1,275,600 km (12,756 x 100)
7. The light took 8.31 minutes to travel from the Sun to the Earth.

Reader Quiz

1. d 2. a 3. c 4. a 5. c
6. Accept all justified answers. Example: I nominate Galileo Galilei for the Star Astronomer Award. Galileo was a hero. He used his own invention to study the planets, moons, and stars. He supported Copernicus's idea that the sun was at the center of the solar system, even though he knew he could die because he believed this. A probe with his name was sent to study Jupiter.

Lab Lesson Plan: Mini Constellation Viewer

Before the Lab

Review with students what they learned about stars and their place in the nighttime sky.

Have students use the index in the back of their readers to find information about constellations. Allow them time to reread these pages in their readers and share what they learned. How have constellations been part of the Earth's history?

Look at the constellation patterns on page 29. How do the names of the constellations reflect the image (or do they)?

Introduce the Lab

Read the introductory information with students.

Read the list of materials. Provide each lab group with the necessary materials, or have them ready to complete as a demonstration lesson in front of the class.

Read through the procedure with the class at least once completely before having students engage in the lab. Check for understanding of the required steps.

Ask if the students think they would be able to identify a constellation if they look through another person's canister. Why or why not?

Conduct the Lab

Allow time for lab groups to conduct the lab, or follow the steps as a class if conducting a demonstration lab.

After Step 6, discuss whether the students were able to identify other constellations.

After the Lab

Discuss how the rotation of the constellation might affect a person's ability to identify it. (Perhaps it was upside down.) Do the students believe the constellations stay upright through the seasons? Why or why not? If possible, research and compare a summer nighttime sky to a winter sky in the northern hemisphere.

Lab: Mini Contellation Viewer

Constellations are patterns formed by stars. Centuries ago, humans used their imaginations to link star patterns. They did this by drawing dot-to-dot pictures in their heads. They named the constellations after ancient gods, objects, and animals. After you do this activity, try to find some constellations in the night sky.

Materials

- 35mm film canisters (one for each constellation you want to view) or other such containers
- scissors
- tape
- pushpin
- constellation patterns (reader page 29)
- paper
- pen

Procedure

Choose a constellation from the patterns on page 29. Trace it and cut it out on the dotted lines. (If you have a copy machine, you can copy it in that way.)

Tape the pattern in place over the bottom of the film canister.

Using a pushpin, punch a small hole through the paper and the canister for each star in the pattern.

Hold the film canister up to the light. You should see light through each hole.

Take the pattern off the canister. Trade with a partner and see if you can both figure out which constellation the other chose.

Try to find the same constellations in the night sky.

Astronomers Through Time

Massive Planets