Voyage: A Journey through our Solar System

Grades K-2

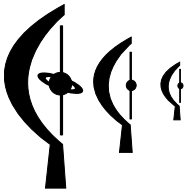
Lesson 3: Taking a Voyage Away From Home

On a visit to the National Mall in Washington, DC, one can see monuments of a nation—Memorials to Lincoln, Jefferson, and WWII, the Vietnam Veterans Memorial Wall, and Washington Monument. Standing among them is *Voyage*—a one to 10-billion scale model of our Solar System—spanning 2,000 feet from the National Air and Space Museum to the Smithsonian Castle. *Voyage* provides visitors a powerful understanding of what we know about Earth's place in space and celebrates our ability to know it. It reveals the true nature of humanity's existence—six billion souls occupying a tiny, fragile, beautiful world in a vast space.

Voyage is an exhibition that speaks to all humanity. Replicas of *Voyage* are therefore available for permanent installation in communities worldwide (http://voyagesolarsystem.org.)

This lesson is one of many grade K-12 lessons developed to bring the *Voyage* experience to classrooms across the nation through the *Journey through the Universe* program. *Journey through the Universe* takes entire communities to the space frontier (http://journeythroughtheuniverse.org.)

Voyage and *Journey through the Universe* are programs of the National Center for Earth and Space Science Education (http://ncesse.org). The exhibition on the National Mall was developed by Challenger Center for Space Science Education, the Smithsonian Institution, and NASA.



Lesson 3: Taking a Voyage Away From Home

Lesson at a Glance

Lesson Overview

From common observations of the sky, students understand that the Sun is a star that is close to the Earth, and it appears to go through a daily motion in our sky. By building a dynamic model of the Earth and the Sun—an orrery—students realize that cycles of night and day are caused by a rotating the Earth. A puzzle version of *Voyage*, a scale model of the Solar System, is then constructed to explore the locations of the Sun, Earth and other planets, and to get a sense of the relative sizes of these objects. By combining the two activities, the Solar System is put in motion, reflecting both the objects within the Solar System and their motions.

Lesson Duration

Two 45-minute class periods

Core Education Standards

National Science Education Standards

Standard D2: Objects in the sky

- The sun, moon, stars, clouds, birds, and airplanes all have properties, locations, and movements that can be observed and described.

Standard D3: Changes in earth and sky

- Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The moon moves across the sky on a daily basis much like the sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.

AAAS Benchmarks for Science Literacy

Benchmark 11B2:

- A model of something is different from the real thing but can be used to learn something about the real thing.

Related Education Standards

AAAS Benchmarks for Science Literacy
Benchmark 9A1:

- Numbers can be used to count things, place them in order, measure them, or name them.

Essential Question

- How can we use models to understand the locations and motions of objects in the Solar System?

Concepts

Students will learn the following concepts:

- The Sun is our star. It is our source of heat and light.
- The Earth rotates on its axis once a day. Earth's rotation causes the day and night cycle.
- While it rotates, the Earth also orbits the Sun once a year.
- The Earth is part of the Solar System—the family of the Sun, which includes the Sun and eight planets.
- The Sun is the largest object in the Solar System.
- The planets are of different sizes and at different distances from the Sun.

Objectives

Students will be able to do the following:

- Build a dynamic model of the Earth and Sun—an orrery.
- Demonstrate that day and night are due to the Earth's rotation.
- Demonstrate how the Earth orbits the Sun as it rotates.
- Describe the relative sizes of the Sun and select planets, and the order of the planets from the Sun.

Science Overview

Voyage, A Journey Through Our Solar System

Voyage is a one to 10 billion scale model of the Solar System that was permanently installed in Washington, DC, in October 2001. The real Solar System is exactly 10 billion times larger than the *Voyage* model. On this scale, the Sun is about the size of a large grapefruit. The Earth is 15 meters (50 feet) away and smaller than the head of a pin. The entire orbit of the Moon fits comfortably in the palm of your hand. Pluto is approximately 600 meters (2,000 feet or 6.5 football fields) away from the Sun. The nearest star to the Sun would be the size of a cherry on the California coast. There is a graphical representation of the Sun and planets at the scale of *Voyage* at the end of the *Science Overview*.

General Concepts

Understanding of phenomena due to the Earth's rotation actually begins at a very early age in children, as the children develop the concept of day and night, when they should be awake or asleep, and when they are hungry or tired.

Students should begin to realize that the Sun only appears during the day, and never at night. The Sun seems to change positions in the sky all day. Though this is due to the Earth's (counterclockwise) rotation every 24 hours and not to any actual movement of the Sun, young children often persist in their belief that the Sun actually rises in the morning and goes down at night (as we say it does). They may recognize the effect of changing light, changing temperatures, and the lengthening of shadows during the course of a day, but they do not identify the cycle of a day with the movement of the Earth.

Many ancient cultures have interesting explanations for what happens in the sky, why the Moon seems to change shape, why the stars seem to make patterns, why the Sun shines only during the day, and more. These stories are worth learning, since they are the early foundation of our own set of current scientific ideas. Many early skywatchers identified planets and other celestial objects well before the invention of modern telescopes, and their observations have contributed to our knowledge today.

The Earth, the Sun, and the Solar System

The Earth is one of eight planets revolving around the Sun, our star. The Sun and the planets are the major components of the Solar System. The eight planets in order from the Sun are Mercury, Venus, Earth,

Mars, Jupiter, Saturn, Uranus, and Neptune. Pluto used to be called the ninth planet, but after the discovery of several objects similar to Pluto further out in the Solar System—the largest of which is larger than Pluto—the International Astronomical Union decided in 2006 that Pluto belongs to a new class of objects called dwarf planets, and is not an actual planet. Pluto is included in the discussion of planets here as an example of this new class of objects.

The Solar System also includes the moons of the planets; asteroids—rocky bodies found mostly between Mars and Jupiter; comets—small icy objects each typically the size of a city; and Kuiper Belt Objects—icy bodies that can be as large as 1,000 km (600 miles) across and found beyond the orbit of Neptune. The largest of these are also called dwarf planets, similar to Pluto.

The Solar System can be thought of as the family of the Sun. What keeps this family together? Gravity. Here are some interesting facts about the Earth, the Sun, and the Solar System:

- The Sun is a star like the stars in the sky. The stars look so small because they are far away compared to the Sun. Think of a headlight on your car. Up close, at night, it looks big and bright. But you can still see the headlight as a dim point of light when it's a mile away.
- The Sun is the only star in the Solar System. The Sun is the nearest star to the Earth. The Sun is *our* star.
- The Sun is a source of light. It is also a source of heat.
- The Earth, the Sun, planets, and the largest moons are spherical objects.
- Earth rotates on its axis once in a day. The Earth completes one revolution around the Sun in one year.
- Many planets have moons. Moons revolve around planets.
- Our Moon is not a source of light; it does not "glow." It makes no visible light of its own. The light that we see from the Moon is sunlight reflected from the Moon's surface. When the Moon is not visible, it may be below the horizon, the sky may be cloudy, or the Sun may be shining on the part of the Moon facing away from us. However, even when we cannot see the Moon, it is always there.

Taking a *Voyage* Away from Home
Lesson at a Glance
Science Overview
Conducting the Lesson
Resources

Teaching Tip

Because of the great distances between the model planets, you may choose to pace out only from the Sun to Mars or Jupiter (which can be done in a long school hallway). You may want to lay out markers for the rest of the planets along the street in front of the school, so that children walking home or riding the bus can see the positions of all the planets in the Solar System.

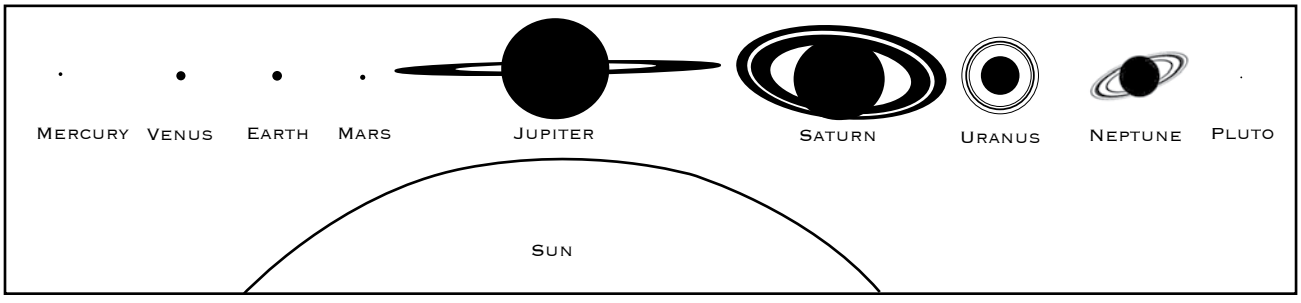
Setting Up the Voyage Scale Model

The charts below provide all the information you need to pace out a *Voyage* scale model of the Solar System. If you choose to set up *Voyage*, be aware that it almost always surprises students when they see how small the Sun and planets are compared to the distances between them. Explore this with them, as you pace out the distances together.

The charts below assume that one pace is one meter in length. For younger students, one 1-meter pace will likely need to be two steps. They can practice how to "pace" if you place tape strips one meter apart on the classroom floor. They can then go outside and pace out the model.

Chart of Paces Between Model Planets								
Sun to Mercury	Mercury to Venus	Venus to Earth	Earth to Mars	Mars to Jupiter	Jupiter to Saturn	Saturn to Uranus	Uranus to Neptune	Neptune to Pluto
6 paces	5 paces	4 paces	8 paces	55 paces	65 paces	144 paces	163 paces	142 paces

Chart of Total Distances (Meters) from Model Sun to Each Model Planet								
Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto (dwarf planet)
6 meters	11 meters	15 meters	23 meters	78 meters	143 meters	287 meters	450 meters	592 meters



NOTES:

Conducting the Lesson

Warm-Up & Pre-Assessment

Teacher Materials

- (Recommended) *There's No Place Like Space!*, a Dr. Seuss book

Student Materials

- One sheet of drawing paper per student
- Crayons or colored pencils

Preparation & Procedures

1. Discuss with students the different objects they can see in the sky during the day and at night. Lead the discussion toward what the students know about the appearance of the Sun, the Moon, and stars. The key points they should describe include: the Sun appears big and blazingly bright during the day; the Moon appears big and bright but not as bright as the Sun; and the stars appear as points of light in the night sky. Some added observations students might make include: the Moon is seen at night *and* sometimes during the day; the Moon's shape appears to change; the stars appear to twinkle; and what appear to be the brightest stars (but are actually the planets) do not seem to twinkle.

   Teaching Tip

   The points listed in Procedure 1 that do not surface in the discussion can be re-explored at a later time if students are directed to observe the night sky with their family for homework. An overnight homework assignment could be assigned to determine whether stars are seen to twinkle, and whether all stars appear to twinkle. A long term homework assignment could be to keep a Moon journal and record the daily appearance of the Moon, as well as the times it was visible.

2. Ask the students what you might see if you could move the Sun, and you moved it farther and farther away. Students should recognize that it will appear smaller and smaller, finally appearing as a tiny point of light. Ask students if they've ever seen a tiny point of light in the sky. Students should conclude that the Sun is a star, but stars must be very far away compared to the Sun.

3. If you have *There's No Place Like Space!,* read to the students through page 13. Wait to read the rest of the story later in the lesson.

Teaching Tip

Explore what you might need to do to show that a big object can appear smaller if it is moved farther from you. For example, compare the apparent size of a basketball held directly in front of your face, with its apparent size when it is held at the end of a long hallway.

4. Ask the students if they know what a planet is. Tell them that they know one planet very well, the Earth. See if they know the names of any of the other planets. After a class-wide discussion, tell them the Earth is one of the eight planets that go around the Sun. In some sense the Earth and other planets belong to the Sun. This *family* of the Sun is called the Solar System.

5. Give students a blank sheet of drawing paper and ask them to draw a picture of the Sun, the Earth, and the other planets. Keep these pages showing their understanding and misconceptions to be discussed later.

Activity 1: The Earth and Sun – A Play in Two Acts

In this activity, the class creates an Earth-Sun orrery.

Teacher Materials

- A lamp without lamp shade (extension cord, if needed for lamp)
- For safety, we strongly advise using an energy-saver fluorescent bulb, since it is cool to the touch
- A regular classroom chair
- A stapler or tape
- Two pieces of paper, 60 cm (24 inches) long, labeled "Earth" and "Sun"

Preparation & Procedures

1. Make a crown of the strips of paper by stapling or taping the ends together. Label one "Sun," and the other with the name of your city and "Earth."

2. Clear about a five-foot circle in the room.

3. Place the lamp and the chair at the center of the circle, facing the area where the rest of the students will be the audience.

Teaching Tip

Give other students a chance to step in and act in the play throughout the activity.

4. Tell the students that they are going to act in a play in the classroom. Ask students how they could create a model of the Sun and Earth where the Earth is free to move.

5. Choose two students to play the roles of the Sun and the Earth.

6. Have a student sit in the chair in the center of the area holding a lamp with a visible light bulb switched on. Place a crown marked "Sun" on his or her head.

7. Have another student stand at the edge of the circle. Place a crown marked with the name of your city and "Earth," on his or her head.

8. Ask the class if it is day or night in your town when the Earth faces the Sun. Ask the students to tell you when it is bright and warm (day), and when it is dark and cooler (night). Relate these experiences to when the Sun is up in the sky, and when it is not.

9. Have the Earth student spin counterclockwise several times. Ask the Earth student when (s)he is in day and when (s)he is in night.

10. Call for students' questions and ideas about the dynamic model they have just built.

11. Tell the "Earth" student to model a day. Two days. A whole week. Have the students count together as the Earth spins (rotates) one, two, and seven times.

12. Ask if this is all the Earth does. Does it just spin in place, or does it move through space as well? After class-wide discussion tell the class that while the Earth spins once a day it is also traveling around the Sun in a near circle. We say that the Earth "orbits" the Sun. Have the "Earth" student demonstrate this motion by walking around the Sun counterclockwise. See if anyone knows how long it takes for the Earth to go around the Sun once. The answer—a year.

13. Add the concept of Earth orbiting around the Sun to the first model of a spinning Earth by having the Earth student spin counterclockwise and walk very slowly counterclockwise around the Sun student. Have the class count off the days (each spin). Tell the class that the Earth rotates 365 times every time it orbits the Sun once, because there are 365 days in a year. Have students explain why this would be hard to act out.

Reflection & Discussion

1. There are a number of concepts that can be discussed as a class at the end of the activity, including:
   - The Sun provides light and heat. The Sun is up in the sky in the daytime. The Sun is not up in the sky at night.
   - A day is one complete rotation of the Earth.
   - A year is one complete orbit of the Earth around the Sun.

2. Ask students to describe how the play they put on was really a model of the Sun and the Earth. They should be able to describe that the students were not really the Sun and the Earth, but 'played' the Sun and the Earth in order to show how the real Earth moves.

Assessment Criteria for Activity 1

During the *Reflection & Discussion* students should recognize that the cycle of day and night is due to the Earth's rotation. They should also recognize that as the Earth rotates once in a day, it orbits the Sun once in a year. As part of the *Transfer of Knowledge* discussion, students should be able to describe the apparent motion of the Sun in the sky. They may also be able to recognize that while the Sun appears to move in the sky, this is actually due to the spinning Earth.

K-2 students may be evaluated as follows. They need not demonstrate all the characteristics of a category to fall within it, though strong evidence of their classification by the teacher should be provided.

4 Points

- Clearly and consistently demonstrates a sophisticated understanding of the concepts nearly 100% of the time by applying them accurately in activities, questions, comments, work, and projects both in the classroom and elsewhere.

3 Points

- Shows a nearly complete grasp of the concepts by using them appropriately at least 75% of the time in class, asking pertinent questions, and by making viable attempts at applying the concepts to other aspects of learning.

2 Points

- Responds correctly to direct questions regarding the meaning of the concepts, but cannot yet express them or demonstrate them consistently and accurately; still makes errors about 50% of the time.

1 Point

- Indicates little more than random guessing at understanding the concepts; cannot focus on essential elements or regularly respond correctly to leading questions; less than 50% accurate.

0 Points

- No work completed.

Transfer of Knowledge

Explore with students how the Sun appears to move in the sky over the course of the day. Students should be able to describe that at sunrise the Sun is close to the ground, it then rises in the sky to a high point and goes back down until it is close to the ground at sunset. They can also describe this motion by imagining they were pointing to the Sun and showing the motion through arm movement. Ask them if the Sun appears to move. They should certainly say yes. Ask if the Sun's apparent motion is related to day and night. They should conclude that daytime begins at sunrise and nighttime begins at sunset.

Teaching Tip

One way to demonstrate a connection between what they observe in the sky and the model they acted out is to place the "Earth" student in a chair that can spin. Have the student hold up a large piece of cardboard (30 cm-1 ft-on a side is good) with a 8-10 cm (3-4 inch) diameter hole cut in the center. Have the student look through the hole as you slowly spin the chair. Ask the student if the Sun appears to move. (The motion should be very apparent. The edge of the hole in the cardboard serves as a reference. The edge can be thought of as a horizon. The Sun will appear to rise and set as you slowly spin the chair.)

Now ask them to recall the play they just acted out. Did the Sun move? They should recognize that it did not. Ask them what caused day and night in the play? They should recall it was caused by the Earth spinning. See if they can conclude that the Sun's apparent motion in the sky is due to Earth spinning, and not the Sun moving.

Placing the Activity Within the Lesson

1. Remind the students that the Earth is only one planet in our Solar System and that there are a total of eight planets.

2. Tell students that they are now going to make a model of the whole Solar System, but that it is so incredibly big that they are going have to make the model planets and Sun incredibly small!

3. If students completed the overnight homework assignment, ask if any of them observed what appeared to be bright stars that don't twinkle. Many of them should have observed this. Tell them these objects are not stars at all. They are planets! Mercury, Venus, Mars, Jupiter, and Saturn can all be seen with the unaided eye, and appear as bright star-like objects that don't twinkle. If students did not complete the homework assignment encourage them to make these observations on the next clear night.

Notes on Activity 1:

Activity 2: Solar System Puzzle

Students construct the *Voyage* scale model puzzle to sequence the Sun and planets.

Student Materials

- One set of *Voyage* puzzle pieces per group (Student Worksheet)
- Small paper bag

Preparation & Procedures

1. Photocopy enough of the *Voyage* puzzle pieces (Student Worksheet) to give one set to each group of students (3-5 students per group).

2. Cut out the *Voyage* puzzle pieces on the Student Worksheet. Place one full set (Sun, eight planets and dwarf planet Pluto) in a small bag for each group.

3. Distribute one bag of *Voyage* puzzle pieces to each group.

4. Have students spread all the puzzle pieces on their table, but not assemble them, yet.

5. Have the students look at the Earth/Moon puzzle piece and recognize that the Moon is much smaller than the Earth.

6. Ask if they could draw their house on this tiny model Earth.

7. Have them compare the size of the model Sun to the size of the model Earth. Repeat with the other planets.

8. Ask the students how they might learn the order of the planets from the Sun in the Solar System. Hint: what do you do with a puzzle? Have students construct the *Voyage* puzzle of the Solar System by sequencing the Sun and planets. The puzzle pieces will only fit in the correct sequence.

9. Have students count the planets, and pronounce the names of the planets as a class.

Reflection & Discussion

1. Take questions from the students.

2. Have the students point to the Sun, the Earth, the Moon, and the other planets as you call them out.

3. Ask: What is the largest object in the Solar System? Which planet is the biggest? The smallest? Closest to the Sun? Farthest from the Sun? You might also ask the students to examine their puzzles carefully, and then cover them up. Draw a Sun on the board together with nine dots in a row from the Sun outward. Pick a dot at random and ask the class to tell you which planet goes with the dot. With the class' help write the name of the planet near each dot.

4. You may have the students learn a mnemonic method to remember the names of the planets. Each word begins with the first letter of the name of a planet. Tell the students, for example, that before placing the planets their correct distances apart, they can memorize the names and sequence of the planets. Invent a funny story using the first letter of each planet [MVEMJSUNP], or recite the mnemonic: My Very Excited Mother Just Served Us Nine Pizzas! (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto; Pluto is included in the mnemonic as a reminder that there are other bodies such as dwarf planets in the Solar System)

Transfer of Knowledge

1. Have the students describe how the puzzle is a model. *(Desired answer: it is a smaller version of the real thing, it is a copy)* Ask what they were able to learn from this model. *(Desired Answer: the order of the planets from the Sun, that the Sun is the biggest object, Jupiter is the largest planet, the Moon is smaller than the Earth, etc.)*

2. With the puzzle assembled, ask the students to look at the Earth and imagine themselves living on it. How big would they be? Now imagine living on this tiny Earth and looking at the Sun in the puzzle. How big would the Sun appear? Another way to get this across is to have the students imagine that the tiny Earth is an ant, and the ant is looking at the Sun which is a ball. Would the ball appear big to the ant? Students should be able to see that if the Sun were this close to the Earth, the Sun would seem absolutely huge. Then ask the students if they think the puzzle has the Sun too close to the

Lesson Adaptation

Talented and Gifted: Have students do an Internet search for photographs of the planets. One website of interest: www.photojournal.jpl.nasa.gov.

Taking a *Voyage* Away from Home
Lesson at a Glance
Science Overview
Conducting the Lesson
Warm-Up & Pre-Assessment
Activity 1: The Earth and Sun–A Play in Two Acts
Activity 2: Solar System Puzzle
Lesson Wrap-Up
Resources

Earth, and why. *(Desired answer: if the Sun were this close to Earth, it would appear huge in our sky. But the Sun does not appear huge in the sky)* Ask the students how they would correct this problem with the puzzle. *(Desired answer: move the model Earth farther from the model Sun. Remember the Warm-Up where the class explored how increasing the distance to an object makes the object appear smaller)*

Tell the students that the planets are also not really this close to each other. They are much, much farther from each other than when the puzzle is put together. In fact, we will have to take the puzzle apart and spread out the pieces across a huge playground to see where they would really go in a model of the Solar System.

Assessment Criteria for Activity 2

During the *Reflection & Discussion* students should be able to describe that the Solar System contains the Sun and nine planets (counting dwarf planet Pluto); the Sun is the largest object. They should also be able to describe the largest and smallest planets, and the planets closest and farthest from the Sun. As part of the *Transfer of Knowledge*, students should be able to determine that the distance between the Earth and Sun on the puzzle is too small.

K-2 students may be evaluated as follows. They need not demonstrate all the characteristics of a category to fall within it, though strong evidence of their classification by the teacher should be provided.

4 Points

- Clearly and consistently demonstrates a sophisticated understanding of the concepts nearly 100% of the time by applying them accurately in activities, questions, comments, work, and projects both in the classroom and elsewhere.

3 Points

- Shows a nearly complete grasp of the concepts by using them appropriately at least 75% of the time in class, asking pertinent questions, and by making viable attempts at applying the concepts to other aspects of learning.

2 Points

- Responds correctly to direct questions regarding the meaning of the concepts, but cannot yet express them or demonstrate them consistently and accurately; still makes errors about 50% of the time.

1 Point

- Indicates little more than random guessing at understanding the concepts; cannot focus on essential elements or regularly respond correctly to leading questions; less than 50% accurate.

0 Points

- No work completed.

Placing the Activity Within the Lesson

Ask students what they have learned about the Solar System from the puzzle activity. Ask students if they had to go out into space to do these things. Point out that the puzzle was a model, and that it taught them a lot about the Solar System without having to actually travel to all the planets.

Notes on Activity 2:

Lesson Wrap-Up

Transfer of Knowledge for the Lesson

1. Have students create a model of the motions in the Solar System—an orrery—similar to the one in Activity 1, but this time including all of the planets and how they orbit the Sun. Have them act out this new play on the playground.

2. While still on the playground, ask students if they think all the planets spin in the same direction and at the same speed. Ask students if they think all the planets orbit the Sun in the same direction and at the same 'walking' speed. After discussion, tell them that:
   - All the planets spin in the same direction as Earth (counterclockwise), except Venus and Uranus, which spin backward.
   - Planets spin at different speeds
   - All the planets orbit the Sun in the same direction (counterclockwise)

   With this new information have the class act out the play again.

Assessment Criteria for the Lesson

Students should be able to describe the major components of the Solar System (the Sun and planets), as well as some of the basic motions (planets both rotate and orbit the Sun).

K-2 students may be evaluated as follows. They need not demonstrate all the characteristics of a category to fall within it, though strong evidence of their classification by the teacher should be provided.

4 Points
- Clearly and consistently demonstrates a sophisticated understanding of the concepts nearly 100% of the time by applying them accurately in activities, questions, comments, work, and projects both in the classroom and elsewhere.

3 Points
- Shows a nearly complete grasp of the concepts by using them appropriately at least 75% of the time in class, asking pertinent questions, and by making viable attempts at applying the concepts to other aspects of learning.

2 Points
- Responds correctly to direct questions regarding the meaning of the concepts, but cannot yet express them or demonstrate them consistently and accurately; still makes errors about 50% of the time.

1 Point
- Indicates little more than random guessing at understanding the concepts; cannot focus on essential elements or regularly respond correctly to leading questions; less than 50% accurate.

0 Points
- No work completed.

Lesson Closure

1. Read the rest of Dr. Seuss's *There's No Place Like Space!* (pp. 14-27 about the planets, and p. 30 to the end).

2. Have students get out their first drawings of the Sun, Earth, and planets, and ask what they might draw differently after learning about them today. Their first drawings likely did not have the correct relative sizes.

3. Tell students that the puzzle, when put together, only shows the relative sizes and the order of the planets and the Sun. But it does not show the planets' distances from the Sun or from each other. Tell them you know the secret as to how far to place the planets from the Sun using this model. Note: at this point you can use the pacing chart in the *Science Overview* to construct the *Voyage* scale model Solar System with your class, or conduct the more robust lesson titled (*Voyage through the Solar System*). Visit www.voyagesolarsystem.org to download this lesson.

Lesson Adaptation

Talented and Gifted: the farther a planet is from the Sun the slower it orbits (the slower it 'walks'). Include this when the class acts out the play again. Ask the class how long it takes planets far from the Sun to orbit the Sun compared to Earth and why? *(Desired Answer: longer because those planets are moving slower, and they have a bigger circle to 'walk.')*

Resources

Internet Resources & References

Student-Friendly Web Sites:

NASA Kids' Club
www.nasa.gov/audience/forkids/kidsclub/flash/

NASA's Planetary Photojournal
photojournal.jpl.nasa.gov

Teacher-Oriented Web Sites:

American Association for the Advancement of Science, Project 2061 Benchmarks
www.project2061.org/tools/benchol/bolintro.htm

Exploring Planets in the Classroom
www.spacegrant.hawaii.edu/class_acts/

National Science Education Standards
www.nap.edu/html/nses/

The Nine Planets
www.nineplanets.org/

Voyage: A Journey through Our Solar System
www.voyagesolarsystem.org

Journey through the Universe
www.journeythroughtheuniverse.org

Discussion about Pluto's reclassification as a dwarf planet
www.voyagesolarsystem.org/pluto/pluto_default.html

Other Resources

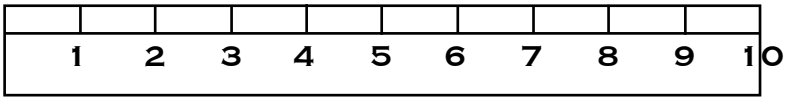
Glaser, Linda. *Our Big Home: An Earth Poem*
Posner, Jackie, et al. *The Magic School Bus Out of This World*
Rabe, Tish. *There's No Place Like Space!* (A Dr. Seuss book)
Willis, Shirley. *Tell Me How Far It Is*

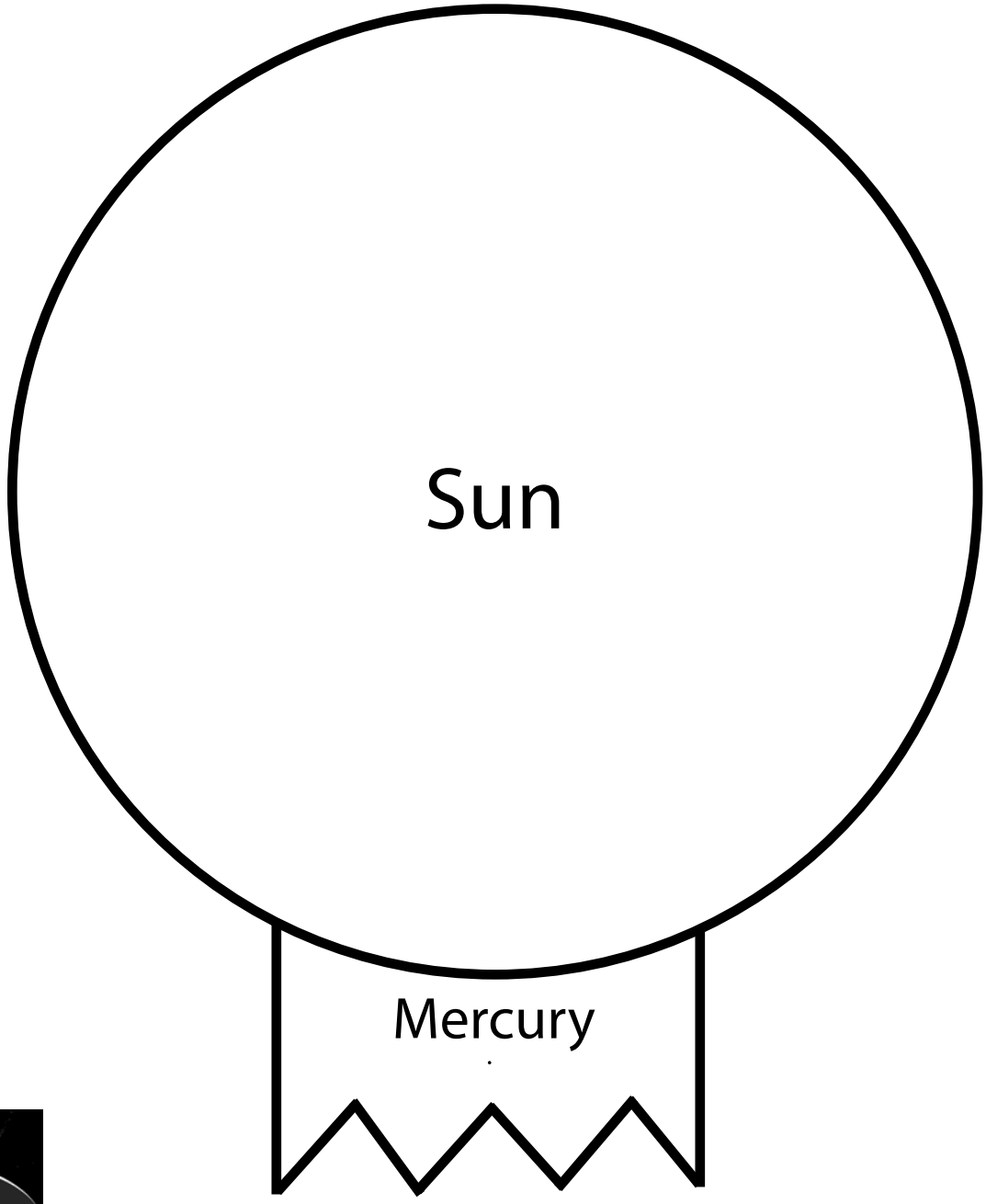
NOTES:

Student Worksheet: Solar System Puzzle

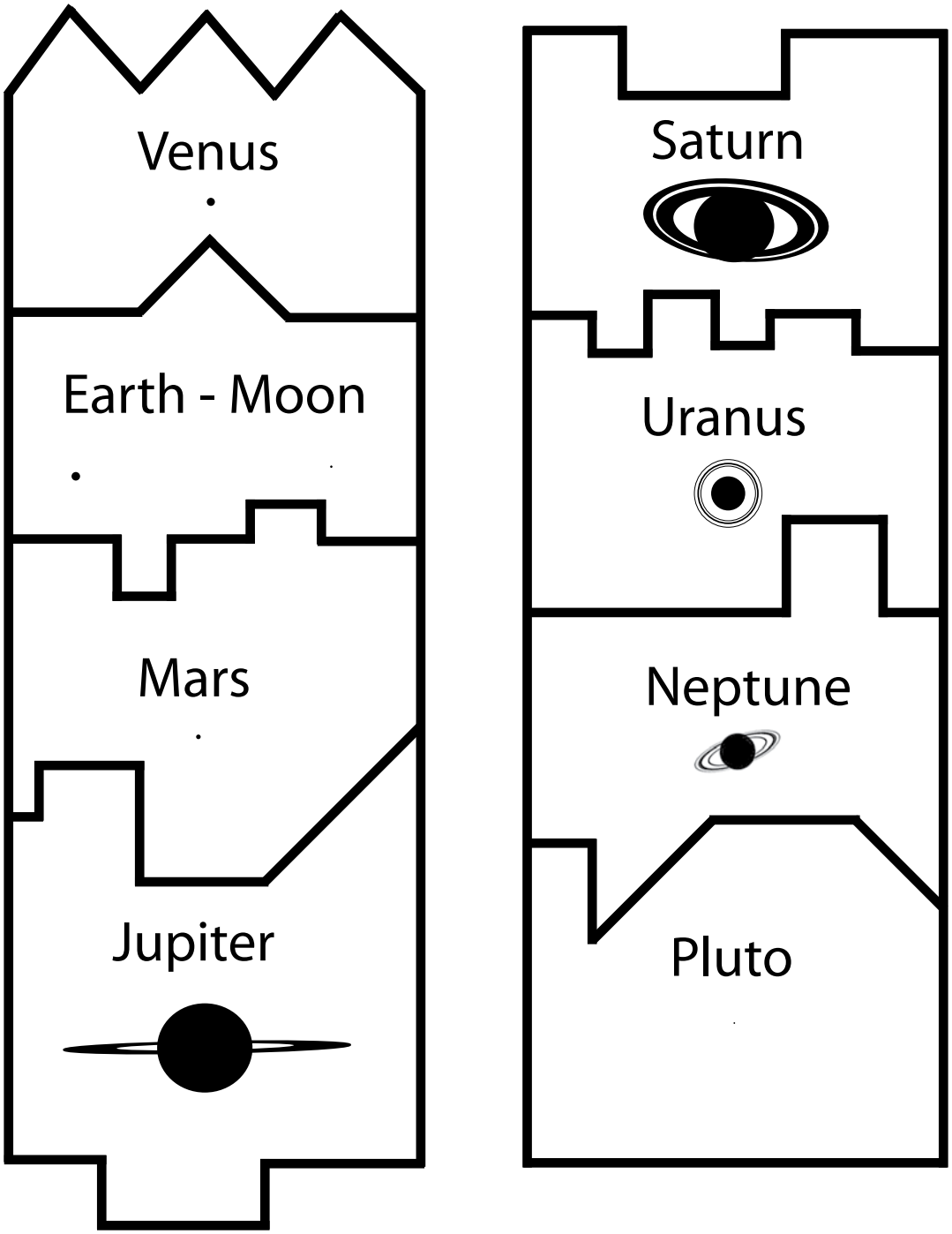
Name _____ Date _____

IMPORTANT NOTE: Your printer may not have produced the planets on these worksheets at their correct size. To check and correct, adjust the enlargement/reduction on your printer to ensure that this ruler measures exactly 10 cm long.





JOURNEY through the UNIVERSE


Venus
Earth - Moon
Mars
Jupiter
Saturn
Uranus
Neptune
Pluto