

The Solar System  
A 2nd Grade Science Unit

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## Overview

More often than not, children have preconceived notions about the solar system and all that it is comprised of. When addressed, these misconceptions can be reformed by constructing more concrete representations of the sun, moon, and planets. In a three-week science unit, second grade students will develop a foundational knowledge about astronomical ideologies as it thoroughly integrates with all other content areas.

As a whole, astronomy deals with our cosmic roots and our place in time and space. Although these concepts may be too broad to visualize, the ideas can be simplified to meet a foundational level of comprehension, while still promoting higher-level thinking. Integrating a variety of multimedia and visuals will provide students with the necessary incite to create more accurate representations. Beginning the unit on a smaller perspective that focuses on the Earth, its sun, and moon, will encourage students to establish a mindset that will allow them to gradually expand toward the rest of the solar system.

A thorough integration of the unit's content throughout the curriculum will enhance the realization of such broad ideologies. Incorporating mathematics, leveled readers, research components, STEM activities, and hands-on experiences will provide students with the necessary tools to expand their perceptions about the world they live in, along with the solar system their world is a part of.

## Objectives

### Cognitive Domain

- ✓ Given a pre-unit assessment, students will evaluate their prior knowledge related to astronomy.
- ✓ Through a read aloud, students will formulate their own hypotheses regarding their planet and the universe.
- ✓ Given a graphic organizer, students will be able to recall what they already know about space.
- ✓ Through direct instruction, students will be able to differentiate between revolution and rotation.
- ✓ Given a poem, students will be able to identify which planetary bodies rotate and which of those revolve.
- ✓ After creating a representation of rotation and revolution in the solar system, students will be able to explain the difference between the two terms.
- ✓ Given a model, students will be able to determine the Earth's axis as an imaginary line that goes through the center of the Earth.
- ✓ Given a visual representation, students will visualize how the Earth's rotation creates night and day.
- ✓ Through direct instruction, students will be recall that it takes 24 hours for the Earth to complete one full rotation.
- ✓ Through direct instruction, students will be able to recall how the Earth's revolution around the sun creates the four seasons.
- ✓ Through direct instruction, students will recall that it takes the moon approximately 29 days to revolve around the Earth.
- ✓ Through direct instruction, students will recall that there are eight phases of the moon.
- ✓ Given a visual, students will be able to describe each phase of the moon.
- ✓ Presented with a visual, students will be able to recall the given phase of the moon.
- ✓ Through direct instruction, students will be able to name the planets in the solar system.
- ✓ Given a mnemonic device, students will be able to identify the correct order of the planets.
- ✓ Through direct instruction, students will recognize that Pluto is considered a dwarf planet because it does not meet the necessary criteria of a classic planet.
- ✓ Through direct instruction, students will be able to recall that 1 astronomical unit is the distance from Earth to the Sun.
- ✓ Given an outline, students will be able to compile a variety of information about their chosen planet through research.
- ✓ Through direct instruction, students will recall that stars go through a life cycle.
- ✓ Through direct instruction, students will be able to define constellation as a pattern made from a group of stars.
- ✓ Given a balloon, students will analyze the different forces that act on the rocket.
- ✓ Provided with a demonstration, students will make predictions based on their observations.

- ✓ After testing their rocket design, students will be able to collect data from the experiment and evaluate how their design effected the distance traveled.
- ✓ Given an opportunity to present, students will be able to identify the different parts of their planet.

### **Affective Domain**

- ✓ Given a graphic organizer, students will be able to pose questions that spark their curiosity about space.
- ✓ Given a KWL chart, students will become active learners as they purposefully seek information about space.
- ✓ Given an opportunity to present, students will confidently recall information about their planet aloud to their peers.
- ✓ After each presentation, students in the audience will be able to recall any relevant information that was presented by the speaker as a result of active listening.
- ✓ After each presentation, students will explain why they chose the given planet.
- ✓ After each presentation, students in the audience will be able to recall any relevant information that was presented by the speaker as a result of active listening.

### **Psychomotor Domain**

- ✓ Through a cooperative activity, students will be able to accurately represent the Sun, Earth, and Moon.
- ✓ Given directions, students will create an concrete representation of the Earth's rotation and revolution around the Sun, and the Moon's revolution around the Earth.
- ✓ Given a hands-on-activity, students will be able to describe the Earth's location in relation to the sun and how it creates the given season.
- ✓ Given the phase of the moon, students will replicate the phase using puff paint and a black paper plate.
- ✓ Given a chart of astronomical units, student will work collaboratively to create a scale model of planetary distances from the sun using toilet paper.
- ✓ Through research and evaluation, students will use multimedia to create an accurate depiction of their planet based on their findings.
- ✓ Given a variety of star stickers, students will be able to design a constellation that relates to an image or character they are familiar with.
- ✓ Given a variety of materials, students will design a balloon rocket that will travel the farthest.
- ✓ Given a balloon rocket model, students will be able to explain the different forces that act on the rocket after testing their design.

## Content Outline

### ★ Lesson 1: Introduction to Space

In an introductory lesson students will be introduced to all components of the solar system and discussing the wonderment of it all. This lesson will assess background knowledge and determine any misconceptions students may have about space.

### ★ Lesson 2: Space KWL Chart

Students will use a graphic organizer to independently determine what they know about space and what they want to learn. This lesson will provide instructional feedback on how to direct the unit to meet the interests of the students. The KWL chart will also serve as a formative assessment at the end of the unit.

### ★ Lesson 3: Rotation and Revolution I

In order for students to develop a foundational understanding of the Solar system, they must first understand the concept of rotation and revolution. These two terms are used to describe the interrelation between the planets, sun, and their moons.

### ★ Lesson 4: Rotation and Revolution II

Students will create a model of how rotation and revolution are relevant to our planet to help demonstrate the relationship between the Earth, sun, and moon.

### ★ Lesson 5: Day and Night

Students will explore how the Earth's rotation is significant to our lives on the planet. Students will learn that as the Earth rotates on its axis, the side of the Earth facing away from the sun experiences night, and the side of the Earth facing the sun experiences day.

### ★ Lesson 6: The Four Seasons

Students will grasp the understanding that while the Earth rotates, it also revolves around the sun. The location of the planet during its revolution around the sun is what causes the four seasons. Students will deduce that the continents on the opposite side of the Earth experience the opposite season.

### ★ Lesson 7: Phases of the Moon

Through discussion and a read-aloud, students will be able to recognize that there are eight phases in the moon's cycle around the Earth. As the word *month* was derived from the word *moon*, students will learn that the moon's cycle repeats itself every 29 days.

### ★ Lesson 8: Phases of the Moon II

In a hands-on activity, students will return to the concept of the moon's phases as they replicate a given phase. This activity will help to reinforce the different phases of the moon and encourage students to understand the vocabulary associated with each phase.

**★ Lesson 9: Introduction to the Planets**

Students will begin to expand their views about the Solar system as they are introduced to the eight planets. A solar walk will provide students with a visual representation of each planet and its place in the Solar system in relation to the sun.

**★ Lesson 10: Distance from the Sun**

To aid students in determining the vastness of our Solar system a concrete model of the distances between the sun and each planet will be created. In this lesson students will integrate their knowledge of measuring and place value to determine each distance on a measurable scale.

**★ Lesson 11: Planet Research**

As part of a culminating project, students will begin researching the planet of their choice. Students will use a variety of resources to present factual information about the planet as well as illustrate it. These projects will be displayed during Open House Night.

**★ Lesson 12: Stars and Constellations**

Students will explore the science of a star's life cycle, and the history of constellations as patterns in the sky that are made of stars. Astronomers used constellations to keep track of the calendars. Constellations help people to recognize significant stars in the sky. Specific stars can be easier to locate by looking for constellations.

**★ Lesson 13: STEM Balloon Rockets - Designing the Rocket**

During this STEM activity, students will be offered a variety of materials to create a balloon rocket with a goal of having their rocket travel the farthest through the Solar system. Students will be required to make generalizations based on the size and shape of the balloon, straws, and type of string their rocket will travel on.

**★ Lesson 14: STEM Balloon Rockets - Testing the Rocket**

Students will take turns experimenting their rocket designs. The students will collect data on the distance traveled and evaluate their designs based on the results.

**★ Lesson 15: Solar Walk Presentations**

Students will have the opportunity to present their research project about their chosen planet. Students in the audience will be required to provide written feedback for their classmates by writing two things they enjoyed about the presentation and one thing they learned.

**★ Trip to the Planetarium**

Students will visit the Lehigh Valley Amateur Astronomical Society to experience a planetarium show.

**★ Unit Assessment**

# Lesson Plans

## Lesson 1 Introduction to Space

**Rationale:** Students will begin their unit on astronomy by accessing background knowledge related to the content. Evaluating students preconceived notions of abstract concepts will aid in guiding instruction. As students begin to gain exposure to new information, their observation skills will be strengthened as more concrete instruction ensues.

### Objectives:

- ✓ Given a pre-unit assessment, students will evaluate their prior knowledge related to astronomy.
- ✓ After a read-aloud, students will formulate their own hypotheses regarding their planet and the universe.

### PDE SAS/PA CORE:

- ➔ **3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.
- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

### Materials:

- Teacher:**     *Me and My Place in Space*, by: Joan Sweeney<sup>1</sup>  
Pre-unit assessment<sup>2</sup>
- Students:**    A crayon of their choice

**Introduction:** Introduce students to their new science unit called astronomy. Astronomy is the study of outer space. Explain to students, before we begin learning about our new unit, I want to see what you already know or think about astronomy. Have students pick one crayon to use on their pre-unit assessment as you hand out the papers.

### Procedure/Strategies:

1. Have students write their names at the top of their paper.
2. Read through the directions as students follow along. Tell students that they shouldn't think too hard about the statement, and they should just circle what they feel is the correct answer. This is not going to be graded, it is just a tool to help me teach.
3. Have students point to the column that says *Before Unit*. Explain that they will be circling yes or no in this column only.

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<sup>1</sup> See 1A

<sup>2</sup> See 1B

4. As a whole group, read through the first statement. Give students a moment to determine their answer. Repeat this process with the rest of the statements.
5. After students have completed their pre-unit assessment collect the papers to store until after the unit is completed.
6. Transition students over to the rug. Prepare to read *Me and My Place in Space* by Joan Sweeney.
7. Remind students to remain attentive because the following day we will complete a KWL chart about outer space.
8. Advise students that the book mentions that there are nine planets in our solar system, but this fact changed a few years ago and now there are only eight planets in our solar system because Pluto is no longer considered a planet.

**Accommodations:** Students with special needs will have statements reread to them during the pre-unit assessment. Students with behavioral needs will be seated near the teacher during the read aloud.

**Closure:** Culminate the lesson by having students discuss what they wonder about Earth and space.

**Evaluation: (students)** Students will be evaluated on their participation during the read aloud.

**Next Step:** Students will create a KWL chart related to astronomy.

## Lesson 2 Space KWL Chart

**Rationale:** KWL charts assist teachers in activating students' prior knowledge of a subject or topic and encourage inquisition. When presented with expository texts and information students benefit from the use of KWL charts by organizing their thoughts and interests in a graphic organizer.

### Objectives:

- ✓ Given a graphic organizer, students will be able to recall what they already know about space.
- ✓ Given a graphic organizer, students will be able to pose questions that spark their curiosity about space.
- ✓ Given a KWL chart, students will become active learners as they purposefully seek information about space.

### PDE SAS/PA CORE:

- ➔ **3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.
- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

### Materials:

<b>Teacher:</b>	KWL chart link <sup>3</sup> : <a href="http://www.readwritethink.org/classroom-resources/student-interactives/creator-30846.html">http://www.readwritethink.org/classroom-resources/student-interactives/creator-30846.html</a>
	Projector
	Printer
<b>Students:</b>	KWL chart handout <sup>4</sup>
	Pencil

**Introduction:** Begin the lesson by discussing what a KWL chart is. Go through the letters of the acronym and have students answer what each letter stands for. The *K* stands for What I **K**now. The *W* stands for What I **W**ant to Know. And, the *L* stands for What I **L**earned. Advise students that we are creating a KWL chart before starting our unit for two reasons. First, we are going to access our background knowledge. What do you already know about space? Second, this will help me guide instruction for the unit. I will use this information to design lessons that will interest you. Inform students that you will be collecting this chart at the end of the lesson.

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<sup>3</sup> See 2A

<sup>4</sup> See 2B

**Procedure/Strategies:**

1. Have students complete the first section of the chart independently. Provide about five minutes to complete this section.
2. Review some of the responses and add them to the online chart.
3. The next step is to have students complete the *W* section of the chart. Since this is the *What I Want to Know* section, inform students that this section should be filled in using questions. Use the 5W's and H: who, what, where, when, why, and how as your sentence starter. For example, how many planets are there in our solar system? Or, what is the largest planet in our solar system?
4. Give students about five minutes to complete this section. Encourage them to think of questions that don't just relate to concepts of space. For example, the sun, the moon, the stars, the planets, etc.
5. Review some of the students' responses as a whole group and fill them in to the online KWL chart.
6. Print the chart on separate pages and as a complete chart. Display the chart on a bulletin board for students to refer to during the unit.

**Accommodations:** Spelling assistance will be provided as needed. Students who require writing support will have their lines highlighted.

**Closure:** Culminate the lesson by asking if any of the information that we added to the chart answered anyone's question. Does anyone have an answer to any of the questions in the *What I Want to Know* section?

**Evaluation: (students)** Evaluate students on their participation during the KWL process, and their ability to work attentively.

**Next Step:** Students will explore the difference between rotation and revolution.

### Lesson 3 Rotation and Revolution I

**Rationale:** Students will be introduced to the concept of rotation and revolution and its relevance to the Earth, moon, and sun. These concepts will provide a solid foundation for when students begin to explore day and night, the four seasons, and the phases of the moon.

**Objectives:**

- ✓ Through direct instruction, students will be able to differentiate between revolution and rotation.
- ✓ Given a poem, students will be able to identify which planetary bodies rotate and which of those revolve.
- ✓ Through a cooperative activity, students will be able to accurately represent the Sun, Earth, and Moon.

**PDE SAS/PA CORE:**

**S.K-2.D.3.1:** Understand that Earth is part of a solar system.

**3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.

**Materials:**

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|------------------|---|
| <b>Teacher:</b>  | Globe<br>Flashlight<br>Ball to represent the Moon<br>Rotate and Revolve Poem <sup>5</sup> |
| <b>Students:</b> | Rotate and Revolve Poem<br>Pencil   |

**Introduction:** Begin lesson by introducing the two vocabulary words, rotate and revolve. Ask students if anyone might know the difference. Explain the difference. To rotate means to spin around in a circle. Model spinning in a circle. Have students stand up and rotate. Explain that to revolve means to orbit, or circle around another object. Model revolving around a chair. Have students stand up and revolve around their seats.

**Procedure/Strategies:**

1. Use the globe to model how the Earth rotates on its axis. The axis is the imaginary line that goes through the north and south poles.
2. Have a student volunteer to use a ball to model how the moon revolves around the Earth. The Earth is still rotating while the moon revolves around the Earth. Inform students that the moon does not rotate, and the one side of the moon always faces the Earth.

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<sup>5</sup> See 3A

3. Have another student volunteer to play the part of the sun. Use the flashlight to represent the sun. Have the Earth rotate as it revolves around the sun. Have the moon revolve around the Earth.
4. Give each student the poem handout and explain the directions.
5. The poem is missing the words rotate and revolve, we have to fill in the correct answers.
6. Read the poem and have students determine what word to use in the blanks. If time permits, have students compare their answers with a partner. Monitor the room during this process.
7. Then read through the entire poem together.

**Accommodations:** Writing accommodations will be provided for students who require them. Higher level thinking will be scaffold by asking students to evaluate how we are affected by the rotation and revolution of the Earth and the Moon.

**Closure:** Culminate the lesson by having students stand up and rotate or revolve, using their seats as a constant.

**Evaluation: (students)** Students will be evaluated on their participation and their ability to identify the difference between rotation and revolution as they fill in the blanks on their poem.

**Next Step:** Students will create a paper model to help the concept of rotation and revolution resonate.

## Lesson 4 Rotation & Revolution II

**Rationale:** Students have begun to build an understanding of rotation and revolution and how these concepts are relevant to the Earth, moon, and sun. This lesson will provide students with a concrete representation of how rotation and revolution are presented in space.

### Objectives:

- ✓ Given directions, students will create a concrete representation of the Earth's rotation and revolution around the sun, and the moon's revolution around the Earth.
- ✓ After creating a representation of rotation and revolution in the Solar system, students will be able to explain the difference between the two terms.

### PDE SAS/PA CORE:

- ➔ **3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.
- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

### Materials:

- |                  |  |
|------------------|--|
| <b>Teacher:</b>  | Teacher's model of craft<br>Craft printable <sup>6</sup><br>Brass brads (2 for each student) |
| <b>Students:</b> | Scissors<br>Crayons or Colored Pencils   |

**Introduction:** Begin with a review of rotation and revolution. Ask students, what does it mean to rotate? *To turn or spin around in a circle.* What does it mean to revolve? *When you revolve you go around, or orbit another object.* Have students stand to rotate and revolve around their seats. Read through the *Rotate & Revolve* poem from the previous day's lesson. Then, introduce craft.

### Procedure/Strategies:

1. First, show students the teacher's model.
2. Inform students that they must complete the sentence with the correct word, rotate or revolve. *The Earth \_\_\_ on its axis (rotates). The Earth \_\_\_ around the sun (revolves).*
3. Then, they will color all of the parts before they begin cutting.
4. When they have finished coloring they may begin to cut the sun and the strip that connects the sun and the Earth.
5. Repeat the same procedure for the strip that connects the Earth and the moon. *The moon \_\_\_ around the Earth (revolves).*

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<sup>6</sup> See 4A

6. Encourage students to think about the order of the parts. The Earth should be in between the sun and the moon.
7. Then, go around and assist students in connecting each part of the craft with the brass brads.

**Accommodations:** Spelling and writing accommodations will be provided as necessary. Students who require cutting assistance will be offered assistance, as needed.

**Closure:** Culminate the lesson by having students volunteer to display their craft and explain how the words rotate and revolve are relevant to space.

**Evaluation: (students)** Students will be evaluated on their ability to follow instructions and correctly label the parts of the Solar system that rotate and revolve.

**Next Step:** Students will explore how day and night are caused by the Earth's rotation.

## Lesson 5 Day and Night

**Rationale:** Students will apply their understanding of the Earth's rotation to develop an understanding of day and night. Students will represent how the Earth, moon, and sun are all counterparts that affect the time of day. This lesson will provide students with a concrete representation of how the Earth's rotation brings to existence day and night.

### Objectives:

- ✓ Given a model, students will be able to determine the Earth's axis as an imaginary line that goes through the center of the Earth.
- ✓ Given a visual representation, students will visualize how the Earth's rotation creates night and day.
- ✓ Through direct instruction, students will be recall that it takes 24 hours for the Earth to complete one full rotation.

### PDE SAS/PA CORE:

- ➔ **3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.
- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

### Materials:

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|------------------|---|
| <b>Teacher:</b>  | Rotate & Revolve craft from prior lesson <sup>7</sup><br>Projector<br>Solar Walk 2 app (prepared to project) <sup>8</sup> |
| <b>Students:</b> | Rotate & Revolve craft from prior lesson  |

**Introduction:** Hand students their rotate and revolve crafts from the previous lesson. Have them lay it flat on their desks with the sun on the left, Earth in the middle, and the moon on the right. Demonstrate how the Earth should look, with North America facing the correct way. Today, we are going to learn how there is night and day on Earth. Who remembers how long it takes the Earth to make one complete rotation? *24 hours or 1 day*. Let's see how the Earth changes as it rotates in a day.

### Procedure/Strategies:

1. Have students draw a straight line through the middle of the Earth, this can represent the axis. Model.

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<sup>7</sup> See 5A

<sup>8</sup> See 5B

2. Explain to students that now, half of the Earth is facing the sun, and the other half is facing the moon. In which half do you think it is morning? *The half that is facing the sun.*
3. The half that is facing the sun is experiencing day time, and the other half that is facing the moon is experiencing night.
4. Have students begin to rotate the Earth counterclockwise, until the other halves begin to experience night and day.
5. Explain to students that as the Earth is rotating the places in the world are going through the hours of the day. The half that was sleeping is beginning to wake up. The sun is slowly starting to come up for the people on this side of the world. Correlate lesson to math by asking students whether this side of the Earth is experiencing AM or PM.
6. The other half is getting ready for bed as the sun goes down and the moon becomes more visible. This side of the Earth is experiencing PM.
7. Introduce the Solar Walk video. Demonstrate to students how the Earth rotates counterclockwise. Show students the position of the sun, and how the time of day is changing as the Earth rotates.
8. Locate North America and demonstrate how the time changes.

**Accommodations:** Students with special needs will be provided assistance when drawing the axis on the Earth. Their learning will be visually supported through the Solar Walk video. Gifted students will be asked to consider the Earth's revolution around the sun. How does this affect our nights and day? When are the nights longer? When are the days longer?

**Closure:** Culminate the lesson by asking students what events might take place in the morning? Examples might include, wake up, go to school, eat breakfast. What might the people on the opposite side of the Earth doing at this time? Examples might include, eating dinner, getting ready for bed, sleeping. Ask students to state how or why we have day and night on Earth. *As the Earth rotates, it is either facing the sun or away from it.*

**Evaluation: (students)** Students will be evaluated on their participation and their ability to follow directions during the activity.

**Next Step:** Students will explore how the Earth's revolution around the sun brings forth the four seasons.

## Lesson 6 The Four Seasons

**Rationale:** Students will continue to build an understanding of the Earth’s rotation and revolution. They will apply these concepts to how the Earth’s orbit around the sun effects our weather patterns. The Northern Hemisphere’s location in relation to the sun determines how much of the sun’s direct light we receive. When the Northern Hemisphere faces the sun, the majority of the sun’s rays are hitting us directly. This results in warmer temperature and longer days. As the Earth continues to rotate, the Northern Hemisphere eventually moves away from the sun’s direct sunlight, causing cooler temperatures and shorter days.

### Objectives:

- ✓ Through direct instruction, students will be able to recall how the Earth’s revolution around the sun creates the four seasons.
- ✓ Given a hands-on-activity, students will be able to describe the Earth’s location in relation to the sun and how it creates the given season.

### PDE SAS/PA CORE:

- ➔ **3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.
- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

### Materials:

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|------------------|--|
| <b>Teacher:</b>  | Teacher’s model of seasons craft <sup>9</sup><br>Printable for students <sup>10</sup><br>Pre-folded construction paper |
| <b>Students:</b> | Season printable and construction paper<br>Glue<br>Scissors<br>Markers/Crayons/Colored Pencils                         |

**Introduction:** Introduce lesson by asking students how many seasons there are in a year? Who can list the four seasons? Ask: Does anyone know why we have four seasons in a year?

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<sup>9</sup> See 6A

<sup>10</sup> See 6B

**Procedure/Strategies:**

1. Explain to students that the the reason for the seasons is due to the position of the Earth as it revolves around the Sun. The Earth's rotation on it's axis, along with its tilt, also affects the seasons we experience.
2. Use the teacher's model to demonstrate our location on the Northern Hemisphere, and the direct sunlight we are receiving.
3. Parts of the Earth experience more or less of the sun's rays as the Earth revolves around the sun. We are located in the Northern Hemisphere.
4. Guide students by asking: What does it feel like when the Northern Hemisphere is facing the sun directly. *Hot.*
5. During which season do we feel hot? *Summer.*
6. Explain that as the Earth continues to revolve, our position from the sun begins to change slowly. We begin to move further away. How might the temperature change if we are moving further away from the sun's direct rays.
7. Which season comes after summer? *Autumn or fall.* Now, our position in relation to the sun is getting further away. We are not getting all of the sun's direct sunlight.
8. Ask students: During what season are we not getting any of the sun's direct rays? *Winter.* During winter we are facing away from the sun, which means it will take longer for the sun's rays to reach us, and when they do, it doesn't get really hot.
9. Repeat for spring.
10. Hand each student their pre-folded construction paper and seasons printable and have them cut each part and paste the sun in the center. Model this process.
11. Have students paste their four images of the Earth on each inner flap of the construction paper. Model. Remind students that the North Pole should be at the top on each flap.
12. Ask students to recall which way the Earth revolves and rotates around the sun. *Counterclockwise.* Model drawing four arrows going counterclockwise around the sun.
13. Then, beginning with the picture of the Earth that is in the Sun's direct sunlight, have students label the season on the outer flap. When all of the seasons have been labeled, have students illustrate the season.

**Accommodations:** Students with special needs will be offered hand-over-hand assistance for cutting, pasting, and labeling. Gifted students will be asked to consider the Earth's rotation as it revolves around the Earth. How does this affect the length of our days?

**Closure:** Culminate the lesson by asking students how the Earth's revolution and rotation around the sun affects our seasons? *As the Earth revolves and rotates we are exposed to more or less of the sun's direct rays.*

**Evaluation: (students)** Evaluate students on their participation, their ability to follow instructions, and whether they are able to deduce how the seasons develop in relation to our location in space.

**Next Step:** Students will begin to explore the phases of the moon.

## Lesson 7 Phases of the Moon I

**Rationale:** As students begin to expand their understanding of Earth’s relationship with the sun and moon, they will explore how the moon changes in relation to the sun and it’s position around the Earth. This relationship stems from the introductory lesson on how rotation and revolution exist in our solar system.

**Objectives:**

- ✓ Through direct instruction, students will recall that it takes the moon approximately 29 days to revolve around the Earth.
- ✓ Through direct instruction, students will recall that there are eight phases of the moon.
- ✓ Given a visual, students will be able to describe each phase of the moon.

**PDE SAS/PA CORE:**

- ➔ **3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.
- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

**Materials:**

- Teacher:**      Faces of the Moon, by: Bob Crelin<sup>11</sup>  
                          Moon Phase Mini Book<sup>12</sup>  
                          YouTube link: <https://www.youtube.com/watch?v=wz01pTvuMa0>  
                          Search: Moon Phases Demonstration
- Students:**      Moon Phase Mini Book pages  
                          Black and Yellow crayons  
                          Pencil

**Introduction:** Begin lesson with a discussion of the moon. Ask students if they have ever looked at the moon? Have they noticed its shape? Describe the different shapes they have seen, or even no shape at all. Have they ever caught a glimpse of the moon in the morning? These questions should lead to how the moon revolves around the Earth, but does not rotate. Explain to students that the word *month* was derived from the word *moon*. Have students keep that in mind as you begin reading. Begin reading Faces of the Moon, by: Bob Crelin.

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<sup>11</sup> See 7A

<sup>12</sup> See 7B

**Procedure/Strategies:**

1. During the read aloud, present images of each moon phase. Beginning on page 8, present a visual of the first phase of the moon. Repeat for Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Last Quarter, Waning Crescent, and New Moon.
2. Explain to students that after the Waning Crescent phase, the moon begins the cycle of phases again. Ask students, how long will the next cycle last? *Approximately 28-30 days.* Explain to students that a cycle is a process that repeats itself over and over.
3. After each phase is mentioned in the story, have students fill in the corresponding page in their Moon Phase mini-book. They will be required to color in the shape of the moon, using yellow to represent the part of the moon we see in the sky, and black to represent the part of the moon's shadow.
4. Lastly, students will cut the pages apart and place them in the correct order, beginning with the New Moon.
5. Have volunteers tell the order of the moon phase cycle. Then, have students staple their books together.
6. If time permits, introduce the YouTube video modeling the moon phases activity. Encourage students to try this activity at home in a dark room.

**Accommodations:** Students with special needs will be offered preferential seating near the teacher, as well as near the screen to watch the video. Gifted students will be asked to evaluate other ways the moon changes. For example, lunar and solar eclipses.

**Closure:** Culminate the lesson by asking students how many phases the moon goes through? *Eight phases.* How long does it take the moon to go through all of the phases? About a month? Refer back to how the word *month* was derived from the word *moon*. Ask students, why does the moon go through these phases? *As the moon revolves around the Earth, the sun lights portions of the moon. The sun's rays and the moon's location around the Earth are what causes the phases.*

**Evaluation: (students)** Students will be evaluated on their attentiveness and their ability to recall that there are eight moon phases, along with why the moon goes through phases. The Moon Phase mini-book will be used as a form of assessment, as well.

**Next Step:** Given visuals, students will replicate the phases of the moon using shaving cream and paper plates.

## Lesson 8 Phases of the Moon II

**Rationale:** In order for students to further explore the phases of the moon, they will be given the opportunity to replicate each phase during a hands-on activity. This interactive component will encourage students to conceptualize the abstract ideology of how the moon changes shape.

### Objectives:

- ✓ Presented with a visual, students will be able to recall the given phase of the moon.
- ✓ Given the phase of the moon, students will replicate the phase using puff paint and a black paper plate.

### PDE SAS/PA CORE:

- ➔ **3.3.2.B1:** Observe and record • location of the Sun and the Moon in the sky over a day. • changes in the appearance of the Moon over a month. Observe, describe, and predict seasonal patterns of sunrise and sunset.
- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

### Materials:

- |                  |   |
|------------------|---|
| <b>Teacher:</b>  | Flocabulary - Moon Phases video: <sup>13</sup><br><a href="https://www.youtube.com/watch?v=xBc8QHSsFgE">https://www.youtube.com/watch?v=xBc8QHSsFgE</a> |
|                  | Black paper plates  |
|                  | Masking tape  |
|                  | Puff paint (shaving cream/glue)   |
|                  | Moon phase choices  |
|                  | Napkins   |
|                  | Paint brushes   |
|                  | Phases of the moon bulletin board with labels <sup>14</sup>   |
| <b>Students:</b> | Black paper plates  |
|                  | Paintbrushes  |
|                  | About 2 Tbsp. of puff paint per student.  |

**Introduction:** Begin lesson by discussing the eight different phases of the moon. Reiterate, when the moon is waxing, it is growing. Similar to when you dip a candle in wax, it gets bigger. When the moon is waning, it is wasting away. It is beginning to disappear into a New Moon. Begin playing the Phases of the Moon video. Begin mixing the paint mixture while students are watching the video. Give explicit directions for behavior and following instructions.

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<sup>13</sup> See 8A

<sup>14</sup> See 8B

**Procedure/Strategies:**

1. When the video is over have students label the phases of the moon on the bulletin board.
2. Discuss with students the position of the sun and moon as the moon rotates around the Earth.
3. Explain to students how they will be using the puff paint to create the moon phase. Model this process.
4. Then, hand students a plate. First, have them write their names on the back of their plate using a marker.
5. Have the puff paint prepared in cups to keep in the center of each group. Use two cups for larger groups.
6. Once students have their names written, go around and have students pick a moon phase out of a hat. Have them recall what the phase of the moon looks like before they begin painting it. They may use the bulletin board as a reference, or their Moon Phase mini-booklets from the previous day's lesson.
7. Monitor students as they are creating the phases. Question the location of the sun during each phase.
8. Encourage higher level thinking by asking students to determine what the next phase would be.

**Accommodations:** Students with special needs will be offered hand-over-hand assistance during this activity. Gifted students will be asked to contemplate the position of the Sun during each phase, as well as which date within the month the current phase would be present.

**Closure:** Culminate the lesson by having students order their moons according to the phase cycle. Begin with New Moon and have students determine which phase is next.

**Evaluation: (students)** Students will be evaluated on their ability to follow instructions and their ability to accurately replicate the given phase of the moon.

**Next Step:** Students will be introduced to the eight planets in the Solar system.

## Lesson 9

### Introduction to the Planets

**Rationale:** In this hands-on activity, students will learn the names of the eight planets in the Solar system, as well as their order from the sun. As the unit begins to expand on the concepts of space, students will be introduced to the eight planetary bodies and basic facts related to each planet.

#### Objectives:

- ✓ Through direct instruction, students will be able to name the planets in the solar system.
- ✓ Given a mnemonic device, students will be able to identify the correct order of the planets from the sun.
- ✓ Through direct instruction, students will recognize that Pluto is considered a dwarf planet because it does not meet the necessary criteria of a classic planet.

#### PDE SAS/PA CORE:

- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

#### Materials:

<b>Teacher:</b>	Yellow string for necklace Planet beads (9 for each student) Solar Walk 2 app Bead order information Mnemonic Device (My Very Excellent Mother Just Served Us Noodles)
<b>Students:</b>	Solar system necklace bags

**Introduction:** Introduce the lesson by telling students that today you will be talking about the Solar system. Ask students if they know what the parts of the Solar system are. Explain that the Solar system is the sun and all the planets that orbit around it.

#### Procedure/Strategies:

1. Ask students to name any of the planets they know. Then, ask them to name the planet we all live on.
2. If students mention Pluto, explain that Pluto is no longer considered a classic planet. In 2005 Pluto was labeled a dwarf planet because its orbit around the sun is inclined, this means it is tilted on an angle. Pluto also intersects with Neptune’s orbit around the sun. There are 70,000 other objects in the sky like Pluto.
3. An object has to meet the following criteria to be considered a planet: It needs to be in orbit around the Sun. It needs to have enough gravity to pull itself into a spherical shape. And, it needs to have “cleared the neighborhood” of its orbit. According to this, Pluto is not a planet because it cannot consume or sling away objects that are in its way.

4. Then, explain to students that they will each receive a bag that includes string and nine different beads. They will be using these materials to create a Solar system necklace.
5. The yellow string represents the sun. All of the planets in the solar system revolve around the sun.
6. As we begin our solar walk, each bead will represent a different planet. When we introduce that planet you will string the bead on your necklace. Inform students that their attention is imperative.
7. Begin the Solar Walk 2 app and identify the eight planets in the solar system. Explore planetary facts for each planet during the Solar Walk app.
8. The first planet is Mercury. It is represented by the small, black bead. Mercury is the closest planet to the Sun. It is small and has many craters.
9. The second planet is Venus. It is the yellow bead. Venus has a very thick atmosphere and is covered with clouds. Much of the Sun's light is reflected by the clouds, making Venus look like a yellow ball.
10. The third planet is Earth. It is represented by the blue bead. Water covers  $\frac{2}{3}$  of Earth and from space it looks like a pretty blue ball.
11. The fourth planet is Mars. Mars is the reddish-orange bead. Mars is often called the Red Planet, because there is more iron in the Martian soil that has rusted.
12. The next bead is small, dark, and roughly-shaped. It does not represent a planet. It represents the asteroid belt that separates the rocky planets from the gas giants. The asteroid belt is a bunch of different sized rocks that orbit the Sun. Asteroids are also called minor planets. Thousands of asteroids have been discovered throughout our Solar system.
13. The next bead is larger. It represents the largest planet in our Solar system which is Jupiter. Jupiter is so large that it could hold 50 Earths within its shell. Jupiter is composed mostly of gas and most of that gas is hydrogen.
14. The sixth planet is Saturn. It is represented by the bead that looks like a ring. Saturn has the largest system of rings in our Solar system. The rings are made of pieces of ice and rock, all moving around Saturn together. Like Jupiter, Saturn is composed mostly of hydrogen gas.
15. Uranus is the seventh planet. It is greenish-blue in color. Uranus is also composed mostly of hydrogen.
16. The eighth planet is Neptune. It is blue in color. It is the last of the outer gas planets. Neptune is composed mostly of hydrogen but the methane in its outer atmospheres makes it blue in color.
17. Have students tie both ends of the string into a knot. Assist students during this process and assess the order of their beads.

**Accommodations:** Students with special needs will be offered hand-over-hand assistance, as needed during the stringing process. These students will also be offered preferential seating near the Smart Board to view the Solar Walk 2 app. Gifted students will be asked to think of a mnemonic device to help remember the order of the planets.

**Closure:** Inform students of the mnemonic device used to remember the planets: My Very Excellent Mother Just Served Us Noodles. Culminate the lesson by asking students to use their

necklace to recall the names of the planets in the Solar system. Ask students to think of another mnemonic device that could be used to remember the order.

**Evaluation: (students)** Evaluate students on their participation and their ability to follow the beading instructions concisely. Formatively assess the order of the beads on their necklaces.

**Next Step:** Students will review the planet order.

## Lesson 10

### Distances from the Sun

**Rationale:** In an attempt to concretize the vastness of our solar system, students will create a scale model of the distances between each planet and the sun. Students will use toilet paper and a chart of distances to actualize each distance. This lesson integrates mathematics, in that it requires students to break apart numbers into groups of ten and use a non-standard unit of measurement.

#### Objectives:

- ✓ Through direct instruction, students will be able to recall that one Astronomical Unit (AU) is the distance from Earth to the Sun.
- ✓ Given a chart of Astronomical Units, students will work collaboratively to create a scale model of planetary distances from the sun using toilet paper.

#### PDE SAS/PA CORE:

- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

#### Materials:

- |                  |   |
|------------------|---|
| <b>Teacher:</b>  | Chart of AU distances <sup>15</sup><br>Toilet Paper (1 for each group)<br>A set of planet labels for each group <sup>16</sup> . |
| <b>Students:</b> | Chart<br>Rolls of toilet paper  |

**Introduction:** Introduce lesson to students by explaining that although we can see pictures of the planets and read facts, we can never truly understand how big our Solar system is. Today, we are going to try to create a scale model that represents the distance between each planet and the sun. A scale model is a representation or copy of an object that is larger or smaller than the actual size of the object being represented. Very often the scale model is smaller than the original and used as a guide to making the object in full size. To create a scale model we need to review specific information.

#### Procedure/Strategies:

1. Explain to students what an Astronomical Unit is. An astronomical unit is the distance from the Earth to the sun. Astronomers use AU to describe distances in the solar system. This makes it easier than having to use very big numbers when talking about space.

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<sup>15</sup> See 10A

<sup>16</sup> See 10B

2. 1 AU equals 93 million miles. This means that the Earth is 93 million miles away from the sun. Instead of saying 93 million miles away, astronomers say 1AU.
3. Project the Solar Walk 2 app. Ask students to recall the order of the planets. Remind them of the mnemonic device (M, V, E, M, J, S, U, N). Ask students: If Earth is 93 million miles away from the sun, or 1 AU, do you think Mars is more than or less than 1 AU away from the sun. Why?
4. Then ask students if Saturn is more than or less than 1 AU away from the sun? Why?
5. Explain to students that today we will create a model of the distance between each planet and the sun. We are going to pretend that one square of toilet paper is equal to 93 million miles, or 1 AU.
6. We have a chart of distances that have been rounded for us to help us determine how many AU each planet is from the sun. Hand each student a chart.
7. Lets begin with Earth. Earth is 1 AU from the sun. One square of toilet paper will equal 1 AU.
8. Mercury and Venus are less than 1 AU from the Sun. What will we have to do to the square? We will have to cut the square to make it smaller. Which planet will have the smallest square? Mercury.
9. Mars is 2 AU away from the sun. How many squares of toilet paper will we have to use to represent how far Mars is away from the sun? *2 squares of toilet paper*. Explain to students that this means we would have to travel 93 million miles twice to get to Mars. Have a student determine the answer to  $93 + 93 = 186$ . This means that Mars is 186 million miles away from the Sun.
10. Jupiter is 5 AU away from the sun. Ask students how many times they would have to had 93? *Five times*.
11. Have students fill in the rest of the chart with a partner.
12. Then explain to students that they will work in groups to create the model. Demonstrate how they will do this. One person from each group will set up the toilet paper as it is being counted. Other members of the group will count out the squares.
13. Explain to students that some of them will be working in the hallway and their behavior is imperative.
14. Hand each group a roll of toilet paper and let them begin.
15. When each group is finished, they will answer the question on their chart.

**Accommodations:** Students with special needs will be working with their learning support teacher. Their role in the group activity will be adjusted as needed. Gifted students will be asked to determine other non-standard units of measurement that could be used to create a model.

**Closure:** Culminate the lesson by asking students why scientists create scale models? *It would be impossible to use actual distances. Also, mistakes would be more likely if astronomers had to use exact numbers.* Ask students how many miles the Earth is from the sun. *93 million miles or 1 Astronomical Unit.*

**Evaluation: (students)** Students will be evaluated on their ability to work cooperatively and use the chart to create a model of each distance to scale.

**Next Step:** Students will begin researching a planet of their choice.

## Lesson 11

### Planet Research

**Rationale:** As students progressively build their knowledge of the Solar system and all that is included, they will be required to apply what they know and further their exploration through research. Students will choose a planet to research and use a variety of resources to answer questions. The creative component of this project will be completed at home where students will design an image of their planet.

#### Objectives:

- ✓ Given an outline, students will be able to compile a variety of information about their chosen planet through research.
- ✓ Through research and evaluation, students will use multimedia to create an accurate depiction of their planet based on their findings.

#### PDE SAS/PA CORE:

- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

#### Materials:

<b>Teacher:</b>	Information outline <sup>17</sup> Model of research project Class list to organize chosen planets
<b>Students:</b>	Research books, computers, and Fact Files Pencil Information Outline

**Introduction:** Explain to students that now it is their turn to teach us about the planets. Each student will choose a planet to research. During this research they will be required to answer the questions on the fact sheet.

#### Procedure/Strategies:

1. Hand each student the Information Outline sheet.
2. Read through each research component. Explain to students that they must use at least one book, one website on the internet, and their Fact Files to find the information to these question.
3. Students will also be required to research at least three interesting facts. They may include more if they wish to do so. Explain to students that the facts must be information that is not already presented in their outline. They should be *interesting* facts.

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<sup>17</sup> See 11A

4. When the outline is complete and accurate students will be given the materials to create their planet. All of the information on the outline must be complete, accurate, and written in complete sentences before they can receive their materials.
5. Go around the room and ask students which planet they wish to research. Make a note of each choice.
6. Have students write the name of their planet on their outline. Assign a due date for the project.

**Accommodations:** Students with special needs will be offered spelling and reading assistance as needed during the research process. Gifted students will be asked to add an extra detail to their assignment that compares and contrasts their planet to another planet.

**Closure:** Culminate the lesson by transitioning students back to their seats in the order of the planets. For example, if you are researching the first planet you may go back to your seat. Etc.

**Evaluation: (students)** Evaluate students on their ability to find accurate information effectively and efficiently.

**Next Step:** Students will continue to research their planets. They will also be introduced to asteroids, meteors, and comets.

## Lesson 12

### Stars and Constellations

**Rationale:** As students continue to explore the parts of the Solar system they will also learn about stars. Students will explore how stars are formed, the many various types of stars, how big our star the Sun is relative to other stars, how many stars there are estimated to be in the universe, and how old stars are. Students should generalize that the Solar system contains more than just the sun, planets, and their moons. This activity allows students to create their own constellations and stories from a given pattern of stars and compare them to what other students have seen in the same pattern.

#### Objectives:

- ✓ Through direct instruction, students will recall that stars go through a life cycle.
- ✓ Through direct instruction, students will be able to define constellation as a pattern made from a group of stars.
- ✓ Given a variety of star stickers, students will be able to design a constellation that relates to an image or character they are familiar with.

#### PDE SAS/PA CORE:

- ➔ **S.K-2.D.3.1.1:** Identify objects that can be observed in the day or night sky (i.e., the Moon, planets, the Sun and other stars).

#### Materials:

- |                  |   |
|------------------|---|
| <b>Teacher:</b>  | YouTube Link: <a href="https://www.youtube.com/watch?v=1sZ15SUeS9w">https://www.youtube.com/watch?v=1sZ15SUeS9w</a><br>Constellation Dot-to-Dot activity sheet <sup>18</sup><br>Star stickers<br>Black construction paper<br>White chalk or white crayons |
| <b>Students:</b> | 10 star stickers per student<br>Black construction paper  |

**Introduction:** Begin lesson by asking students, what other objects they might notice in the night sky besides the moon. Which star is closest to Earth? *The sun*. What do you think stars are made of? *Stars are massive, bright, spheres of very hot gas called plasma which are held together by their own gravity*. Each galaxy contains billions of stars.

#### Procedure/Strategies:

1. Explain to students that scientists have learned that stars go through life cycles. Stars are formed from clouds of dust that spiral together due to gravity. Then they begin to expand and grow, until they eventually explode. This process takes billions of years.

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<sup>18</sup> See 12A-12B

2. But, before scientists learned that stars go through a life cycle they used stars to keep track of the calendar.
3. Introduce the YouTube video, Constellations: Connect the Dots in the Sky.
4. After watching the video, ask students what a pattern made of a group of stars in the sky is called. These patterns are called constellations.
5. Has anyone ever seen any of the constellations mentioned in the video, at night? Discuss what else the famous constellations might look like.
6. Explain to students that many years ago people used to tell stories about the constellations in the sky, and they even used the constellations to keep track of the calendar. Each constellation has a name and a story of how it came to be.
7. These stars are part of the zodiac constellations and are present as specific times during each month. Each month has its own special constellation.
8. Explain to students that they will use their creativity to design a constellation that is unique to a story or character they are familiar with. Show students the teacher's model of a constellation.
9. Students will have to place the stickers down to form a specific shape and then use a white crayon or chalk to connect the stars. Remind students that not every detail of the picture will have a star to represent it. Some details of a figure need to be imagined, like it showed in the video.
10. Hand each student the necessary materials and inform students that they will have the chance to write about their constellation during Daily 5.

**Accommodations:** Students with special needs will be scaffolded through the process of making a constellation. First, they will choose a symbol or character to represent and then attempt to lay the stickers out to create an outline of the image. Gifted students will be asked to determine when their constellation would be visible in accordance with the zodiac. Gifted students will also have the option to create a different constellation using a group of stars that is already present in the night sky.

**Closure:** Culminate the lesson by having students recall what a constellation is. Have volunteers share their constellations and describe how and why they chose to represent that image.

**Evaluation: (students)** Students will be evaluated on their participation and their ability to design a constellation that is cohesive with the image they have in mind.

**Next Step:** Students will explore meteors, comets, and asteroids as different particles in space.

## Lesson 13

### STEM Balloon Rocket - Designing the Rocket

**Rationale:** A physics STEM activity will challenge students to design a balloon rocket that will travel the farthest through the solar system - a ten-foot span between two chairs. Students will analyze the aerodynamics of a balloon rocket and how it compares to a real rocket engine. Students will have to examine the effect of different forces by considering their materials and how altering these materials will effect their outcome.

#### Objectives:

- ✓ Provided with a demonstration, students will make predictions based on their observations.
- ✓ Given a variety of materials, students will design a balloon rocket that will travel the farthest.
- ✓ Given a balloon, students will analyze the different forces that act on the rocket.

#### PDE SAS/PA CORE:

- ➔ **3.1.3.B6:** Plan and conduct a simple investigation and understand that different questions require different kinds of investigations.
- ➔ Use simple equipment (tools and other technologies) to gather data and understand that this allows scientists to collect more information than relying only on their senses to gather information.
- ➔ Communicate procedures and explanations giving priority to evidence and understanding that scientists make their results public, describe their investigations so they can be reproduced, and review and ask questions about the work of other scientists.
- ➔ **3.4.3.C1:** Recognize **design** is a creative process and everyone can design solutions to problems.

#### Materials:

<b>Teacher:</b>	Variety of balloons Balloon Rocket design handout <sup>19</sup> String Straws Masking tape Bags labeled with each students name
<b>Students:</b>	Pencils

**Introduction:** Begin lesson by blowing a balloon and asking students what they think would happen if it was let go. Have students write their prediction on their white boards. Let the balloon go and discuss the reaction. Ask: How did the balloon travel from one place to another? Explain to students that a balloon provides a simple example of how a rocket engine works. The air trapped inside the balloon pushes out the open end, causing the balloon to move forward. The

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<sup>19</sup> See 14A

force of the air escaping is the “action”; the movement of the balloon moving forward is the “reaction.”

**Procedure/Strategies:**

1. Explain to students, when space agencies, like NASA, send rocket ships into space they use rocket engines filled with fuel to help push the rocket up into space. The force that comes out of the rocket, is similar to the air in the balloon. The air acted as the fuel, which caused the balloon to travel.
2. What happened when you let go of the end of the balloon?
3. Which direction, and how far did it go?
4. Try it again with the balloon only half inflated. *How fast and how far do you think it will go?*
5. For this STEM activity you are going to design balloon rockets that will travel through a model of the Solar system.
6. A 10-foot long string will be attached to two chairs. You will choose what type of string to use for your rocket.
7. Blow up your balloon (this is the part that’s like filling a rocket engine with fuel) and pinch the opening with your fingers to keep the air inside. (Don't tie it off.)
8. While you are pinching the end of the balloon, secure it onto the bottom of the plastic straw with a few pieces of tape.
9. Pull the full balloon with the straw to one end of the string, so that its opening faces in the opposite direction from the clear line of string ahead of the balloon. Ask students to predict what will happen when they let go of the balloon opening?
10. Then we will evaluate our designs based on the results.
11. Demonstrate how this process will work.
12. Explain to students that they will have to choose three materials, a balloon, a straw, and the type of string.
13. Students will have the opportunity to explore the materials and create a design for their balloon rocket.
14. Remind students to consider all aspects of the design. Which materials will help their balloon rocket travel the farthest? Think about how one material might react with another material. What are other ways you could get a balloon to go faster or slower—or longer or shorter distances? Try other sizes and shapes of balloons. *How do they perform?* Try using other types of materials for your line, such as ribbon, twine or fishing line. *Do these make a difference in balloon rocket speed or distance?*
15. Provide students with enough time to explore the materials and create their designs.

**Accommodations:** Students with special needs will be provided assistance as needed during the planning process. Gifted students will be asked to analyze the relationship between the balloon and the other materials involved. These students will also be asked to consider the results of their designs if they were set on an incline.

**Closure:** Culminate the lesson by having students place their materials in their labeled zip-lock bag. Have volunteers describe the materials they used and why they chose those specific items.

**Evaluation: (students)** Students will be evaluated on their ability to design a balloon rocket that effectively considers each part of the design. Do students consider the how each material will affect the distance traveled? How do they explain their reasoning for their choices, including the straw, string, and type of balloon?

**Next Step:** Students will begin testing their balloon rockets.

## Lesson 14

### STEM Balloon Rockets - Testing the Rocket

**Rationale:** After a day of design, students will prepare to test how far their balloon rockets will travel. During this process, students will collect data on how far their rocket traveled and evaluate the distance in relation to the design.

**Objectives:**

- ✓ Given a balloon rocket model, students will be able to explain the different forces that act on the rocket after testing their design.
- ✓ After testing their rocket design, students will be able to collect data from the experiment and evaluate how their design affected the distance traveled.

**PDE SAS/PA CORE:**

- ➔ **3.1.3.B6:** Plan and conduct a simple investigation and understand that different questions require different kinds of investigations.

**Materials:**

**Teacher:** Marker  
 Analysis Exit Ticket<sup>20</sup>  
 Data collecting chart<sup>21</sup>  
 Two chairs measured 10 feet apart  
 Planet labels placed in between the chairs at 1 foot intervals  
 Masking tape  
 Camera to record  
 Yard stick  
 Extra balloons  
 Unit review<sup>22</sup>

**Students:** All components of their design: balloon rocket, straw, and string

**Introduction:** Explain the procedures for the rocket test to students. Students who are waiting to test their rockets will complete the What I Learned section of their KWL chart and the post-unit formative assessment. Students who complete both of these assignments will be allowed to begin their assessment review. Whatever is not completed will be assigned for homework. After testing their rocket, students will analyze their results using the analysis exit ticket.

---

<sup>20</sup> See 14A

<sup>21</sup> See 14B

<sup>22</sup> See 14C

**Procedure/Strategies:**

1. Take students out in groups of three or four. While one student is testing their rocket, the others should be blowing their balloon to the desired size.
2. Emphasize that if students cannot do this maturely they will not be able to test their rocket.
3. After testing, students will fill in how far their rocket traveled on the data chart.
4. Once they have filled in the data, they will return to the room and call another student out to test their rocket.

**Accommodations:** Students who require assistance in filling their balloons with air will be provided with a pump. Gifted students will be asked to analyze how the amount of air in the balloon relates to the distance traveled.

**Closure:** Culminate the lesson by reviewing the results of the class. Volunteers can share their analysis of the results.

**Evaluation: (students)** Students will be evaluated on their ability to follow directions, and their ability to investigate how the results of their rocket test correlated with their design. These process skills are necessary components of a STEM project.

**Next Step:** Students will be summatively assessed on their comprehension of the space unit.

## Lesson 15

### Solar Walk Presentations

**Rationale:** Students will be given the opportunity to present their research on their chosen planet as part of a creative culmination to the space unit. Student presentations benefit the presenter in significant ways. Students learn how to speak in front of a group and they learn how to prepare material for a presentation. Peer evaluations aid in the idea of student presentations because active listening becomes imperative to the success of the activity.

#### Objectives:

- ✓ Given an opportunity to present, students will be able to identify the different parts of their planet.
- ✓ After each presentation, students will explain why they chose the given planet.
- ✓ After each presentation, students in the audience will be able to recall any relevant information that was presented by the speaker as a result of active listening.

#### PDE SAS/PA CORE:

- ➔ **CC.1.4.2.V:** Participate in individual or shared research and writing projects.
- ➔ **CC.1.5.2.A:** Participate in collaborative conversations with peers and adults in small and larger groups.
- ➔ **CC.1.5.2.B:** Recount or describe key ideas or details from a text read aloud or information presented orally or through other media.
- ➔ **CC.1.5.2.C:** Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.

#### Materials:

- |                  |   |
|------------------|---|
| <b>Teacher:</b>  | Presentation feedback slips <sup>23</sup><br>Rubric <sup>24</sup> |
| <b>Students:</b> | Presentation feedback slips<br>Pencil                             |

**Introduction:** Today we will begin presenting our planet projects. Inform students that while a classmate is presenting, the rest of the class will be respectful and attentive. After each presentation, students will have a few minutes to complete the presentation feedback. In order to provide good feedback you must be paying attention to your classmates. Try your best to spell words.

#### Procedure/Strategies:

---

<sup>23</sup> See 15A

<sup>24</sup> See 15B

1. Ask if there are any volunteers willing to present first. If there are no volunteers pick a name stick out of the can. This will randomize the presentations assuring students that it is fair.
2. Remind presenters to use their *teacher voices*, so all of the students can hear their information.
3. After each presentation allow students in the audience to ask questions. If the presenter is unable to answer the question encourage the class to research the information on their own and present the facts later on.
4. Provide students with a few minutes to complete the feedback sheet after each presentation. Collect each sheet as it is completed and hand out another one to prepare for the next presenter.
5. Repeat this process until all presentations are completed. If necessary, divide the presentations among a two-day period.

**Accommodations:** Students will be offered reading assistance during their presentations. Students will also be asked to explain why they chose their planet of study.

**Closure:** Culminate the lesson by having students volunteer to share their favorite facts that they learned during the presentations. Transition students to display their projects on the bulletin board in the correct order of the planets. For example, students who researched the first planet, bring your projects to the bulletin board, etc.

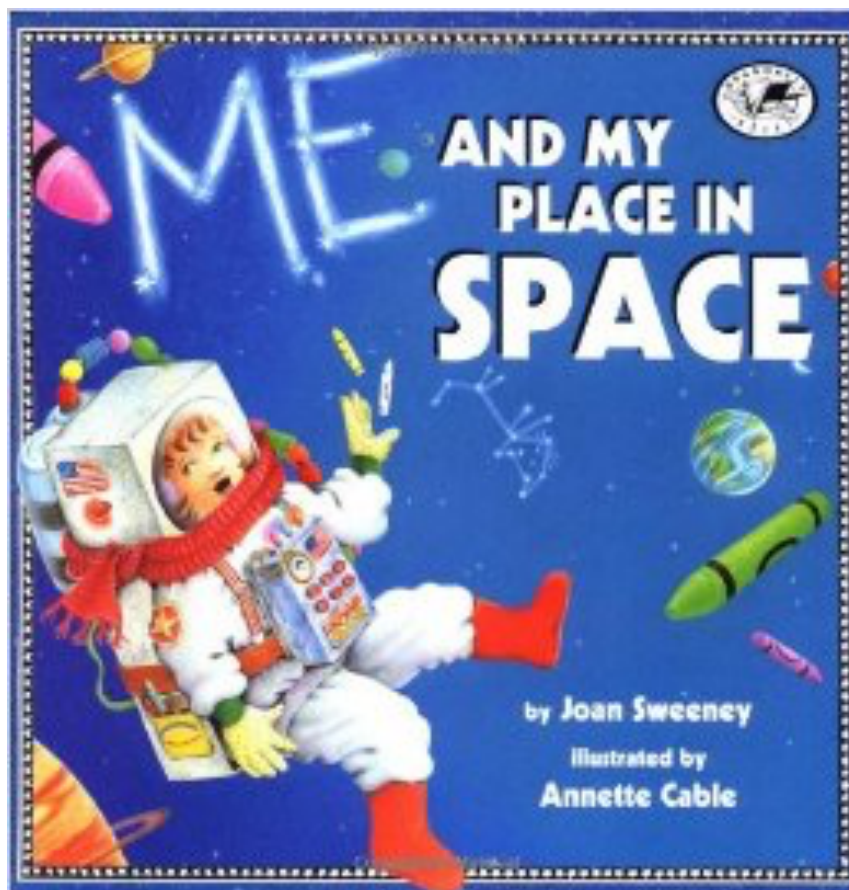
**Evaluation: (students)** Evaluate students using the research and presentation rubric.

**Next Step:** Students will attend their trip to the planetarium<sup>25</sup>.

---

<sup>25</sup> See 15C

# Appendices






## Appendix 1B

Name: \_\_\_\_\_


 My Solar System Knowledge 

Directions: Circle yes or no for what you believe about the statement about the solar system before you begin the unit and after you are finished. Read together as a class.

Before Unit		After Unit		
Yes	No	Yes	No	There are 9 planets in our solar system. 
Yes	No	Yes	No	The moon is a planet. 
Yes	No	Yes	No	The sun is a star. 
Yes	No	Yes	No	The earth rotates.
Yes	No	Yes	No	The moon changes shape.
Yes	No	Yes	No	The earth revolves around the sun.
Yes	No	Yes	No	Some planets have rings around them.
Yes	No	Yes	No	Our planet is a part of the Milky Way.
Yes	No	Yes	No	Humans can breathe in space.
Yes	No	Yes	No	The moon shines because the sun reflects on it.

Appendix 2A

The screenshot shows a web browser window with the URL `readwritethink.org`. The main content area has a dark red background with a yellow banner at the top that reads "K-W-L Creator". Below the banner, a white box contains the text "Welcome to the K-W-L Creator". Underneath, a white box prompts the user: "Please enter your name and the topic of your K-W-L chart." This is followed by two input fields: "Your Name:" and "Topic:". At the bottom left, there is a question mark icon and the text "What is a K-W-L chart?". At the bottom right, there is a "Continue" button with a right-pointing arrow. The footer contains logos for "readwritethink" (International Reading Association), "NCTE", "Thinkfinity", and "verizon foundation". Small copyright text reads: "Copyright 2011 IRA/NCTE. All rights reserved. ReadWriteThink materials may be reproduced for educational purposes."



## Appendix 3A

### Rotate & Revolve in Space

(Sing to "The Farmer in the Dell")

**Directions:** Choose the correct word to fill in the blanks.

**rotates                  revolves**

The Earth \_\_\_\_\_ around its axis.

The Earth \_\_\_\_\_ around its axis.

Once a day, every day,

The Earth \_\_\_\_\_ around.

The moon \_\_\_\_\_ around the Earth.

The moon \_\_\_\_\_ around the Earth.

Once a month, every month,

The moon \_\_\_\_\_ around.

The Earth \_\_\_\_\_ around the Sun.

The Earth \_\_\_\_\_ around the Sun.

Once a year, every year,

The Earth \_\_\_\_\_ around.

### Rotate & Revolve in Space

(Sing to "The Farmer in the Dell")

**Directions:** Choose the correct word to fill in the blanks.

**rotates                  revolves**

The Earth \_\_\_\_\_ around its axis.

The Earth \_\_\_\_\_ around its axis.

Once a day, every day,

The Earth \_\_\_\_\_ around.

The moon \_\_\_\_\_ around the Earth.

The moon \_\_\_\_\_ around the Earth.

Once a month, every month,

The moon \_\_\_\_\_ around.

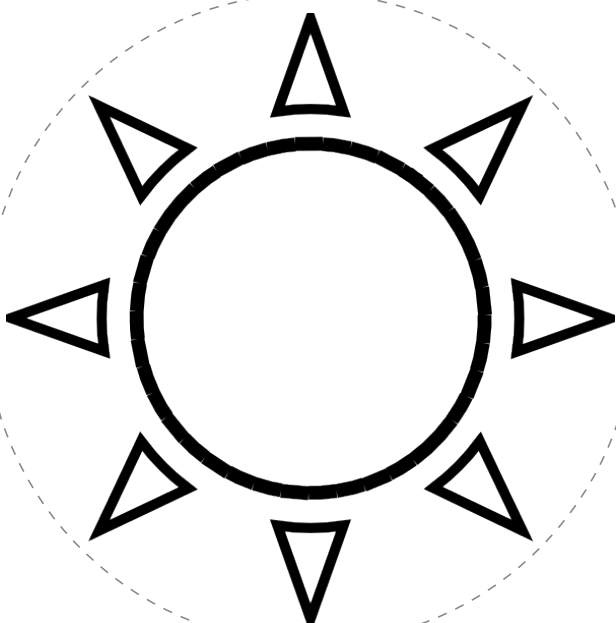
The Earth \_\_\_\_\_ around the Sun.

The Earth \_\_\_\_\_ around the Sun.

Once a year, every year,

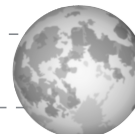
The Earth \_\_\_\_\_ around.

Appendix 4A

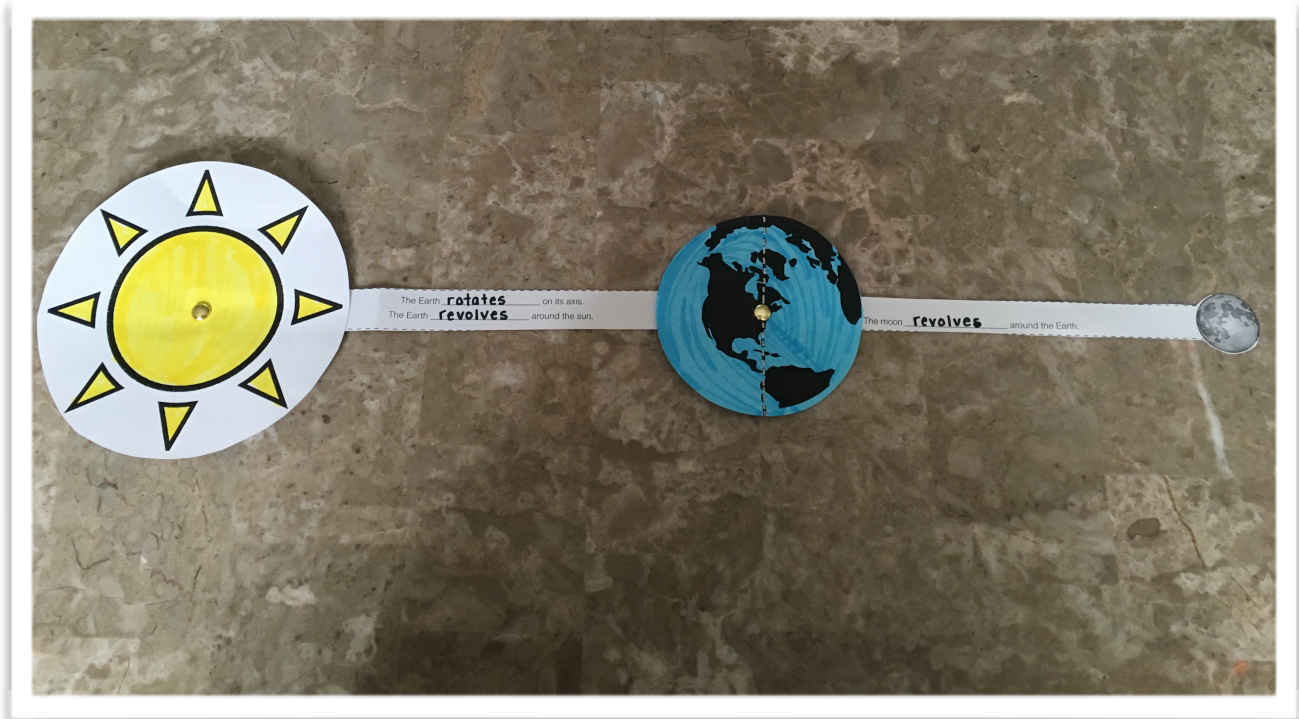


The Earth \_\_\_\_\_ on its axis.  
The Earth \_\_\_\_\_ around the sun.

The moon \_\_\_\_\_ around the Earth.



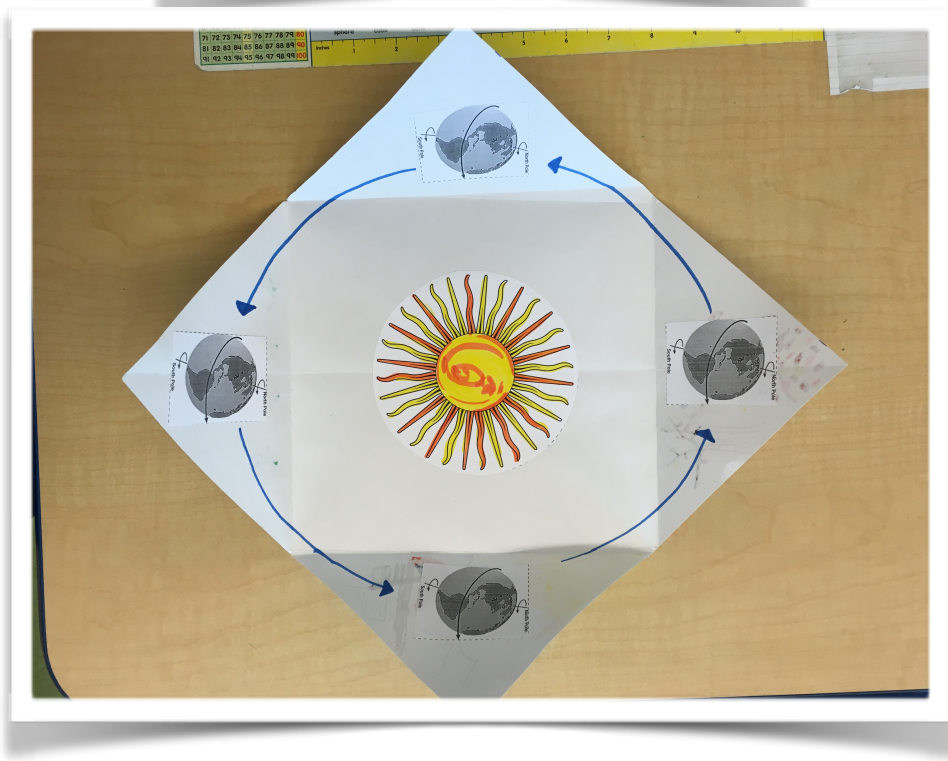
Appendix 5A



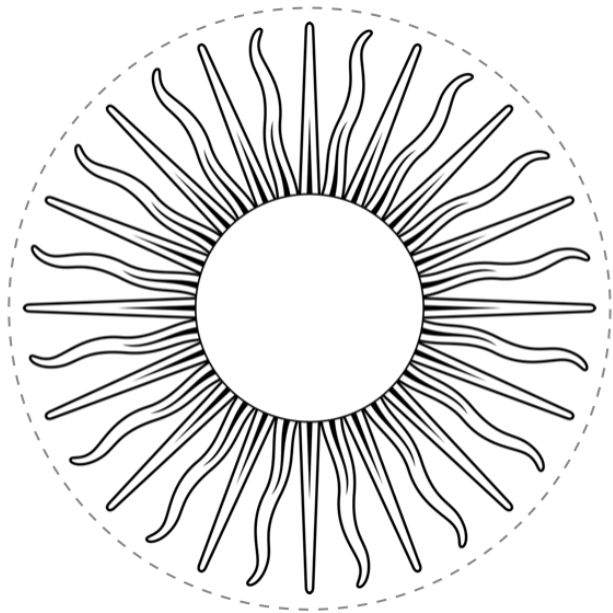
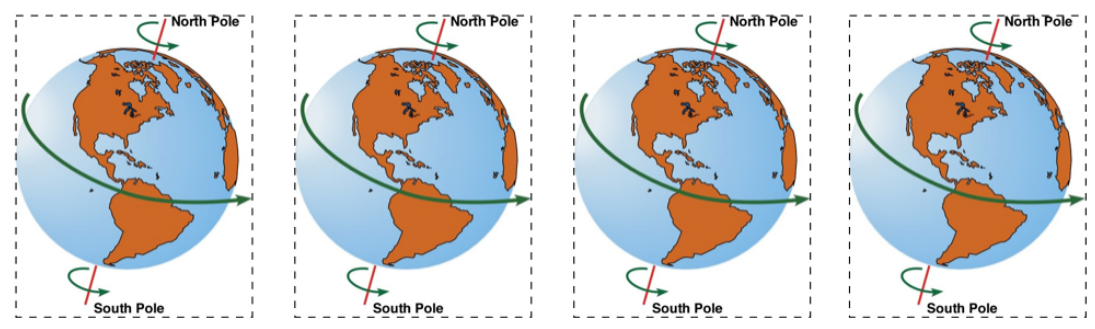
Appendix 5B

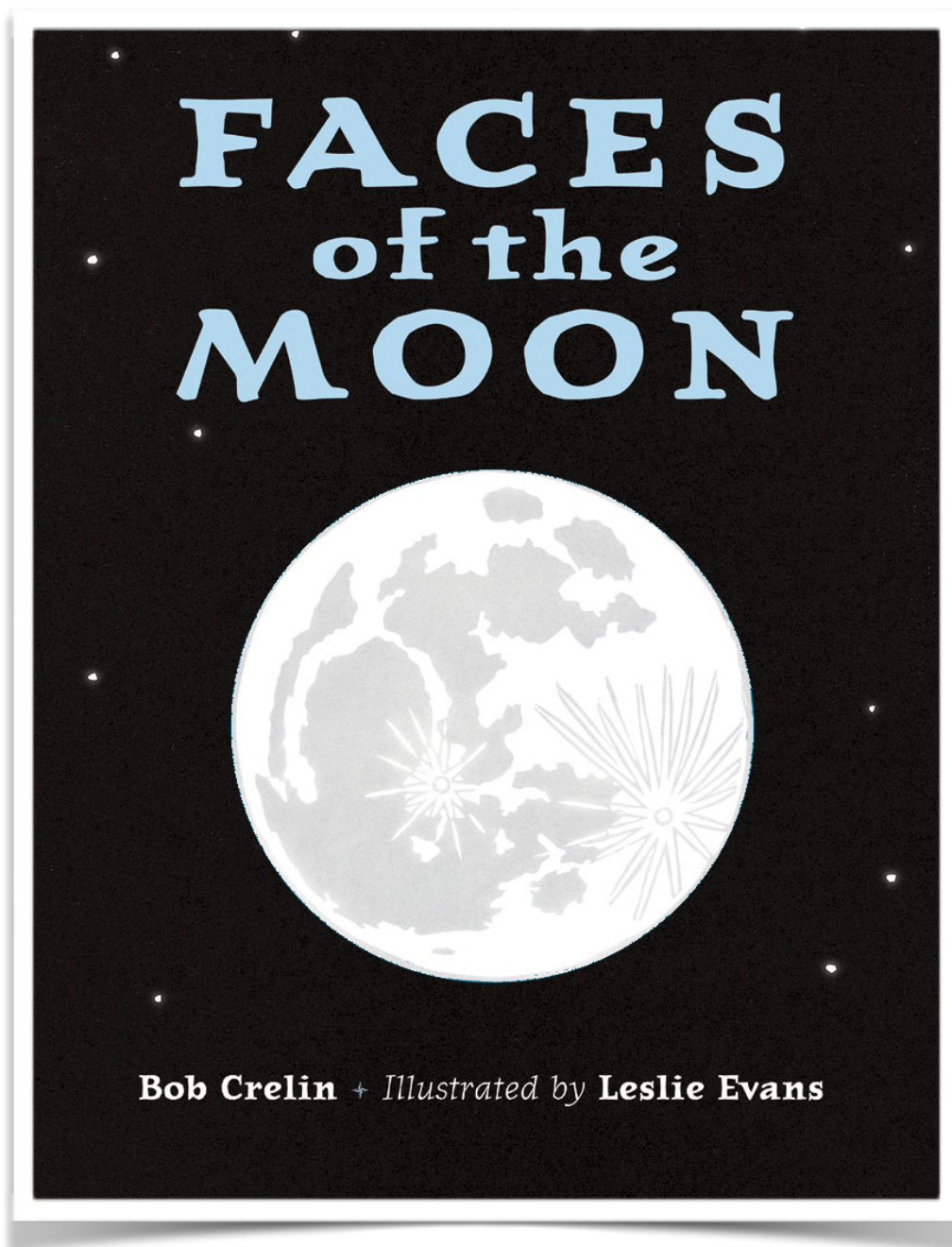


Appendix 6A



Appendix 6B



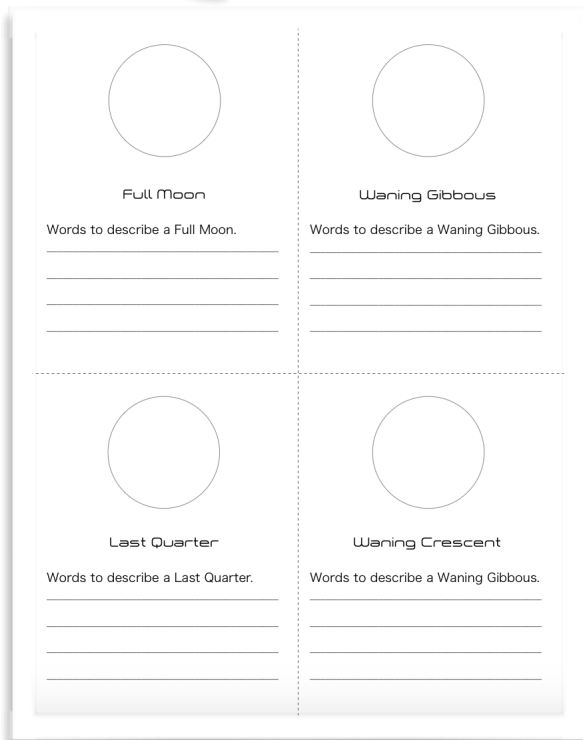
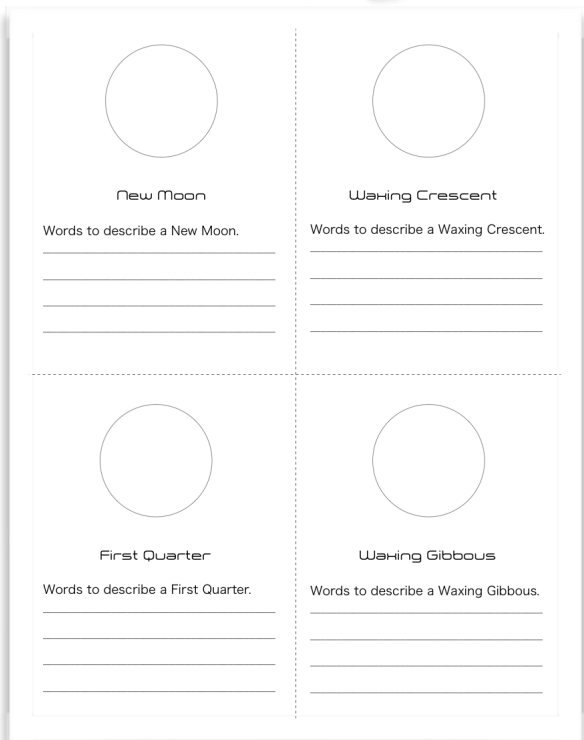
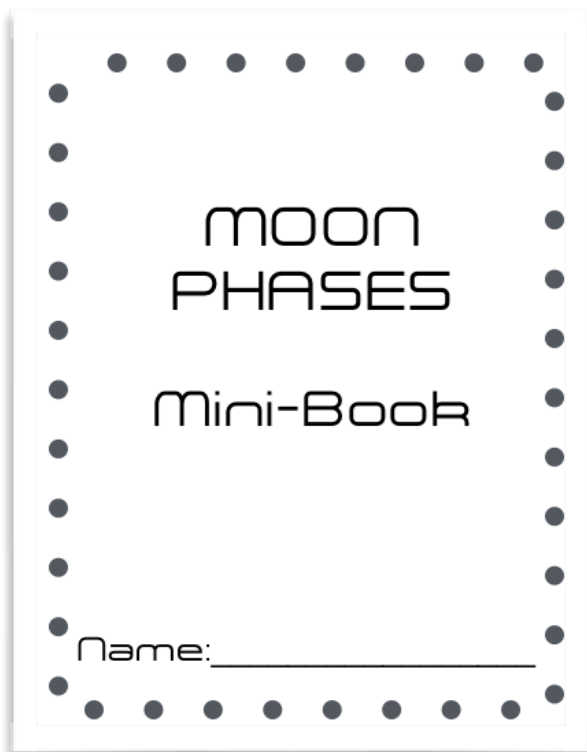


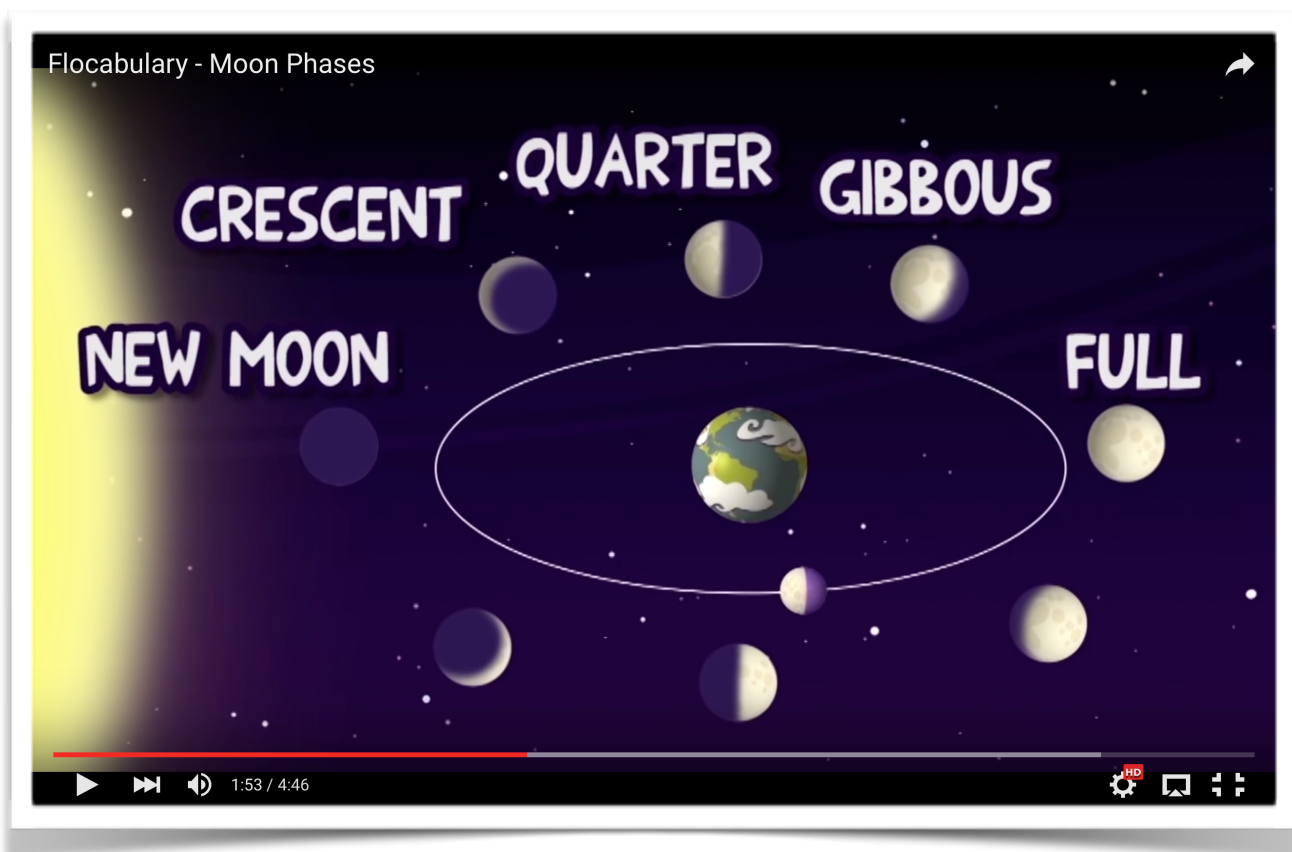
**FACES**  
of the  
**MOON**



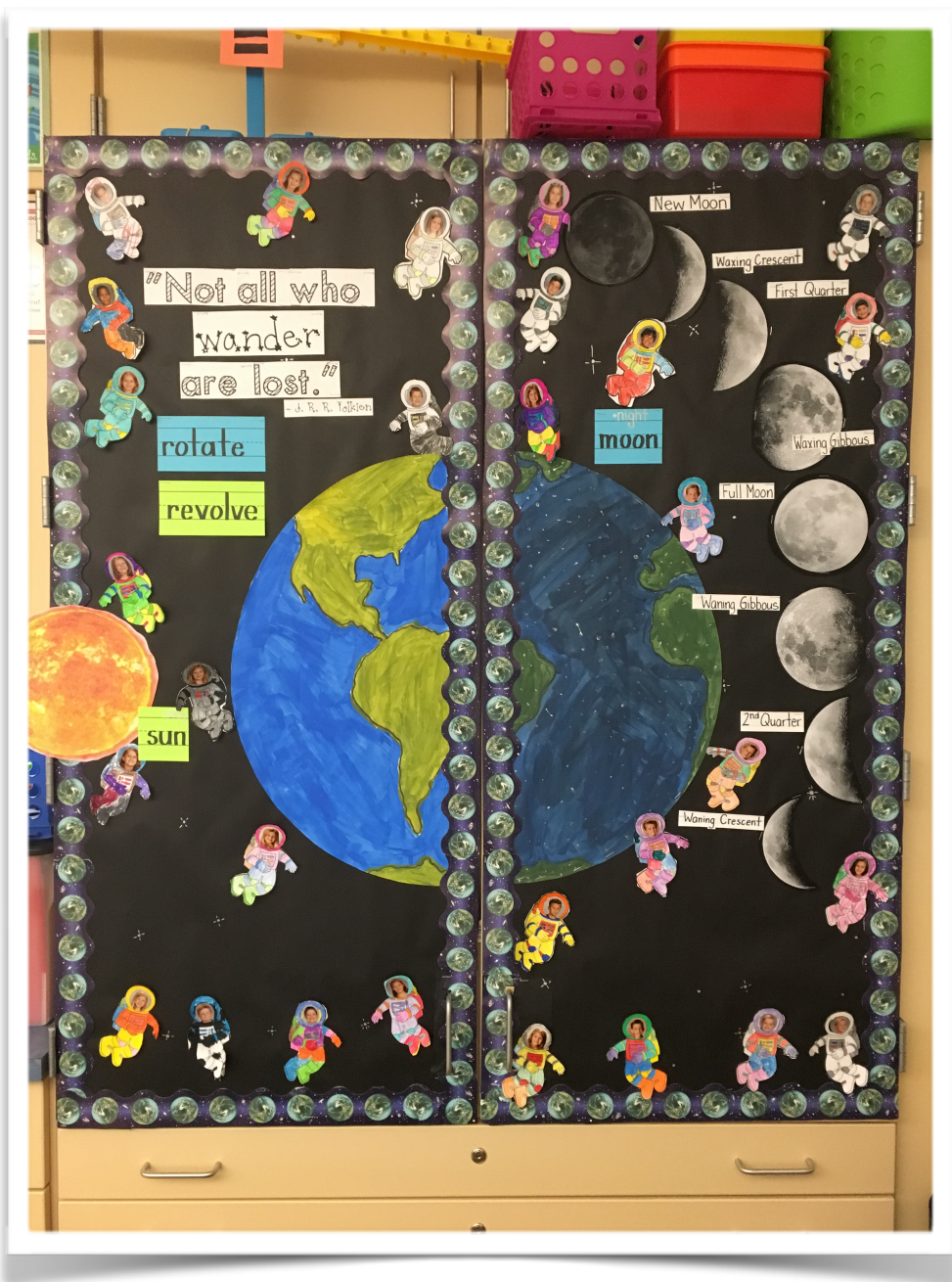
**Bob Crelin** + *Illustrated by* **Leslie Evans**

Appendix 7B





Appendix 8B



**Appendix 9A**



## Appendix 10A

Name: \_\_\_\_\_

## Distances from the Sun

1 Astronomical Unit = 93 million miles  
 1 Toilet Paper Square = 1 Astronomical Unit

Planet	Distance from the Sun in AU	Distance from the Sun in Toilet Paper Squares
Mercury	0.4	
Venus	0.7	
Earth	1	
Mars	2	
Jupiter	5	
Saturn	10	
Uranus	19	
Neptune	30	
Pluto (dwarf planet)	40	

★ How many Astronomical Units do you think the Asteroid Belt is from the Sun? **Hint:** Which planets does the Asteroid Belt separate?

\_\_\_\_\_

\_\_\_\_\_

★ **HOT Question**

How would the distances change if 1 Astronomical Unit = 2 Toilet Paper Squares?

\_\_\_\_\_

\_\_\_\_\_

## Appendix 10B

Mercury

Venus

Earth

Jupiter

Saturn

Uranus

Neptune

Pluto

(dwarf planet)

Name: \_\_\_\_\_

### My Planet Research

1. My planet is called: \_\_\_\_\_
2. My planet is the \_\_\_\_\_ planet in our solar system.
3. My planet is \_\_\_\_\_ miles from the sun. It is \_\_\_\_\_  
Astronomical Units from the sun.

4. This is what my planet looks like.

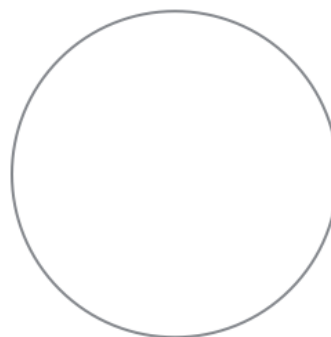
\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



5. It takes my planet \_\_\_\_\_ to orbit the sun. This means that  
one year on my planet is actually \_\_\_\_\_ years on Earth.
6. It takes my planet \_\_\_\_\_ to make one rotation. This means that  
one day on my planet is actually \_\_\_\_\_ days on Earth.
7. These are **3 interesting facts** about my planet.

★ \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

★ \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

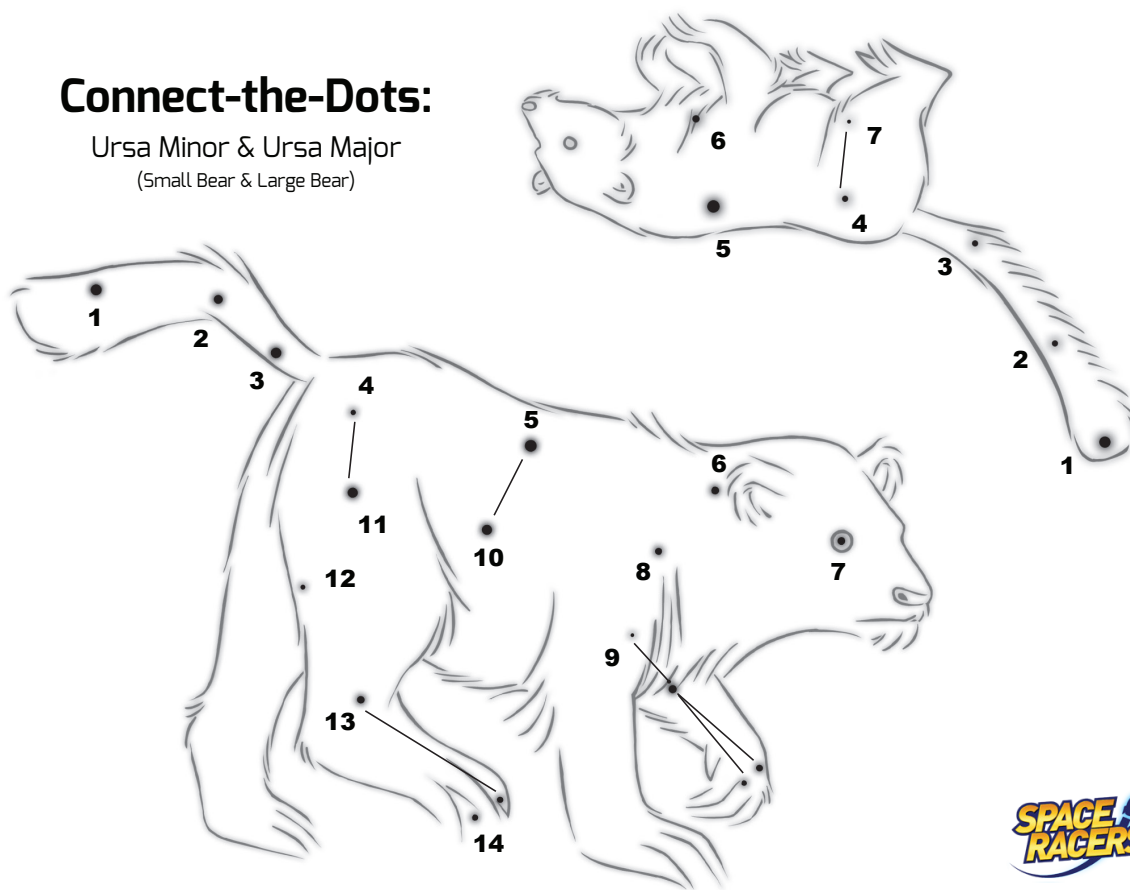
★ \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

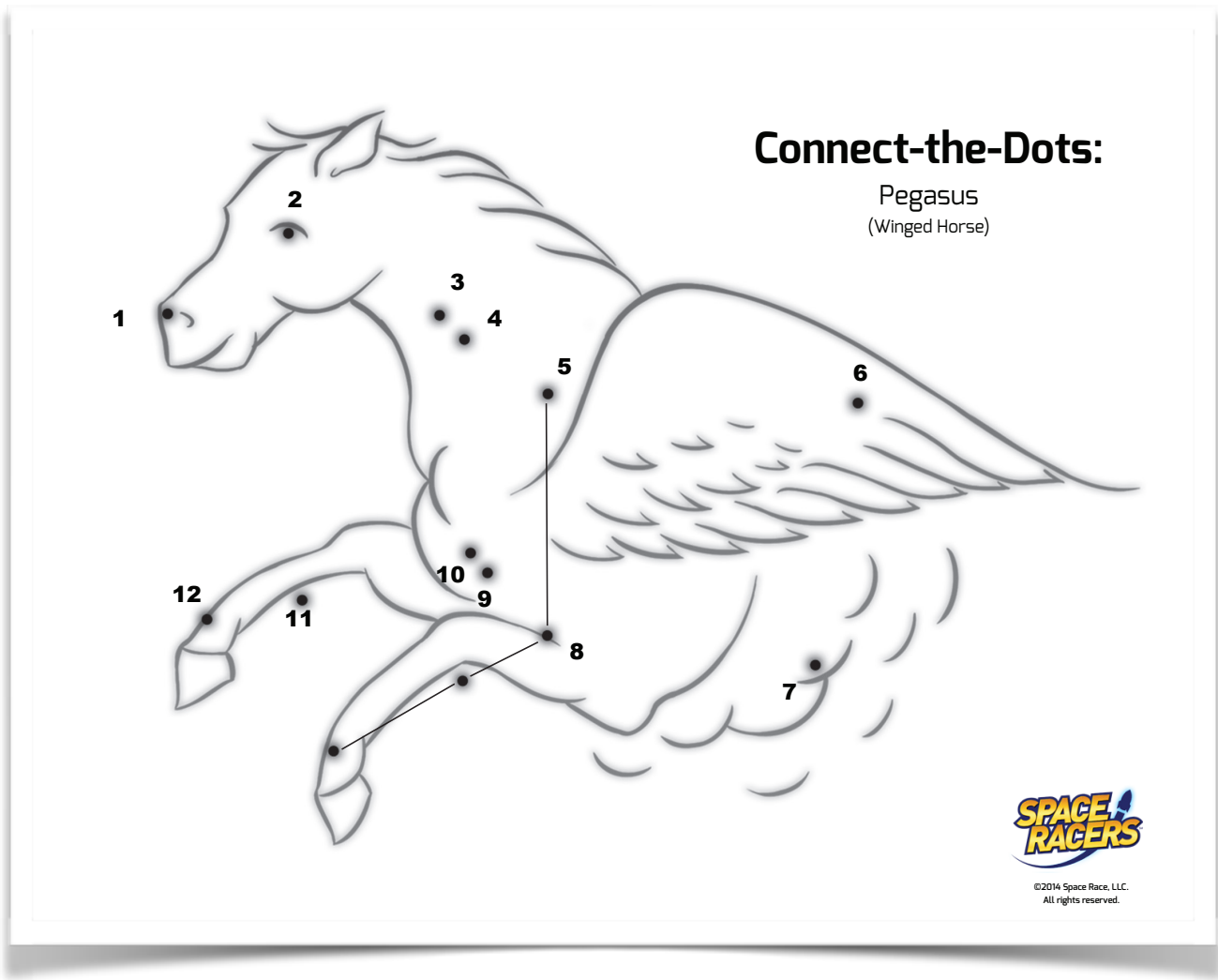
### Connect-the-Dots:

Ursa Minor & Ursa Major  
(Small Bear & Large Bear)



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Appendix 12B



## Appendix 13A

Name: \_\_\_\_\_

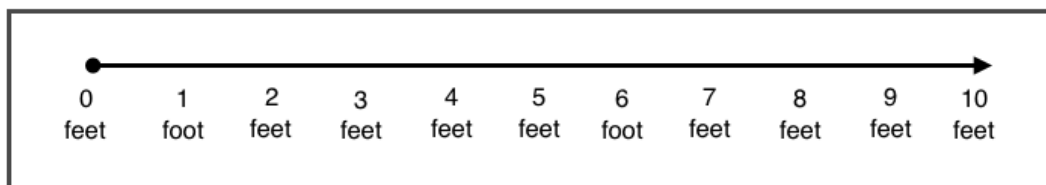
**BALLOON ROCKET**

Describe the materials you will use for your rocket.

Balloon	String	Straw

Explain why you chose those materials.


Predict how far your balloon rocket will travel.



Appendix 14A

**BALLOON ROCKET EXIT TICKET**

★ How far did your rocket travel? \_\_\_\_\_ feet

★ How could you have changed your design to make your rocket go farther?

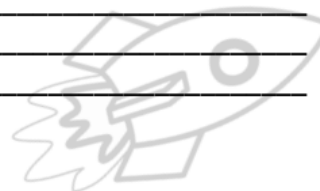
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Name: \_\_\_\_\_



# Appendix 14C

## Space Review

### Rotate or Revolve?

\_\_\_\_\_ means to turn around in a circle.

\_\_\_\_\_ means to orbit around another object.

The Earth \_\_\_\_\_ on its axis.

The Earth \_\_\_\_\_ around the sun.

Name: \_\_\_\_\_

### Phases of the Moon

Fill in each phases of the moon.

New Moon



Waxing Crescent



Full Moon



Waning Gibbous



First Quarter



Waxing Gibbous



Last Quarter



Waning Crescent



### The Planets

What are the three inner planets?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

Which planet do we live on?

1. \_\_\_\_\_

How many Astronomical Units are we away from the sun?

1. \_\_\_\_\_

### The Planets

What are the 5 outer planets?

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

Which planet is considered a dwarf planet?

1. \_\_\_\_\_

What is a constellation?

\_\_\_\_\_  
\_\_\_\_\_

What is the name of this constellation?

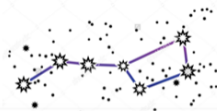
\_\_\_\_\_  
\_\_\_\_\_

What is your favorite planet?

\_\_\_\_\_

List 2 reasons why that is your favorite planet.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

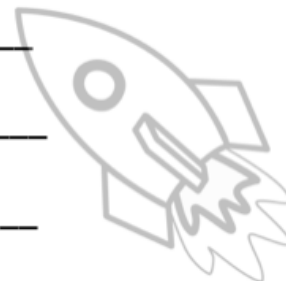


**Appendix 15A**

Your Name: \_\_\_\_\_

Name of Presenter: \_\_\_\_\_

Planet: \_\_\_\_\_



★ What I liked about your presentation:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

★ What I learned from your presentation:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Appendix 15B

### The Lehigh Valley Amateur Astronomical Society Planetarium Trip

Dear Families,

As we culminate our unit on space, your child will have the opportunity to take a trip to visit the Planetary Society in Allentown. On the trip the students will explore a planetarium, which is a building in which images of stars, planets, and constellations are projected on the inner surface of dome. The trip will be held on **Friday, April 22<sup>nd</sup>** from **12:30pm-2:30pm**. Your child will not need to bring a lunch on the trip. Thanks to our Parent Association the cost of the trip is free.

Please complete the bottom portion of this slip and return it to school with your child no later than April 15<sup>th</sup>.

Thank you,  
Mrs. Tominaj

**Event Name:** The Lehigh Valley Amateur Astronomical Society:  
Planetarium

**Date of Event:** Friday, April 22<sup>nd</sup>

**Time:** 12:30pm - 2:30pm

I give permission for my child, \_\_\_\_\_ to visit the Planetarium on April 22<sup>nd</sup>. I understand that transportation will be provided by the East Penn School District. During the event, I can be reached at \_\_\_\_\_ or \_\_\_\_\_.

In the event that you are unable to contact me, please contact:

Emergency Contact Name: \_\_\_\_\_

Emergency Contact Phone: \_\_\_\_\_

\_\_\_\_\_  
Parent/Guardian Signature

\_\_\_\_\_  
Date

### Oral Presentation Rubric : Planet Presentation

Teacher Name: **Mrs. Tominaj**

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1
<b>Information</b>	All information is reported accurately.	8-10 of the sentences are answered accurately.	5-7 of the sentences are answered accurately.	Less than 4 of the sentences are answered accurately.
<b>Quality of Information</b>	Presenter includes 3 pieces of additional information that clearly relates to the main topic.	Presenter includes 2 pieces of additional information that clearly relates to the main topic.	Presenter includes 1 piece of additional information that relates to the main topic.	There is no additional information related to the topic.
<b>Mechanics</b>	No grammatical, spelling, or punctuation errors.	1-3 grammatical, spelling or punctuation errors.	4-6 grammatical, spelling or punctuation errors.	7+ grammatical, spelling or punctuation errors.
<b>Research</b>	Successfully used suggested resources: books, internet, and fact files to find information.	Used 2 out of the 3 resources available to them: books, internet, and fact files to find information.	Used 1 out of the 3 resources available to them: books, internet, and fact files to find information.	Did not use any resources.
<b>Uses Complete Sentences</b>	Always (99-100% of time) speaks in complete sentences.	Mostly (80-98%) speaks in complete sentences.	Sometimes (70-80%) speaks in complete sentences.	Rarely speaks in complete sentences.
<b>Listens to Other Presentations</b>	Listens intently. Does not make distracting noises or movements.	Listens intently but has one distracting noise or movement.	Sometimes does not appear to be listening but is not distracting.	Sometimes does not appear to be listening and has distracting noises or movements.

# Unit Assessment

Name: \_\_\_\_\_

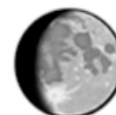
**Directions:** Fill in the blank with the correct vocabulary word.

**rotate(s)**      **revolve(s)**

1. The Earth \_\_\_\_\_ on its axis.
2. The Earth \_\_\_\_\_ around the sun.
3. The Earth can \_\_\_\_\_ in 24 hours.
4. The moon \_\_\_\_\_ around the Earth.
5. The moon does not \_\_\_\_\_ on an axis.
6. We have seasons because the Earth \_\_\_\_\_.
7. Day and night are caused when the Earth \_\_\_\_\_.
8. It takes one year for the Earth to \_\_\_\_\_.

**Directions:** Use the word bank to label each phase of the moon.

<b>Waning Gibbous</b>	<b>Last Quarter</b>	<b>Waxing Crescent</b>	<b>New Moon</b>
<b>Waning Crescent</b>	<b>Waxing Gibbous</b>	<b>First Quarter</b>	<b>Full Moon</b>



\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

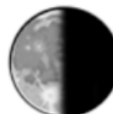
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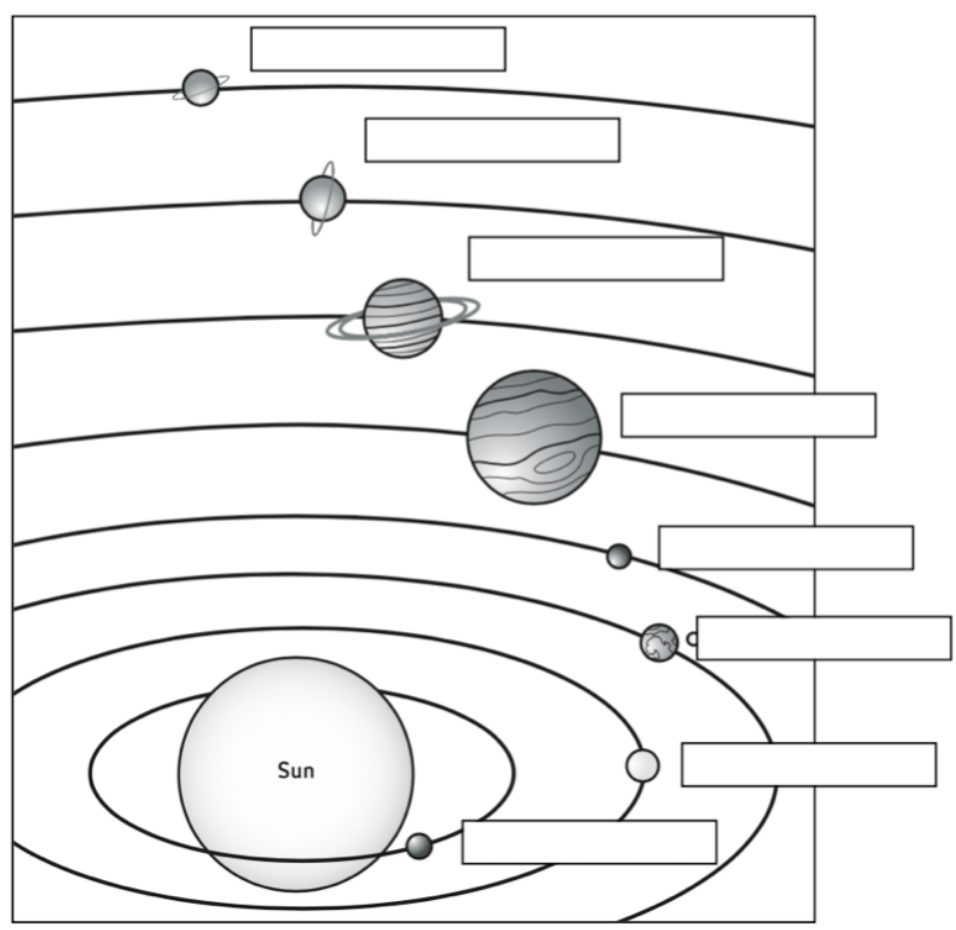
\_\_\_\_\_

\_\_\_\_\_

Name: \_\_\_\_\_

**Directions:** Use the word bank to label each planet in the Solar System.

<b>Jupiter</b>	<b>Earth</b>	<b>Saturn</b>	<b>Venus</b>
<b>Uranus</b>	<b>Mars</b>	<b>Mercury</b>	<b>Neptune</b>



\_\_\_\_\_

Name: \_\_\_\_\_

**Directions:** Circle the best choice.

★ The distance from a planet to the sun is measured in \_\_\_\_\_.

- a. inches
- b. feet
- c. rockets
- d. astronomical units

★ Pluto is considered a \_\_\_\_\_.

- a. classic planet
- b. fake planet
- c. dwarf planet
- d. plutoid

★ A group of stars that create a pattern is called a \_\_\_\_\_.

- a. constellation
- b. star cluster
- c. Big Dipper
- d. none of the above

★ In the balloon rocket experiment, the air represented the \_\_\_\_\_ in a real rocket.

- a. jet pack
- b. fuel
- c. engine
- d. gravity

★ \_\_\_\_\_ is the planet that is known to have a Giant Red Spot.

- a. Venus
- b. Earth
- c. Mars
- d. Jupiter

★ List two facts you learned about any of the planets.

---

---

---

Name: \_\_\_\_\_

**Directions:** Fill in the blank with the correct vocabulary word.

**rotate(s)**      **revolve(s)**

1. The Earth rotates on its axis.
2. The Earth revolves around the sun.
3. The Earth can rotate in 24 hours.
4. The moon revolves around the Earth.
5. The moon does not rotate on an axis.
6. We have seasons because the Earth revolves.
7. Day and night are caused when the Earth rotates.
8. It takes one year for the Earth to revolve.

**Directions:** Use the word bank to label each phase of the moon.

<b>Waning Gibbous</b>	<b>Last Quarter</b>	<b>Waxing Crescent</b>	<b>New Moon</b>
<b>Waning Crescent</b>	<b>Waxing Gibbous</b>	<b>First Quarter</b>	<b>Full Moon</b>



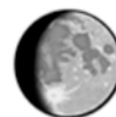
New Moon



Waxing Crescent



First Quarter



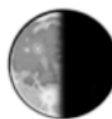
Waxing Gibbous



Full Moon



Waning Gibbous



Last Quarter

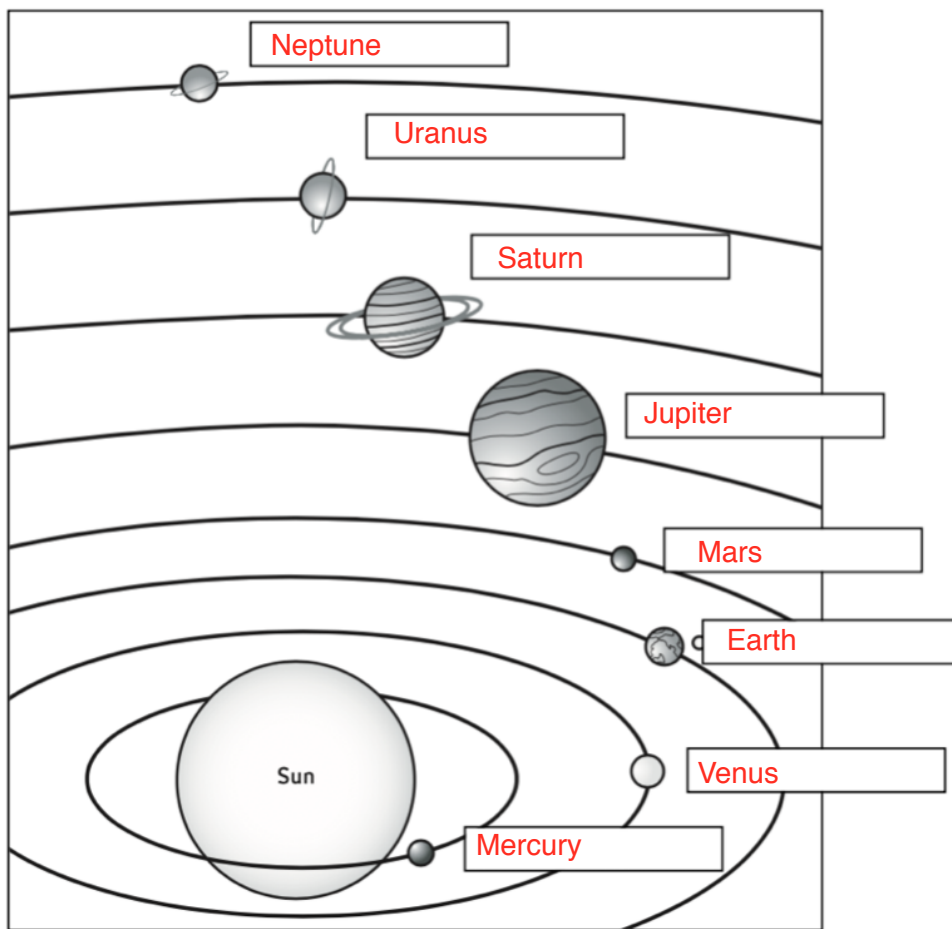


Waning Quarter

Name: \_\_\_\_\_

**Directions:** Use the word bank to label each planet in the Solar System.

Jupiter	Earth	Saturn	Venus
Uranus	Mars	Mercury	Neptune



--	--	--

Name: \_\_\_\_\_

**Directions:** Circle the best choice.

- ★ The distance from a planet to the sun is measured in \_\_\_\_\_.
- a. inches
  - b. feet
  - c. rockets
  - d. astronomical units
- ★ Pluto is considered a \_\_\_\_\_.
- a. classic planet
  - b. fake planet
  - c. dwarf planet
  - d. plutoid
- ★ A group of stars that create a pattern is called a \_\_\_\_\_.
- a. constellation
  - b. star cluster
  - c. Big Dipper
  - d. none of the above
- ★ In the balloon rocket experiment, the air represented the \_\_\_\_\_ in a real rocket.
- a. jet pack
  - b. fuel
  - c. engine
  - d. gravity
- ★ \_\_\_\_\_ is the planet that is known to have a Giant Red Spot.
- a. Venus
  - b. Earth
  - c. Mars
  - d. Jupiter
- ★ List two facts you learned about any of the planets.

**Answers will vary.**

---

---

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## References

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