**Science SCI.V.4.2** **Grade: 4**

**Strand:** **Using Scientific Knowledge in Earth Science**
- **Space**

**Standard:** **All students will describe and explain how objects in the solar system move.**

**Benchmark:** **Describe the motion of the earth around the sun, and the moon around the earth.**

**Constructing and Reflecting:**

**SCI.I.1.1** - Generate reasonable questions about the world based on observation.
**SCI.I.1.2** - Develop solutions to problems through reasoning, observation, and investigation.
**SCI.I.1.3 -** Manipulate simple devices that aid observation and data collection.
**SCI.I.1.5 -** Develop strategies and skills for information gathering and problem solving.
**SCI.II.1.1 -** Develop an awareness of the need for evidence in making decisions scientifically.
**SCI.II.1.2**.- Show how science concepts can be illustrated through creative expression such as language arts and fine arts.
**SCI.II.1.4 -** Develop an awareness of and sensitivity to the natural world.

| **Vocabulary / Key Concept** | **Context** |
|---|---|
| • revolve<br>• revolution<br>• orbit<br>• month<br>• year<br>• observed movement of the Sun and stars across the sky<br>• observed movement of the Moon from day to day<br>• calendar | Outdoor observing of the sun's and star's motions during the night and moon's motions over several days. |

| Knowledge and Skills | Resources |
| --- | --- |
| The earth travels around the sun while the moon travels around the earth.<br><br>Students will describe the motion of the earth around the sun and the motion of the moon around the earth.<br><br>The motion can be observed and described by using a calendar.<br>• day/night - earth spins once every 24 hours<br>• month - moon orbits the earth in 29/30 days<br>• year - earth orbits the sun in one year<br><br>Coloma Teaching Tip:<br>Given a diagram of the system, students will be able to identify day and night on earth.<br><br>Other Resources: (continued from column at right)<br><br>StarChild young astronomer pages – NASA interactive learning site for kids – NICE!! http://starchild.gsfc.nasa.gov/docs/StarChild/StarChild.html<br><br>Michigan Teacher Network Resources - http://mtn.merit.edu/mcf/SCI.V.4.E.2.html<br><br>The Exploratorium Guide to Astronomy Resources – AWESOME stuff! - http://www.exploratorium.edu/observatory/<br><br>Bourgeois, Paulette. *Moon*. Starting With Space Series. Kids Can Press, 1997.<br><br>Fowler, Allan. *So That's How The Moon Changes Shape!* Rookie Read – About Science Series. Children's Press, 1991. | Coloma Resources:<br>Discover the Wonder, Scott Foresman<br>Grade 4 Module A Chapter 1<br><br>Other Resources:<br>10 common misconceptions about astronomy – OUTSTANDING guide to reteaching! - http://sunearth.gsfc.nasa.gov/sunearthday/2004/vt_edu2004_ten.htm<br><br>BCISD Classroom resources – Solar System, Galaxy and Universe - http://www.remc11.k12.mi.us/bcisd/classres/escience.htm#solar<br><br>NASA – Viewing Earth from Space – images and movie clips – EXCELLENT! - http://spacelink.nasa.gov/Educator.Focus/Articles/013_Viewing_Earth_From_Space/<br><br>Recipe for a Galactic Mobile – neat art project making galaxy mobiles! From our friends at NASA - http://spaceplace.jpl.nasa.gov/en/kids/galex_make2.shtml<br><br>Those Whirling, Twirling Planets – NASA Spacelink Activity – learn the planets! http://spacelink.nasa.gov/Instructional.Materials/On-line.Educational.Activities/Planets/index.html |

| Instruction | Assessment |
| --- | --- |
| **Benchmark Question**: Describe the motions of the earth around the sun and the moon around the earth?<br><br>**Focus Question**: How does the moon move around the earth?<br><br>The teacher poses the focus question.<br><br>The students, small groups, will design a model of how the moon moves around the earth.<br><br>The students will collect needed materials and create their models. Groups will have some time to practice how they will present their model. (Teachers should avoid "correcting" misconceptions.)<br><br>Each group presents their model. After presentations are done the class discusses similarities and differences between the models. Teachers may guide discussion to correct student misconceptions through inquiry. Groups are then allowed to alter their presentations and correct. The groups will present their models again. | <u>Coloma Assessment</u>:<br>Discover the Wonder Performance Assessment<br>Module A pages 39-46.<br><br><u>Optional Assessments</u><br>Each student will make a labeled diagram of how the moon moves around the earth.<br><br>(Give students rubric before activity.)<br><br>**Scoring Rubric**<br><br>**Criteria: Correctness of Moon's Orbit**<br>**Apprentice** – Draws moon's orbit incorrectly .<br>**Basic** – Draws moon's orbit correctly.<br>**Meets** – Draws moon's orbit correctly.<br>**Exceeds** – Draws moon's orbit correctly and includes earth's orbit around sun.<br>**Criteria: Completeness of Labels**<br>**Apprentice –** None / Few labels or title for diagram.<br>**Basic –** Some labels and title for diagram.<br>**Meets –** Many labels and title for diagram.<br>**Exceeds –** All labels and title for diagram. |

**Teacher Notes:**

**Describe and explain how objects in the solar system move.**

Students often think that the phases of the moon are caused by the earth's shadow on the moon or by the shadow cast on the moon's surface by clouds. Modeling the position of the sun, earth and moon while the students observe the moon phases may help students understand how the system works together. In order to understand the phases of the moon, students also need to understand the idea that light reflects and that the moon is not its own source of light. Deep understanding of all these ideas is difficult for some students because of their lack of knowledge of the relative size, motion and distance of the sun and other solar system objects from the earth. Modeling of the earth, moon and sun may help students realize that the moon can be visible in the day as well as the night, depending on its position.

In order to understand the day/night cycle, students must first accept that the sun is stationary and that the earth turns on its axis. The apparent movement of the sun across the sky leads novice astronomers to think about the movement of the sun rather than the movement of the earth. This is not difficult to understand given that for 1500 years professional astronomers thought similarly. Common terms like sunrise and sunset support the idea that the sun moves around the earth.

Moving beyond the solar system, farther out into the universe, we know that students have difficulty understanding certain aspects of stars. They might assume that stars are all the same size and that the brightness of stars depends on how far they are from the earth. In fact, the brightness of most stars like our sun is more dependent on the mass of the star, larger stars burning brighter. Students also need to maintain their night sky observations to realize that the stars appear to move across the sky. The constellations visible in the night sky change as the seasons of the year change, due to the position of the Earth in its orbit. This cycle of constellations has been used for centuries as a means for navigation and telling time.

The movement of the solar system objects and of all objects in the universe is caused by gravity. Elementary students, in general, may not see gravity as a force and attribute the falling of objects to some feature of the object. High school students frequently have difficulty understanding the interaction of gravitational forces. These issues are critical when learning about the universe and must be attended to in teaching.

The scale of the solar system and the overwhelming immensity of the universe are difficult to understand. Young students and some adults find it hard to fully comprehend distances to other planets, or the sun. They may also not fully realize the enormous size differences among the planets in our solar system and other celestial bodies. The elementary and middle school years focus primarily on our solar system and the objects in it. Identifying the differences among the sun, the earth and the moon, understanding how the sun, the earth and the moon move together, comparisons of the earth to other planets, and describing how those other planets move with regard to the sun, are all critical ideas for the elementary and middle school years.

Discussion of the relative sizes of planets and distances between solar system objects is begun at the middle school level with the introduction of key concepts of relative size and relative distance. The high school student is prepared to discuss more abstract concepts regarding the universe. High school is the appropriate time to compare our sun to other stars and how to describe how our solar system moves in the universe. These concepts begin to build the idea of the age of the universe and methods used to determine that age.

## Materials List

## Performance Assessment Test MODULE A

## Station 1

**Consumable**
none

**Non-consumable**
1 tennis ball
1 large marble
1 flashlight with batteries

## Station 2

**Consumable**
none

**Non-consumable**
1 hand lens
1 poster or large photograph of the moon
1 metric ruler

## Station 3

**Consumable**
none

**Non-consumable**
1 pan balance with set of masses
1 golf ball or rubber ball
1 ping-pong ball or plastic foam ball (or any 2 balls about the same size but having different masses, both small enough to fit in a pan balance)

## Additional materials to set up the Stations

none

## How to Set Up

## Performance Assessment Test MODULE A

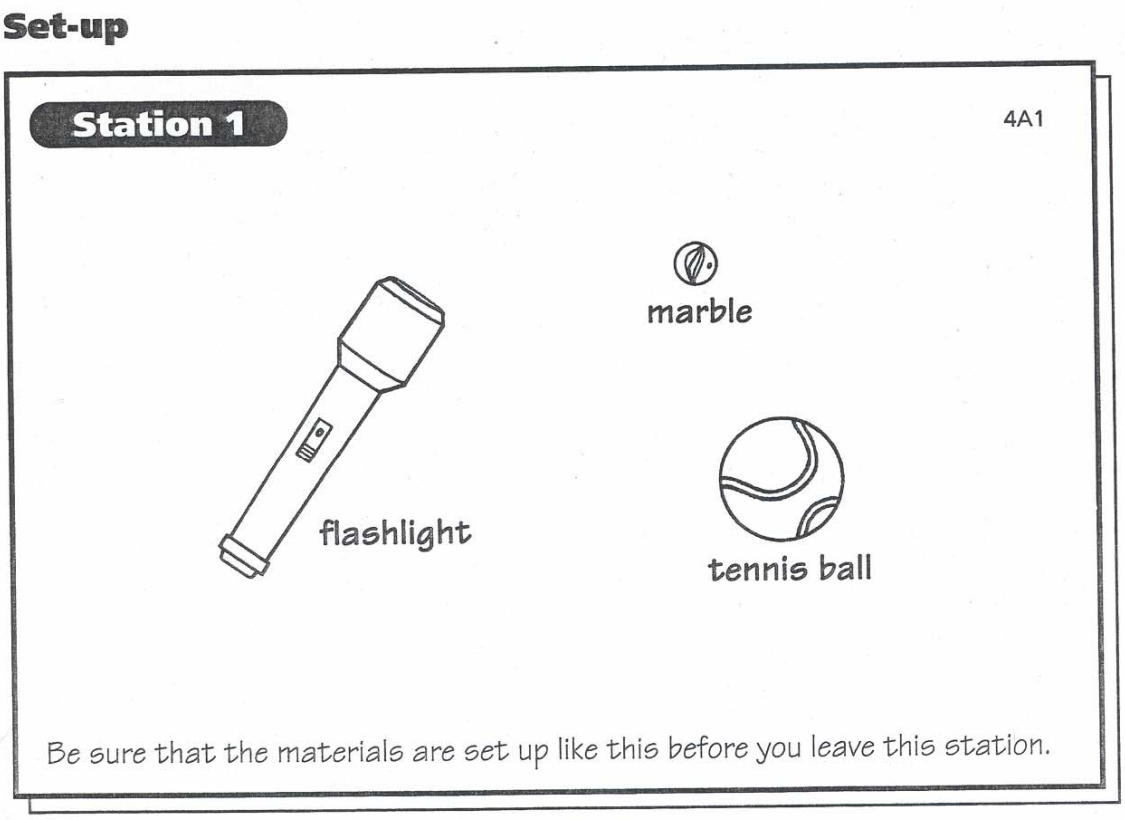
## Station 1

### Materials
1 tennis ball
1 large marble
1 flashlight with batteries

### Preparation
1. Make sure the materials are not aligned in a way that would suggest how to set up the eclipse demonstration.
2. To prevent the balls from rolling, possibly put them in a shoebox lid.

### Helpful Information
- One possible configuration for the solar eclipse would be to have the flashlight represent the Sun, the marble represent the moon, and the tennis ball represent the Earth. When the student shines the light on the moon, the moon's shadow should be cast on the Earth.

**Set-up**



## How to Set Up

## Performance Assessment Test MODULE A

## Station 2

### Materials

1 hand lens
1 poster or large photograph of the moon
1 metric ruler

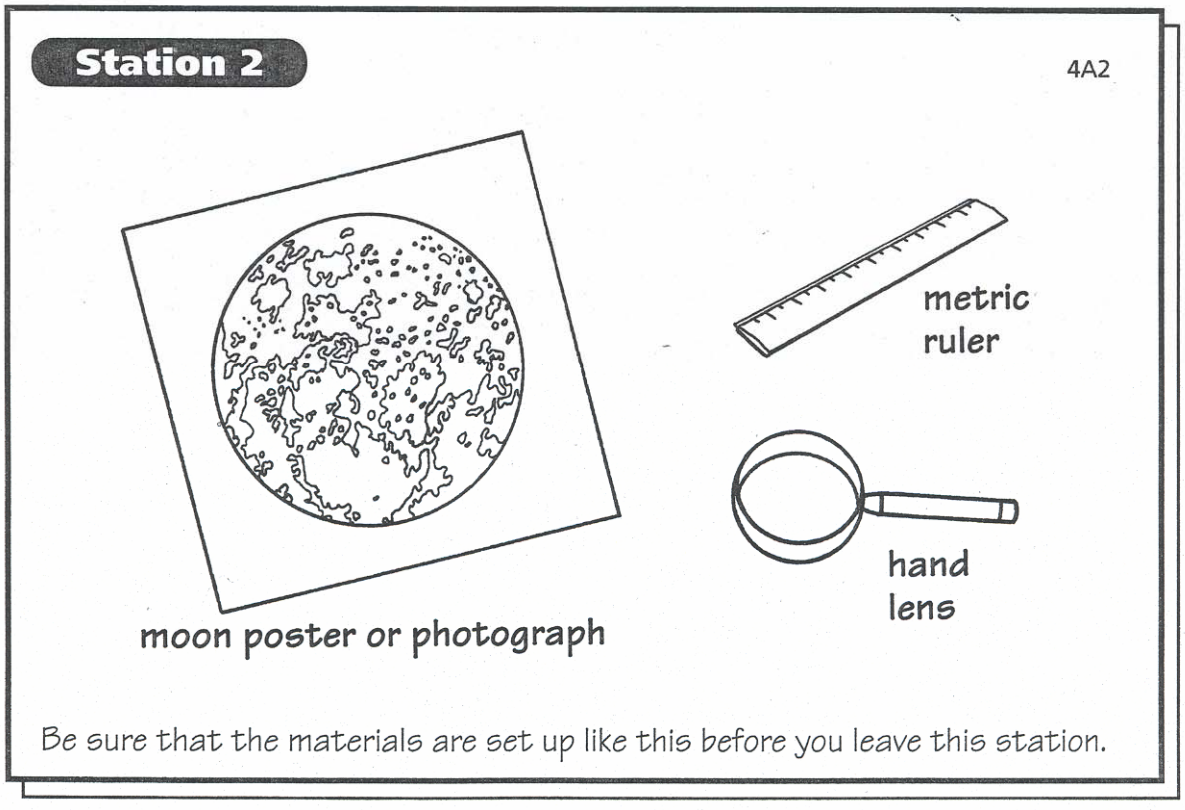
### Preparation

1. To be prepared to review the student's measurements and observations, make a few measurements and observations of your own to use as a reference.

### Helpful Information

- The large craters and dark areas on the moon would make good features for the students to measure and examine.

**Set-up**



## How to Set Up

## Performance Assessment Test MODULE A

# Station 3

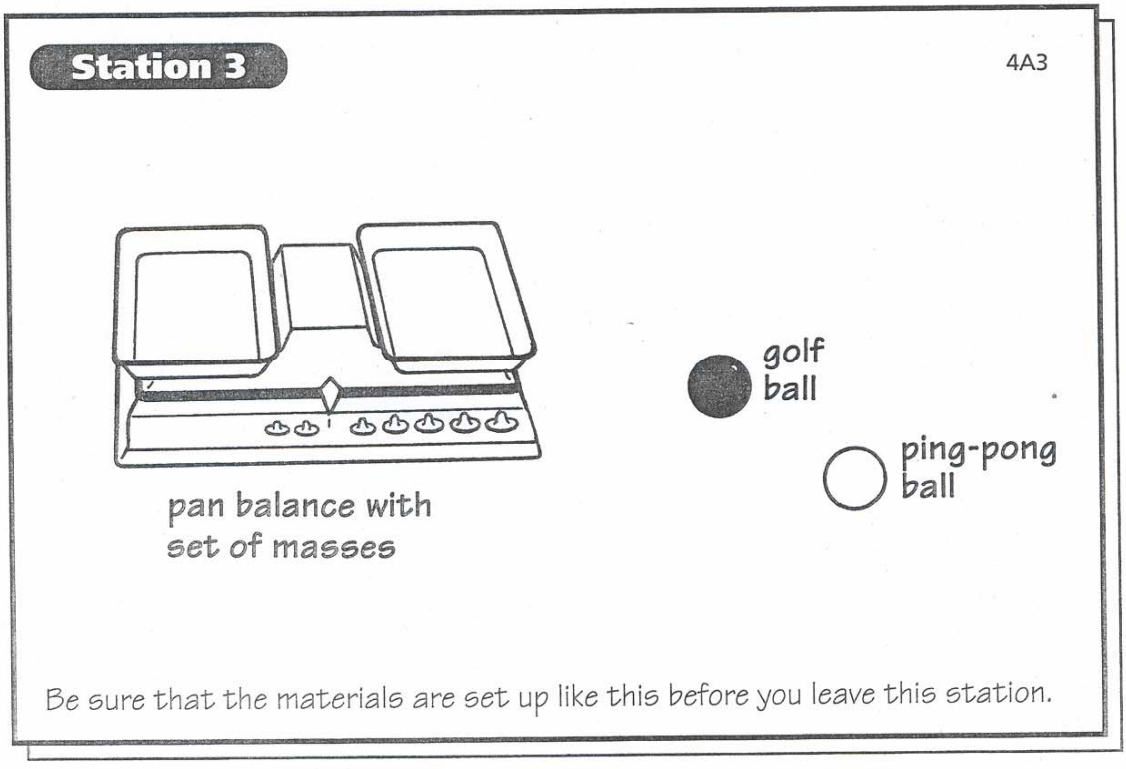
### Materials

pan balance with set of masses
1 golf ball or rubber ball
1 ping-pong ball or plastic foam ball
(or any 2 balls about the same size
but having different masses,
both small enough to fit on a pan balance)

### Preparation

1. Periodically check to make sure that the pans of the balance are evenly balanced.
2. Measure and record the masses of the two balls for your own reference. The golf ball will have a mass of about 44 grams, while the ping-pong ball will have a mass of about 2.5 grams.

**Set-up**



Name _____

Date _____

# Performance Assessment Test MODULE A

*Imagine that you are a student volunteer at the Planetarium. The astronomer there has asked you to help design some exhibits for the new Solar System Show.*

## My Data Collection

**Station 1.** Use the card at the station to correctly set up the equipment.

### Exhibit 1

Use the materials at this station to make an exhibit to demonstrate a solar eclipse.

- Make and label a drawing to show how your exhibit would be set up.

**Station 2.** Use the card at the station to correctly set up the equipment.

### Exhibit 2

Measure and examine some features on the surface of the moon that you can see on this moon map.

- Write a short description of the moon that highlights and tells about some of its interesting surface features.

_____

_____

_____

_____

**Station 3.** Use the card at the station to correctly set up the equipment.

## Exhibit 3

Use these two balls as models of two planets called Golf (golf ball) and Ping (ping-pong ball). Measure the mass of the two "planets" to tell which "planet" has the stronger force of gravity.

- Compare the data table.

| **"Planet"** | **Mass** | **Gravity** (Stronger or Weaker) |
|---|---|---|
| Golf | | |
| Ping | | |

## My Data Analysis

*Now you have completed the plans for three exhibits. Use the data you've collected and what you know about gravity to answer the following question.*

How would the gravity of planets Golf and Ping affect a spaceship that passes the same distance away from each planet? Explain.

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_____

_____

_____

# Evaluation Guide

# Performance Assessment Test MODULE A

## Station 1 (Solar Eclipse)

### Purpose

To evaluate the student's ability to use the objects to show how the sun, moon, and Earth form a solar eclipse

### Criteria

| | |
|---|---|
| 3 points = | Student's drawing shows, with labels, the bodies in their proper order: sun, moon, and Earth. |
| 2 points = | Student's drawing is not labeled or is missing one of the bodies. |
| 1 point = | Student's drawing does not show a depiction of a solar eclipse. |

## Station 2 (Moon Map)

### Purpose

To evaluate the student's ability to measure and observe features on the moon poster or photograph

### Criteria

| | |
|---|---|
| 3 points = | Student notes one or more measurements and one or more notable features on the moon picture. |
| 2 points = | Student notes only one measurement or notable feature on the moon picture. |
| 1 point = | Student does not describe any features on the moon picture. |

## Station 3 (Gravity)

### Purpose

To evaluate the student's ability to measure the mass of the two "planets" and to compare which "planet" has the stronger force of gravity

### Criteria

| | |
|---|---|
| 3 points = | Student records fairly accurate mass measurements and notes that the "planet" Golf (golf ball) has the stronger force of gravity. |
| 2 points = | Student only partially correctly completes the data table. |
| 1 point = | Student does not record the masses or compare the gravity of the two planets. |

# Data Analysis

## Purpose

To evaluate a student's ability to consider a planet's mass and distance from another object when analyzing the effect of its gravitational pull on that object

## Criteria

| | |
|---|---|
| 3 points = | Student notes that Golf, the "planet" with the stronger force of gravity, would exert a stronger pull on the spaceship than would Ping, as long as each "planet" was the same distance from the spaceship. |
| 2 points = | Student notes that Golf would exert a stronger pull on the spaceship but doesn't mention that the distance between the spaceship and each planet is important. |
| 1 point = | Student does not note that Golf would exert a stronger pull on the spaceship. |

# Performance Assessment Test Scoring Guide

| Points | $ equivalent |
|---|---|
| 12 | 100 |
| 11 | 92 |
| 10 | 83 |
| 9 | 75 |
| 8 | 67 |
| 7 | 58 |
| 6 | 50 |
| 5 | 42 |
| 4 | 33 |
| 3 | 25 |
| 2 | 16 |
| 1 | 8 |