The following instructional plan is part of a GaDOE collection of Unit Frameworks, Performance Tasks, examples of Student Work, and Teacher Commentary. Many more GaDOE approved instructional plans are available by using the Search Standards feature located on GeorgiaStandards.Org.

Georgia Performance Standards Framework for Earth Science – 6th Grade

Earth, Moon, and Sun
Inquiry Template
Eclipses

Subject Area: Earth Science
Grade: 6

Standards (Content and Characteristics):

S6E1 Students will explore current scientific views of the universe and how those views evolved.
   d. Explain the motion of objects in the day/night sky in terms of relative motion.

S6E2. Students will understand the effects of the relative positions of the earth, moon and sun.
   a. Demonstrate the phases of the moon by showing the alignment of the earth, moon, and sun.
   b. Relate the tilt of the earth to the distribution of sunlight throughout the year and its effect on climate.

S6CS1. Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.
   a. Understand the importance of—and keep—honest, clear, and accurate records in science.
   b. Understand that hypotheses are valuable if they lead to fruitful investigations, even if the hypotheses turn out not to be completely accurate descriptions.

S6CS2. Students will use standard safety practices for all classroom laboratory and field investigations.
   a. Follow correct procedures for use of scientific apparatus.
   b. Demonstrate appropriate techniques in all laboratory situations.
   c. Follow correct protocol for identifying and reporting safety problems and violations.

S6CS4. Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities.
   a. Use appropriate technology to store and retrieve scientific information in topical, alphabetical, numerical, and keyword files, and create simple files.
   b. Estimate the effect of making a change in one part of a system on the system as a whole.

S6CS5. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.
   a. Observe and explain how parts are related to other parts in systems such as weather systems, solar systems, and ocean systems including how the output from one part of a system (in the form of material, energy, or information) can become the input to other parts. (For example: El Nino’s effect on weather)

b. Identify several different models (such as physical replicas, pictures, and analogies) that could be used to represent the same thing, and evaluate their usefulness, taking into account such things as the model’s purpose and complexity.

**S6CS6. Students will communicate scientific ideas and activities clearly.**

a. Write clear, step-by-step instructions for conducting scientific investigations, operating a piece of equipment, or following a procedure.
b. Understand and describe how writing for scientific purposes is different than writing for literary purposes.
c. Organize scientific information using appropriate tables, charts, and graphs, and identify relationships they reveal.

**S6CS8. Students will investigate the characteristics of scientific knowledge and how it is achieved.**

Students will apply the following to scientific concepts:
a. When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, which often requires further study. Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as meaningful.
b. When new experimental results are inconsistent with an existing, well-established theory, scientists may require further experimentation to decide whether the results are flawed or the theory requires modification.
c. As prevailing theories are challenged by new information, scientific knowledge may change and grow.

**S6CS9. Students will investigate the features of the process of scientific inquiry.**

Students will apply the following to inquiry learning practices:
a. Scientific investigations are conducted for different reasons. They usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations.
b. Scientists often collaborate to design research. To prevent bias, scientists conduct independent studies of the same questions.
c. Accurate record keeping, data sharing, and replication of results are essential for maintaining an investigator’s credibility with other scientists and society.
d. Scientists use technology and mathematics to enhance the process of scientific inquiry.
e. The ethics of science require that special care must be taken and used for human subjects and animals in scientific research. Scientists must adhere to the appropriate rules and guidelines when conducting research.

**S6CS10. Students will enhance reading in all curriculum areas by:**

a. Reading in All Curriculum Areas
b. Building vocabulary knowledge
c. Establishing context
Georgia Performance Standards Framework for Earth Science – 6th Grade

Enduring Understanding:
- The moon’s orbit around the Earth once in about 28 days changes what part of the moon is lighted by the sun and how much of that part can be seen from the earth.
- A lunar eclipse occurs when the moon passes through the Earth’s shadow.
- A solar eclipse occurs when the moon passes between the Earth and the sun.
- Because the Earth turns daily on an axis that is tilted relative to the plane of the Earth’s yearly orbit around the sun, sunlight falls more intensely on different parts of the Earth during the year. The difference in heating of the Earth’s surface produces the planet’s seasons and weather patterns.

Essential Question(s):
- Why does the moon appear to change shapes?
- How do lunar and solar eclipses differ? How are lunar and solar eclipses alike?
- Why does the earth have different seasons?

Pre-Assessment:
To assess student prior knowledge of the standards content-- administer the teacher handout, “What do You Know”. The questions on the pre-assessment questionnaire elicit students’ prior knowledge related to sky motions, Earth rotation & orbit, seasons, and what we can see in the sky at different times of day and year. Examine the questionnaire results for missing pre-requisite knowledge and for any misconceptions related to lesson content. Save the un-graded pre-assessment questionnaires to compare to post lesson assessment results (“What Have You Learned?”

<table>
<thead>
<tr>
<th>Outcome/ Performance Expectations</th>
<th>Identify the learning goals for this inquiry-based task.</th>
<th>Students will be able to:</th>
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<tbody>
<tr>
<td></td>
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<td>- Demonstrate the Earth’s rotation on its axis causes the sun to appear to rise in the east and set in the west.</td>
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<td>- Determine why the earth has different seasons.</td>
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<td></td>
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<td>- Explain why the moon appears to change shapes.</td>
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<table>
<thead>
<tr>
<th>Write a concept statement...How would you formulate an expert idea?</th>
<th>List examples of how students may incorporate their ideas into experiments:</th>
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<tbody>
<tr>
<td></td>
<td>- The Earth turns daily on an axis that is tilted relative to the plane of the Earth’s yearly orbit around the sun. The difference in heating of the Earth’s surface produces the planet’s seasons.</td>
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<tr>
<td></td>
<td>- The effects of the relative positions of the earth, moon and sun.</td>
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## Write a concept statement / question...

**What kind of situation would cause this concept to become apparent in students’ understanding?**

## Write questions or statements to assist students develop and explain their ideas (i.e. aid in conceptualizing their knowledge-making exploration).

- Does the earth move?
- What are the relative sizes and positions of the Earth, Sun, and moon? Teachers are provided with Student Activity 1, “Scale Model of the Sun, Earth, and Moon”. Teacher may reinforce scale model of the Sun and Earth using a grapefruit-size round object to represent the Sun; the size of the Earth in this model is about the size of the tip of a pencil.
- What is the difference between Earth’s rotation and Earth’s orbit? Students may kinesthetically model rotation and orbit.
- Students observe light rays on an object. Students interpret the increase/decrease in the total area of light on the object as a result of changing the “angle of incidence” of the light source. Teachers are provided with Student Activity 2,
- Students observe the appearance of the Moon produced by the changing position of the Sun, Earth, and Moon. Student Activity 3: Eclipses. Teachers caution students of heated light sources, hazards of electricity.

## Identify necessary data and observations...

**What data would demonstrate the mastery of the concept by ALL students in the classroom?**

## Identify relevant observations and data collected by students to aid in conceptualizing their knowledge-making exploration. In addition, lists misconceptions that arise and may prohibit students internalizing their own understandings, and what steps should a teacher take to overcome these misconceptions?

- Earth’s tilt toward Polaris, earth rotational period is about 24 hours, earth’s orbital period about 365 days.

### ACTIVITY: Observe effect of angle of light rays and intensity of light

#### Student Activity 1: Light Angle and Intensity

**Angle of Incidence for Light Rays**

Objective: The students will explain light intensity is dependent upon the “angle of incidence” of light rays.

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One Stop Shop For Teachers

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<table>
<thead>
<tr>
<th>Materials Needed:</th>
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<tbody>
<tr>
<td>Flashlight</td>
<td></td>
</tr>
<tr>
<td>Sheet of dark paper</td>
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<tr>
<td>Pencil</td>
<td></td>
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<tr>
<td>Globe</td>
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<tr>
<td>Symbolic sun</td>
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</table>

Use flashlight to demonstrate the effect of the Sun’s rays coming in at higher or lower angles.

1. Darken the classroom.

2. Give the students a flashlight and sheet of paper

3. With lights dim, ask students to compare the patch of light resulting from shining a flashlight on the paper from almost directly overhead to the patch of light that results from shining the flashlight from lower angles. Guide students to notice at lower angles (like the Sun being lower in the sky), the light is dispersed over a greater area and so it is less intense than the more concentrated patch of light resulting from higher angles of incidence (like the Sun being higher in the sky).

4. Ask students to guide you to place an inflatable Earth in the proper tilt of the northern hemisphere toward the Sun. Arrange students so they can all easily see the light shining on the globe. Shine the light on the Northern hemisphere for several seconds, then toward the Southern hemisphere for several seconds. Ask: What do you notice? What is different about the way the light plays on the two hemispheres?” Guide students to see how the light patch shining on the hemisphere leaning toward the light has a greater intensity, and the light patch on the hemisphere leaning away is more spread out.

5. Explain the more intense sunlight in the Southern hemisphere means more heating of Earth’s surface and warmer temperatures of summer. Less intense sunlight in the Northern hemisphere means less heating of Earth’s surface and the colder temperatures of winter.

6. Introduce a rhyming poem that serves as a reminder for why it is cooler in winter and warmer in summer:

   Length of days…
   Angles of rays…
   Nothing to do with how far away

Extension/Reinforcement

1. Gather sunrise/sunset data for each of the seasons at school latitude using internet database. Compare length of days and daily temperature for each of the seasons.

   Video Link: Reasons for the Seasons:

ACTIVITY: Position of Sun, Earth, Moon during eclipses.
Earth Moon Sun Inquiry

Student Activity 2

Objective: The student will explain that a solar eclipse is produced when the moon passes between the sun and the earth.
### Georgia Performance Standards Framework for Earth Science – 6th Grade

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<tbody>
<tr>
<td>Light sources (flashlight, bare bulb, lamp, etc.)</td>
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<tr>
<td>Small balls (handball, tennis ball, etc.)</td>
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<tr>
<td>Globes</td>
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**Exploration:**

**Part I**

1. Darken the room.
2. Ask the students why the room is dark.
3. Ask them how the outdoors could be darkened during the daytime.
4. Give the students a flashlight and a ball.
5. Challenge them to make different shadows with the flashlight and ball

**Part II**

1. Have the students put a globe on a table.
2. Ask them what the light source represents.
3. Ask them where the moon might be in the model. Have them place the moon in different positions. Make sure that at some point they all place the “moon” between the sun and the earth and that they see the shadow on the earth. Have them also place the moon in the Earth’s shadow.

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1. Ask the students: When the moon is between the sun and earth and causing a shadow on the earth, what happens to our view of the sun? Explain that this is called a solar eclipse.

2. Ask the students: When the earth is between the sun and the moon causing a shadow on the moon, what happens to our view of the moon? Explain that this is called a lunar eclipse.

Application:

1. Why do we not have solar and lunar eclipses every month?
2. How do we observe a solar eclipse since we cannot look directly at the sun?
3. Gather lunar phase data, and/or eclipse data from the internet and chart these over a period of time.

Video Link: Lunar Eclipse

Write procedures that will cause students to organize data…Test a procedure using known concepts.

List sample procedural statements that students may use to organize their data:

- What are the relative positions of the Earth, Sun, and moon?
- Students observe light rays on an object. Activity 1: Light Angle and Light Intensity
- Students observe the appearance of the Moon produced by the changing position of the Sun, Earth, and Moon. Activity 2: Eclipses

Write questions or activities to use or apply the concept (represent, model, visualize, or design new experiments).

- Why do we not have solar and lunar eclipses every month?
- How do we observe a solar eclipse since we cannot look directly at the sun?
- Are there seasons on Mars? If so, duration of a Mars season?

<table>
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<tbody>
<tr>
<td>1. Gather sunrise/sunset data for each of the seasons at school latitude using internet database.</td>
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<td>Students sketch location of the sun relative to a reference point (i.e. horizon looking N) at 9 am, 12 pm, 3 pm, and 6 pm. Student traces the path of the Sun across the sky. Student observes stars in the night sky, record changes in position.</td>
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<td>Students research the first European astronomer to discover sunspots (Galileo). Students explain what is meant by “Daylight Savings Time” and why do we use it?</td>
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