The Earth and the Moon

**Subject:** The Earth and the Moon

**Topic:** Students will consider the interrelationship and interdependence of the earth and moon system.

**NSTA Teaching Standards**: A, B, C, D, E, F

**NSTA Content Standards:**

 Unifying Concepts and Processes:

 K-12: Change, constancy and measurement

 Science as Inquiry

 K-12: Abilities necessary to do scientific inquiry

 Earth and Space Science

 K-4: Changes in earth and sky

 5-8: Earth's history

 Physical Science

 9-12: Motions and forces

 History and Nature of Science

 9-12: Historical perspectives

**NCTM Standards**

 Content Standard: Number Sense and Operations

 Process Standards: Connections, Representations, and Problem Solving

**Teaching Procedures:**

 **Essential Questions:**

 1. How are the earth and the moon alike and different?

 2. How are the earth and the moon interdependent?

 3. How is the relationship between the earth and the moon changing?

 **Introduction (Activating):**

1. Introduce the lesson by showing the picture of the earth and the moon together. (Handout #1)
2. Ask the students how they think that the earth and the moon are alike and how they are different.
3. Ask the students how they think the earth and the moon are interdependent.
4. Ask the students if they think that the relationship between the earth and moon is changing. If so, how?

**Teaching Strategies:**

1. Begin with a teacher/student discussion. Use handout #2 as a two- dimensional model to record feedback elicited from the students.
2. Provide some three dimensional models for the students to demonstrate their thinking.
3. Some possible attributes of the earth and moon that the students might notice include size, shape, gravitational pull, spin, tilt, distances and tides.

1. Refer to handout #3 and use the website to show the effect of the moon on the earth's tides. Have them demonstrate understanding by manipulating the models.
2. Ask the students, "What holds the moon in its orbit?" Discuss the fact that the moon is slowly slipping away from the earth at the rate of 3.8 cm per year. If this has been continuing at the same rate, where would the moon have been in the past? What effect would these changes have on the gravity and tides? Have the students calculate and estimate how long they think this could have been happening. (Handout #4)
3. Use the discussion guide (Handout #5) in small groups.
4. Have each group use the models to demonstrate the relationship between the earth and the moon.

 **Extension:**

See Handout #6: Determine the radius of the earth and the moon to calculate the circumference and volume of each.

 The Circumference of a Circle = Diameter X π

 OR

 The Circumference of a Circle = 2 X π X Radius

 The Volume of a Sphere = 4/3 π Radius3

 A great website for understanding this formula can be found at:

 http://library.thinkquest.org/12006/S-M-2.shtml

 Have the students calculate the volume of each and compare this information with the fact that the pull of gravity on the earth is 6 times the pull of gravity on the moon.

 **Closure:**

1. Have each group report their findings to the class.

2. Students should write a summary of their conclusions with possible implications.

 **Differentiated Instruction:**

1. As the students are working in groups, circulate to assist when needed.

2. Multiple intelligences addressed:

1. Verbal/Linguistic: Students communicate in groups and write about their findings. Students complete an essay on their findings.
2. Logical/Mathematical: Students use basic math to apply the inverse square law to gravitational pull. They use geometry as they compare angles to comprehend the phases of the moon.
3. Spatial: Students compare the relative sizes and distances between the earth and moon. Students use 3-dimensional models to demonstrate understanding.
4. Musical/Rhythmic: Students use algebra to uncover a pattern in gravitational attraction.
5. Interpersonal: Students work in groups.
6. Intrapersonal: Students reflect in journals.
7. Bodily/Kinesthetic: Students use three-dimensional models and student motion to demonstrate the changing processes.
8. Naturalist: When students see the earth and the moon, they can appreciate the night sky as they make connections to the world around them.

 **Lesson Assessment:**

 1. Essay question assessment and scoring rubric

 **Materials/Resources**

1. Handout #1 Activating Activity: The Earth and the Moon
2. Handout #2 Teacher/Student Discussion
3. Handout #3 The Movement of the Earth and Moon
4. Handout #4 The Gravitational Pull of the Earth and Moon
5. Handout #5 Discussion Guide
6. Handout #6 Extension: The Circumference and Volume of the Earth and Moon

Handout #1 Activating Activity

The Earth and Moon



Essential Questions:

1. How are the earth and moon alike and different?

2. How are the earth and moon interdependent?

3. How is the relationship between the earth and the moon changing?

Handout #2

Student/Teacher Discussion:

Use the pictures below to illustrate any of the similarities and differences as well as the interrelatedness of the earth and moon.

![MPj04308490000[1]]()

![MPj04222540000[1]]()

Handout #3 The Movement of the Earth and Moon

Use the following website to demonstrate the movement of the moon relative to the sun.

http://www.mmscrusaders.com/newscirocks/tides/tideanim.htm





Handout #4 The Gravitational Pull of the Earth and Moon

How can the gravitational pull be calculated?

The Inverse Square Law states:

The force of attraction between two objects is inversely proportional to the square of the distance between them.

For Example:

If the distance between the earth and the moon was 1/2, then the gravitational force would be 4 times greater.

If the distance was 1/3rd of what it is now, the gravitational force would be 9 times greater.

If the distance was 1/4th of what it is now, the gravitational force would be 16 times greater.





"Gravitational interaction (tides on the Earth caused by the Moon) transfers kinetic energy from Earth to the Moon, slowing Earth's rotation and raising the Moon's orbit, currently at a rate of 3.8 centimeters per year."

from: http://www.freemars.org/jeff/planets/Luna/Luna.htm

The moon is slowly slipping away from the earth at the rate of 3.8 cm per year. How long do you think this could have been happening? How long do you think this will continue?

The average distance to the Moon is 384,403 km (238,857 miles).

The following website can be used to obtain more detailed information on these calculations.

http://www.freemars.org/jeff/planets/Luna/Luna.htm

The pictures are from the NASA website.

The Earth and Moon Discussion Guide Handout #5

1. How is the earth different from the moon?

2. How is the earth similar to the moon?

3. What causes the phases of the moon?

4. Why do tides rise and fall?

5. What keeps the earth and moon in motion year after year?

6. How does the distance between the earth and the moon effect the gravitational pull between the earth and the moon? Apply the inverse square law to explain your answer.

7. The moon is slowly moving away from the earth. How might this affect the earth and the moon in the future?

8. Do you think the moon is moving away from the earth at a constant rate?

9. How long do you think this process could have been occurring?

10. What affects would increased gravitational pull have had on the earth in the past?

Handout # 6 The Circumference and Volume of the Earth and the Moon

**Diameter of the Earth 12,756 km**

**Diameter of the Moon**

**3,476 km**

**Distance from the Earth to the Moon**

**356,000- 407,000 km**

Citation:

http://www.enchantedlearning.com/subjects/astronomy/activities/coloring/earthmoon.shtml

**Extension:**

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 Have the students calculate the volume of each and compare this information with the fact that the pull of gravity on the earth is 6 times the pull of gravity on the moon.

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Essay Scoring Rubric

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Describe the similarities and differences between the earth and the moon. Describe how the earth and the moon are interrelated in terms of movement and gravitational forces. Describe the effects of the gravitational pull between the earth and moon. Assuming that the rate of change of the moon moving away from the earth has remained constant, how long do you think this process could have been continuing? What do you think will happen in the future?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Not Evident (0) | Needs Work (15) | Acceptable (20) | Exemplary (25) |
| Mathematical Thinking | There is no evidence of mathematical thinking. | The mathematical thinking is not expressed clearly or is expressed erroneously.  | The mathematical thinking is correct. | The mathematical thinking is expressed correctly and in detail. |
| Calculations | No calculations are present. | The calculations are incorrect. | The calculations are correct. | The calculations are correct and detailed. |
| Scientific Reasoning | No scientific reasoning is present. | The scientific reasoning present is incorrect. | Scientific reasoning is correct. | Scientific reasoning is correct and detailed. |
| Written Expression | The essay is not related to the topic or the essay is incoherent. | The writing is minimally coherent and/or has many grammar, punctuation, or spelling errors. | The writing is coherent, clear and understandable with few grammar, punctuation or spelling errors. | The writing is coherent, clear, expressive, and persuasive with no errors.  |
| Total |  |  |  |  |