Document Id: 03_10_04_1
Date Received: 2004-03-10 Date Revised: 2004-06-01 Date Accepted: 2004-06-07
Curriculum Topic Benchmarks: S1.2.5, S1.2.6, S3.2.1, S3.2.2, S3.3.2, S3.3.4, S3.3.6
Grade Level: Upper Elementary [3-5]
Subject Keywords: Earth, Moon, Sun, orbit, rotation
Rating: easy

Modeling the Motions of the Earth, Moon and Sun

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The purpose of this lesson is for students to learn the relative motions of the Earth, Sun and Moon. Awareness of these different motions is needed to develop an understanding of the causes of the day/night cycle, the seasons and the cycle of lunar phases.

Students will act out the motions of the three objects. This should be done outdoors in a large cleared area. With a small class this could be done indoors in a gym. It can be an introductory lesson, and can precede lessons about lunar phases and the Earth's seasons (PUMAS Examples 03_10_04_2 and 03_10_04_3).

Introduce the activity to the students: "The motions of the planets, moons and other objects of our solar system have been evolving since they all formed, about 4.5 billion years ago. We are going to explore the motions of the Sun, the Earth and the Moon as they are today."

Form groups of three students by having the students count off by 3's. Begin the lesson with the 1's modeling the Sun, the 2's modeling the Earth and the 3's modeling the Moon. Bring the class outside to the edge of a large field and ask the students modeling the Sun to go out on to the filed. Have the students spread out from each other as much as possible.

1) Start with students modeling the Sun. The students modeling the Sun should begin slowly rotating.
Question: "To be accurate, how long should the student take to make a complete revolution?" (Around 25 to 35 days, depending on latitude.)[1]
Have student rotate briefly and then stop.

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[1] The Sun is a large ball of gas and plasma. (A plasma is like a gas but also contains charged particles and can generate electric currents.) There is no solid surface. That is why different parts of the Sun have different rotation rates.

2) Next add the motion of the Earth. Have the students modeling the Earth go out on to the field near their Suns. Earths need to be at least 10 feet away from the Suns. Farther away is better if there is enough room.
Question: "How should the Earth move?" (Earth should go around the Sun while rotating.)
The students modeling the Earth should begin rotating while slowly moving around the Sun.
Question: "How many times should the students modeling the Earth rotate as he/she goes completely around the Sun 1 time?" (365)

3) Have both students try out motions briefly and then stop.

4) Finally add motion of the Moon. Have the students modeling the Moon go out on to the field close to their Earths. Be sure that the groups are far enough away from each other that members from different groups will not crash into each other as they perform their motions.
Question: "How should the Moon move?" (Moons should go around the Earths)
Question: "Does the Moon also rotate?" (Yes)
Have the students modeling the Moon begin orbiting the Earth, telling them that they must always face the Earth as they go around it.
Question: "How long does it take the Moon to go around the Earth? (28 days)
Question: "How long does it take the Moon to rotate? (28 days.)[2]
Next have Earths and Suns begin their motions while the Moons continue moving. Earths will need to orbit slowly so the Moons can keep up.[3] Have students stop after a few seconds, before anyone gets too dizzy.

5) Have students switch positions—Suns becomes Earths, Earths becomes Moons, Moons becomes Suns—and begin again. Continue until students have modeled motions of all three objects.

The lesson can be followed up with a lesson on lunar phases.

Because the same side is facing Earth, many students may make the mistaken assumption that the Moon does not rotate. It does, but the period of its rotation is the

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[2] The Moon makes 1 rotation as it makes an orbit. This means that the same side of the Moon is always facing the Earth. The student modeling the Moon must always be facing the Earth, but the student facing the Earth does not need to be facing the Moon all the time.

[3] To be accurate, the Earth should move a little under one twelfth its orbit around the Sun in the time it takes the Moon to orbit the Earth. If all distances were to scale the result would be that the Moon's motion would be a sinuous, wavelike motion around the Sun rather than a series of loops around the Earth as is commonly believed. Correcting this misconception, however, may be beyond the scope of this lesson.

same as the period of its orbit around the Earth. This can be pointed out by the following activity:

Have a student modeling Earth stand facing the Sun. Have the class note which way the student is facing (toward the Sun). Ask the student modeling Earth to perform one half of a rotation. Ask the class which way the student is now facing (away from the Sun). Ask the student to complete their rotation and note which way they are facing (back toward the Sun). Point out that as the student modeling the Earth performed a complete rotation, he/she started off facing the Sun, then faced away from the Sun, and ended up facing the Sun again.

Now ask a student to take his or her position as the Moon, with the Earth between the Moon and the Sun. Ask the class: “Which way is the Moon facing?” (Toward the Sun). Ask the student to go halfway around the Earth. Ask: “Which way are they facing now?” (Away from the Sun). “Think about the Earth. What did we call it when the Earth changed from facing the Sun to facing away from the Sun?” (Half a rotation). Now ask the Moon to complete its orbit around the Earth. Ask the class: “Which way is the Moon facing now?” (Back toward the Sun.) “What can we conclude from this?” (The Moon makes a complete rotation in the same time that it orbits the Earth.)