

Investigation Five – Gravity

Standard 03: Students will understand the relationship and attributes of objects in the solar system
Objective 3: Describe the forces that keep objects in orbit in the solar system
<u>Intended Learning Outcomes:</u> <ol style="list-style-type: none">1. Use science process and thinking skills2. Manifest scientific attitudes and interests3. Understand science concepts and principles4. Communicate effectively using science language and reasoning

**Standard
III**

**Objective
3**

Background Information

Any object with mass has “gravity.” Gravitational force mutually attracts all objects in the universe. Earth’s gravity attracts, or pulls us towards it. We also pull Earth towards us. Because Earth is so much more massive than we are, Earth has a greater gravitational force and we are attracted to it. Our mass is so small that our gravitational force is miniscule. An object’s gravitational force is dependent upon its mass. Earth is more massive than the moon, but the gravity of each affects the other. Earth’s gravity pulls the moon towards it as the moon moves around Earth. In this way, the moon orbits Earth. The moon’s gravity causes tides on Earth. They both attract each other, but Earth is more massive, which makes the gravitational force of Earth greater than that of the moon. So, if we were to compare our weight on the moon with our weight on Earth, it would be different. The weight of an object on any planet depends on the gravitational force of the planet attracting the object. The mass of the object, however, always remains the same (i.e. the amount of “stuff” (mass) something is made up of does not magically change). So, the weight of an object on Earth would be different that the weight of the same object on another planet. Since the gravitational force or surface gravity of each planet has been determined, we can calculate our weight on other “worlds.”

Pre-Assessment/Invitation to Learn

Talk to the students about gravity. Gravity is a force that pulls us towards the center of Earth. Ask them if the moon has the same gravity as Earth. Why not? The moon is less massive than Earth (and has a different surface gravity). Does that mean that objects would weigh less on the moon? Yes! The moon’s gravity is about 1/6 of Earth’s. This means if a person weighs 120 pounds on Earth he/she weighs only 20 pounds on the moon. Have the students figure out how much they would weigh on the moon by dividing their weight on Earth by 6.

Materials

- Sturdy* empty cereal boxes
- 1 box with the cereal in it and the manufacturer's weight of the box written on the front
- 6-12 pounds of rocks and sand or dirt (depending on the number of objects you wish to compare)
- Accurate scale to measure the rocks or dirt
- Solar System fact sheet

Instructional Procedures

1. Determine the number of objects in the Solar System with which you would like to do weight comparisons and obtain the same number of boxes.
2. Find the weight written on the full box. This is the number you will need to multiply by every other planet's surface gravity to determine how much that same full box on Earth would weigh on the different planets.
3. Using the "Solar System Fact Sheet", find the Surface Gravity measurements (9 boxes down from the top of the chart) for the planets you have chosen. Multiply the cereal box weight and the Surface Gravity measurement to find how much the cereal box would weigh on that planet. For instance, a Grape Nuts box weighs approximately 2 pounds. Jupiter has a surface gravity of 2.53. Multiplying 2×2.3 , we get 3.06. On Jupiter, the same Grape Nuts box would weigh 5.06 pounds.
4. Students can do all the multiplication and then measure out the correct amount of sand, dirt, or rocks and dump it into an empty box. Label the box.
5. Students can take turns lifting each labeled box, along with the unused box still full of cereal to compare the weight on other worlds.
6. Students can figure out their own weight on other worlds using the same procedure.

Curriculum Extensions

Language Arts

- Have students read how planets stay in orbit. Have them model how it works. (Standard VII, Objective 2)

Assessment Suggestion

- Have students explain in their own words why the moon cannot have an atmosphere.
- Have students explain in their own words how planets stay in orbit.

Reference to Assessment Section:

	Multiple Choice	Constructive Response	Performance Test
Unit Test 1	8, 9, 10	3	Staying in Orbit
Unit Test 2	9, 10	5	Staying in Orbit

Resources

Videos

- All About Planets, Schlessinger Media, 2000
- Inner Planets, Stanton Films, 1983
- Outer Planets, Stanton Films, 1983
- Our Solar System, Allied Video, 1992