



Drexel-SDP GK-12 ACTIVITY

Activity: Gravity, Mass and Weight

Subject Area(s) Physical Science, Number & operations

Associated Unit Astronomy, module 1

Associated Lesson

Activity Title Gravity, Mass and Weight

Grade Level 6 (3-8)

Activity Dependency None

Time Required 50 minutes

Group Size 2

Expendable Cost per Group approx. \$0.20 or less

Summary

Students will work together in groups to determine the relationship between their weight on Earth and other planets based on the varying forces of gravity.

Engineering Connection

Suppose an engineer designs an instrument for the Mars Rover that contains a coiled spring. Now, suppose that spring will only compress with 50 pounds of weight upon it. She builds and tests the device on Earth, and finds the spring compresses and releases as expected. Now, the instrument is dropped onto the surface of Mars, and the spring no longer works. Why? Well, it's because a pound is actually a weight---a force exerted on a surface that depends upon the amount of gravity acting on the object. The gravity on Mars is much less than the gravity on Earth. Therefore, a 50 pound force (weight) on Earth will be far less than that on Mars. That is why the spring did not compress on Mars. In this lesson, we will learn about the difference between weight and mass.

Keywords

Astronomy, scale, planets

Educational Standards

Pennsylvania Standards

3.1.7 Unifying Themes

3.1.7.D. Explain scale as a way of relating concepts and ideas to one another by some measure.

3.4.7. Physical Science

3.4.7.C. Identify and explain the principle of force and motion.

3.4.7.D. Describe essential ideas about the composition and structure of the universe and the earth's place in it.

Pre-Requisite Knowledge

None.

Learning Objectives

- Students will work in teams to research an assigned planet within our solar system.
- Students will be given a ratio of the real diameter of the sun and a scaled diameter. They will then determine the scaled diameter of their assigned planet and use it to make a paper model. Each team will then place their planet in the proper order on the chalkboard.
- Students will determine the length of time it takes sunlight to reach their assigned planet.
- Students will determine the density of their planet.

Materials List

- Computer (for research)
- Informational books (encyclopedias and/or science books)
- Construction paper
- Ruler
- Compass
- String
- Scissors
- Calculator (optional)
- Tape

Introduction / Motivation

Engineers play a large part in the exploration of our solar system and beyond. One of the most basic things that must be known in order to determine how rovers or satellites will behave on another planet is based on the mass (size and material) of those planets. This is because the force

due to gravity on a planet is directly related to its mass. Today we will be investigating the size of the other planets in the solar system compared to Earth and the sun.

(After researching the nine planets of our solar system and the sun, the students will be able to describe the detail characteristics of the planets, sun, and stars of our solar system.

Review the background material with the students, discuss the vocabulary, then begin the activity.)

Vocabulary / Definitions

Word	Definition
Mass	How much matter there is in an object.
Inertia	The reluctance of any object to change its state of motion. Mass is the measure of inertia.
Weight	A measurement of the gravitational force acting on an object.
Gravity	A natural phenomenon by which all objects with mass attract each other.
Unit conversion	The process of equating different units of measurement
Dimensional analysis	A technique that uses unit conversion as a tool to check the correctness of a calculation.

Procedure

Background

The terms "mass" and "weight" are used interchangeably in our daily speech, but to an astronomer or a physicist they are completely different things. The mass of a body is a measure of how much matter it contains. An object with mass has a quality called **inertia**. If you shake an object like a stone in your hand, you would notice that it takes a push to get it moving, and another push to stop it again. If the stone is at rest, it wants to remain at rest. Once you've got it moving, it wants to stay moving. This quality or "sluggishness" of matter is its inertia. Mass is a measure of how much inertia an object displays.

Weight is an entirely different thing. Every object in the universe with mass attracts every other object with mass. The amount of attraction depends on the size of the masses and how far apart they are. For everyday-sized objects, this gravitational pull is vanishingly small, but the pull between a very large object, like the Earth, and another object, like you, can be easily measured. Scales measure the force of attraction between you and the Earth. This force of attraction between you and the Earth (or any other planet) is called your weight.

If you are in a spaceship far between the stars and you put a scale underneath you, the scale would read zero. Your weight is zero. You are weightless. There is an anvil floating next to you. It's also weightless. Are you or the anvil mass-less? Absolutely not. If you grabbed the anvil and tried to shake it, you would have to push it to get it going and pull it to get it to stop. It still has inertia, and hence mass, yet it has no weight. See the difference?

Before the Activity

Collect and distribute materials.

With the Students

Procedure:

1. Organize the students into small groups.
2. Ask for a volunteer from each group to be weighed on the bathroom scale.
3. Give the students the conversion: 1 pound = 0.4536 kilogram. Have the students determine the mass of the weighed student using **unit conversion and dimensional analysis**.
4. Using the given gravity multiplier on the chart below, have the students determine the mass and weight on the various planets.

Location	Mass	Gravity	Weight
Earth		1	
Outer space		0	
Earth's moon		0.17	
Venus		0.90	
Mars		0.38	
Mercury		0.38	
Jupiter		2.36	
Saturn		0.92	
Uranus		0.89	
Neptune		1.13	
Pluto		.07	

Safety Issues

- None

Troubleshooting Tips

Help the students to calculate the volume of the planet using pi and a calculator.

Investigating Questions

Have student groups complete the following table.

NAME: _____

DATE: _____

Location	Mass	Gravity	Weight
Earth		1	
Outer space		0	
Earth's moon		0.17	
Venus		0.90	
Mars		0.38	
Mercury		0.38	
Jupiter		2.36	
Saturn		0.92	
Uranus		0.89	
Neptune		1.13	
Pluto		.07	

Assessment

Pre-Activity Assessment

None

Activity Embedded Assessment

Have the student groups prepare a report and presentation to be given in front of the class.

Post-Activity Assessment

Evaluation will be based upon teacher observation of student participation and completion of the homework assignment.

Give the students a homework assignment: using the same chart as used in the class activity, determine the weight and mass on all the planets of a household pet weighing 25 pounds.

Activity Extensions

(<http://www.exploratorium.edu/ronh/weight/>).

Owner

Drexel University GK-12 Program

Contributors

Theresa Andrejack

Copyright

Copyright 2007 Drexel University GK12 Program. Reproduction permission is granted for non-profit educational use

Version: Mar 2007