Drexel-SDP GK-12 ACTIVITY

Activity: Calculate Your Weight on Another Planet

Subject Area(s) **Earth and Space**

Associated Unit **Astronomy, module 2**

Associated Lesson **"Lesson: History of the Planets in Our Solar System"**

Activity Title **Activity: Calculate your Weight on Another Planet**

Grade Level 6 (3-7)

Activity Dependency **None**

Time Required **20 minutes**

Group Size **1**

Expendable Cost per Group **$0**

Summary

In the preceding lesson we'll have traveled through 4.5 billion years of history to learn how our solar system was born. We'll then discussed planetary motion and some properties of the planets, ending with a math exercise for the students to use the factor label method to calculate their age and weight on several other planets.

Engineering Connection

Engineers often must make conversions to measurements depending upon the environmental conditions. For example, a wire will have an increased resistance to the flow of electricity as the ambient and internal temperature increase. Therefore, the operating temperature is an important factor to estimating the electrical resistance of a component. In astronomy, the gravitational force of a planet is an important factor to calculating the weight of an object. These two examples illustrate how environmental conditions affect the properties of a object, and how scientists and engineers use these factors in their calculations.

Keywords
Astronomy, big bang, factor label, solar nebula

Educational Standards (PA)
- Science: Physical Science, Chemistry and Physics - Astronomy 3.4.D
- Math: Computation and Estimation 2.2

Pre-Requisite Knowledge
Be familiar with the concept of multiplying by one (e.g. no change in the value).

Learning Objectives
After this lesson, students should be able to:

- Apply the factor label method to convert their weight on another planet
- Explain what is the cause of differences in our weight from one planet to another.

Materials List
Each individual needs:
- A pencil
- A worksheet (below)

Introduction / Motivation

Have you ever wondered what it feels like to walk on Mars? Would you feel heavier or lighter or just the same? Engineers and scientists who design equipment to explore the surface of other plants must consider differences in weight on other planets so they can plan for equipment drops (to the surface), stress on the equipment over time, and how much weight a device can carry or pull. In this activity, we will calculate our weight on other planets, then compare to see if we weight more than or less than on Earth.

(This activity will help students practice their basic arithmetic skills, as well as to learn the factor label method of canceling units. The background for the exercise is material on the formation of the solar system, taken directly from their 6th grade astronomy textbook.)

Vocabulary / Definitions

Word	Definition
Factor label method	A unit conversion process
Gravity (Gravitational force)	A phenomenon through which all objects attract each other. The more mass an object has, the greater its gravitational force.

Procedure

Background
Factor-Label is a fairly simple process. It essentially means that the student multiplies by quantities of one. For example, if you wanted to convert 20 cm to ____ km, you would set up the problem with the appropriate conversion in terms of "ones" as follows:

20 cm X 1m/100cm X 1km/1000m =

Deciding whether to multiply by 100cm/1m or 1m/100cm depends upon which unit of measurement you would like to "cancel out".

Before the Activity

Review the concept of multiplying by one, and reiterate that it does NOT change the value of the number. Introduce the factor label method with a few examples of converting feet to cm, or miles to kilometers, or seconds to minutes. Ask students to come to the blackboard to complete a few problems. Require that the students perform the multiplication by hand.

Distribute worksheets.

With the Students

Step 1. Walk around the room as students complete the worksheet below, or step through the exercise as a class.

Name: ____

How much would you weigh on Mercury?

_____ your weight in lbs. on Earth	0.38 lbs. on Mercury	= ____________
Mercury lbs.	1 lb. on Earth	

How much would you weigh on Venus? (use: 0.91 Venus lbs. = 1 Earth lb.)

How much would you weigh on Neptune? (use: 1.12 Neptune lbs. = 1Earth lb.)

How much would you weigh on Jupiter? (use: 2.36 Jupiter lbs. = 1 Earth lb.)

If your mass is 41 kg on Earth, what is your mass on Jupiter?

Step 2. Analyze your results. From the set of planets we evaluated, on what planet would we weigh the most? The least? Recall from the lesson what is the cause of these differences on each of the planets.

Step 3: Discuss how an engineer might make use of this information (e.g. if a sensor were triggered by weight pressing on a coil spring, then they would have to account for the weight differences in order to get the sensor to activate).

Safety Issues

- None

Troubleshooting Tips

Students often have trouble reasoning whether their answer should be bigger or smaller than the number with which they began. Help those students by asking them to PREDICT whether their answer will be bigger or smaller and ask them how they arrived at that conclusion. This type of "bigger/smaller" reasoning helps to make the connection between labels (units) and their expected magnitudes (values).

Investigating Questions

Ask the students what kinds of conversions they make in their heads every days. E.g. do they ask for pants with two legs? Or for a pair of pants? Do they ask for a bagful of potato chips or 20 potato chips? These are equivalent quantities that involve them making unit conversions in their head every day.

Assessment

Pre-Activity Assessment
None

Activity Embedded Assessment
Each student completes worksheet of problems during class.

Post-Activity Assessment

Observe the students during the exercise, and/or ask them to turn in their worksheets to be graded after class. Use the following evaluation criteria.

Students will be evaluated on a scale from 0 to 4 on:

________	________	________
Task Completion	Correctness of answers	Participation in discussion

Activity Extensions

The following worksheet asks the students to extend this exercise to the difference in days per year on other planets.

Name: ____

How old would you be on Mercury?

_____ your age in Earth years	1 Mercury year	= ____________	Mercury years
	0.24 Earth years		

How old would you be on Earth? (use: 1 Earth year = 1 Earth year)

How old would you be on Venus? (use: 1 Venus year = 0.61 Earth years)

How old would you be on Mars? (use: 1 Mars year = 1.88 Earth years)

How old would you be on Jupiter? (use: 1 Jupiter year = 11.86 Earth years)

Owner

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Contributors

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