Jumping on Other Planets

OBJECTIVES

Students will be able to:

- ★ Indicate that gravitational force of planets pulls objects toward the planet's center.
- ★ Differentiate between weight and mass.
- ★ Multiply with decimals (with calculators).

TIME REQUIRED

One to two 40-minute periods

MATERIALS

- ★ Meter stick or tape measure
- ★ Calculators
- ★ Activity Sheet

Your students can dream of visiting other planets with future astronaut Luciana Vega. She can't wait to be the first person on Mars!

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LESSON STEPS

1. Show video of astronaut hopping on the moon: **youtu.be/HKdwcLytloU**
2. Ask the class how the astronaut is able to jump with so much ease. Discuss how the moon has less mass than the Earth so its gravitational pull is weaker.
3. Make sure that the class understands the difference between mass (the amount of material contained in a body, measured in kilograms) and weight (the gravitational force exerted on an object).
4. Also make sure the class understands that the gravitational force exerted by an object pulls other objects toward its center, which is why we fall down, not up.
5. Indicate that the planet Mars has less mass than Earth. Ask the class to predict whether they could jump higher on Mars or Earth (Mars, because less mass means less gravitational pull, resulting in a higher jump).
6. As appropriate for your class, provide background:
   - Gravity on Earth equals 9.81 meters per second^2.
   - Gravity on Mars equals 3.71 meters per second^2.
   - Therefore, gravity on Mars relative to Earth equals 9.81/3.71 = 2.64.
   - Explain that 2.64 is called a *conversion factor*, a number used to convert a quantity of one type (Earth's gravity) to an equivalent amount of a different type (Mars' gravity). To calculate how high one could jump on Mars, multiply the height of a jump on Earth by 2.64. Similar conversion factors for other planets are provided on the worksheet.
7. Show the class how to measure the height of a jump on Earth, with a partner.

   Note: Try one of the following two methods for measuring the height of a jump on Earth:

   a. Tape a measuring tape to the wall so that 0 is about 1 meter off the floor. Students measure the height they can reach on the tape. Then they jump and touch the highest point on the tape they can. The difference between the two measures is the height of the jump.

   b. Have one student hold a meter stick with the zero end touching the ground. A partner stands next to the meter stick and jumps. The first partner observes the height of the jump against the meter stick.
8. Hand out the worksheet. After students complete calculations, discuss the results. Consider extending the discussion with:
   - ★ Ordering (e.g., planet by mass or planet by height of jump)
   - ★ Averaging (ask students to record three jumps and calculate the mean height)
   - ★ Conversions between metric and customary length, centimeters and meters, etc.

Name

How High Can You Jump on Other Planets?

In the book *Luciana* by Erin Teagan, the main character learns that, to reach her dream of being the first kid on Mars, **she'll have to use her smarts and her determination to leap over obstacles in her path!**

Directions

1. Make a prediction of how high you could jump on other planets and dwarf planets based on each planet's gravity, which is determined by its mass.

Planet or Dwarf Planet	Mass (times 1023 kg)	Predict Height of Jump
Earth	59.8	
Venus	48.7	
Mercury	3.3	
Mars	6.42	
Pluto	0.129	

2. Follow the procedure explained by your teacher to measure the height you can jump on Earth. Then determine how high you could jump on other planets and dwarf planets by multiplying the height of your jump on Earth by the conversion factor.

Planet or Dwarf Planet	Height of Jump on Earth	x	Conversion Factor	=	Calculate Height of Jump
Earth		x	1	=	
Venus		x	1.10	=	
Mercury		x	2.65	=	
Mars		x	2.64	=	
Pluto		x	14.86	=	

3. Why is the height of your jump different on each planet? _____

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