

Gravity: Mass, Density and Size - Due Friday 4/12

The latest theory on how gravity and space works was put forward by Einstein and other scientists of his time. This theory views space as a kind of fabric or field. This field is affected or deformed by mass. Because gravity is a weak force, it takes extremely large masses to really affect the fabric of space. In this lab, we will be modeling this idea as well as looking at the concepts of volume, mass and density.

Essential Question: Does size (volume) or mass affect the gravitational force of an object?

In this activity, you will be finding the **density** of objects. The density is how much stuff there is in a given space. Work together in your group to do the math.

Step 1: Find the radius (r) of the sphere. (½ diameter)

Step 2: Calculate the volume of the object (cm³) (π = 3.14)

Step 3: Use the electronic scale to find the mass of the object.

Step 4: Calculate the density. Put in the data table.

$$V = \frac{4}{3} \pi r^3$$

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

mass in grams (g)
volume in centimeters cubed (cm³)
density in g/cm³

Setting up the Model

1. Place the blue material over the top of the bin.
2. Place the black band over the material around the edge of the bin.
3. Adjust the material so that it is not too tight or too loose.
4. Place the orange in the middle and take it off. The orange should sink into the material, but the material should bounce back when the orange is removed.
5. You may need to adjust the material during the investigation. Try to make sure it is about the same tension for each trial.

Lab procedure

6. Select an object.
7. Place it on the gravity space model.
8. Measure (cm) how far down the fabric moves. Record in data table.
9. Find the density of the sphere. (see above)
10. Repeat with a number of the objects.

Object	Radius (cm)	Volume (cm ³)	Mass (g)	Density (g/cm ³)	Movement (cm)
2.5 cm steel ball	1.25 cm	8.18	67.0	8.19	4.75
Golf ball	2.0	33.49	45.7	1.36	3.5
orange	2.5	65.41	78.8	5.47	5.0
Small marble	0.5	1.57	5.0	3.18	1.25
baseball	3.5	42.87	140.9	3.28	6.0
Ping pong ball	1.75	22.4	1.3	0.05	0.1

Analysis Questions

1. Which object had the most density?
2. Which object moved the material the most? Did this the object have the most volume or the most mass?
3. Which property of an object determines it gravitational force (mass or size/volume)?
Compare at least two of the objects as your evidence. Use the information from your data table.

4. HIGHLY PROFICIENT:

- a. Create a graph to support your answer to analysis question 3 above. Explain the results of your graph. You decide on the data to use.
- b. You must make the correct kind of graph to get credit for the HP. As always, please do your own work on the HP.

Gravity is an attractive force that is dependent on mass and distance

4 Highly Proficient	3 Proficient	2 Close to Proficient	1 Developing
<input type="checkbox"/> My graph uses the data to help support my findings in the lab. <input type="checkbox"/> The results of the graph are explained.	<input type="checkbox"/> The lab is complete and mostly correct. <input type="checkbox"/> Property that affects gravity is identified. <input type="checkbox"/> Evidence is used to explain answer #3.	<input type="checkbox"/> My answers need more detail. <input type="checkbox"/> Some information is incorrect. <input type="checkbox"/> My work is <u>incomplete</u> .	<input type="checkbox"/> Not attempted or mostly incomplete.