Name: _____ Date: _____ Period: _____ Page: _____

Student Exploration: Gravitational Force

Vocabulary:

Force - _____

_____

Gravity - _____

_____

Vector - _____

_____

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
On the night of a Full Moon, Mary decides to do an experiment with **gravity**. At midnight, she climbs into her backyard tree house, leans out the window, and holds an acorn as high as she can. She lets go and is disappointed to see the acorn plummet back down to Earth.

1. Why did the acorn fall to Earth instead of rising up to the Moon? _____

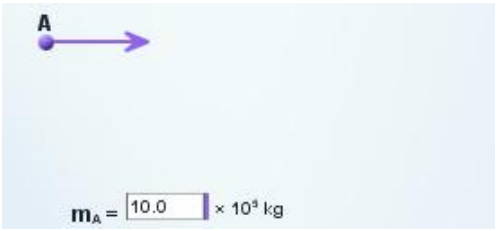
_____

2. Give a reason why we feel Earth's gravity more strongly than the Moon's gravity.

_____

_____

Gizmo Warm-up
From acorns to apples, gravity causes nearly any object to fall to Earth's surface. Gravity also causes the Moon to orbit Earth and Earth and the other planets to orbit the Sun. The *Gravitational Force* Gizmo™ allows you to explore the factors that influence the strength of gravitational force.

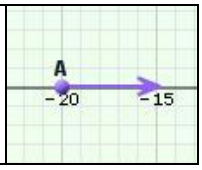


To begin, turn on the **Show force vector** checkboxes for objects A and B. The arrows coming from each object are **vectors** that represent gravitational **force**. **The length of each vector arrow indicates the magnitude (strength) of the force on each object.**

1. Move object **A** around. As object **A** is moved, what do you notice about the direction of the two force vectors? _____

2. How do the lengths of the two vectors compare? _____

3. Drag object **A** closer to object **B**. How does this change the gravitational force between the two objects? _____

Activity A: **Gravity and mass**	Get the Gizmo ready: • Turn on **Show vector notation** for each object. • Check that each object's mass ($\mathbf{m_A}$ and $\mathbf{m_B}$) is set to 10.0×10^5 kg.	

Question: How does mass affect the strength of gravitational force?

1. Form hypothesis: How do you think the masses of objects **A** and **B** will affect the strength of the gravitational force between them? _____

   _____

2. Predict: How do you think the gravitational force between two objects will change if the mass of each object is doubled? _____

3. Measure: Turn on **Show grid**. Place object **A** on the ***x*** axis at -20 and object **B** on the ***x*** axis at 20. The force on object **A** is now 0.0417**i** + 0**j** N. That means that the force is 0.0417 newtons in the *x* direction (east) and 0.0 newtons in the *y* direction (north).

   A. What is the magnitude of the force on object **A**? $|\mathbf{F_A}|$ = _____

   B. What is the magnitude of the force on object **B**? $|\mathbf{F_B}|$ = _____

4. Gather data: You can change the mass of each object by clicking in the text boxes. For each mass combination listed in the table below, write magnitude of the force on object A. **Leave the last column (Force Factor) of the table blank for now.**

m_A (kg)	m_B (kg)	$\|F_A\|$ (N)	Force factor
10.0×10^5 kg	10.0×10^5 kg		
10.0×10^5 kg	20.0×10^5 kg		
20.0×10^5 kg	20.0×10^5 kg		
20.0×10^5 kg	30.0×10^5 kg		

5. Calculate: To determine how much the force is multiplied, divide each force by the first value, 0.0417 N. Round each value the nearest whole number and record in the "Force factor" column.

Activity A (continued from previous page)

6. Analyze: How much does the force increase if each mass is doubled? _____

   _____

7. Apply: What would you expect the force to be if the mass of object **A** was 50.0×10^5 kg and the mass of object **B** was 40.0×10^5 kg? _____

   Check your answer with the Gizmo.

8. Draw conclusions: If the mass of one object is doubled, how much is the force multiplied?

   _____

   If both object's masses are doubled, how much is the force multiplied?

   _____

9. Summarize: Fill in the blank: The gravitational force between two objects is proportional to the _____ of the objects.

10. Apply: Suppose an elephant has a mass of 1,800 kg and a person has a mass of 75 kg. If the strength of gravitational force on the person was 735 N, what would be the gravitational force on the elephant? (Assume both the person and elephant are on Earth's surface.)

    Show your work:

$$\frac{75\ \text{kg}}{735\ \text{N}} = \frac{1800\ \text{kg}}{(x)\ \text{N}}$$

    Cross multiply and solve for the Newtons of force (x) N:

$$75\ \text{Kg} \times (x) = 1800\ \text{kg} \times 735\ \text{N}$$

$$(x) = \frac{1800\ \text{kg} \times 735\ \text{N}}{75\ \text{kg}}$$

$$(x) = \_\_\_\_\_\ \text{N}$$