

Name \_\_\_\_\_  
 Period \_\_\_\_\_

## Gravity, Mass, Weight And Inertia

### Matter is anything that has MASS & VOLUME

**BUT.....If it has MASS and it's on Earth( or any place else with gravity) ...it also has WEIGHT!**



Earth lots of mass= lots of gravity

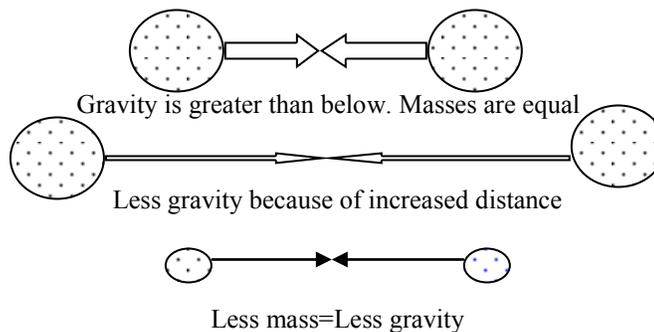
All Matter has **MASS**  
**GRAVITY** is the Force of attraction between objects due to their masses  
 THEREFORE, **ALL MATTER** experiences **GRAVITY**.



Humans have little mass= very little gravity

#### GRAVITY DEPENDS ON 2 THINGS

1. **MASS** of the objects
2. **DISTANCE** between them



### Weight

**A measure of the Force of Gravity**



Measured using a spring scale.

Units are **Newtons (N)** =Measure of **FORCE**

**1N= Force needed to accelerate 1Kg@1m/s<sup>2</sup>**

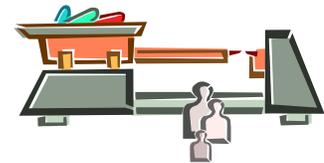
**Force = Mass X Acceleration due to Gravity (F=mg)**

Acceleration of gravity on earth = 9.8m/s/s

### MASS

**A measure of the Amount of Matter**

Measured with a triple Beam Balance



Units are \_\_\_\_\_

Mass of an object can only change if matter is added or taken away.

**Mass does not change with location in the universe!!!**

**Example: An object with a 10 kg mass will have what weight on earth?**

**ANSWER:**  
 Force(N)= Mass (kg) X Acc. Due to Gravity (m/s/s)  
 10kg X 9.8 m/s/s (earth)= 98N

**Weight will change with an objects location in the Universe.**

**For example:** A person on earth (9.8m/s/s) has a MASS of 75kg therefore his weight is \_\_\_\_\_

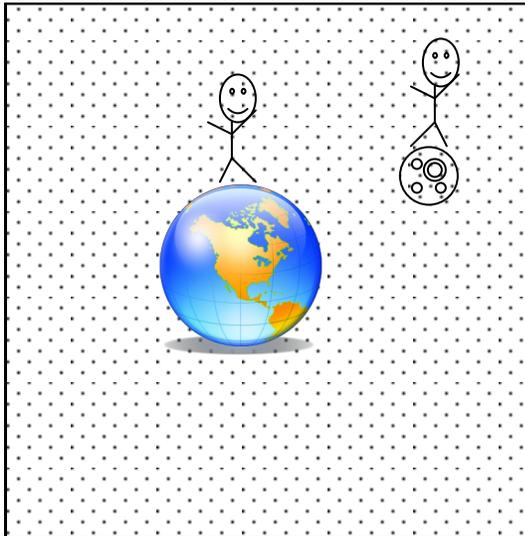
What will this person's *Mass* be on the moon? His weight? (What do you need to know?)

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## Weight and Mass

**Choose weight or mass. (W or M)**

- |   |  |
|---|--|
| 1) Measure of the amount of matter. _____       | 6) Depends on the acceleration due to gravity. _____ |
| 2) Measure of the force of gravity. _____       | 7) Units are Newtons. _____                          |
| 3) Measured with a spring scale. _____          | 8) Measured with a triple beam balance. _____        |
| 4) Units are grams. _____                       | 9) Measure of the amount of force. _____             |
| 5) Changes with location in the universe. _____ | 10) Inertia increases as _____ increases.            |



**Calculate the Stick Figure's weight on both earth and the moon.**

**Mass of stick figure on earth: 100kg**

**Acceleration due to gravity on Earth \_\_\_\_\_**  
 $F_N = \text{mass} \times \text{gravity}$

**Weight on earth \_\_\_\_\_**

**Acceleration due to gravity on moon: 1.62m/s/s**

**Mass On MOON \_\_\_\_\_**

**Weight on Moon \_\_\_\_\_**

**Using your NASA App, Click on a planet and scroll down the left side and look for the surface gravity of that planet. Should be the number with m/s<sup>2</sup>. Use the formula  $F_N = \text{mass} (\text{Kg}) * \text{gravity} (\text{m/s}^2)$  to calculate the weight of an 80Kg person on three planets.**

**Planet 1**  
 Planet \_\_\_\_\_

**Planet 2**  
 Planet \_\_\_\_\_

**Planet 3**  
 Planet \_\_\_\_\_

Surface Gravity \_\_\_\_\_

Surface Gravity \_\_\_\_\_

Surface Gravity \_\_\_\_\_

To get weight or Force in Newtons,  
 multiply 80Kg x surface gravity

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Weight<sub>(N)</sub> = \_\_\_\_\_

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Weight<sub>(N)</sub> = \_\_\_\_\_

**What is the mass of the object?**  
**Density 3.g/cm<sup>3</sup>**  
**Volume 3cm<sup>3</sup>**  
**Mass = \_\_\_\_\_**



**What if the object was on the surface of MARS? What would it's mass be? \_\_\_\_\_**

*REMEMBER:*  
**MASS IS THE SAME FOR ALL MATTER EVERYWHERE.**  
**WEIGHT CHANGES WITH LOCATION IN THE UNIVERSE**

## Inertia

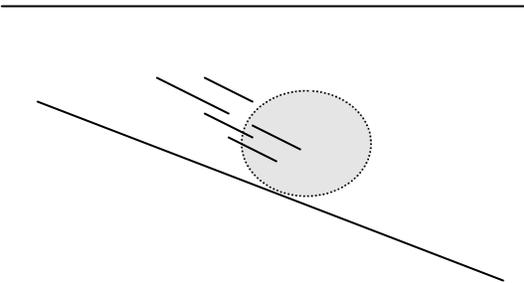
An object's *resistance* to changes in its state of motion.

- All Matter has Inertia.
- Inertia is dependent on *mass*!
- Greater the mass, the greater inertia.

An object in motion will remain in motions unless acted upon by an outside force.



An object at rest will remain at rest unless acted upon by an outside force.



**In order to overcome an objects inertia, whether it be moving or static (not moving), the force must be greater than the force of the object.**

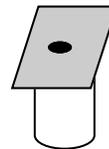
**Circle the object with a greater inertia.**

1. Baseball / Bowling ball
2. Empty grocery cart / full grocery cart
3. An egg / A paper towel tube
4. Dishes / tablecloth
5. A train / A Car

**AT HOME LAB**

**Materials:** Quarter, drinking glass and index card.

Set up:



**Problem: Can the card be moved without overcoming the inertia of the coin?**

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Physical Science  
Mass and Weight

Use the following formula to solve for weight:

$$\text{Weight (W)} = \text{Mass (m)} \times \text{gravity (g)}$$

$$W = mg$$

Mass is measured in kilograms (kg)

Gravity on earth is a constant:  $9.8 \text{ m/s}^2$

Weight is measured in Newton's ( $1 \text{ N} = 1 \text{ kg} \cdot \text{m/s}^2$ )

Answer the following questions – show **ALL WORK** and **UNITS**

1. Define Mass –

2. Define Weight –

3. Describe what will happen (if anything) to mass and weight when you go to the moon.

a. Why would this happen?

4. Find the weight of a 60 kg astronaut on earth

a. Find the weight of the same object on a planet where the gravitational attraction has been reduced to 1/10 of the earth's pull. Show all work.

5. A backpack weighs 8.2 newtons and has a mass of 5 kg on the moon. What is the strength of gravity on the moon? (Be careful with units, remember  $1\text{N} = 1\text{ kg} \cdot \text{m/s}^2$ )
6. A physical science test book has a mass of 2.2 kg
- What is the weight on the Earth?
  - What is the weight on Mars ( $g = 3.7\text{ m/s}^2$ )
  - If the textbook weighs 19.6 newtons on Venus, What is the strength of gravity on Venus?
7. Of all the planets in our solar system, Jupiter has the greatest gravitational strength.
- If a 0.5 kg pair of running shoes would weigh 11.55 newtons on Jupiter, what is the strength of gravity there?
  - If the same pair of shoes weighs 0.3 newtons on Pluto, what is the strength of gravity on Pluto?
  - What does the pair of shoes weigh on earth?