



5.1 Mass vs. Weight

READ



What is the difference between mass and weight?

mass	weight
<ul style="list-style-type: none"> • Mass is a measure of the amount of matter in an object. Mass is not related to gravity. • The mass of an object does not change when it is moved from one place to another. • Mass is commonly measured in grams or kilograms. 	<ul style="list-style-type: none"> • Weight is a measure of the gravitational force between two objects. • The weight of an object does change when the amount of gravitational force changes, as when an object is moved from Earth to the moon. • Weight is commonly measured in newtons or pounds.

Weightlessness: When a diver dives off of a 10-meter diving board, she is in free-fall. If she jumped off the board with a scale attached to her feet, the scale would read zero even though she is under the influence of gravity. She is “weightless” because her feet have nothing to push against. Similarly, astronauts and everything inside a space shuttle seem to be weightless because they are in constant free fall. The space shuttle moves at high speed, therefore its constant fall toward Earth results in an orbit around the planet.

EXAMPLE

- On Earth’s surface, the force of gravity acting on one kilogram is 2.2 pounds. So, if an object has a mass of 2.0 kilograms, the force of gravity acting on that mass *on Earth* will be:

$$2.0 \text{ kg} \times \frac{0.37 \text{ pounds}}{\text{kg}} = 4.4 \text{ pounds}$$

- On the moon’s surface, the force of gravity is about 0.37 pounds per kilogram. The same object, if it were carried to the moon, would have a mass of 2.0 kilograms, but its weight would be just 0.74 pounds.

$$2.0 \text{ kg} \times \frac{0.37 \text{ pounds}}{\text{kg}} = 0.74 \text{ pounds}$$

PRACTICE

1. What is the weight (in pounds) of a 7.0-kilogram bowling ball on Earth’s surface?
2. What is the weight (in pounds) of a 7.0-kilogram bowling ball on the surface of the moon?
3. What is the mass of a 7.0-kilogram bowling ball on the surface of the moon?
4. Would a balance function correctly on the moon? Why or why not?

Challenge Question

5. Take a bathroom scale into an elevator. Step on the scale.
 - a. What happens to the reading on the scale as the elevator begins to move upward? to move downward?
 - b. What happens to the reading on the scale when the elevator stops moving?
 - c. Why does your weight appear to change, even though you never left Earth’s gravity?