Thinking About Mass and Weight

Weight measures the **force** of gravity between an object and the Earth.

Weight depends on $\frac{\text{mass of object X mass of Earth (or other planet)}}{(\text{distance between centers of Earth and object})^2}$

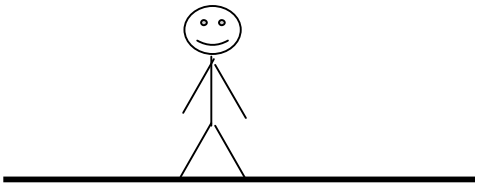
Mass is measured with a balance. Weight is measured with a scale (puts the object on a spring and lets the Earth pull on it).

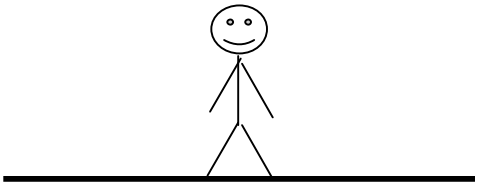
1. If we could beam you Star-Trek style to the top of Mt. Everest, what would happen to your mass? What would happen to your weight?

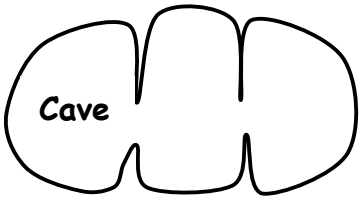
2. Now we beam you to Death Valley. Does mass change? weight?

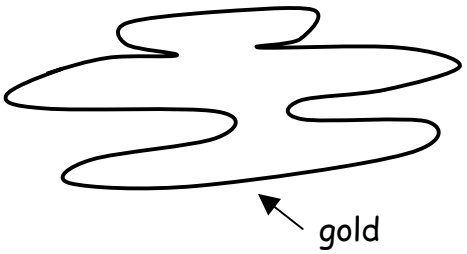
One more level of sophistication: it's not just the total mass of the Earth that counts, it's every single particle of the Earth pulling on every single particle of you. Since some pieces of the Earth are denser than others, they pull more strongly on objects at the surface.

3. Here are pictures of two identical geologists standing on the Earth's surface – identical twins with identical mass. Under one geologist there's a giant cave. Under the other one, there's a big deposit of gold. Who weighs more?









Thinking About Weight

Your weight depends on $\frac{\text{Your mass X mass of Earth (or other planet)}}{(\text{distance between centers of Earth and object})^2}$

1. Which do you think matters more in determining your weight: your mass, or the distance between your center and the center of the Earth? Explain your thinking.

2. How could you increase your mass?

   What part of the ratio changes, the top or the bottom?

   What happens to your weight?

3. Supposing an asteroid made of lead hit the Earth and buried itself (no big explosion, no bits blown out into space).

   What part of the ratio changes, the top or the bottom?

   What happens to your weight?

4. Supposing I could push a button and turn the whole Earth into marshmallow – same size, but made of marshmallow.

   What part of the ratio changes, the top or the bottom?

   What happens to your weight?