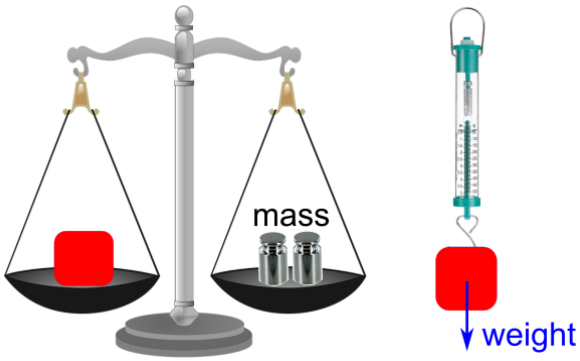
Force of Gravity: Mass vs Weight

- The **mass** of an object measures how much material is in it. It is measured by comparing to standard masses (grams, kilograms.
- The **weight** of an object measures the force of **gravity** pulling down on it. It is measured with a scale that often involves stretching or compressing a spring.



1. We can use a **spring** to measure how strong a force is. Try having two students grab opposite ends of a spring and pull it out (slightly!). What happens to the spring as you pull harder?

If we pull harder, the spring stretches: more / less / the same

Pulling the spring even longer requires: more force / less force / same force

An **elastic** object is one that stretches more the more it is pulled.

Discuss:
When you were pulling on the spring, did you also feel the spring pulling on you? Which of Newton's Laws does this illustrate?

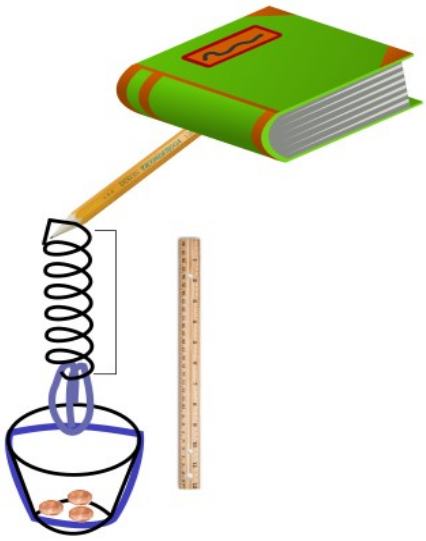
(Law 1) inertia
(Law 2) more mass is harder to accelerate
(Law 3) action-reaction

We will make a spring scale to see how the force of gravity depends on mass.

2. First, use the balance scale to find the mass of 2 pennies, by balancing them against standard masses. Move the slider to add masses below 5g.

Mass of 2 pennies = _____ g

3. Use heavy books to balance a pencil with the tip off the edge of the desk.
4. Hang a spring from the dangling end of the pencil.
5. Put a rubber band vertically around a cup and fold another rubber band around it to make a handle. Hang the cup off the lower end of the spring.
6. Measure the length of your spring. This is the **resting length**.



Resting length of spring = _____ cm

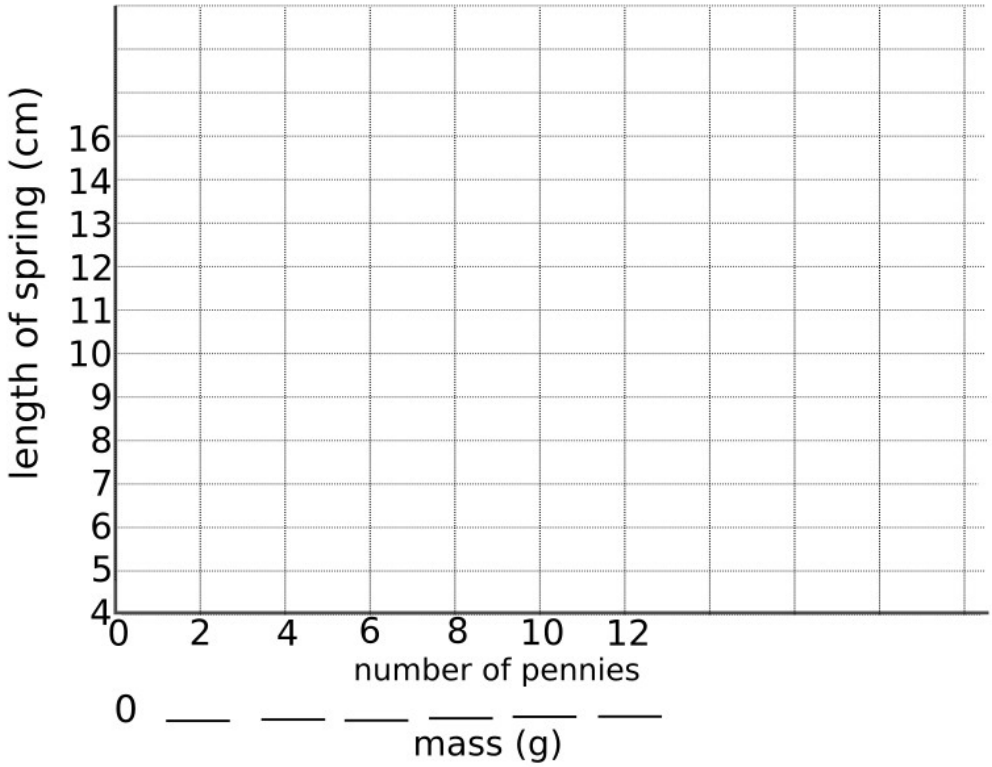
7. Add 2 pennies to the cup and measure the new length of the spring.

Spring length with 2 pennies = _____ cm

Plot your answers in the graph below.

8. Now put 4 pennies in the cup. Again measure the length of the spring and make a dot on the graph. Write in the mass of the 4 pennies underneath (you can multiply, or use the balance scale again).

9. Continue to measure for 6, 8, and 10 pennies. Connect the dots on the graph with straight lines.



When more mass was in the cup, the spring stretched: more / less / same

When the cup had more mass the force of gravity pulling it down was:
bigger / smaller / same

10) Make a prediction:

What will be the length of the spring when a 50g mass is put into the cup? Extend the line on your graph to make the estimate.

_____ cm

Test your prediction. Were you right?

11) Use your spring scale and your graph to estimate the mass of the metal fishing weight.

Spring length: _____ cm
Estimated mass: _____ g

Check your mass estimate with the balance scale. Were you right?

Discuss:
How does **weight** (force of gravity) depend on **mass** (amount of material)?

Imagine performing this whole activity on the moon, where the force of gravity is smaller. What would be different?

- When you use the balance scale to find the mass of the pennies, would you get a different number of grams?
- When you hang the pennies on the spring, would the force pulling down on the spring change? Would the spring stretch to a different length?