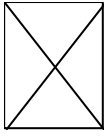Center of Gravity (CG): The point at which the weight of the object acts. This is the 'balance' point of an object, where ½ of the weight is to one side and ½ to the other.
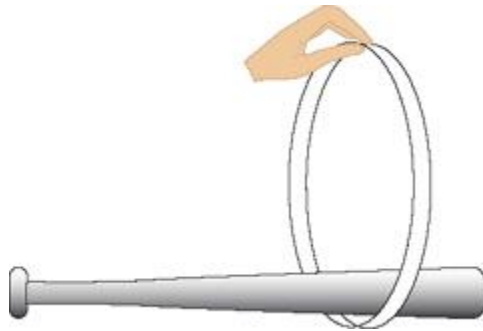
Scientists, try the exploration below:

EXPLORATION: Finding the Center of Gravity of a Baseball Bat
Materials:
Baseball bat
Ribbon (about ½ inch wide)

1. Form a loop with the ribbon, large enough for the bat to pass through, like this:

2. Loop the ribbon around the bat and find the location where the bat will balance so that it rests horizontally. That's the baseball bat's "Center of Gravity" (CG).

Geometric Center: ½ the length of the bat
Is this where the bat balances?
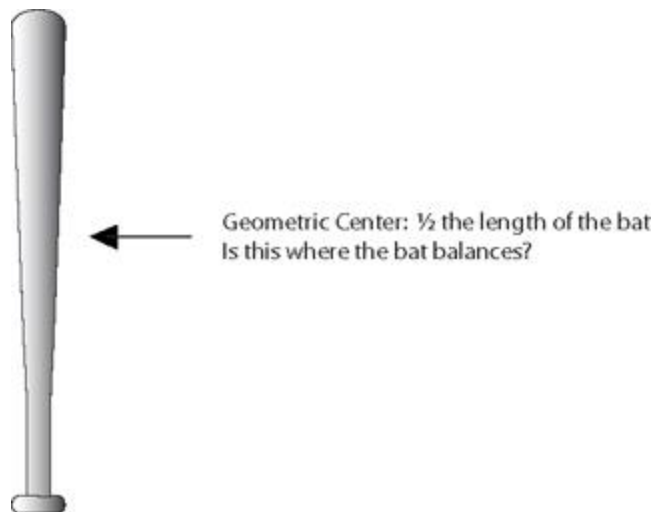
3. Questions to ask yourself:

a) Is it located at the geometric center?
b) Why do you think the Center of Gravity (the balance point) is located where it is?

On a water rocket, this point is not easy to determine since we can't turn the rocket on its side while it's loaded with water. (***Do you know why?***)

There are a couple of ways to estimate the location:

A. Calculation

1. Find the center of gravity of the empty bottle (with nosecone, fins, etc.) using the method explained above. Measure the distance from the bottom of the rocket to the balance point: $= Y_1$.

2. Weigh the empty bottle: $= W_1$

3. Fill the bottle with water to the level you wish to use. You must know the weight of the water added. (You can find this after you fill by re-weighing the bottle and water. The weight above the weight you found in Step 2 will be the water weight.): $= W_2$.

4. Find ½ the height of the water (don't count the nozzle) and measure from the ground up to that point. Set: $= Y_2$.

5. Use this equation:
$$CG = \frac{(W_1 \times Y_1) + (W_2 \times Y_2)}{(W_1 + W_2)}$$
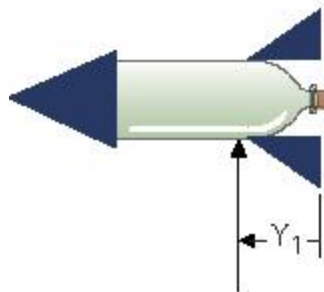
Center of Gravity
for an empty rocket
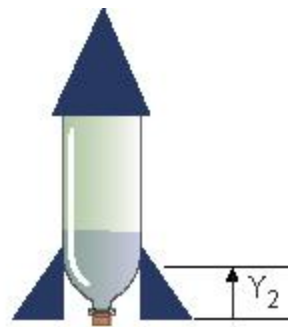
Find 1/2 the height of the
water (do not count the nozzle)
and measure from the ground
up to that point

B. Empirical:
The other way to determine the center of gravity requires a fairly tall freezer section. Fill your fully prepared rocket with water to the correct level and place it in the freezer in the launch position. When frozen, remove the rocket and find the balance point. That will be your center of gravity.

Interesting fact: Juggling pins (like bowling pins) are heavier on one end so that when they are spun in the air they rotate around their off-center balance point (CG).