

## Easy and Cheap Metric Balance

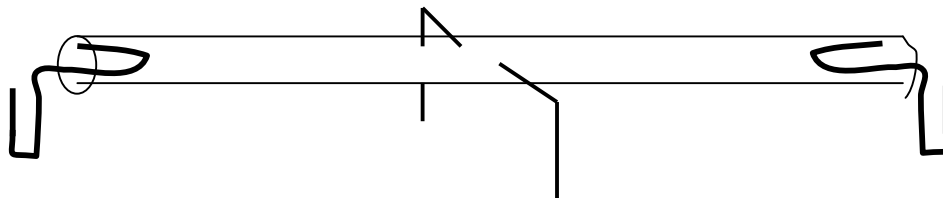
(This activity is based on TOPS "Build a Straw Balance" and some good ideas from the Exploratorium's Math Explorer Activity Development team.)

### Materials:

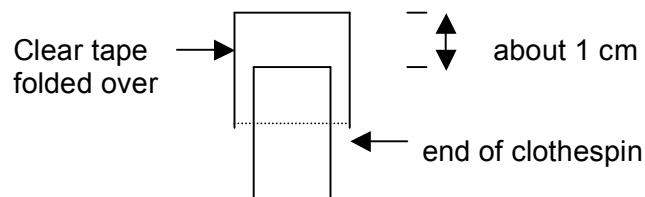
- 1 empty soda can
- 1 wooden clothespin
- 1 plastic straw
- 1 pushpin
- 3 small paper clips
- 2 cups
- Scissors
- Tape
- String
- Metric ruler
- Many small objects of a known mass:
  - ACCO brand paper clips, size 1, mass .5 g each
  - Skittles candies mass about 1.1 g each

### To Build:

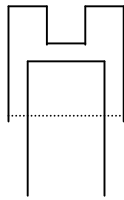
1. Use the ruler to find the center of the straw, and push the pushpin straight through it. Remove the pushpin.
2. Un-bend one paper clip, and "thread" it through the center holes in the straw. This will be the pivot for the balance.



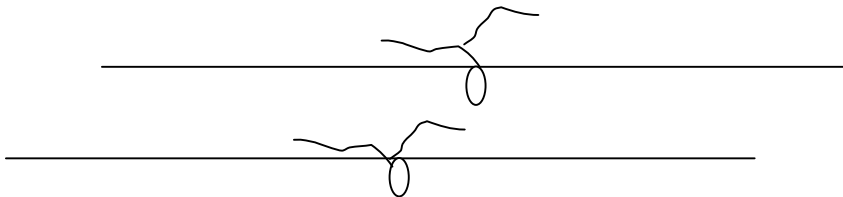
3. Un-bend the two other paper clips into L shapes.
4. Push the larger end of each L into the each end of the straw. Make sure the smaller ends point the same direction (which will be down when the balance is complete).
5. Bend two paper clips into "L shapes" and insert the end of the "L" into each open end of the straw. You now have hooks from which weight will be hung.
6. Fold a piece of tape over each of the ends of the clothespin. Each piece should stick out about 1 cm.



- Cut a notch into each of the tape “tags”, creating a narrow channel for the fulcrum of the balance.



- Adjust the pull tab on the soda can so that it sticks straight up.
- Clamp the clothespin onto the pull-tab of the soda can.
- Cut two pieces of string, each about 20 cm long.
- Tie the middle of each string around a pencil with a square or granny knot.
- Slide the string off the pencil, so you have two strings -each with a little loop near the center.



- Stretch each string across the opening of a cup and tape it near the rim. Keep the loop in the center, and let each end hang loose.
- Pull up the loose ends of string and tape them again. Trim off excess string.
- Place the ends of the paper clip that is threaded through the straw onto the clothespin fulcrum.
- Hang each cup on the balance by hooking the loops of string onto the ends of the paper clips.
- Adjust the paper clips on the ends of the straw to make the straw level (pull out or push in).



**To Do and Notice:**

Use your objects of known mass to find the masses of other small objects. Estimate and then find the mass of a variety of objects. You can check the accuracy of this balance with a triple beam balance or an electronic balance.

### What's Going On?

If your balance should become “unbalanced”, it can be adjusted again by pushing or pulling the paper clip hooks on the ends of the straw. When the straw is level, and the balance is “balanced”, the “force x distance” on one side of the pivot (or balance point) equals the “force x distance” on the other side of the pivot. If the balance becomes unbalanced, we can adjust it by increasing or decreasing the “distance” by pulling the paper clip hook further out or by pushing the paper clip hook further into the straw.

