

Rubber Band newton Scale

It's not a mistake! -- it really *is* newton, not Newton

When you weigh something with a spring scale, you are really measuring the force of gravity on the object. In the metric, or SI System, of units (see discussion in the What's Going On section below), force is measured in newtons (with a small n). The abbreviation for newton is N. One newton is **roughly** equal to 1/4 pound in our everyday measuring system -- a McDonald's "Quarter Pounder" could therefore reasonably be called a "One newtoner!"

Materials

- cardboard or mat board, approximate 3 in wide x 11 - 12 in long
- rubber band -- #33 works well, but any rubber band that will work is OK
- 3 or 4 jumbo paper clips
- brass fasteners -- 1 in or 1½ in
- large nail (or anything that will poke a hole in the cardboard)
- marker pen (pencil or ordinary pen will do if marker pen not available)
- needle nose pliers (optional, but good to have -- see comments in Assembly section below)
- balance that will weigh to nearest whole gram (Harbor Freight is a good source for inexpensive small digital balances)
- 3 plastic water bottles -- 2 may be either 250 mL or 500 mL; the third must be 500 mL
- calibration weights: -- 500 mL or 250 mL plastic water bottles can be filled with the appropriate amount of water to make a set of calibration weights. A mass of 100 grams weighs approximately 1 N here on earth (see What's Going On section below for background discussion). Fill a water bottle until the combined mass of the bottle plus cap plus water is 100 g. A brass cup hook screwed into the lid allows the bottle to be conveniently hung. Similarly create a 200 g and a 300 g bottle. You now have calibration weights of 1, 2 and 3 N.

Assembly

Use the appropriate materials listed to make the scale shown in the two photos to the right.

NOTE -- The needle nose pliers are used to bend the paper clips. If they are not available you can eliminate the "indicator" bend on the paper clip hanging from the bottom of the rubber band, and you can eliminate the long straight hanger with its two "hooks" entirely. Just hang things directly from paper clip at the bottom of the rubber band and use the top or bottom of the paper clip as an "index." Also, see the comments in the To Do and Notice section below about hanging things, particularly the one about the second "hook," which can be bent by hand without the need for needle nose pliers.

Use calibration weights to calibrate the scale from 0 to 3N. Be aware that the rubber band may not be "linear" in its stretch -- that is, the calibration marks may not be evenly spaced. Label the calibration marks with their values.

(If you want to recalibrate at some point, just cover the original marks with masking tape, and write the new values on the masking tape.)

To Do and Notice

Weigh several different objects with the calibrated scale. Some examples of common items that might be weighed are a D-cell battery, an apple, a coffee cup, etc.

If the object cannot be hung conveniently, try sticking a masking tape loop to the object or wrapping a rubber band tightly around it and inserting one of the hooks under the tight rubber band.

A second "hook" such as the one shown at the right may be helpful in hanging various objects. It can be hung directly from the "indicator" paper clip or from the lower hook on the straight extension hook. As noted in the Assembly section above, this hook can be bent by hand without the need for needle nose pliers.

Weighing a variety of objects will hopefully help give a sense for the newton (N) as a unit of force.

Notes, Comments and Tips

Rubber bands have a limited useful lifetime. Your calibration marks may change somewhat with repeated stretching, or if the rubber band is overstretched. Over longer periods of time the rubber band will likely degrade and break, even if not used. You can use other rubber bands that are shorter, longer, lighter, heavier, etc. (e.g., if you want to measure larger weights, use a heavier rubber band -- or use two rubber bands side by side). The balance will have to be recalibrated if the rubber band is changed.

Rubber Band Scale.....4/27/15

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