# Clinometer Use

**Accompanying classroom worksheet:** W-E-01

**Background:** A clinometer is a tool used for measuring angles of a slope, and can also be used to calculate the height of taller objects such as trees or buildings. This module will teach you how to make two simple clinometers with classroom materials.

## Construction

(Reference http://www.wikihow.com/Make-a-Clinometer for further instructions or clarification)

**Clinometer Type 1 ("Fixed Angle Clinometer"):** This clinometer can only be used for measuring height. If you wish to be able to measure slope as well, you will need to construct the Clinometer Type 2 below.

**Materials:** plastic soda straw, paper, string, washer or paperclip, tape

**Instructions:** (see image on next page for a picture of a completed clinometer)

1. Cut the paper into a square with a diagonal slightly shorter than the length of the straw.
2. Fold the square sheet of paper in half along the diagonal so that it forms an isosceles right triangle. Crease the fold and tape along the legs of the triangle to secure any openings.
3. Tape the straw along the hypotenuse of the paper, ensuring that both ends of the straw stick out slightly past the paper.
4. Poke a small hole in the upper corner of the clinometer, just below where the hypotenuse meets the leg. Run the string through the hole, and tie a knot or tape the end of the string so that it does not fall through. The string should optimally hang a few inches below the paper.
5. Tie the paperclip or washer to the hanging end of the string. If it doesn't appear to be heavy enough to swing freely, wrap a few loops of tape around the paperclip to add weight. Or, of course, you can always add more paperclips.
6. The clinometer is now ready for use!

**Clinometer Type 2:** This clinometer is very similar to the previous, but uses a protractor so that a variety of angles can be measured instead of just $45^{o}$.

**Materials:**

___ plastic soda straw

___ protractor (the flimsy clear plastic kinds will do just fine)

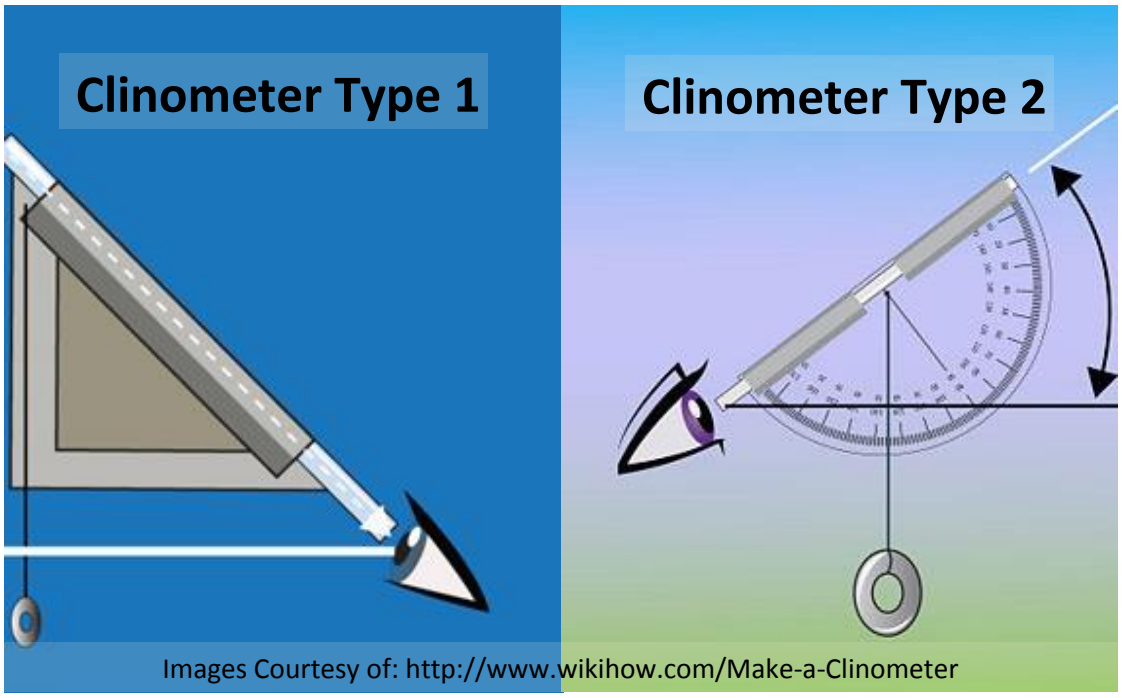
___ string

___ washer or paperclip

___ tape

**Instructions**:

1. Run a string through the hole in the center of the protractor. If your protractor does not have a hole, bore one in the middle of the zero line along the straight edge with a pair of scissors or hole-punch. Tie a knot in the string or tape down one end so that it does not slip through the hole. Extended, the string should hang a couple of inches below the edge of the protractor.
2. Tape the straw to the straight protractor so that the bottom edge aligns with the zero line. Cut the ends of the straw so about half an inch extends from either side of the protractor.
3. Tie the paperclip or washer to the hanging end of the string. If it doesn't appear to be heavy enough to swing freely, wrap a few loops of tape around the paperclip to add weight. Or, of course, you can always add more paperclips.
4. The clinometer is now ready for use!



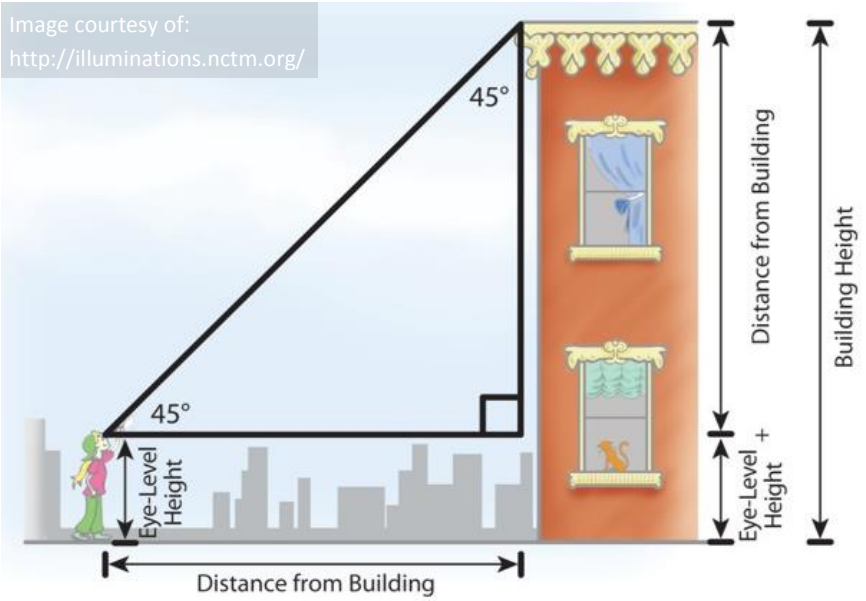

Images Courtesy of: http://www.wikihow.com/Make-a-Clinometer

**Using Your Clinometers**

**Measuring Height**

Measuring heights of large objects using a clinometer relies on the fact that a $45^{o}$ right triangle is isosceles and as such has equal legs. Thus, you no longer have to have to measure the height of something by going to the top, but merely have to measure a distance along the ground and perform a few simple additions.

To begin, measure your own height up to your eyes. This gives you "eye-level height." Look through the straw of the clinometer, and find the top of the object. Holding the clinometer steady, remove your eye and look at the angle of the descending string. Your goal is to find a location on the ground where the string forms a $45^{o}$ angle (or lines up with the edge of your paper) when you look through the straw at the top of the object. At this location, the height of the object equals the viewing height plus your current distance from the base of the object. See figure below for a visual representation.




**Measuring Slope**

For this you will need two yardsticks, or else group students into pairs of approximately equal height. To measure slope, student A will kneel at the bottom of the slope so that his eye level is equal to the yardstick. He will then look through the clinometer to the top of the yardstick held by student B at the top of the slope (alternatively, if the students are of reasonably equal height, student A can simply look through the clinometer at the face of student B). Student A will record the angle the clinometer indicates.

**Note: If Student A is looking up the slope at student B, the angle of the slope will be equal to the **complement** (ie 90-angle) of the angle indicated by the clinometer. If you wish to create a slightly easier activity, having student A located at the top of the slope looking down onto student B will produce the correct slope on the clinometer, and will eliminate the need for the extra step of calculating complements.

**Note: Converting degrees to percent grade is beyond the scope of this module, but if you wish to incorporate these calculations, information and instructions can be found at:

ftp://ftp.fao.org/fi/cdrom/fao_training/FAO_Training/General/x6707e/x6707e04.htm#90a