Kit: $2.00

RAFT IDEAS

Topics: Angles, Similar Triangles, Trigonometry, and Measurement

Materials List

- ✓ CD case, media tray removed
- ✓ Straw
- ✓ 3 Paperclips, smooth finish, #1 size
- ✓ Thread
- ✓ Paper or index card
- ✓ Tape
- ✓ Graph paper
- ✓ Blackline master of inclinometer scale (see page 3)

This activity can be used to teach:
CO Math Standard 4: Shape, Dimension and Geometric Relationships

- Use measurement of sides and angles to solve problems

21st Century Skills

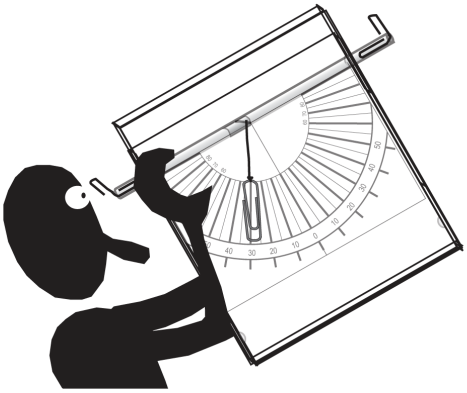
- Critical Thinking and Reasoning
- Invention

Grades: 3, 4, 6, 7, 8, HS

raft resource area for teaching
2875 Blake Street • Denver, CO 80205

Dangle Angle

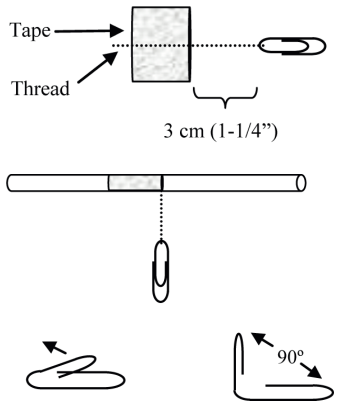
An inclinometer, for measuring unreachable heights and more!

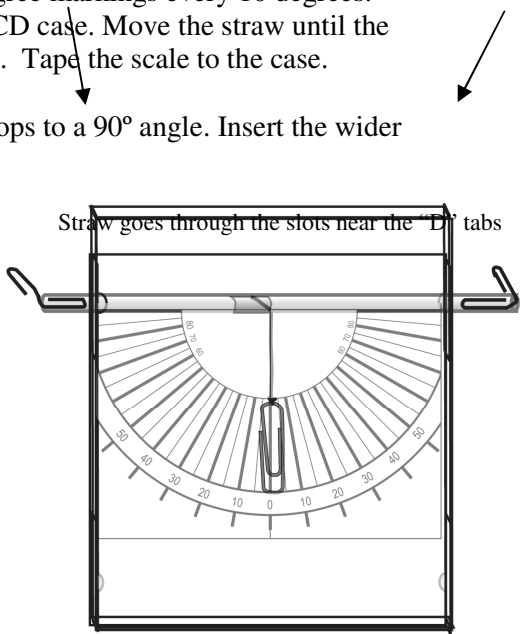


This easily made sighting device can measure the angles of lines of sight.

Assembly

1. Cut an 8 cm (3") piece of fine thread.
2. Tie one end of the thread to the narrower end of a paperclip.
3. Cut a 3 cm (1-1/4") section of tape. Touch the tape to the thread so the edge of the tape is at a point 3 cm (1-1/4") away from the knot on the paperclip.
4. Wrap the tape around the straw, as shown, so that the thread will hang from the straw's middle.
5. Pinch the end of the straw, and, starting from the inside of the CD case cover; insert it into one of the 4 slots in the cover located under the "D" shaped tabs. Insert the other end of the straw into the slot on the opposite side of the cover.
6. Copy the blackline master, located at the end of this activity, and cut out a scale.
7. If not using the blackline master, draw a protractor scale with 0º at the vertical, and 90º at the horizontal on a 12 cm x 9 cm (4-3/4" x 3-1/2") piece of paper or index card. Label other degree markings every 10 degrees.
8. Insert the paper scale under the straw in the CD case. Move the straw until the thread/straw junction is centered on the scale. Tape the scale to the case.
9. Close the CD case.
10. Take 2 paperclips and bend up the narrow loops to a 90º angle. Insert the wider loops into the ends of the straw. Adjust so the narrower paperclip loops are at 90º to the CD case and are in line on the same side of the straw.

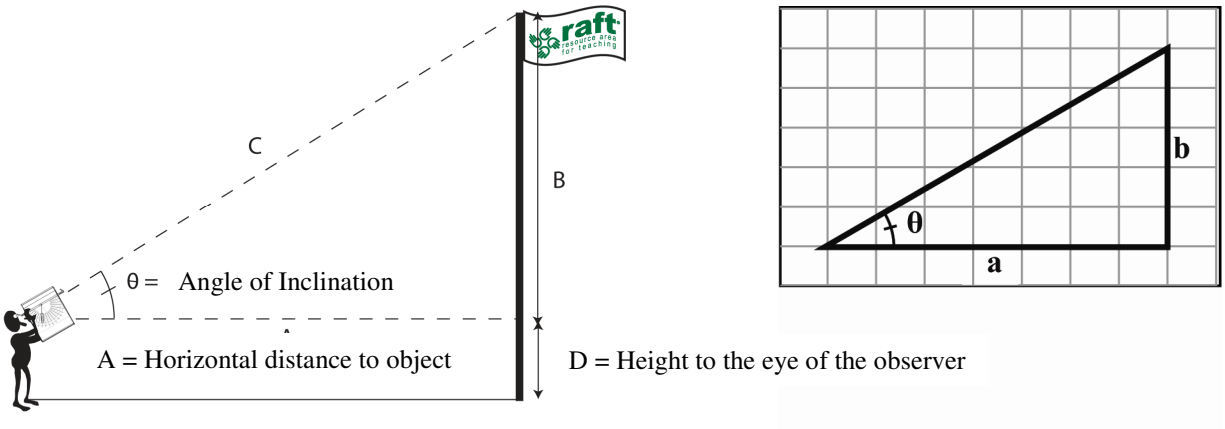




Developed and written by Michael Pollock (RAFT) and Jay Gluckman (RAFT)
Illustrations by Jay Gluckman (RAFT)

To Do and Notice

1. Place the inclinometer on a variety of slanted or sloped surfaces (hand rail, ramp) and practice taking degree measurements.
2. Choose a tall object such as a building, tree, or flagpole. Locate an observation point where the object's top can be seen and which is level with the bottom of the object to be measured (or is a known distance above or below the bottom of the object).
3. Measure the horizontal distance from the object to the selected observation spot.
4. Hold the inclinometer vertical, look through the two paperclips, and tilt the inclinometer upward until the top of the object can be seen through the two paperclips. **Do not place the near paperclip too close to the eye!**
5. Record the angle indicated on the inclinometer. Having a 2nd person take the reading would be helpful.
6. When the top of a tall object is observed through the inclinometer, the inclinometer will indicate the angle from the horizon to the top of the object.



7. Use similar triangles to calculate the distance from the observer's eye to the top of the object.
   Similar Triangles Method: Draw a right triangle with the same measured angle on graph paper. For easier calculations make the base of the right triangle to be some multiple of 10. The ratio of b/a and B/A will be the same on both the small triangle on paper and the observational triangle. The height (B) of the object can be found by multiplying the horizontal distance (A) to the object by the ratio b/a (B = A x (b/a)).
   {Teacher Note: Advanced students can also use trigonometry for the distance calculation. For a right triangle, the tangent of the angle will equal the length of the opposite side divided by the adjacent side (Tan (θ) = B/A). To calculate the opposite side of the triangle (B), multiply the horizontal distance (A) by the tangent of the angle of inclination (B = A x Tan[θ]).
8. To the calculated height of the object add the distance from the ground to the eye of the observer (D).

The Content Behind the Activity

Clinometers have applications in many professional fields, including land surveying and forestry, where they are used to estimate the height of trees and measure the slope of mountains. Clinometers are related to early instruments of naval navigation such as the astrolabe, which originated over 2000 years ago, and the sextant, which was invented in the 18th century. These instruments were used for mapmaking, to locate and predict the positions of celestial objects, and to determine the local time based on the local longitude (or vice-versa).

Web Resources (Visit www.raft.net/more for how-to videos and more ideas!)
Using similar triangles to find heights - http://mathforum.org/~sanders/connectinggeometry/ch_09Similar.html

Dangle Angle Scales - Black line