SECTION 3: BUILD A CLINOMETER

Foundational Objectives:

To develop an understanding of the primary trigonometric ratios and their applications (10 05 03).

Specific Objectives:

Apply the trigonometric ratios to problems involving right triangles.

*Students will construct an angle-measuring device called a *clinometer*, and will use it to measure the *Angle of Elevation* of several inaccessible objects outside of the school. They will then use trig ratios to determine the heights of these objects.

Background:

Knowledge of right triangles and the three primary trigonometic ratios. (This activity only uses Tangent).

Time:

This activity takes 1 hour to set up and explain; 1/2 hour to complete measurements and 1/2 hour to do the calculations and analysis.

Classroom Management Tips:

Because of the freedom allowed to the students in this activity, it is very important that students are absolutely clear as to what is expected of them. Clearly explain where they can go, what they do, and when to be back.

Instructional Strategies:

A. Direct Instruction
B. Interactive Instruction
C. Experiential Learning

Instructional Methods and Activities:

A. 1. Structured Overview
Student should practise "Angle of Elevation" problems. Begin with a discussion of how the students could use trigonometry to determine the measure of an inaccessible object. (See "Angle of Evaluation" Problems).

A. 2. Demonstrate use and construction of Clinometer (See instructions and pattern)

B 1. Laboratory Groups
In groups of 2 or 4, have students assemble Clinometer and prepare data-collection sheet. (See "Jobs to be Done" and "Data Collection Sheet").

B. 2. Clearly outline to students before they leave the classroom:
a) how many items they are to measure (recommendation: 5).
b) how results are to be recorded; what is to be handed in; when work is due.

C. 1. Field Trip:
Outline areas students may go. Suggestions: outside, anywhere on school grounds, within 1 block of school, etc. [in bad weather: gym, cafeteria, hallways, just outside the door]. **BE VERY SPECIFIC!**

C. 2. Outline time allowed. (Suggestion: 1/2 hour and they must be in their seats or take a zero on the project.) **BE VERY SPECIFIC!**

C. 3. After collecting the data, students will need about 20 minutes to complete diagrams, calculations and summary statements. *Be clear whether group or individual results are to be turned in.

Equipment:

(A) Clinometer:
- piece of cardboard or stiff paper, approximately 25 cm x 30 cm.
- photocopy of enlarged protractor 0 - 90°
- straw
- tape
- scissors
- thread
- button

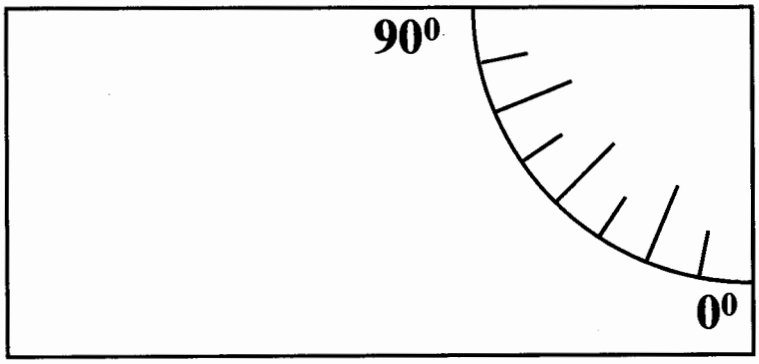
(B) Measurement Device for baseline:
- Trundle Wheel or
- Meter sticks or tape or
- Students can pace off the distance and measure a "typical pacing step" after returning to the classroom.

(C) Data Sheet: can be hand-drawn by student or photocopied.

(D) Calculator

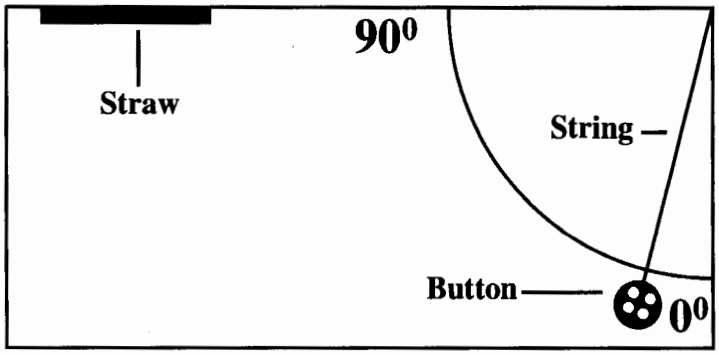
Instructions for Clinometer:

1. Cut out the photocopy of the protractor carefully along to 0° and the 90° lines.
2. Glue the protractor into the upper right corner of the cardboard so that the edges match.

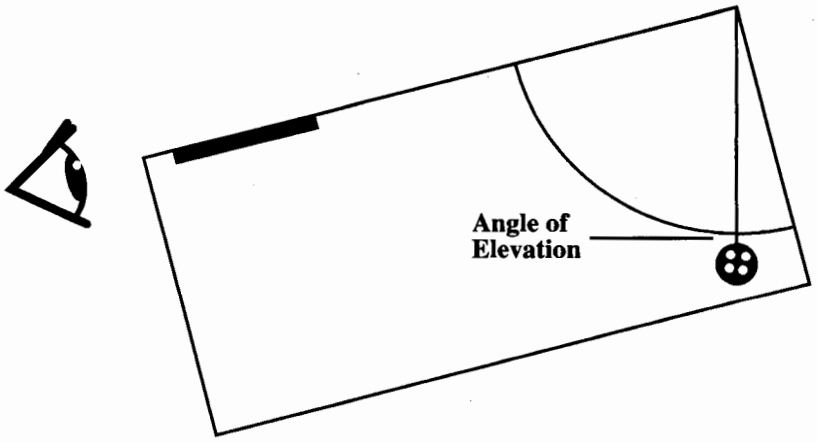


3. Attach the string as close as possible to the upper right corner of the cardboard and attach the button so that it swings freely below the numbers.

4. Tape a 5 - 10 cm piece of straw in the upper left corner so that it sights along the 90° line.



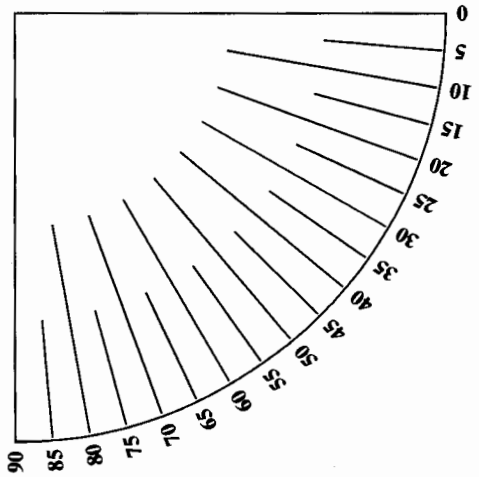
5. To use clinometer: Look through the straw at the object. Have partner read the angle of elevation shown by the string.



Instructions for Groups:

See Clinometer: Jobs to be Done

Note: These four jobs can be done by four people *or* by *two* people.



Data Chart:

Students can design their own, or this can be developed together on the board and copied by students or it can be photocopied.

ANGLE OF ELEVATION PROBLEMS

1. To measure the height of an inaccessible TV tower, a surveyor paces out a base line of 200m and measures the angle of elevation to the top of the tower to be 62° . How high is the tower?

2. A tourist stands 15m back from the base of a statue and looks up to the top of the statue. If the angle of evaluation is 48°, find the height of the statue.

3. A student paces a base line 12m from the bottom of flagpole. She then uses a clinometer to measure a 35° Angle of Elevation. How high is the flagpole? (The distance from the ground to the student's eyes is 150 cm).

CLINOMETER: JOBS TO BE DONE

1. **PACER**: for each object to be measured, this person must pace off the distance from the object to the **SIGHTER**. This must be done in a straight line. The **PACER** must then tell the **RECORDER** how many paces it took.
2. **SIGHTER:** this person is in charge of the Clinometer. For each measurement, the **SIGHTER** sights the top of the object and remains still while the **ANGLE READER** has read the angle. He/she should also remain still until the **PACER** has measured the base line.
3. **ANGLE READER:** when the **SIGHTER** has sighted the top of the object, this person reads the size of the **ANGLE OF ELEVATION** shown on the Clinometer and approximates it to the nearest degree. The **ANGLE READER** then tells the **RECORDER** the value of the angle.
4. **RECORDER:** this person will record on the chart the **ANGLE OF ELEVATION,** the number of paces in the base line and the distance from the sighter's eyes to the ground.

PROCEDURES

1. The RECORDER should be the one to take the instructions and chart outside.
2. The SIGHTER should have the Clinometer.
3. When the measurements are finished, return to the classroom and copy the information collected by the RECORDER.
4. Draw the diagrams and calculate the rest of the information needed in the table.