ACRE BY ACRE

SUBJECTS: Mathematics, Science, Practical Living/ Vocational Studies

GRADES: 4-8

DURATION: One class period

GROUP SIZE: One class of 25-30 students

SETTING: Indoors and/or Outdoors

KEY VOCABULARY: Estimate, educated guess, frame of reference

ANTICIPATORY SET: How often have you been asked to estimate the size, weight, or volume of some item? Most people don't carry a ruler or measuring cup with them all day long. Learning to make a good estimate is essential in science and beneficial in your everyday life.

OBJECTIVES: Students will learn to make estimates of size based on a given quantity.

MATERIALS: Four students of various heights, measuring tape marked in centimeters, tape or string, wire bent to form a square that measures 10-centimeters to a side

BACKGROUND: News reporters like facts. Their favorite questions are who, what, when, where, and how did it happen? In reporting events such as a wildland fire, initial news reports usually tell when and how the fire started. Later daily updates will tell the number of acres burned, any threats to homes, and the percentage of the fire that is under control (contained) or completely out.

Have you ever wondered how someone knows that a fire burned 3,000 acres today or is 20% contained? How do they measure sizes this large while still fighting the fire? Firefighters have learned to estimate size through years of experience.

Estimates are also used in homes every day as people fix meals for you to eat. Cookbooks will instruct you to add one teaspoon of salt or one-eighth teaspoon of pepper. But how many of you have ever watched your parents or grandparents cook a meal? Does the cook measure out the exact amount of salt and pepper in order to season the food or do they just sprinkle these seasonings over the food? How do they know when to stop so dinner isn't too salty or too spicy to eat? They have learned to estimate these amounts extremely accurately!

This is easier to do then you might expect! Today's lesson will give you experience in estimating size and distance.

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PROCEDURE:

1. Before class, the teacher should mark off a 2-meter by 3-meter rectangular plot with masking tape, flagging tape, or string.

2. Have one student stand in front of the class. Ask the class to estimate this student's height in centimeters. As a frame of reference, tell students that the distance from their cuticle to the white area on their fingernail is approximately 1 centimeter. Record all estimates on the board.

3. Tell the class they will now check their answers. Using a tape measure, have classmates measure his/her height in centimeters.

4. Compare the range of estimates to the actual height of this student.

5. Choose a second student to stand next to the first student. Since the height of the first student is now known, ask the class to estimate the height of the second student. Record these estimates on the board.

6. Measure the actual height of the second student and compare this figure with the second set of estimates. Was the range of estimates closer to the actual height of this second student?

7. Repeat until the heights of four different students have been estimated. Point out that the range of guesses got closer to the exact height as the students had more practice.

8. Next, ask one of the four students to raise and extend both arms out at shoulder height. The distance from finger tip to finger tip is their "reach". Are students able to estimate the length of this student's reach?

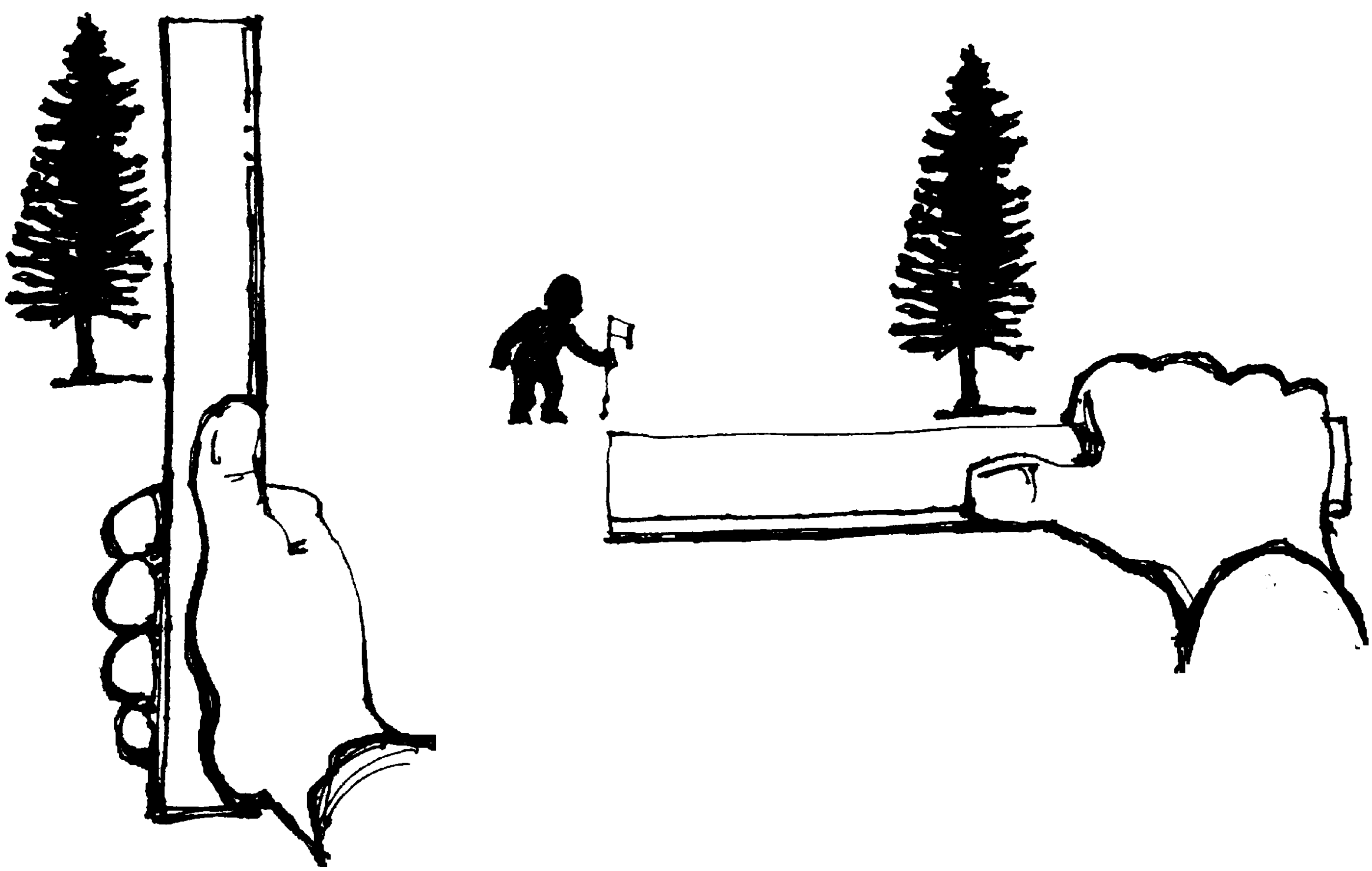
9. Working in pairs, have each student estimate the reach of their partner. Next, have them estimate their own reach. Allow them to use the original four students as a base for comparison if they would like. Were they able to correctly estimate reach to within 10% of the actual distance? [NOTE: A student's reach will be the same as his/her height.]

10. Still working in pairs, ask students to estimate the distance of their pace. A pace is the length of two normal steps. Have one student place their heels at a set line and take two normal steps. Their partner should mark the spot where the heel of their second foot hits the ground. Students should then estimate the distance traveled. Have them measure this distance. Repeat with your partner. How accurately were they able to estimate these distances?

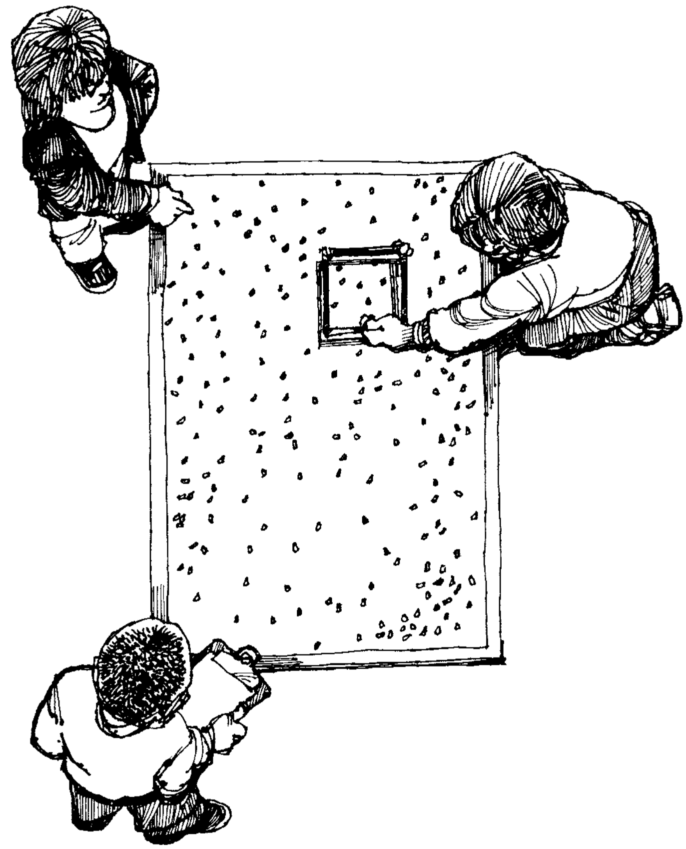
11. Ask the students if they think they would be able to estimate the height of a tree. All they will need is a stiff object such as a pencil, piece of dowel rod, or stick from the ground. Take the class out into the schoolyard. Pick a tree at the edge of the yard, preferably one that is standing by itself. Have one student stand next to this tree (we'll call this student Ted). Ask Ted how tall he is. Standing 25-30 feet away from the tree, the rest of the class should hold their pencil at arms length in front of them. Instruct students to use their pencil to measure the height of Ted. Students should close one eye, place the top of their pencil at Ted's head and place their thumbnail at the point on the pencil where they see Ted's feet. This length along the pencil represents Ted's height. Now have them use this distance along their pencil to measure how many Teds high the tree is. If the tree is 3 ½ times Ted's height, then they can multiply Ted's height by 3 ½ to find out the approximate height of the tree!

12. There is a second way to measure the tree's height. Holding their pencils at arm's length from their eye, have each student measure from the top to bottom of the tree along their pencil. Now turn their pencil sideways so that the distance along the pencil that represented the height of their tree is marking the ground from the tree trunk to a spot on the ground the same distance from the tree. Have their partner mark this spot by placing a stick, flag, or other object at the correct spot. By measuring the distance back to the tree, you will know the tree's height! Instruct students to pace the distance from the marked spot to the tree. Since they know the length of their pace, they can now calculate the height of the tree.

13. Lead the students to your pre-marked rectangular plot. Show them the wire frame and tell them the frame is one decimeter (10 centimeters) on each side. Ask, "What size is this plot of land"? Allow the students to experiment with various methods of estimating the size of the plot.



CLOSURE: It is easy to make fairly accurate estimates if you have a frame of reference. Today you practiced estimating. Can you think of other incidences where you would want to estimate?



EVALUATION: Teachers are able to observe: 1) student's ability to work alone, in pairs, and in large group situations; 2) student's skill levels in using a tape measure and making basic mathematical computations; 3) student's willingness to participate during a variety of new situations; 4) student's problem solving skills and growing ability to estimate size and distance.

EXTENSIONS:

1. Have students graph the results of their estimation attempts. Do they notice any trend from their first attempt to estimate to their final "educated guess"?

2. Ask students to list ways they use estimations over a set period of time. Do they feel it is valuable for them to estimate accurately?

3. Practice estimating populations. Sprinkle three pounds of beans within your marked plot. Ask students how they could accurately estimate the total number of beans within this plot. Students may suggest using the wire frame to count the exact population of a small area and multiplying by 600. (They will multiply by 600 because the plot is 20 decimeters by 30 decimeters in size, or 600 frames large). Ask students how they can achieve more accuracy. They may eventually suggest counting the exact number of beans in 10 random plots, taking an average, and multiplying that number by 600. [NOTE: To save time, the teacher can "estimate" the total number of beans by counting the number of beans that will fit in one cup. Multiply that number by the total number of cups of beans spread in the survey plot!]