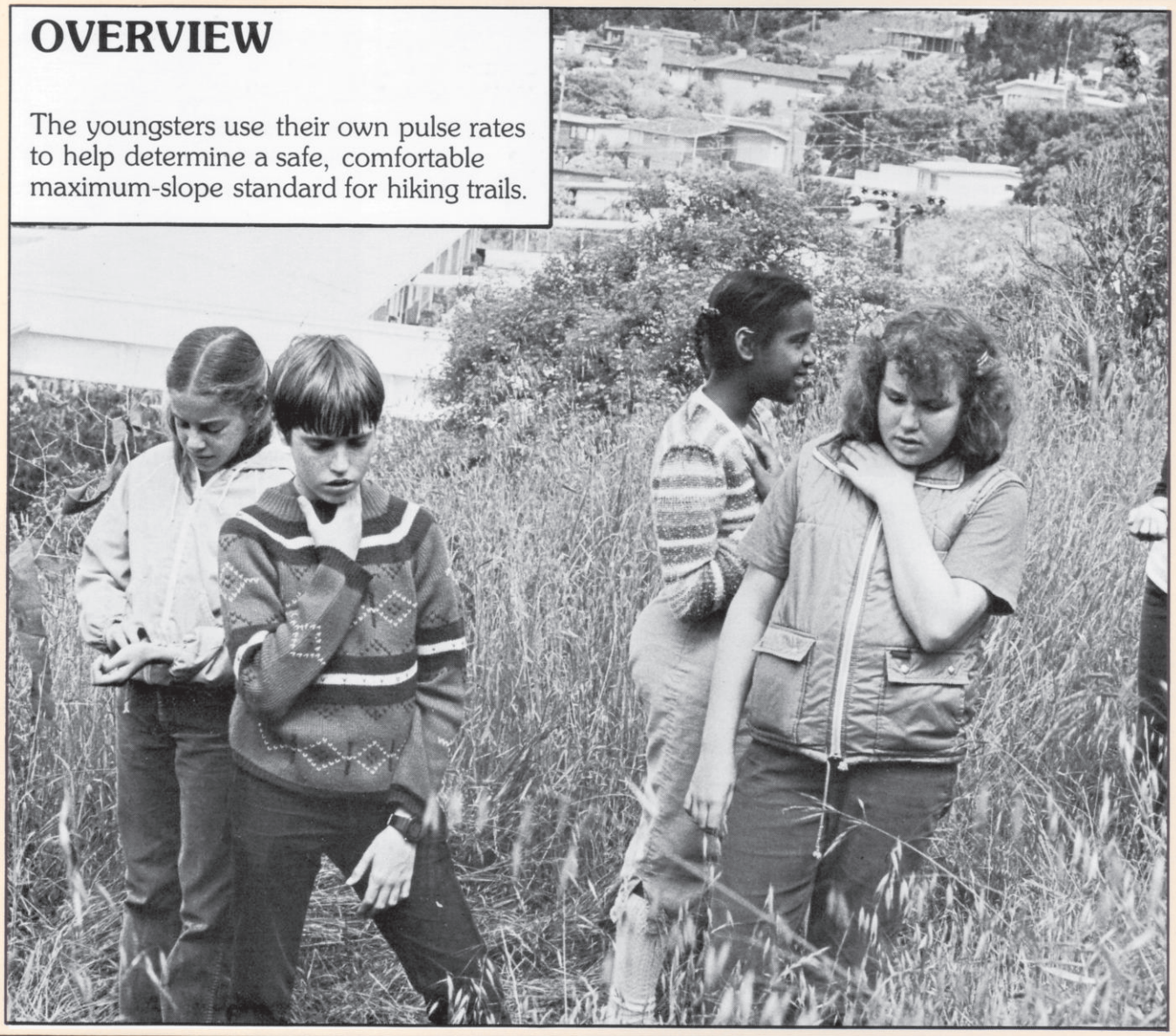
CARDIAC HILL

BIO KEY
Impact on Humans
Slope
Trail Study

OVERVIEW

The youngsters use their own pulse rates to help determine a safe, comfortable maximum-slope standard for hiking trails.



BACKGROUND

Slope is an important factor to consider when designing a trail on a hillside. Steep trails require more physical effort to hike on than do trails with a gentle slope. A very steep slope may be too difficult for young children, old people, and people in poor physical condition.

Pulse rate is a good indicator of physical exertion. Working muscles need more blood circulating through them than do resting muscles to remove waste products and to supply oxygen and nutrients. The harder muscles work, the faster the heart pumps to provide the required blood. The increased heart rate produces a faster pulse rate in the arteries.

In this activity, the youngsters use their pulse rates as a measure of the effort expended in walking on different slopes. By checking their pulse rates after walking up various slopes, the group decides on an appropriate maximum slope for trails.

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CHALLENGE: USING YOUR PULSE RATE AS A GUIDE, DETERMINE THE MAXIMUM SLOPE FOR A TRAIL THAT HIKERS CAN USE COMFORTABLY.

MATERIALS

For the group:

1 watch with a second hand
1 slope-measuring device (See the "Measuring Slope" Equipment Card.)
1 data board or large drawing pad* (with at least three sheets of paper)
1 marking pen*
1 5- or 10-meter length of cord* or twine* (for measuring distance)
6 to 8 flags (cloth or plastic flagging* tied to sticks)
index cards* and pencil

Optional:

hand calculator

* Available from Delta Education.

PREPARATION

Note: Because the youngsters must be able to locate and count their pulse for this activity, you may need to spend some time before the session teaching your group how to take their pulse. (See the "Action" section.)

Group Size. This activity is easiest to conduct with groups of up to sixteen youngsters.

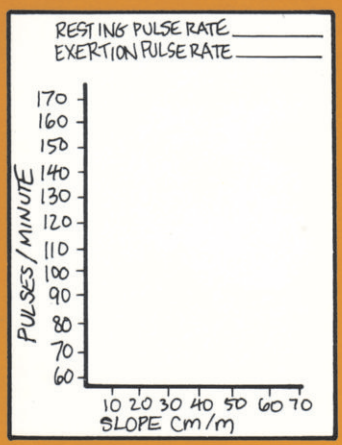
Time. Plan on fifty to sixty minutes for this activity.

Site. Choose a hillside with a variety of slopes, ranging from gentle to very steep. Before meeting with the kids, use a slope-measuring device to select three test slopes: one gentle slope (under 20 cm per meter), one very steep slope (over 40 cm per meter), and one in between. The three slopes should all be the same length: 25 to 35 meters long. (Use the pre-measured cord or twine to measure off the slopes.) Mark the slopes with start and finish flags. Record the slope of the test trails by marking an "X" where the slope of each trail falls on the slope line of the graph. (See the illustration.)

Materials

1. Slope-Measuring Device. Assemble one slope-measuring device, and familiarize yourself with its use. (See the "Measuring Slope" Equipment Card.)

2. Data-Board Graph. Draw the illustrated graph on your data board or large drawing pad.



3. A number of group-pulse-rate averages are calculated during the activity. You can ask the kids to make the calculations using index cards and pencils, or you can calculate the averages with a hand calculator.

CARDIAC HILL

BIO KEY Impact on Humans Trail Study Slope

ACTION

1. Meet at your hillside, and introduce the activity with a story: "The County Trail Commission has invited you to set the standard for the maximum steepness of a trail for comfortable family hiking." Tell the youngsters that they will base their decision on the effect different slopes have on their pulse rates.

2. Introduce ***pulse rate*** as a measure of physical exertion. Demonstrate the procedure for taking a wrist pulse. Show the group the correct hand and finger positions. (See the illustration.)

Correct Ways to Take Wrist Pulse

Explain that each youngster should arch the first three fingers of one hand and place the finger tips on his other wrist between the center of the wrist and the bone on the thumb side. Ask the youngsters to find their wrist pulse. Mention that pressing too hard will shut off the blood flow so that the pulse can't be felt.

3. When all the youngsters are relaxed and ready, have everyone silently count his own pulse for thirty seconds while standing still. Record each youngster's pulse rate in *pulses per minute* (multiply the thirty-second counts by 2) on a blank sheet of the data board. Average the rates to find the *resting pulse rate* for your group, and record that rate at the top of the graph page. Draw a horizontal line across the graph at that resting-pulse value.

4. Next determine the pulse rate resulting fron extreme exertion. Take your group out for a long and fast run. When everyone is puffing, stop and immediately take a pulse reading. Again average the pulse readings. This group average will be the *excessive-exertion pulse rate*, that is, too much work for walking over a trail. Record this value as you did the resting-pulse rate, and draw the horizontal line on the graph. You now have two values that represent extremes of physical exertion: no exertion (resting) and excessive exertion (running).

5. Tell the group that you have selected three test slopes that vary in steepness from gentle to very steep. Point out the flag markers. Explain that the group will

THEIR PRELIMINARY DATA:

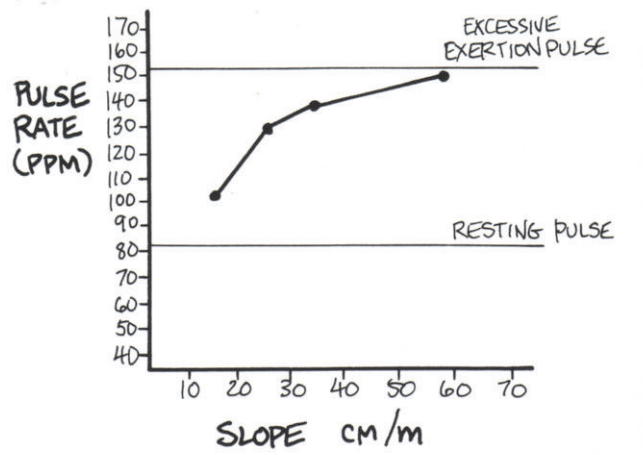
GROUP RESTING PULSE RATE: 82 PPM

GROUP EXERTION PULSE RATE (RUNNING): 154 PPM

THEIR SLOPE DATA:

SLOPE (m/m)	PULSE RATE
16	101
35	138
60	150
26	130

PLOTTING THEIR DATA:



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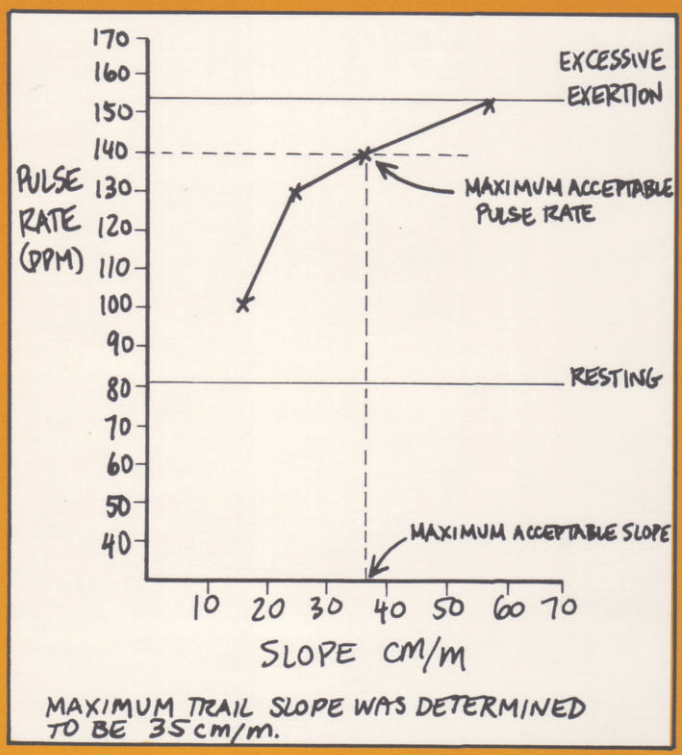
start at the upper end of each test slope and rest long enough to allow their pulse rates to return to near the resting rate. The group will then *walk* at a trail-hiking pace down to the end of the test slope and back up to the starting point (round trip). The youngsters then immediately take pulse readings, which are averaged and recorded on the graph. Start with the gentle slope and repeat this procedure for the other test slopes.

6. When you have finished graphing the group pulse rates for the three test slopes, review the pulse rates associated with the various slopes, and have the kids decide on the *maximum acceptable pulse rate* for trail hikers. The value should fall between the resting and the excessive-exertion pulse rates. Once a pulse rate is chosen, you can use your graph to discover the slope most likely to produce that pulse rate. (The youngsters who prepared the illustrated graph chose 140 pulses per minute as the maximum pulse rate, and used their graph to determine that a slope of about 35 centimeters per meter would produce that rate.)



THINKING ABOUT SLOPES AND PULSE

1. What happens to a person's pulse rate as she walks on increasingly steep slopes? Do you think the pulse rate would continue to rise with increase of slope or would it eventually level off?

2. What was the range of pulse rates in your group for any one slope (that is, what was the difference between the highest and the lowest rates)?

3. If you were going to build a trail through your activity area, what other factors might affect the decision of the maximum acceptable slope? (Trail surface, plants and animals living in the environment, erosion, length of trail.)

BRANCHING OUT

1. Use pulse rate to evaluate the amount of exertion used to perform other tasks: tree climbing, reclining, playing tag or tug-of-war, swimming, etc. Rank the tasks in order: most exertion to least exertion.

2. Visit some trails and measure maximum, minimum, and average slopes. Do the maximum slopes on these trails fall within your acceptable range?

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Cardiac Hill
MEASURING SLOPE

Equipment Card

MATERIALS FOR ONE SLOPE-MEASURING DEVICE

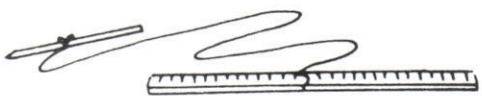
1 meter stick*
1 125-cm length of strong cord*
1 25-cm sharpened stick
1 line level* or level tube consisting of a test tube*, popsicle stick*, and a cork*
household ammonia*
water
tape*

* Available from Delta Education.

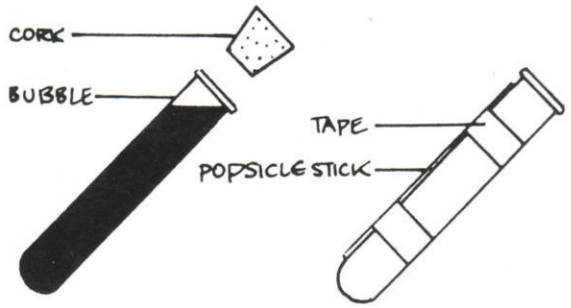
ASSEMBLING THE SLOPE-MEASURING DEVICE

1. Sharpen the 25-cm stick and fasten the cord to it with a knot that enables the cord to slide up and down the stick. This is the "anchor stick."

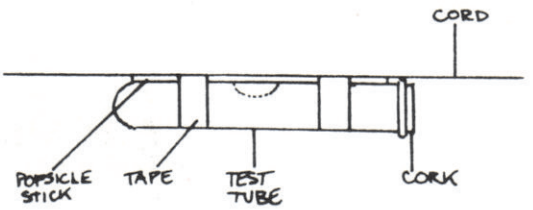
2. Attach the free end of the cord to the meter stick so that the distance between the two sticks is one meter. Make a knot that can slide on the meter stick. (You can use any stick marked off in centimeters if you do not have a meter stick.)



3. Attach a line level to the center of the line between the sticks. Here are instructions for making a level, if you choose to make your own. Fill the test tube almost full of water and add a drop of ammonia to stop algae growth. Cork the tube so that a small bubble remains. Trim off the top of the cork. If your test tube has a flared lip



at the top, tape a popsicle stick to the side of the tube before taping the tube to the center of the cord. Your level should look like this:



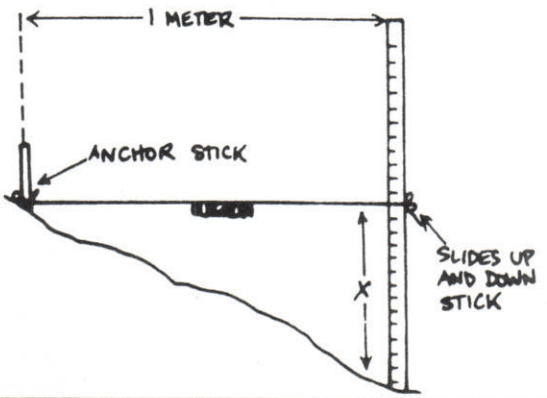
TO USE THE SLOPE-MEASURING DEVICE

1. Place the anchor stick in the ground at the upper part of the slope. Push the string down to ground level.

2. Go down the slope until the string is taut, and rest the meter stick vertically on the ground (zero-end down).

3. Slide the knot on the meter stick up or down until the line level indicates the cord is level.

4. Read the value under the knot on the meter stick. This is the slope in centimeters per meter.



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