



Sample Activity:
Treads and Risers

from the Pre-AP workshop

Pre-AP[®]: Strategies in Mathematics –
Helping Students Learn Mathematics
Through Problem Solving

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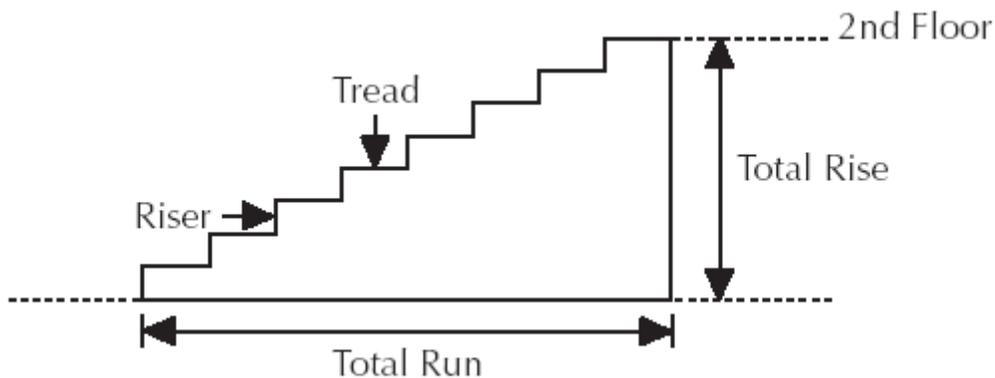
Treads and Risers

This activity concerns the mathematics involved in the design of a flight of stairs. First there is some vocabulary important in describing stairs.

Tread: The tread is the actual step, the part that your foot rests on while going up the flight.

Riser: The riser is the board that holds one step above another.

It is possible to measure both the tread and the riser of a set of stairs. In addition, the total run and the total rise of a flight of stairs are important factors in design. Notice in the diagram below that the top step ends on the second floor. So that each step will consist of a tread and a riser, the total run includes a tread-length stretch of the second floor as the "top step."



Because stairs take up a great deal of space, many flights of stairs turn back on themselves. For the purposes of this activity, we will only be concerned with straight flights of stairs with no landings.

Part One

Find a flight of stairs.

1. Measure and record the height of one riser on this flight. (Note: All risers in a flight should be the same size.) Measure and record the length of one tread on this flight. This may be tricky because some stairs have an overhang, called a nosing. If the end of each step hangs over the front of the riser, you have a nosing. You need to find the size of the tread without the nosing so you may need to estimate some. (Note: All treads should be the same size as well.)
2. Count the number of stairs in the flight and use this to calculate the total rise and the total run for your flight of stairs.

Part Two

In addition to the sizes of the parts of the stairs, another important property of a flight of stairs is how steep it is. Stairs that are very steep are much harder to climb, but take up less space. One way to measure the steepness of a flight of stairs is to use the slope.

Slope = length of the riser of a step / length of the tread of a step.

1. Find the slope of the stairs you used in Part 1.

Because stairs are a common place for accidents to occur, various government bodies have issued regulations regarding the design of stairs. These regulations vary from place to place. In addition, architects use a variety of rules of thumb to make stairs practical and attractive. In this activity we will use the following guidelines:

GUIDELINES

1. All steps must be the same size.
2. The slope must be between 0.3 and 0.9, inclusive.
3. Twice the rise (in inches) plus the tread (in inches) should be between 24 and 25, inclusive.

2. Does the set of stairs that you worked with in Part 1 follow the guidelines?

An architect is working on a design for a new house. The distance between the first and second floors is going to be 10 feet. Her clients suggest designing the stairs as follows:

each riser: 6 inches
each tread: 12.5 inches

3. How many steps will this staircase have?
4. How much horizontal length is required to build the staircase? (This is not the "total run." The staircase would not include the top tread, as it is part of the second floor.)
5. Calculate the slope of the staircase.
6. Does this staircase conform to the guidelines?

The architect is worried about how much horizontal space this staircase takes up so she redesigns it as follows:

each riser: 7.5 inches
each tread: 10 inches

Find the following for the new stairs:

7. How many steps will the new staircase have?

8. What is the slope of the new design?
9. How do these new stairs compare to the original?
10. Does this new design meet the guidelines?

Suppose you want to decrease the slope of this staircase.

11. Give an example of a rise for each step of this staircase that would satisfy guideline 2 without changing the size of each tread.
12. Does the rise you gave as an example above, together with a 10-inch tread, satisfy guideline 3? How can you tell?