MEASURING LAKE SUPERIOR: APPROXIMATING A NON-LINEAR, NON-CIRCULAR AREA

Objective: Students will estimate the area of Lake Superior using left-hand, right-hand, and midpoint rectangular approximations, and then determine how to make their estimates more accurate.

Materials: Map of Lake Superior, ruler, calculator, paper and pencil.

Initiation: Students recall formulas for finding the areas of many geometric figures, including triangles, rectangles, rhombi, trapezoids, and circles. How do you calculate area when a figure has some other shape?

Procedure: Students trace the outline of Lake Superior from a classroom map. Given only a ruler and the map scale, they will create various methods for estimating the actual surface area of the lake.

After a period of exploring students' ideas, direct the focus to rectangular approximations. To estimate the area of the whole lake, we can partition the lake into a series of equally wide vertical strips (1/4 inch width works well), each being almost rectangular in shape. The sum of the areas of the strips will approximate the area of the entire lake. (Note: In calculus, this approximation is commonly referred to as a Reimann sum).

Left-hand rectangles:
Measure the height of each vertical strip using the length of the left side of each rectangle.

Right-hand rectangles:
Measure the height of each vertical strip using the length of the right side of each rectangle.

Midpoint rectangles:
Measure the height of each vertical strip using the length of a vertical line going through the middle of the rectangle.

Assessment: Monitor student progress throughout the activity. Each student (or group of students) submits a written report that addresses the following:

1. Describe the method you used to estimate the area of Lake Superior.
2. How does your approximate area compare with the actual area of the lake? Why?
3. How could you make your approximation better? Describe at least 2 different ways.
4. Theoretically, how could you use rectangular approximations along with a concept from calculus to find the exact area of the lake? (Hint: take #3 to the extreme.)

Closure: We can make a reasonable estimate for the area of any 2-dimensional shape by finding the area of a series of skinny rectangles. Can we broaden this idea to 3-dimensional solids? How would it work? Next week, we'll apply what we've learned to estimate the volume of a soda bottle. Before then, see if you can develop a good strategy.

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