Unit 5 Lesson 16: Surface Area and Volume

1 Maximize Area (Warm up)

Student Task Statement

The zoo wants to give the elephants as much space as possible in a rectangular enclosure meant for feeding. The zoo has 180 feet of fencing. What should the dimensions of the rectangle be? Be prepared to share your reasoning.

2 Maximize in Three Dimensions

Student Task Statement

1. Find a set of dimensions for a rectangular prism with volume 60 cubic units. Calculate the surface area of your prism. Add your data to the class chart.

2. A lithium ion battery contains a rectangular prism made of lithium. The energy in the battery is proportional to the surface area of this prism. Assume the lithium has a fixed volume of 60 cubic millimeters. Find the dimensions of a rectangular prism with this volume that maximizes its surface area. What is its surface area?

3 Assume a Spherical Elephant

Student Task Statement

For a sphere with radius r, its volume is $\frac{4}{3}\pi r^3$ and its surface area is $4\pi r^2$.

1. Let's model an elephant with a sphere that has a radius of 4.5 feet.
   a. What is the volume of the elephant?

   b. What is the surface area of the elephant?

2. Let's model a snake with a cylinder of length 3 feet and diameter 0.2 feet.
   a. What is the volume of the snake?

   b. What is the surface area of the snake?

3. Compute the surface area to volume ratio, or $\frac{SA}{V}$, for each animal.

4 Measuring Strength (Optional)

Student Task Statement

Suppose a human is a sphere with a radius of 1 unit, an ant is a sphere with a radius of $\frac{1}{200}$ unit, and an elephant is a sphere with a radius of 5 units.

1. The *raw strength* of a living creature is the cross-sectional area of its muscles. The cross section of each of our spherical beings is a circle of radius r where r is the creature's radius. Order the human, ant, and elephant by their *raw strength* from least to greatest. Show your reasoning.

2. *Relative strength* is given by the ratio of raw strength to volume. It measures how strong a creature is for its size. Create an expression for the relative strength of a spherical being with radius r. (Remember that the raw strength formula is πr^2 and the volume formula for a sphere is $\frac{4}{3}\pi r^3$.)

3. Order the human, the ant, and the elephant by their *relative strength*. Which is the strongest for its size?