Name:_____ Date:_____ Hour:_____

Scaling Lab

Background: As early as the 17th century the importance of scaling effects on structural strength were noted by Galileo in a discussion of differences between a horse and a dog. The discussion compares a horse falling eight feet and breaking bones to a dog falling eight feet and walking away, and continues to note that a dog could carry two or three similarly sized dogs on its back, whereas a horse could not carry even one similarly sized horse. Scaling has important applications in biology of animals, engineering and design of structures, and the rate of chemical reactions.

Definition: Two objects are said to be scaled if one object can be obtained from the other by increasing its every dimension by the same factor, called the scaling factor (S.F.). In other words, two objects are scaled if one can be obtained from the other by proportional adjustment of all its dimensions. Notice that the scaling factor is a pure number (i.e., it has no unit).

Problem: What will happen to the surface area and the volume of a cube if every edge of the cube is doubled? Tripled, etc? Will both variables (surface area and volume) increase or decrease? Will one variable increase while the other decreases? If both variables increase, will they increase by the same rate? What do you think?

Predict: I think....because....

Experiment: Using the provided materials, construct cubes with the lengths listed in the table and determine the surface area and volume for each cube. You will only be able to construct the first 3 or 4 as we do not have enough materials for the other values.

Length	Surface area/cm²	Volume/cm³	Ratio of Surface Area to Volume (SA ÷ V)	Scaling Factor (compared to smallest cube)
1				
2				
3				
4				
10				
100				
1000				

Questions:

1. What interesting/surprising patterns have you observed in the Table above? Describe them.

2. When the scaling factor increases, the surface area and the volume of the object also increase. Do they increase at the same rate? Explain.

3. Scaling is widely used in map-making. A map of a certain town is produced to a scale of 1:10,000. The town has a circular shape, and the map is 0.5 m across. What is the town's real dimension?

4. How do you think the scaling phenomenon might be relevant to other aspects of everyday life?