



*Drexel-SDP GK-12 ACTIVITY*

## Activity Template

**Subject Area(s)** Measurement, Physical Science, Problem Solving

**Associated Unit** Nanotechnology

**Associated Lesson** Surface Area to Volume Ratio

**Activity Title** Clay, Surface Area, and Volume

**Grade Level** 10 (7-12)

**Activity Dependency**

**Time Required** 30 minutes

**Group Size** 1

**Expendable Cost per Group** \$0

### Summary

In this activity, students learn about an important physical property, the surface area to volume ratio. Students are first introduced to the concept of surface area to volume and are introduced to some biological structures in which a high surface area to volume ratio is important. Then the students are given a specified volume of clay. Their task is to try to create the largest surface area with the given volume of clay. After the students have created their shapes, they estimate the surface area to volume ratio of their creations.

### Engineering Connection

Engineers must understand the properties of any structures they plan on building. When creating structures on the micro and nano scale, the surface area to volume ratio has very large impacts on the device performance. For instance, engineers utilize the high surface area to volume ratio in designs of microfluidic structures. In addition, engineers try to mimic the high surface area to volume ratios of biological structures.

### Keywords

clay, estimation, measurement, ratio, surface area, volume

## **Educational Standards**

- Science: 3.1D, 3.4A
- Math: 2.3, 2.9

## **Learning Objectives**

After this lesson, students should be able to:

- Compute surface area to volume ratios for various shapes
- Explain why the surface area to volume ratio is an important property when dealing with nanotechnology

## **Materials List**

Each group needs:

- Clay
- 1 sheet of paper

## **Introduction / Motivation**

Although surface area is not a property that is easily measured like mass or volume, it is a very important property in physics, chemistry, and biology. One of the most convenient ways of discussing surface area effects is to define the surface area to volume ratio. This ratio gives you a good idea of how a sample will behave. For example, everyday flour is not very reactive, but when the surface area to volume ratio is very large, it can be explosive. Another place where a high surface area to volume ratio is important is in our lungs. The alveoli in our lungs have many ridges and folds to increase surface area which allows for greater oxygen absorption. We will see how the surface area to volume ratio changes when we move to the nanoscale and why this is important for many applications.

## **Procedure**

### **Before the Activity**

- Prepare the materials. Make sure the clay is wet enough to be molded easily but not too wet so it is muddy.

### **With the Students**

1. Ask the students what they know about surface area to volume ratios and their importance. Discuss cases in which surface area to volume ratio plays a large role in biology and other fields.
2. Hand out the clay and paper to each student.
3. Have the students estimate and record the volume of their clay.
4. Tell the students that their goal is to obtain the highest surface area to volume ratio with their clay. Have the students mold the clay into the shape or shapes of their choice, estimate the surface area, and calculate the surface area to volume ratio. The students should use a piece of paper to build their structure on to keep things clean.
5. Discuss with the class what structures had the highest surface area to volume ratio and which ones had the smallest.

### **Safety Issues**

- None

### **Investigating Questions**

After completing the activity, why do you think surface area to volume ratio is an important factor to consider when dealing with objects on the nanoscale?

## **Assessment**

### **Pre-Activity Assessment**

*Discussion:* Through the discussion, the students' prior knowledge concerning the surface area to volume ratio and its importance will be determined.

### **Activity Embedded Assessment**

*Clay structure and calculation:* The students' understanding of surface area to volume ratio will be seen by their structures and calculations.

### **Post-Activity Assessment**

*Discussion:* Discuss with the students what they learned from the activity; what shapes have the highest surface area to volume ratio and why they think that is important in nanotechnology.

### **Owner**

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