

## Surface Area to Volume Effects...Which Shape can Dissolve the Fastest?

### Content Standards

Indiana Chemistry I Standards - C.6.1, C.7.2, C.7.5

### Introduction

Surface-area-to-volume (SA/V) ratio is used by people, animals and plants. Since many interactions occur at the surface of a material, the surface area can play an important role. Cells survive by constantly exchanging ions, gases, nutrients and wastes with their environment. Since all of these exchanges take place on the surface of the cell, there must be an appropriate ratio between surface area and volume.

Here are several examples where SA/V plays a role in nature. Think about why these examples occur.

- 1) Within the human body, the intestines have a surface area about the size of a tennis court.
- 2) Rabbits in warmer climates tend to have larger ears and rabbits in colder climates have smaller ears.
- 3) Smaller animals, like mice, lose heat to their surroundings quicker while larger animals, like elephants, lose heat slowly and have a hard time avoiding overheating.
- 4) Plant leaves have a larger surface area compared to volume.

In this activity, you will be exploring surface area to volume effects on sugar to see how the amount of surface area compared to volume affects the dissolution of the sugar.

### Safety

- Wear Goggles during this lab investigation.
- DO NOT eat or drink anything in the lab.
- Waste can be poured down the drain.

### Materials

- Sugar Cubes
- Granulated Sugar
- 250 mL Erlenmeyer flasks
- Weigh boats
- Spatulas
- Stirring rods
- Balance
- Hot plate
- Stopwatch/Cell phone

- DI Water
- 100 mL graduated cylinder

### **Procedure**

You are going to come up with your own investigation to answer the following question: how does surface area affect the rate of dissolution of sugar? Using the materials listed above, develop an experiment that can be used to answer this question. From your experiment, collect data to support your answer to this question.

Be prepared to briefly present the experiment you developed, the results you obtained and what they mean to the rest of the class.

### **Questions to Consider**

1. What relationship did you observe between the surface area and the rate of dissolution of the sugar?
2. What do you think is the reasoning behind this relationship?
3. How does surface-area-to-volume ratio (SA/V) relate to the concept of size and scale?
4. Based on your observations, what role do you think surface area plays for nanoscale objects?

### **Part 2: Affect of Temperature and Agitation on Rate of Dissolution**

#### **Procedure:**

Aside from surface-area-to-volume ratio, dissolution depends on temperature and amount of agitation (stirring). Following the same procedure above, investigate how temperature and agitation affect the rate of dissolution of sugar in water.

#### **Questions to Consider:**

1. What was the relationship between temperature and rate of dissolution?
2. What was the relationship between agitation and rate of dissolution?
3. Develop a real-life example to explain how surface area, temperature and agitation affect the rate of dissolution of a solute in a solvent.

#### **References**

[http://nanosense.sri.com/activities/sizematters/properties/SM\\_Lesson3Student.pdf](http://nanosense.sri.com/activities/sizematters/properties/SM_Lesson3Student.pdf)

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