Length, Area, & Volume: HOMEWORK (answer these questions on separate sheets of paper)

1. Many single-celled organisms eat by absorbing food through their surface, so their ability to absorb food is determined by their surface area. In order to survive, these organisms must feed their entire bodies, so their need for food is determined by their volume.

   a. As these organisms grow, which increases faster, their ability to absorb food or their need for food? Explain your reasoning.

   b. Based on your answer above, what would happen to the ability of this kind of an organism to feed itself, as it grew larger and larger? (And so why do you suppose that we don't see six-foot tall single celled organisms?)

2. In the desert country of the American Southwest water is a scarce resource. To supply the cities of that region with water, the US government has built a series of dams and reservoirs along the Colorado River. These cities could not support their current populations if it were not for the dams along the Colorado River.

   However, there is an environmental price for this water—the Colorado River does not make it to the ocean. It dries up in the desert of Mexico. Why? Certainly diverting water out of the river basin is one reason, but even with the diverted water accounted for, it appears that there is less water in the river system than prior to the construction of the dams. Most of this loss of water is that there is more water loss due to evaporation from the reservoir surfaces in the dry, hot weather than from the small river surface.

   One of the reservoirs along the Colorado River is Lake Mead impounded behind Hoover Dam (near Las Vegas). The following are average rates for Lake Mead:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area of the reservoir (water surface)</td>
<td>157,900 square miles</td>
</tr>
<tr>
<td>Evaporation from the reservoir per year</td>
<td>1,902,668 acre-ft</td>
</tr>
<tr>
<td>Flow of the Colorado River per year</td>
<td>10,186,636 acre-ft</td>
</tr>
</tbody>
</table>

   (an acre-ft is the volume of water required to cover an acre of land to a depth of one foot)

   a) What percentage of the flow of the Colorado River is lost by evaporation?

   b) Imagine that someone proposed building a “reservoir” that would be square in shape and would have a dimension of 1 mile on each side in the Lake Mead
area. Predict the amount of water that would be evaporated from this reservoir using the figures for Lake Mead on the previous page.

c) Would there be any other factors that might affect the evaporation from this square reservoir that would affect the calculation of the evaporation rate? (There could be many possible answers to this question—just answer with one or two possible ideas. Your ideas will not be graded rigorously).

3. Weather balloons are large "lighter-than-air" balloons that are used to lift weather sensing equipment miles into the air. As the balloons rise they remain the same shape but they expand (we'll discuss why this happens later). During one experiment, a meteorologist noticed that the weather balloon she was using increased in volume by a factor of 27. By what factor did the diameter of the weather balloon increase? Show your work/Explain your answer.

4. This photo is of the Tacoma waterfront. The large cylinders are used to store grain prior to export. They are called grain elevators. Let’s assume that we want to paint the grain elevators and we are considering building more grain elevators so we are interested in the volume of grain that can be stored in the elevator.

Some facts you need for this question:
The area of a circle is \( \text{Area} = \pi r^2 \)
The circumference of a circle (distance around the grain elevator) is \( C = \pi d \)
The area of surface to be painted is the area of the top (a circle) and the area of the sides (circum. times the height).
One gallon of paint will cover 15 m\(^2\) of the grain elevator surface

*Your answers to the following questions are not complete without the correct units!*
a) What is the area of the grain elevator to be painted if the diameter is 8 meters and the height is 16 meters?

b) How much paint will be required to paint an elevator of this size?

c) What is the volume of this elevator?