Plants and Human Affairs – Biol106 name _____

Post-Lab: Surface-to-Volume Ratios

Exercise 1

1. Append to your post-lab a single graph plotting: surface area vs. cube size, volume vs. cube size, and s/v ratio vs. cube size.

2. Complete the following:
   - As a cube gets larger, its S/V ratio will (circle one: decrease / remain the same / increase)
   - As a cube gets larger, the surface area of the cube will increase by *(circle one: twice / the square of / the cube of)* the linear dimension.
   - As a cube gets larger, the volume of the cube will increase by (circle one: three times / the square of / the cube of) the linear dimension.

3. Did you see the classic Grade B horror movie, "The Attack of the 60 foot Woman?" How much would this woman weigh? Assume an 'average' woman who is 5 foot tall weighs 110 pounds. Show your work.

4. According the *Guinness Book of World Records* the tallest living human female is 7 feet 7 ¼ inches tall. Using our assumption that a 5 foot woman weighs 100 pounds, how much do you predict this woman weighs? _____. (note: her actual weight = 462 pounds). Show your work.

Exercise 2 & 3

1. Fill-in-the-blank with the appropriate response
   a. As a cube it flattened its S/V ratio will _____.
   b. As a cube is elongated its S/V ratio will _____.

Exercise 4

1. Complete Table 4.
2. On a separate sheet of paper (preferably graph paper), make a sketch, to scale, of the three objects (sphere, cube, filament).

Table 4. Effect of shape on surface-to-volume ratios

Shape	Dimensions (cm)	Volume (cm^3)	Surface Area (cm^2)	S/V ratio	Volume of environment within 1.0 cm
Sphere	1.2 diameter	1.0			
Cube	1 x 1 x1	1.0			
Filament	0.1 x 0.1 x 100	1.0			

Exercise 5

1. Complete Table 5.
2. Which plant is better adapted for xeric conditions. Explain, but don't just say, because of its S/V ratio – explain why.

Table 5. S/V ratio of leaves of different plants.					
Species	Number of boxes	SA (cm^2) – one side of leaf	Ttl SA (cm^2) – both sides	volume (gm = cm^3)	S/V
Jade plant					
Ironwood					

Exercise 6

1. Complete Table 6.
2. Which sponge lost most total water? Why?
3. Which sponge lost the most water proportionally to its size (g / cm3)? Why?
4. Which sponge, if any, lost the most water per unit area (g / cm2)? Why?

Table 6. Water loss from leaf models		
	large sponge	small sponge
length (cm)		
width (cm)		
height (cm)		
SA (cm^2)		
vol (cm^3)		
S/V		
Initial weight sponge (g)		
Final weight sponge, after evaporation (g)		
Amount of water lost (g = mL)		
Water loss per unit volume (g / cm^3)		
Water loss per unit surface area (g / cm^2)		

Exercise 7

1. Complete table 7.

2. Fill-in-the-blank with the appropriate response.
   a. The cell model in which cell the greatest portion will get fed is the _____ one.
   b. The cell model in the greatest danger of starving is the _____ one.

3. Suggest a reason why the rate of cell growth slows as a cell gets larger.

4. Suggest a reason why cells divide when they get large.

Table 7. Volume, surface area and surface-to-volume ratio of a series of cubes of varying sizes

		small cell	large cell
Colored portion before feeding	dia (mm)		
	radius (mm)		
	height (mm)		
	SA (mm^2)		
	vol (mm^3)		
	S/V		
Colored portion after feeding	radius (mm)		
	height (mm)		
	SA (mm^2)		
	vol (mm^3)		
	S/V		
Percent of volume (cell) fed = (initial volume - final volume)/initial volume x 100			

Exercise 8.

1. Complete Table 8.
2. Fill-in-the-blank with the appropriate response.
   a. The _____ beaker lost the most total heat.
   b. The _____ beaker lost heat at the greatest rate
   c. The _____ beaker would require the most total heat input to maintain a constant temperature.
   d. The _____ beaker would require the greatest total heat input relative to its size to maintain a constant temperature.

3. Answer the following questions either "mouse" or "elephant."
   a. Looses the most heat during a given period of time _____
   b. Looses the most heat relative to its size during a given time period _____
   c. Needs to eat the most food _____
   d. Eats the most food relative to its size _____

4. Referring to your data, explain why mice have a greater metabolic rate than an elephant.

Table 8. Effect of size on the rate of cooling (equations)		
	small	large
1. height (cm)		
2. diameter (cm)		
3. radius (cm)		
4. volume (cm^3)	8	80
5. surface area (cm^2)		
6. S/V ratio		
7. initial temp (C)	40	40
8. initial heat content (J)		
9. final temp (C)		
10. final heat content (J)		
11. total heat loss (Joules)		
12. total heat loss (Joules/min)		
13. relative heat loss (J/cm^3)		
14. Percent heat loss [(initial heat content - final heat content)/initial heat content * 100]		

Exercise 9. Answer ONE of the following questions. There are articles in the public folder, listed under "Size" that can help you answer these questions.

1. Explain why cats can fall off tall buildings and survive. Why do people splat?
2. Medieval churches were often built in the shape of a crucifix. Explain why.
3. Explain why there are no such things as giants like Brobdinangians or mini-people like Liliputians.