**BIOLOGY 100**
**SOLUTIONS TO PROBLEMS**

# PLANT STRUCTURE AND FUNCTION

1. If a leaf blade has a surface area of 150 cm$^2$ and weighs 2.00 gm, what is the surface-area/volume ratio for the leaf blade?

To solve this problem we must make an estimation of the density of the leaf blade in order to determine the blade volume. Since water has a density of 1 g/cm$^3$, and since most of the mass of a leaf blade is water, we can estimate the density of a leaf blade as 1 g/cm$^3$. Therefore, 1 g of leaf blade tissue has the approximate volume of 1 cm$^3$, and 2 g of leaf blade tissue has the approximate volume of 2 cm$^3$.

If the total surface area of the leaf blade is 150 cm$^2$, then the surface area:volume ratio is:

$$150 \text{ cm}^2/2 \text{ cm}^3 = 75 \text{ cm}^{-1}$$

2. If a petiole is 20.0 cm in length and has a perimeter at the large end of 8.4 cm and a perimeter at the small end of 2.2 cm, what is the surface area of the petiole?

Since the petiole is wider at the bottom than it is at the top, its shape resembles a trapezoid more than a rectangle. To find the area, we use the following equation:

Petiole area = [LP - 0.5(LP-SP)] x length
Where LP is the large perimeter or the width at the petiole base, and SP is the width at the top of the petiole. Note that all measurements are in cm.

So, Petiole area = [8.4 cm - 0.5 (8.4 cm - 2.2 cm)] x 20

[8.4 cm - 0.5 (6.2 cm)] x 20 cm
[8.4 cm - 3.1 cm] x 20 cm
5.3 cm x 20 cm
106 cm$^2$

3.  After tracing a leaf blade on the page of + marks, you count 154 + marks inside the tracing and 12 + marks are on the line of the tracing. What is the surface area of the leaf blade?

Each cross inside the leaf tracing corresponds to 18 mm². If a cross lies on the edge of the tracing (in other words, the entire cross is not inside the tracing), we estimate this area as 1/2 of 18 mm², or 9 mm².

$$(154 \text{ crosses})(18 \text{ mm}^2) + (12 \text{ crosses})(9 \text{ mm}^2) = 2880 \text{ mm}^2$$

To obtain the surface area in cm², divide the surface area in mm² by 100, since there are 100 mm² in a cm²:

$$(2880 \text{ mm}^2)(1 \text{ cm}^2/100 \text{ mm}^2) = 28.8 \text{ cm}^2$$

This calculation gives you the surface area of one leaf surface. To determine the total surface area of the leaf blade, you need to consider the other blade surface as well. To do this, simply multiply the surface area of one surface by 2: $(28.8 \text{ cm}^2)(2) = 57.6 \text{ cm}^2$.

4.  After making an impression of the upper surface of a celery leaf, you view the impression using a microscope at l00X magnification. You count 12 stomata in a field, what is the stomatal density for this leaf surface?

First we need to know the area field of view at 100X. Referring to the Microscopy Laboratory Exercise, we find that the diameter of the field of view at 100X is 1.8 mm, which means the radius (half the diameter) of the field of view is 0.9 mm.

The area of a circle is found using the equation:

$$\text{Area} = \pi r^2, \text{ where } r = \text{radius of the circle}$$

So,

$$(3.14)(0.9 \text{ mm})^2$$
$$3.14 \times 0.81 \text{ mm}^2$$

$$\text{Area of the field of view at 100X} = 2.5 \text{ mm}^2$$

If we saw 12 stomata in one field of view, then the stomatal density is 12 stomata/2.5 mm². To obtain the stomatal density per mm², divide by 2.5 to obtain a stomatal density of 4.8 stomata/mm².