

Stomata Density Lab



Part I. Background Information and Pre-lab work:

Leaf stomata are the principal means of gas exchange in vascular plants. **Stomata** are small pores on leaves, that are opened or closed under the control of a pair of banana-shaped cells called **guard cells**. When open, stomata allow CO₂ to enter the leaf, and allow for water and oxygen to escape. In addition to opening and closing the stomata, plants may exert control over their gas exchange rates by varying stomata density in new leaves when they are produced (such as in the spring or summer). The number of stomata per known unit area is called the **stomata density**, expressed in the unit of stomata/mm².

Why might it be adaptive for a plant to control its rates of water loss and CO₂ uptake? One answer can be found in the sun. Increases in heat could denature proteins of membranes of chloroplasts, the organelle in plant cells that absorb the sun's radiant energy. When overheated, plants may open the stomata to evaporate water to lower the temperature. Based on this, you could hypothesize that leaves in the sun would have a higher stomata density than leaves in the shade.

On the other hand, if water is not available, such as under drought conditions, excessive evaporation might lead to desiccation (drying out.) Plants in hot areas may benefit from fewer stomata so that they can conserve water.

The discussion illustrates an important concept in experimental biology, that there are often alternative hypotheses to explain variation in nature. In this case, the stomata density may increase or decrease in response to environmental variation in sunlight or heat, and water availability.

In this lab activity, we will be using succulent and non-succulent plant leaves. Succulents are plants with parts that are thickened, fleshy and engorged, usually to retain water in arid climates or soil conditions. They will also have a noticeable waxy coating on the surface of the leaves, especially the upper surface. The word "succulent" comes from the Latin word *sucus*, meaning juice, or sap which describes succulent plants' ability to store water in various structures, such as leaves and stems.

Phenomenon: View the [video](#) closely and brainstorm observations and the questions you come up with afterward. You should note at least 3 observations and three questions you think of afterward.

Video link: https://www.youtube.com/watch?v=6_fGT1ksXKM

Observations	Questions

Use the background information to answer the following questions.

1. Which gases enter the stomata, and which exit?
2. Two hypotheses for stomata density are described in the background information. What are they?
3. Plant species might have variation in the number of stomata present on their leaves. Why?
4. Plants move water from the roots of the plant to the leaves through a process called transpiration. As water evaporates from the leaf, water in the roots is pulled up. How is stomata density related to the rate of transpiration? [Transpiration and stomata](#) reading.

Link to reading:

<https://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1092853841&topicorder=6>

Part II. Laboratory Instructions and Information:

Materials:

Glass slides, collected leaves, clear nail polish, clear tape, microscopes, and pencils.

Plant Species – see stakes and labels for each plant to see which ones are available for this lab.

<u>Succulent Plant Species</u>	<u>Non-succulent Plant Species</u>
<ul style="list-style-type: none">• Purple heart (<i>Tradescantia pallida</i>)• Florist kalanchoe, aka widow's thrill and Flaming Katy (<i>Kalanchoe blossfeldiana</i>)• Goldfish Plant (<i>Columnea gloriosa</i>)	<ul style="list-style-type: none">• Brazilian Jasmine, aka Mexican love vine (<i>Mandevilla sanderi</i>)• Golden pothos, aka Devil's ivy, Taro vine, and Hunter's robe (<i>Epipremnum aureum</i>)
*Unknown plant species (leaves have red borders)	

Methodology: Procedure for Counting Stomata [Tutorial Guide](#)

Link to leaf cast tape application: https://www.youtube.com/watch?v=CbcbiT_m8Sk

1. Obtain a leaf. Be sure it is dry and free from dirt.
2. Paint a **thin strip** of clear nail polish a section of the leaf (paint between parallel veins). Allow the fingernail polish to completely dry.
3. Place a piece of clear tape over the outer third of the dried nail polish. Gently but firmly press the tape onto the leaf so it sticks enough for the next step.
4. Peel the tape from the leaf and place the tape sticky side down onto a microscope slide. Fold the tape over itself so it makes a tab on which you can label the sample you have. Examine the nail polish leaf casting attached to the tape which now contains an impression of the leaf cells. Try to use both scanning and low power to find the stomata.
5. Count the number of **stomata** in the field of view. Move the slide so you can see other areas. It is best to take an average of several areas on the leaf.

Name: _____ Per: _____ Date: _____

Stomata Lab Student Responses

/45

After researching the different plant species, write a **measurable hypothesis** to compare succulent vs. non-succulent leaves and number of stomata. 6 pts

If _____
(IV: "This is done" to the variable the scientist chooses to change)

then _____
(DV: this will happen to the variable measured as a result)

because _____
([research](#) how stomata # may differ in succulent vs. non-succulent plant types)

A. Sketch (choose power with a reasonable number of stomata to count) 8 points

If absent view photos linked below:

[Upper surface Goldfish](#)

[Lower surface Goldfish](#)

[Upper Surface Brazilian Jasmine](#)

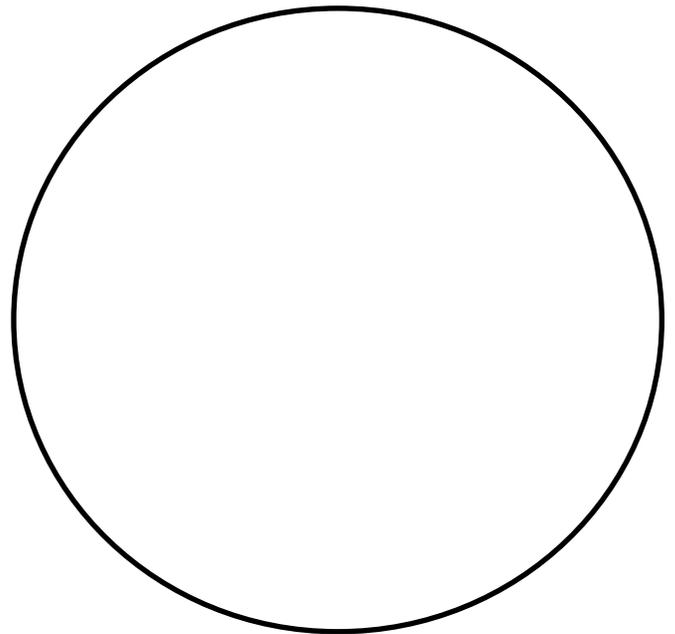
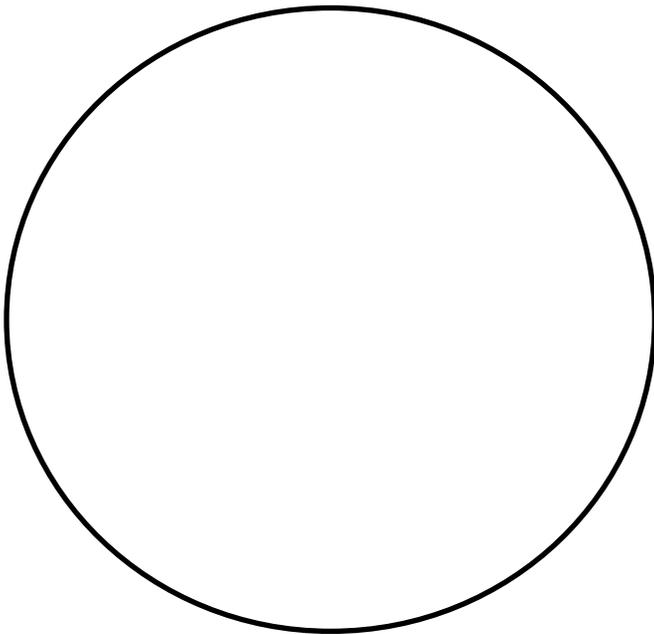
[Lower Surface Brazilian Jasmine](#)

Slide/specimen title: _____

Slide/specimen title: _____

Total Magnification: _____

Total Magnification: _____



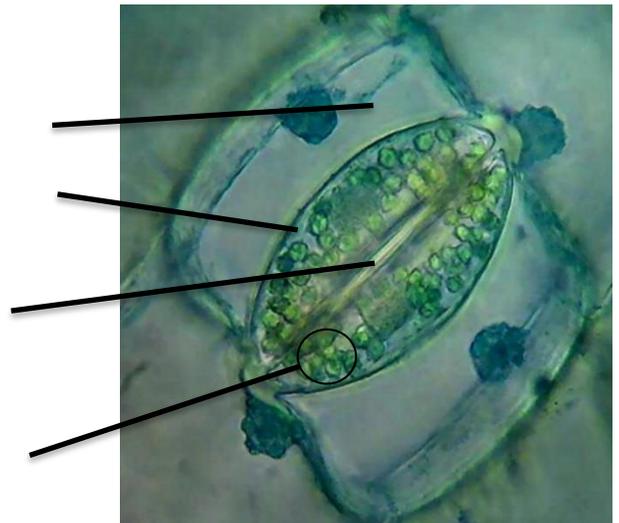
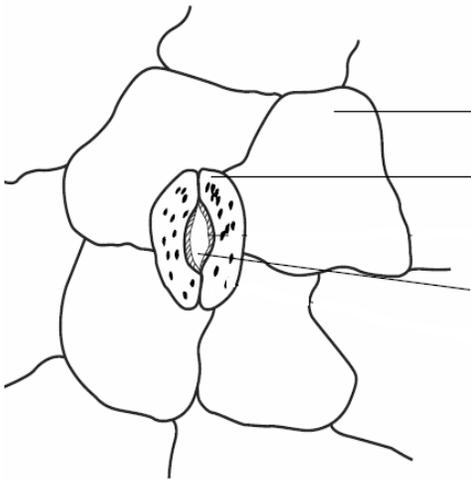
Number of Stomata in Fields of View on each surface of Leaf Samples. 8 pts

Surface of Leaf Sample #1 (Succulent)	View 1	View 2	Average Number of Stomata	Stomatal Density Average # of Stomata/area Low power area=3.14mm ² High power area= 0.13mm ²
Top Surface				
Bottom Surface				

Surface of Leaf Sample #2 (Non-Succulent)	View 1	View 2	Average Number of Stomata	Stomatal Density Average # of Stomata/area Low power area=3.14mm ² High power area= 0.13mm ²
Top Surface				
Bottom Surface				

Calculation Space

B. Label the diagrams below using the words (guard cell, stoma (opening), chloroplasts (green dots), & plant leaf cell)



C. Discussion Questions (20 pts):

1. Which plant sample (succulent or non-succulent) has more stomata? Use data. [conclusion] (3 pts)
2. Which surface (top or bottom) has a greater stomatal density? Use data [conclusion]. (3 pts)
3. What was an advantage and a disadvantage to using the nail polish casting method? [validity] (3 pts)
4. What would likely happen to the stomata in the following situations: [predictions] (3 pts)

High wind **open** **closed** (circle one)

Daylight **open** **closed** (circle one)

Night **open** **closed** (circle one)

5. Different types of plants (succulents vs. non-succulents) often have different numbers of stomata. Why might this be the case? What abiotic factors may be involved? [predictions] (3 pts)

6. Reflection: The following image was taken from a Venus Fly Trap lower leaf surface. How does the stomatal density compare to student collected leaf data? What does this infer (mean) about the Venus Fly Trap? [application] **SHOW WORK** (5 pts)

