Name_____

Changing Planet: Withering Plants – Stressing Over Lost Water

Background

Plants have entry and exit points for the materials necessary for their growth and survival. Water is taken up by plant roots, and after it used it exits through pores on the underside of plant leaves called stomata. Carbon dioxide enters and oxygen exits through the stomata as well. Stomata have guard cells that regulate the opening and closing of the stomata. Can you think of situations when it is not beneficial for the plant to have the stomata open? Periods of drought and exposure to environmental stressors such as pollutants and high temperatures can trigger the opening or closing of the stomata, as can something as simple as availability of sunlight. In the case of temperature, the stomata tend to stay open to release water. The water assists in cooling the plant as it evaporates, although an issue arises when the amount of water taken up by plant roots does not equal the amount of water that exits the plant leaves through the stomata, causing the plant stress. In this laboratory you will hypothesize about the variation in the status of the stomata (open or closed), create and analyze microscope slides of stomata, and use your results to reflect on your hypothesis. Figures 1 and 2 are examples of tomato leaf stomata as viewed under the microscope.

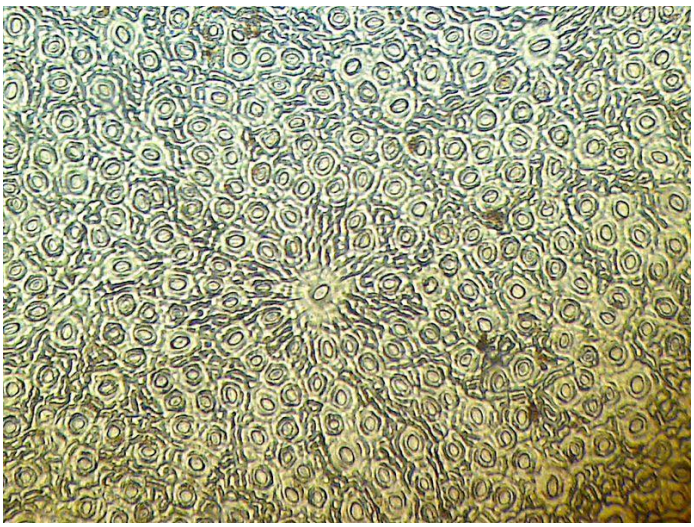


Figure 1: Impression of leaf stomata using clear nail polish. Viewed at 40x under a microscope. (Wikipedia - public domain)

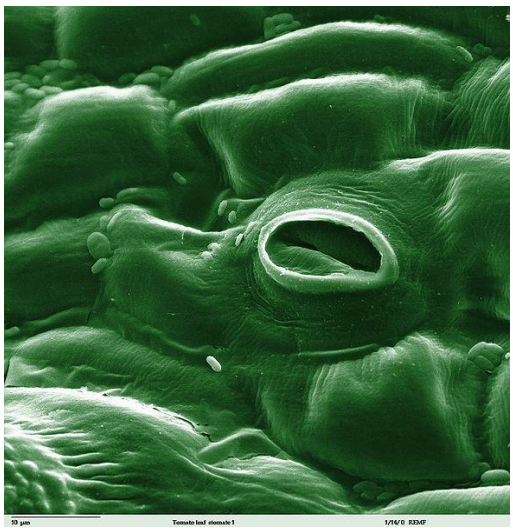


Figure 2: Colorized electron microscope image of a stoma on the leaf of a tomato plant. (Wikipedia – public domain)

Lab Question

Is there variability in the stomata founded in wilted plants and fresh plants?

Hypothesis

Use the space below to write a hypothesis that reflects on the above question.

Materials per lab team
4 Microscope slides
Clear adhesive tape
Clear nail polish
Scissors
Marking pen
Microscope (40X)
2 fresh and 2 wilted leaves from the same plant species

Procedure
1. Acquire the materials in the list above.

2. Start with one of the fresh leaves, and on the underside of the leaf, paint a patch the size of your fingernail with the clear nail polish. If you are using a fuzzy leaf, be sure to paint below the fuzz in order to reach the stomata.

3. It will take the nail polish several minutes to dry. After it has dried, place a piece of clear tape slightly larger than the size of the painted patch over the nail polish and gently press down to allow the nail polish and leaf layer with stomata to adhere to the tape.

4. Gently peel off the tape, and place it tacky side down on the microscope slide. The stomata cast will look cloudy when it is on the tape. Use scissors to remove excess tape. Use the marker to label the slide. Repeat procedure steps 2 and 3 for the other 3 leaves.

4. Using high power (40x) on the microscope view the stomata. Confirm with your teacher that what you are looking at are leaf stomata. Use the space below to draw what you observe.

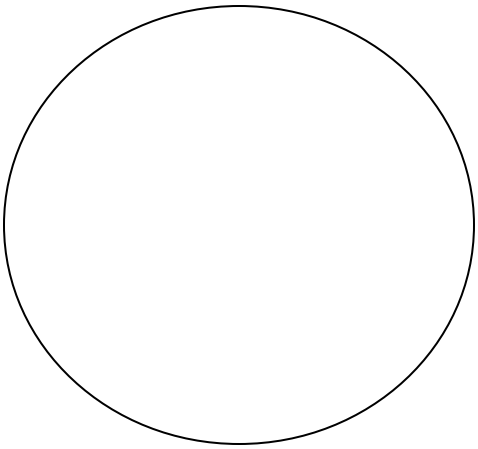


Figure 3: 40X view of leaf stomata

5. Move the slide to 3 different locations (fields) and record in the data table below the number of open and closed stomata in each field of the slide. Add up the total number of open and the total number of closed stomata viewed and record it on the data table.

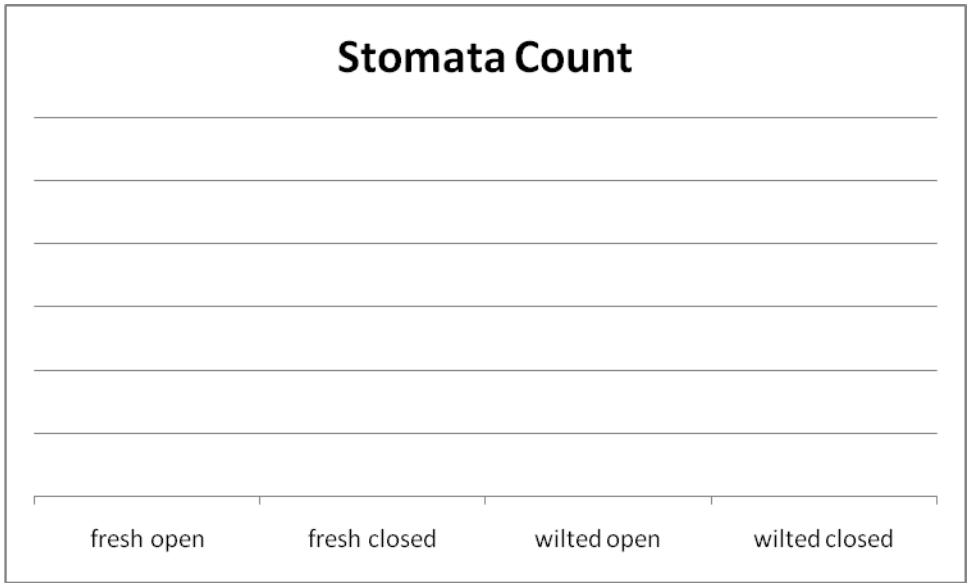
6. Repeat step 5 for each of the other 3 slides.

Data Table

	Field #1		Field #2		Field #3			
	Open stomata	**Closed stomata**	**Open stomata**	**Closed stomata**	**Open stomata**	**Closed stomata**	**Total open**	**Total closed**
Slide 1 *fresh*								
Slide 2 *fresh*								
Slide 3 *wilted*								
Slide 4 *wilted*								

7. Use the space below to create bar graph of the total number open and closed stomata for the fresh and wilted leaves. Use your data to determine the range for the vertical axis.

Graph



Analysis

1. Which leaves had the most open stomata, fresh or wilted? _____ Why do you think this is so?

2. Compare your data with that of other teams. Is the data consistent from one team to the next? Explain your response citing examples from the data of other teams?

3. Why do scientists use multiple samples when they perform experiments?

Conclusion

4. Do you accept or reject your hypothesis? _____ Explain why using your data in your response.

5. Review the procedure you used in this laboratory investigation. Were there errors in your procedure? _____ What would you do differently in the future to ensure you have a quality data?

Application

6. How do stomata open and close?

How do guard cells work?

7. Plants confronted with differing environmental conditions vary in the number of stomata and whether they are open or closed. The number of stomata on a leaf varies, although stomata size does not. Why would a plant vary the number of stomata and not size?

8. Some plants have stomata on the surface and the underside of their leaves. What is this adaptation for?

9. Reflect back to the content of the *Changing Planet* video *Withering Crops*. Describe how this laboratory investigation demonstrates the impact of a changing climate on the survival of crops. Suggest one other investigation that can be performed to determine the consequences of a warming planet on the growth of crops.

10. Describe some physical aspects of leaf design that would reduce water loss in a dry environment. Consider the following:

Leaf size:

Leaf shape:

Leaf thickness:

Water proofing:

Stomata quantity & placement: