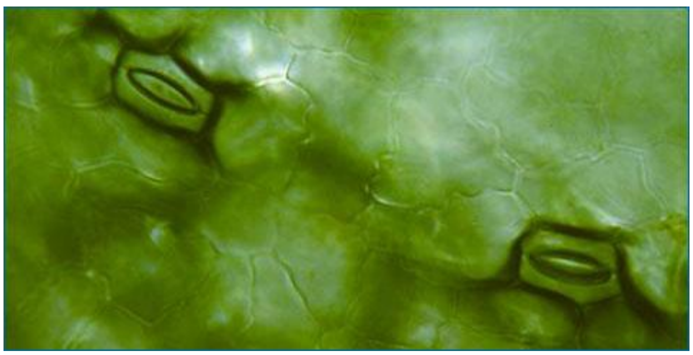
Name: ____Per:__________Date:_________

Stomata Reading honors

Leaves with microscopic mouths

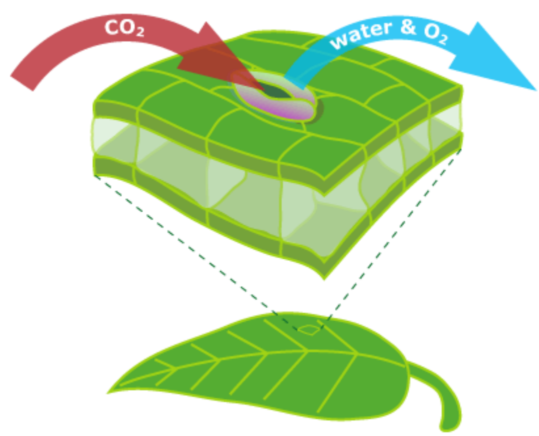
The keys to Jennifer's research are microscopic pores on the surfaces of leaves called stomata (singular: stoma) which plants use to "breathe." Plants need carbon dioxide, just as we need oxygen, and stomata allow the plant to take in carbon dioxide to perform photosynthesis. In the process of photosynthesis, the plant will chemically convert that gas into sugar, which the plant can use to fuel cellular processes, grow, and reproduce.



Two stomata on a duckweed leaf.

Stomata, which means "mouths" in Greek, do indeed resemble tiny mouths surrounded by swollen lips. The "lips" are actually individual cells (called guard cells) that can swell up to open the stomata or deflate to close them off. But why would a plant want to close off its stomata, effectively cutting it off from essential carbon dioxide? Well, plants also need water, and any time that a stoma is open, the plant loses water (along with oxygen, one of the waste products of photosynthesis). By closing the stoma when the plant has enough carbon dioxide, the plant can preserve its water and prevent itself from drying out.

Carbon dioxide enters, while water and oxygen exit, through a leaf's stomata.

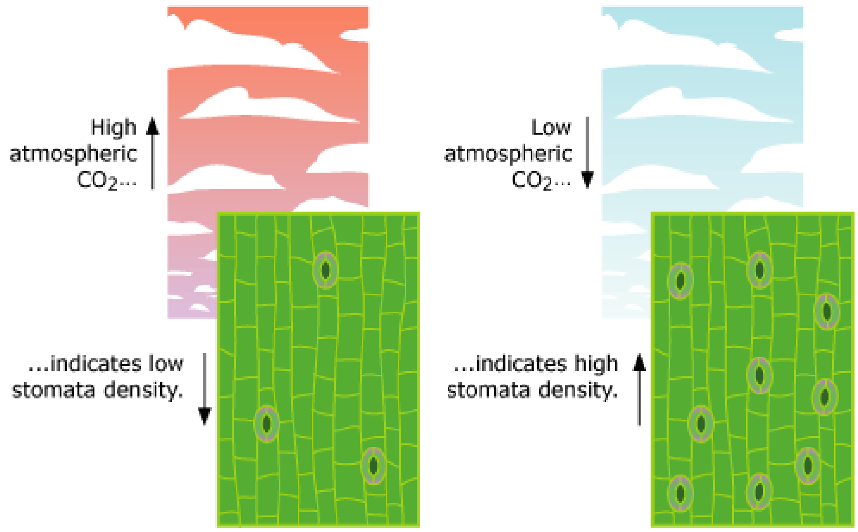


The story in the stomata

Jennifer studies stomata that are preserved on the surfaces of fossil leaves. But what do stomata have to do with climate change? As an undergraduate in Ireland, Jennifer discovered that the number of stomata per square inch of leaf surface can reveal different aspects of the atmosphere in which that plant lived. Since then, she has continued in this vein of research. As Jennifer puts it, "Plants are wonderfully in tune with their environments, so there are many proxies or signals that we can obtain from fossil plants. We can work out the temperature they lived in, the atmospheric environment, and the carbon dioxide concentration."

It works like this. Stomata control a tradeoff for the plant: they allow carbon dioxide in, but they also let precious water escape. A plant that could get enough carbon dioxide with fewer stomata would have an advantage since it would be better able to conserve its water. Levels of carbon dioxide in Earth's atmosphere change over time — so at times when the atmosphere is carbon-dioxide-rich, plants can get away with having fewer stomata since each individual stoma will be able to bring in more carbon dioxide. During those high-carbon-dioxide times, plants with fewer stomata will have an advantage and will be common. On the other hand, when carbon dioxide levels are low, plants need many stomata in order to scrape together enough carbon dioxide to survive. During low-carbon-dioxide times, plants with more stomata will have an advantage and will be common.

Jennifer uses stomata as indicators of carbon dioxide levels at different points in Earth's history. Experiments help her figure out the exact relationship between stomata and carbon dioxide. Using growth chambers, she can simulate the temperature, light level, and atmospheric conditions common at different times in the deep past and at different places on Earth. So even when it's subzero in Chicago, her seedlings might feel as though they are growing in sunny California or in the humid swamps of the Jurassic. Studying how modern plants respond to these environments helps Jennifer understand how the characteristics of long extinct plants were affected by their environments.



Questions

1. What is the function of stomata? How do they assist in an important cellular process?

2. How can stomata be used to study the environment over time?

3. Describe the tradeoff stomata have for the plant.

4. How are stomata examples of an adaptation?