Name _____

STEM Data Analysis: Optimal Conditions for Photosynthesis

Plants use photosynthesis to make the nutrients they need to grow. Different plants require different amounts of light, water, and carbon dioxide, and different temperatures. Growth chambers allow plant biologists to maintain the most favorable growing environment for different species of plants.

Temperature: Temperature, including air temperature and soil temperature, affects plant growth processes: photosynthesis, water intake, nutrient intake, and cell division. High temperatures can slow photosynthesis by causing enzymes to denature ("unravel.") Cold temperatures can damage plant roots and cause the plant to die. **At temperatures below 7°C (about 45°F), the roots of a plant cannot take up water and nutrients.**

Light: Plants get the energy for photosynthesis from light. Plants only use some of the wavelengths of light from the sun. Light sources other than sunlight, such as fluorescent light and grow lights also emit the same range of light wavelengths. **Too little light, too much light, or the wrong kind of light, will slow down the growth plants.**

Carbon Dioxide: Plants need carbon dioxide for photosynthesis. They take carbon dioxide in from the atmosphere through tiny holes in their leaves. It seems like an increase of atmospheric carbon dioxide would help plants. **But the increase in carbon dioxide could cause the temperature to rise to a point that is damaging to some plants.**

Water: Water is absorbed from soil through plant roots, and is then transported to all cells in the plant. Excess water is released as gas through pores in leaves called stomata. When the air around the plant becomes saturated with water, the humidity rises. This prevents water vapor from evaporating from the leaf and water from being drawn up from the roots. **Thus, high humidity can cause a water deficit in the plant, causing the plant to close its stomata. With the stomata closed, carbon dioxide is blocked from entering the plant, slowing photosynthesis.**

Analyze It

Different plants have different requirements for photosynthesis and growth. ***Geraniums*** are common garden plants that are hardy plants, meaning they do well in most climates. Use the data about temperature and light needs of geraniums to answer the analysis questions:

Ideal conditions for a geranium:

Ideal Daytime Temperatures: 21°C-23°C (about 70-75°F)

Ideal Nighttime Temperature: 16°C - 18°C (about 61°F - 65°F)

Natural Light: at least 6 hours of direct sunlight

Artificial light: 12 inches below a 40-watt fluorescent bulb for 16 hours per day

1. Selena is growing geraniums outdoors in a pot. During the day, the temperature averages 22°C (72°F). At night, the temperature has been dropping to around 13°C (55°F). What advice would you give to Selena and why?

2. Jaden grows geraniums in his greenhouse. He has noticed that his flowers are not growing very well. The greenhouse is in the shade for much of the day and maintains a temperature of 23°C (74°F). What might be the problem and what could Jaden do to fix it?

3. Emma lives in Wisconsin and wants to plant geraniums in her yard. The average daily temperature in her area is 21°C (70°F) and the nighttime temperatures are averaging 18°C (65°F). The area where she would plant the geraniums gets full sun all day. Would you suggest she plant her geraniums? Why or why not?