ScienceCube

Transpiration

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1. **Observe and explain the change in humidity when a plant is placed in a sealed space.**

2. **Identify and explain the conditions for active transpiration.**

Fundamental Concept

1. **Transpiration**

① Water absorbed by the roots travels up the xylem and primarily exits as water vapor through the leaves. This process of water vapor exiting through the leaves is called transpiration.

② Occurrence location: Stomata in the leaves.

2. Significance of Transpiration

① It drives the absorption of water and nutrients from the roots.

② It concentrates minerals by evaporating unnecessary water into the air, thus regulating the water content within the plant.

③ It helps regulate the plant's temperature by removing heat through the evaporation process..

3. Conditions for Active Transpiration

① Light: Strong light intensity increases photosynthesis in guard cells, raising their turgor pressure and opening the stomata. Conversely, weak light closes the stomata.

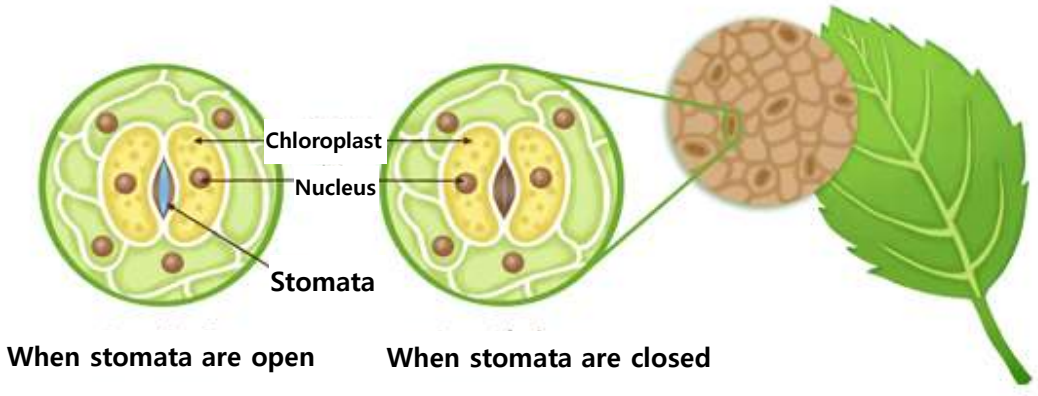
② Temperature: Higher temperatures increase stomatal opening, enhancing transpiration.

③ Wind: Moderate wind removes water vapor or gases around the stomata, promoting transpiration.

④ Humidity: High air humidity closes the stomata, reducing transpiration. Dry air opens the stomata, increasing transpiration.

4. Mechanism of Transpiration

Transpiration is regulated by the opening and closing of stomata.



① When stomata are open: Guard cells absorb water, increasing turgor pressure. The thin outer walls expand, while the thick inner walls remain less expanded, causing the cells to curve outward and open the stomata.

② When stomata are closed: When water content decreases, turgor pressure drops, and the cells return to their original state, closing the stomata..

Experiment

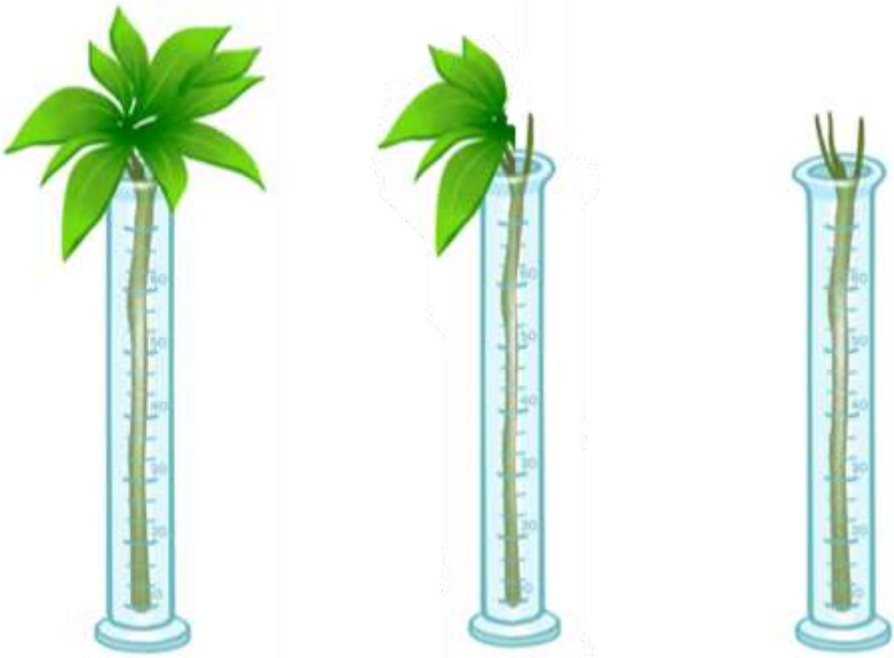
Materials Needed

Interface, Science# Program, Humidity Sensors (3), Graduated Cylinders (3), Plant with many broad leaves, Cooking Oil, Water, Dropper, 500 mL Beaker, Light Block, Disposable Plastic Bags, Transparent Tape

Preparation of Experimental Setup

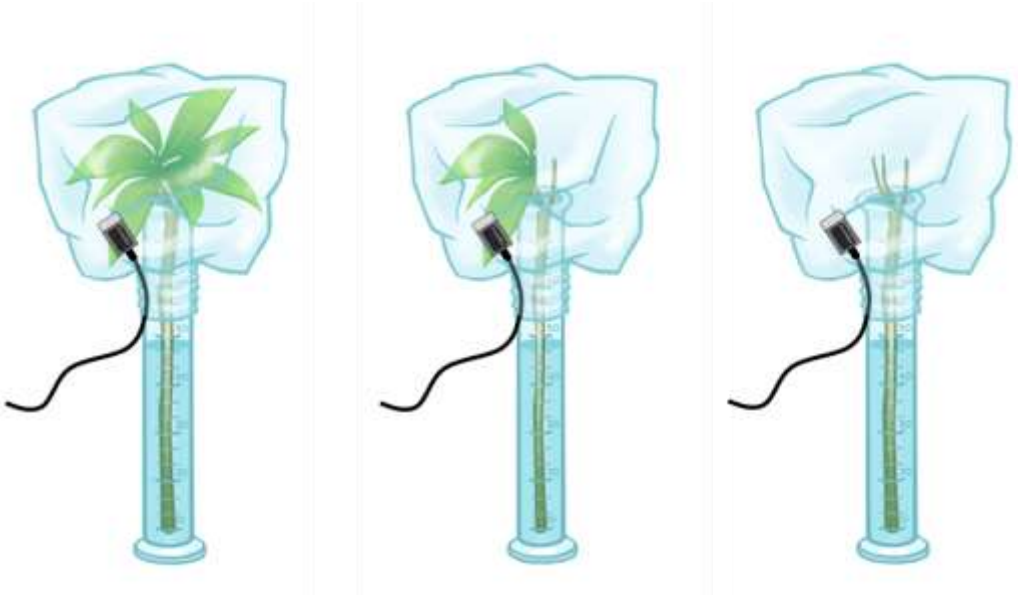
[Experiment 1] Transpiration Based on the Number of Leaves

1. Place plants with different numbers of leaves in three graduated cylinders. Ensure the roots and stem lengths are similar.



2. Add 50 mL of water to each graduated cylinder, then add 5 mL of cooking oil on top to prevent water evaporation.

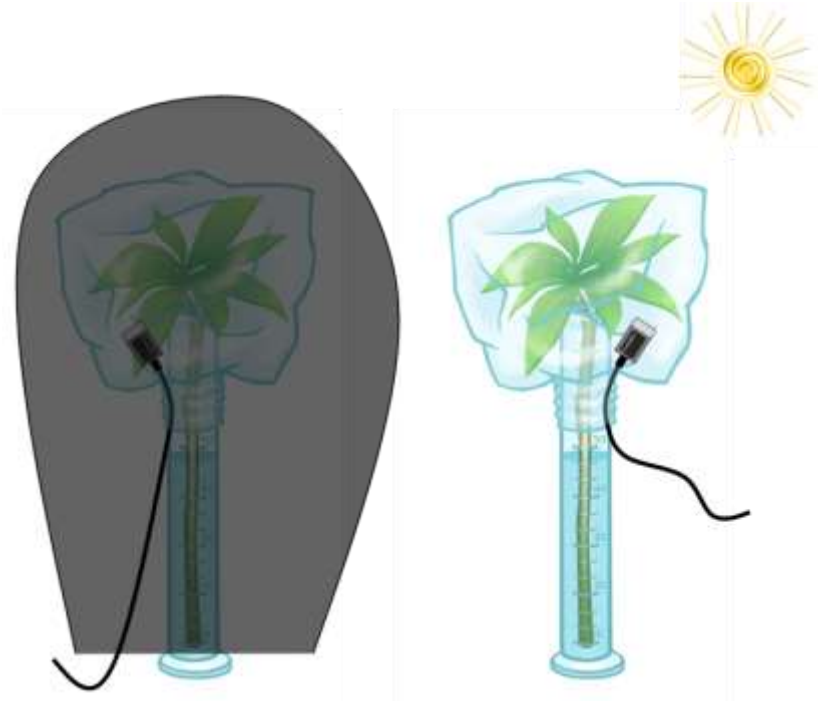
3. Insert a humidity sensor connected with a cable into a plastic bag, cover the plant, and seal with transparent tape.



[Experiment 2] Transpiration Based on Light Intensity

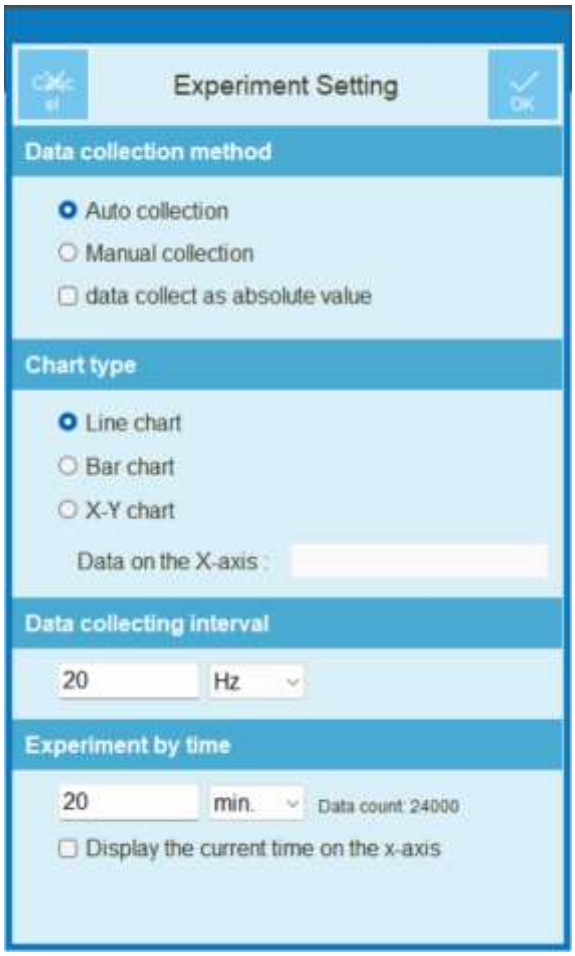
4. Place two plants with similar numbers of leaves, roots, and stem lengths in separate graduated cylinders and repeat steps #2-3.

5. Cover one plant with a light block to prevent light exposure.



Interface Setup

1. Launch the Science# program.
2. Connect the humidity sensors to the interface.
3. Press to set up the experimental environment as shown below, or use the automatic setting option.



Data Collection

1. Press to start data collection.

Data Analysis

Recording Data

1. Draw a graph showing the change in humidity based on the number of leaves.

2. Record the change in humidity based on the number of leaves in the table below.

Condition	Number of Leaves	Initial Humidity (%)	Final Humidity (%)	Change (%)
Many leaves				
Few leaves				
No leaves				

3. Draw a graph showing the change in humidity based on light intensity.

4. Record the change in humidity based on light intensity in the table below..

Condition	Initial Humidity (%)	Final Humidity (%)	Change (%)
In darkness			

In light			

Data Application

1. Describe how humidity changed over time in a sealed space and explain the reason.

2. Summarize the findings from the change in humidity based on light intensity and explain the reason.

3. Summarize the findings from the change in humidity based on the number of leaves and explain the reason.

4. Identify conditions that affect transpiration and summarize the conditions for active transpiration.

Extension Activity

1. Identify the incorrect effect of transpiration from plant leaves..
   ① It drives the upward movement of water and minerals absorbed by the roots.
   ② It prevents the plant's temperature from rising.
   ③ Transpiration slows down when there is a high water content in the plant.
   ④ It concentrates nutrients in the plant by evaporating water.
   ⑤ High water content in the plant opens stomata, promoting active transpiration.

2. Cacti, covered in spines, do not have leaves. Their leaves have evolved into spines to adapt to the arid desert environment. This adaptation helps reduce water loss by minimizing the surface area from which transpiration can occur. Additionally, spines provide shade, reducing the temperature of the cactus surface and further decreasing water loss. The spines also protect the cactus from herbivores that might consume the plant for its moisture. This evolutionary change is crucial for the survival of cacti in the harsh, dry conditions of the desert.


Report
(For Students)
Report
(For Teachers)