ScienceCube

Transpiration (SSB)

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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 mainly 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.

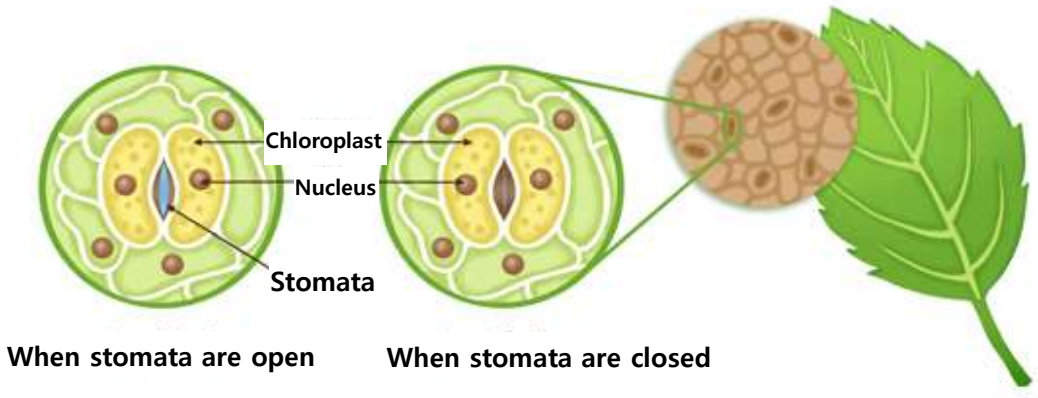
② Temperature: Higher temperatures increase stomatal opening, enhancing transpiration.

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

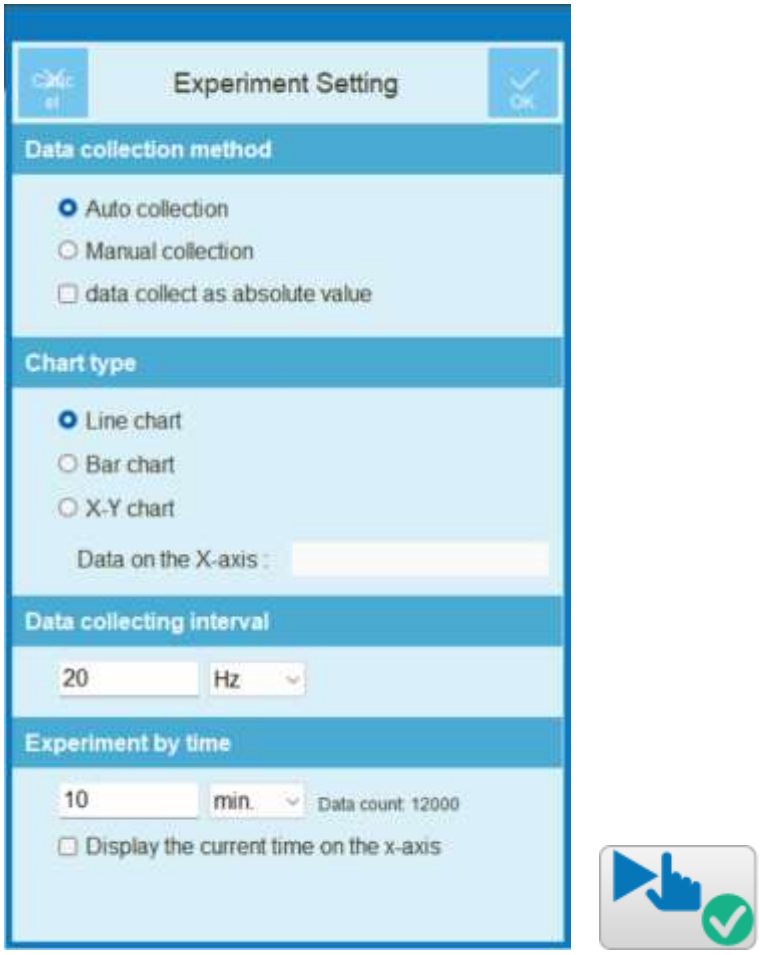
Smart Sensor Box (Interface), Science# Program, Potted plant (e.g., Myeongwolcho), Transparent plastic bag, Black plastic bag, Rubber bands

Preparation of Experimental Setup

1. Place a potted plant with many leaves and the Smart Sensor Box inside a transparent plastic bag and seal it with a rubber band.


Interface Setup

1.  Launch the Science# program.
2. Select 'Humidity' by pressing  .
3.  Set up the experimental environment as shown below, or use the automatic setting option. 



Data Collection

[Experiment 1] Transpiration Based on Light Intensity

1. Observe the humidity data of the plant in light by pressing . 
2. After the experiment, remove the transparent plastic bag and cover the plant with a black plastic bag.


3. Observe the humidity data of the plant in darkness by pressing .
4. Compare the humidity data of the plant in light and darkness.

[Experiment 2] Transpiration Based on the Number of Leaves

5. Press to observe the humidity data changes of the plant with many leaves.
6. After the experiment, remove the rubber band and take off the plastic bag. Remove about half of the leaves and reseal the bag.


7. Press to observe the humidity data changes of the plant with fewer leaves.
8. After the experiment, remove the rubber band and take off the plastic bag. Remove all the leaves and reseal the bag.


9. Press to observe the humidity data changes of the plant with no leaves.
10. After the experiment, compare the humidity data changes based on the number of leaves.

Data Analysis

Recording Data

[Experiment 1] Transpiration Based on Light Intensity

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

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

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

[Experiment 2] Transpiration Based on the Number of Leaves

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

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

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

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 evolution is related to their habitat because in dry deserts, reducing water loss is crucial for survival. Spines help minimize water loss by reducing the surface area from which transpiration can occur. Additionally, spines can

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.