

## HOW DO PLANTS QUENCH THEIR THIRST?

### Confused geraniums

Mrs. Westwood lives in a small, calm village. She has been in retire for two years now thus she has plenty of time for her hobby – gardening. She is very proud especially of her geraniums which are admired by all the inhabitants of the village. Mrs. Westwood has the geraniums on all her window ledges and also hanging on the fence so that everyone walking by can see them.

This June has started very tough time for the village. Due to the closure on nearby highway a road diversion has been going through the village. All the noises and smells of fumes produced by cars and trucks have affected the calm life of villagers very much.

At the end of June, Mrs. Westwood noticed that her always so beautiful geraniums had started to wilt even though she watered and manured them as usually. And moreover, Mrs. Westwood also noticed that the water level in flower boxes stayed the same for many days. “Why the geraniums don’t drink when there is obviously lack of water in them?” That was a real mystery for Mrs. Westwood...



**Can you think of a reason why the geraniums don’t absorb any water despite of the fact that they are wilting?**

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**Useful to remember:**

1. As well as other living organisms on Earth, plants need water. What is the role of water in plants? Which physiological processes require water in their reactions?

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2. Match the following terms (action – part of plant – process) so that the triplets describe water economy of plants.

Intake of water	Stomata, cuticle	Absorption
Water transport	Vascular tissue	Transpiration
Water loss	Root hair	Transpiration stream

3. Which environmental factors have an influence on the transpiration? What is the mechanism of the influence?

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4. Which physical quantities could you measure for confirmation of transpiration in plant?  
How would the quantity change in time?

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5. There are two ways of transpiration. Water vapour can be lost either through the stomata or directly from the epidermal cells through the cuticle.

→ Which type of transpiration has a bigger proportion of total water loss? Compare young and mature leaf.

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6. Human activities produce emissions which can be very harmful to plants. In which way can emissions influence plant transpiration?

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## Experiment: transpiration of plants – changes in air humidity

**Task:** Explore an effect of clogged stomata on transpiration rates.

### Questions:

1. What are your expectations about changes of transpiration rate after clogging of stomata? Explain.

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2. Blockage of stomata means complications in other plant processes. Which ones?

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### Materials and devices:

- Relative Air Humidity Sensor + connector
- Datalogger or computer with an appropriate software
- Green live leaves: cowslip/ maple/ ivy/ ...
- Jam jar (0.75 – 1 l)
- Small glass (0.5 dl)
- Scalpel (or razor blade)
- Cling wrap
- Vaseline
- Paper tissues

### Procedure:

- 1) Prepare a leaf for the experiment: working under the water (e.g. in a sink), use the scalpel or the razor blade to cut obliquely the petiole. Hold the petiole under the water and the blade of the leaf above the water surface.
- 2) Fill the small glass with water and seal it up with cling wrap. Then, make a small hole into the cling wrap so that the leaf petiole can go through. Push the petiole through the hole into the water (the petiole has to be submerged).

- 3) Put the apparatus together as shown in Fig. 1:
  - a. Put the small glass with the leaf and the Relative Air Humidity Sensor into the jar.
  - b. Using the cling wrap, seal the neck of the jar. No air from outside should penetrate inside the jar.

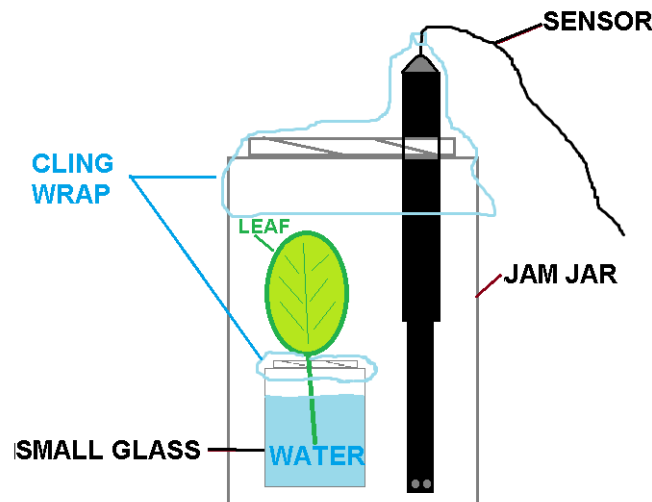


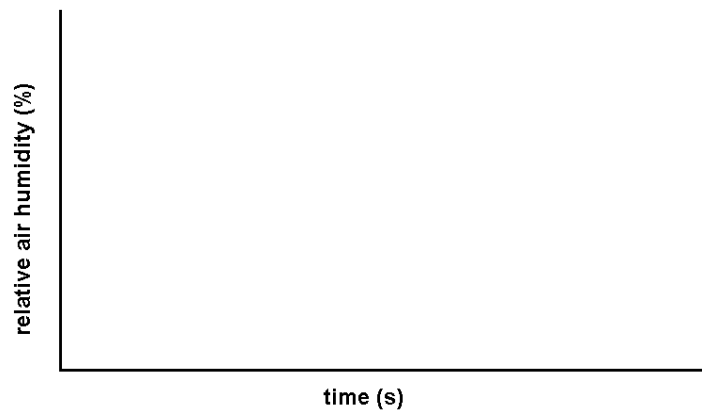
Fig. 1: Apparatus for measuring the changes in relative air humidity (Bílá, J).

- 4) Connect the Relative Air Humidity Sensor to the computer.
- 5) Run the computer interface for collecting data from sensors.
- 6) Wait approximately 5 minutes for sensor equilibration.
- 7) Start 15 minutes (900 s) data collection. Note the first measured value of relative air humidity to the table in section *Data*.
- 8) Stop the data collection and note the value of relative air humidity for time=900 s to the table in section *Data*.
- 9) Put the cling wrap aside and take out the small glass with the leaf.
- 10) Put the vaseline all over the lower (abaxial) epidermis of the leaf. Change the air in the jar for a fresh air from the room.
- 11) Put the apparatus together. Make sure it is sealed up properly.
- 12) Start 15 minutes (900 s) data collection – chose the option '*add new data to the end*'. Note the time ( $t=.....$  s) and the value of relative air humidity in the beginning of the new measurement to the table in section *Data*.
- 13) After 15 minutes, stop the data collection. Note the value of relative air humidity in time  $t+900$  s to the table in section *Data*.
- 14) Count the difference between the beginning and the end of each measurement. Note the results to the table in section *Data*.
- 15) Find the rate of transpiration (%/s) for your leaf: record the slope of the lines for the two phases in your graph.
- 16) Save your data.
- 17) Clean and dry the apparatus.

**Data:**

Write your data into following table. Then, draw a shape of the curve of measured data to the empty graphs. Don't forget to mark on the x-axis also the conditions of measurement.

	Initial value of relative air humidity [%]	Terminal value of relative air humidity [%]	Difference [%]	Slope [%/s]
Leaf with free stomata				
Leaf with clogged stomata				



**Conclusions:**

1. How did the value of relative air humidity change during the first phase of measurement? Why?

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2. What was the result of clogging of stomata? Why?

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3. Do your expectations match with the measured data? If not, why it could be?

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4. Write to Mrs. Westwood a short message. Explain to her what probably happened to her precious geraniums.

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