Transpiration: By pressure change (potometer).

Apparatus

A ±25 kPa Differential Gas Pressure sensor

Clear plastic tubing 3 mm inside diameter (as used to supply oxygen to aquaria)

Variety of leafy shoots – with stem to fit into tubing

Tubing adapters, small pieces of tubing of different sizes.

Plastic pipette points

Desk lamp

Electric fan

Data recording setup.

Single pane layout, graph.

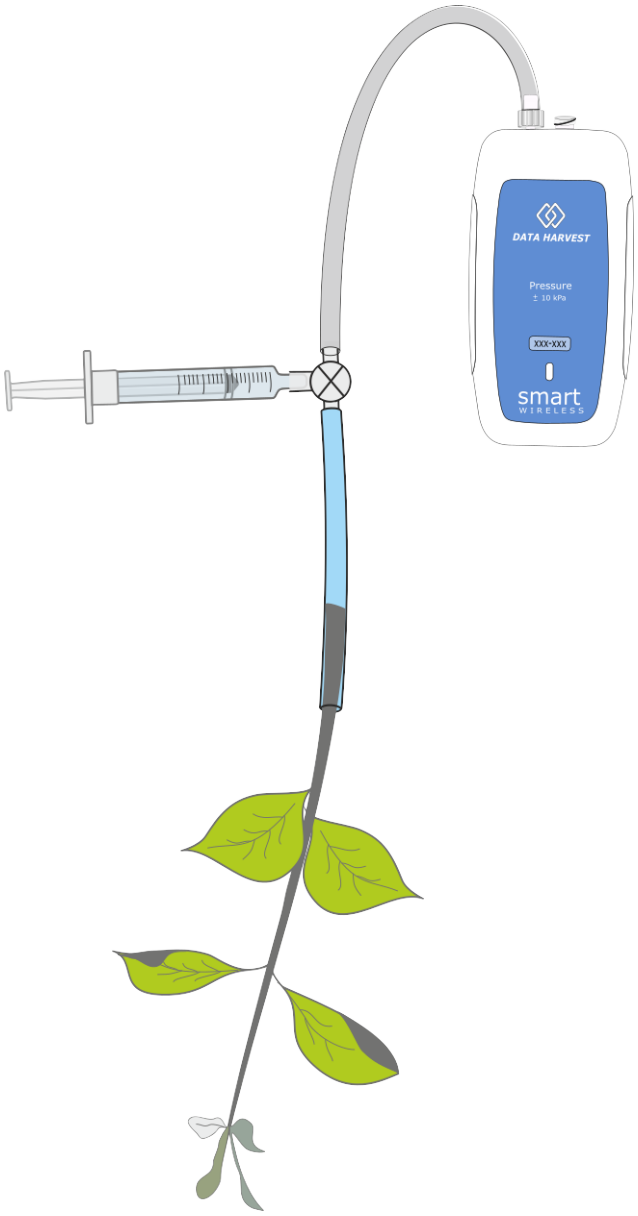
Settings

Collection time 10 minutes

Intersample time 1 second.

Start on click, stop after duration.

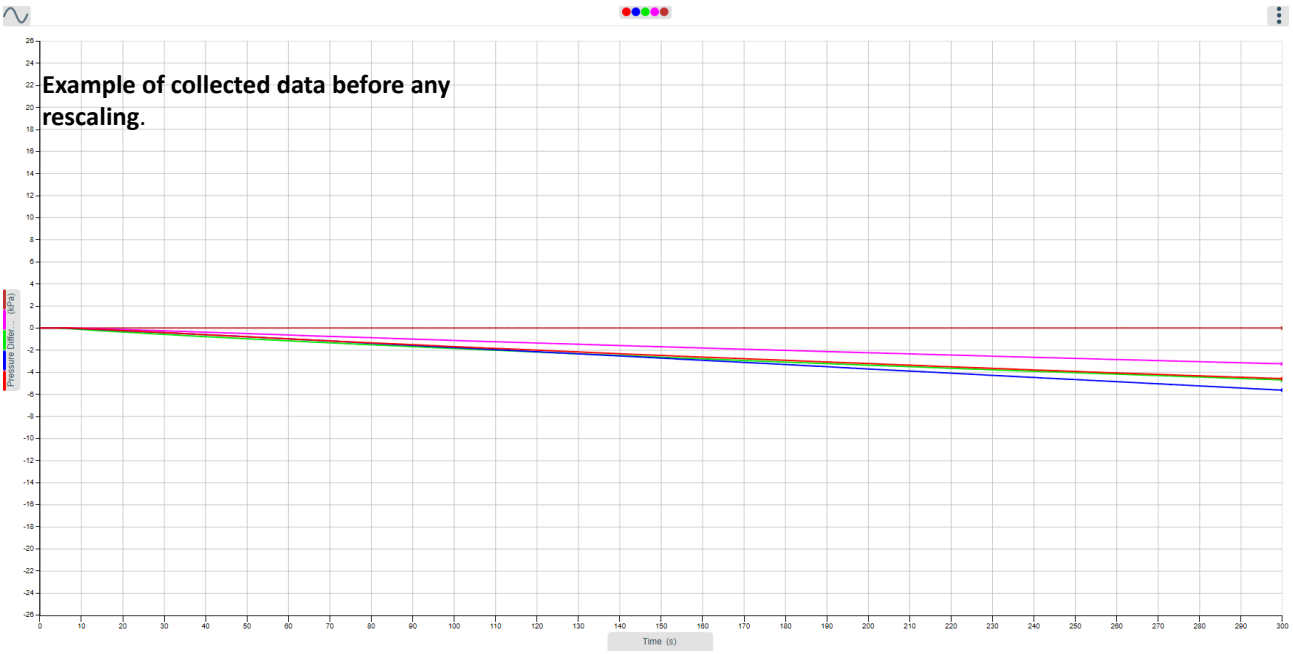
Overlay (if making condition comparisons)



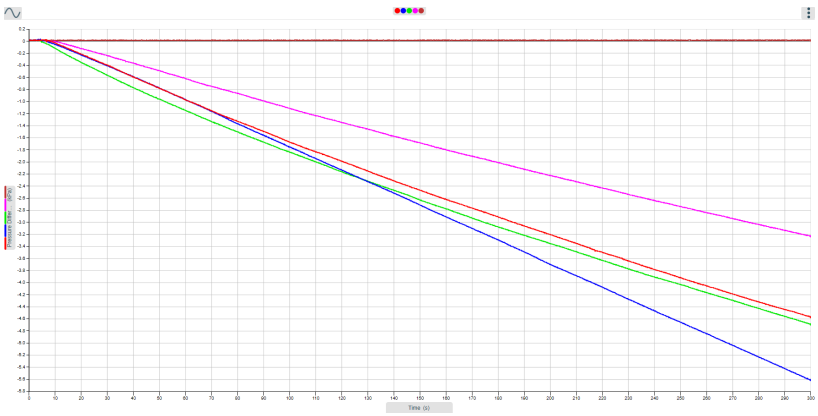
Method

1. Place the stem of the leafy shoot into water and cut it to to make a fresh, clean cut end, (make the cut at a slight angle).
2. Connect the 3-way tap to the tubing and connect a syringe filled with water to the side arm of the tap.
3. Use the syringe to fill the plastic tubing with water and agitate to remove air from inside the tubing.
4. Push the end of the plant into the tubing, taking care to not damage the outer layer of the stem. A good water and airtight connection is required. A piece of elastic tubing is advised for the connection.
5. Use the syringe to pull air into the piece of tubing that is not connected to the shoot. Dry the end of this section and push a small piece of cotton wool into the end (very loosely packed, this is to stop water moving back down the tube and into the Pressure sensor)
6. Connect the tubing to port P1 of the Pressure sensor.
7. Use a retort stand and clamp to support the apparatus. If the plant is positioned upside down any trapped bubbles will move away from the cut end. Air bubbles over the cut end will stop water from reaching the plant stem
8. Arrange the 3-way tap so the plant is connected to the water supply in the syringe and the Pressure sensor is isolated. Check for air bubbles near the cut end of the shoot.
9. You may need to use a small amount of sealing grease around the junction of the tubing to the shoot.
10. When you are happy the apparatus is leak proof, let the plant get used to its environment for several minutes.
11. Connect the pressure sensor to the software and set up the recording as shown at the top of the worksheet,

12. Turn the 3-way valve so that the plant and Pressure sensor only are connected (leave the syringe attached).
13. Start the recording. At the end of the logging time, Save the data.
14. Check that the water in the tube connecting the Pressure sensor has not reached the 3-way tap; if necessary use the syringe to replace the water that has moved along the tube. You may need to disconnect the Pressure sensor to bring pressure back to zero.
15. Check that Overlay is on.
16. Change the conditions surrounding the leaf by (for example) directing moving air over the leaf from a fan and repeat the experiment. If the conditions surrounding the leaf are changed give the leaf 2 - 3 minutes to adapt to the new conditions before logging the new data



Click on the y axis labels and select the scale option of min to max. Your graph should change to something like this.



You can now find the start pressure, the end pressure and then calculate the pressure change and rate of pressure change.

The negative in the pressure change indicates direction of pressure change. Minus 5 and plus 5 are the same numerical value.

The table gives and example of how to present the data collected.

Conditions around the leaves	Lowest (start) pressure	Highest (end pressure)	Time to reach end pressure	Change in pressure per second
Control				
Bright light				
Darkness				
Slight breeze				
Strong breeze				

Questions

1. What causes the change in pressure in the practical?
2. Compare the graphs of the data collected and describe the differences between them.
3. How does the conditions surrounding the leaf change how quickly the pressure changes?
4. Which condition creates the greatest change?
5. Explain why you think the water loss takes place and why any change to the environment around the leaf would create more or less water loss?
6. Was there any visible sign of water loss in the experiment?
7. How could you make the experiments a fair test?
8. How do you create a control, explain why you think the control is true?
9. Are the results what you would expect? Can you explain them in terms of the plants transpiration and need to stop water loss.
10. What would be a logical response of the plant to water loss? Is there any evidence this is happening in this investigation?
11. In the living plant where does the water come from to replace the water loss from the leaf?

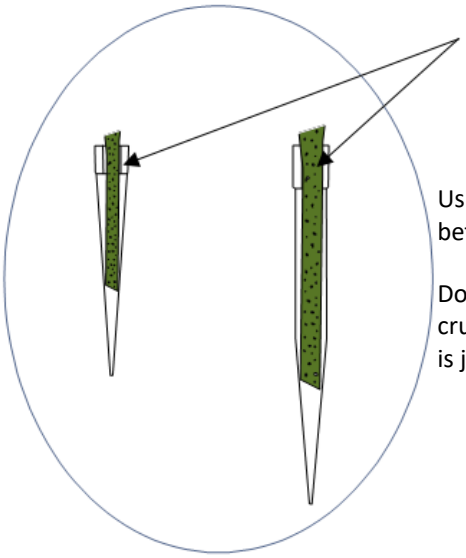
Extension

Try shoots off different plants and see if the transpiration rate is different. E.g. silver leaves, shiny leaves, long thin, etc.

Does the colour of the light have any effect? Place a coloured filter (gel) between the light source and the plant. Which colour has most effect?

Does the rate of transpiration remain constant over time?

Use a Light sensor to find out the intensity of light vs. water loss (could you plot light intensity against transpiration rate?)



Using pipette tips to make a connector between the tubing and plant stem.

Do not force the stem into the tip and crush the stem. You need a snug fit that is just water and airtight.