An experiment to investigate the water loss from leaves through stomata

In the experiment I intend to find out which of the four leaves will lose the most water and why.

Method

For the experiment to be carried out the following materials will be needed:

- Four leaves which approximately have the same mass and surface area
- Petroleum jelly
- String
- Four paperclips
- Two clamps
- Electronic balance

Four leaves were chosen with approximately the same mass and volume. Petroleum jelly was put on three of the four leaves using the finger. On leaf 1, petroleum jelly was smeared on both the upper side of the leaf and the also the bottom side of leaf. On leaf 2, petroleum jelly was then put on the upper side only. Petroleum jelly was then put on the underside of leaf 3. On leaf 4, the controlled leaf, no petroleum jelly was put on. The leaves were then weighed on an electro balance (the results were recorded in a table). The four leaves would then hang on a string, which were tied to the poles of two clamps. This was done to allow the leaves to do active transpiration. They were then placed in position where all the leaves will get the same amount of light, carbon dioxide and heat.

The readings were taken at 12'o'clock and then every 24 hours for 7 days. The leaves were weighed. By doing this, we could measure how much water loss there had been.

Diagram

Prediction

I predict that leaves one and three (leaf one being the leaf with petroleum jelly on the underside only and leaf three was the leaf with petroleum jelly on both side of the leaf) will lose the least amount of water.

This is because petroleum jelly is a non-permeable substance. When it is applied to leaf four it forms a watertight seal around the whole leaf. This means, that no water cannot escape through the stomata.
Similarly on leaf three the petroleum jelly is applied, but on the underside only. Stomata are only found on the bottom of the leaf (no water can escape through the top of the leaf because water escapes though stomata only. Also the leaf is covered in a waxy substance.) The petroleum jelly forms a watertight seal so no water can escape.

I also predict that leaves two and four (leaf two being the leaf with petroleum jelly on the top and leaf 4 being the leaf which had no petroleum jelly on at all.) will loose the most water.

This is because if petroleum jelly is put on the top of the leaf only, the water will be through the stomata found at the bottom of the leaf because nothing is blocking the water from escaping. If no petroleum jelly is put on the leaf then water will escape through the stomata because nothing is preventing the water vapour from escaping.

Plan of the experiment

In the experiment the independent variables will be the amount of petroleum jelly put on the leaves.

For ideal conditions to allow the leaves to transpire efficiently the surrounding atmosphere should not be humid. This will increase the amount of water the atmosphere can hold and this will mean that more water can transpire. Also it should be warm and windy. There should be a lot light because the stomata will open so water can escape more rapidly.

Throughout the experiment the amount of light received by each plant will be kept the same. Also they will be kept in the same temperature, and each will receive the same light intensity.

A total of seven readings will be taken for each leave. They readings will be taken at 12 0 clock and then again 24 hours later for seven days. The overall result in water loss will be measured by weighing all the leaves at the start of the experiment (with the inclusion of the petroleum jelly) and then again at the end of the experiment. This will tell us the total amount of weight loss, which will give us an indication of how much water loss there has been.

Results that have been taken must be reliable. Also all calculations that have been performed will also be done twice. This will reduce the chance of a mistake.

Background Knowledge

Water is lost through small pores found in the underside of the leaf called stomata. The water is lost through a process called Active Transpiration. The water turns into water vapour and then it diffuses into the air. It happens mainly inside the leaves in the cellulose wall. The stomata are open throughout the day to allow carbon dioxide to pass through (this lets water escape too).

In order for the leaves to transpire the leaves will need to be in light at all times (otherwise the stomata would close up).

Diagram

Obtaining evidence

To obtain evidence we weighed the leaves. This was done again after 24 hours for seven days. Then the original mass of the leaves was taken away from the mass of leaves at the end of the experiment. This was done to see the overall loss in mass. This was done for all for leaves. This would have indicated the amount of water lost. There were no hazards whilst the experiment was done. However we washed our hands when we finished doing the experiment.

Table of results

All results were accurate to two decimal places to ensure maximum accuracy. In total twenty-eight measurements were taken over a period of seven days (seven measurements, four for each leaf).

Analysis - conclusion

As you can see from the table of results leaf 4 lost the least amount of water. Leaf 4 lost the most water because it had no petroleum jelly covering the stomata. This meant water vapour could diffuse from the leaf. My prediction was correct. However I also stated that leaf 3 would lose just as much water as leaf 1. I was incorrect. This was an anomalous result. Leaf 1 lost the least amount of water because it was covered in petroleum jelly. The water vapour, which is formed, was not allowed to diffuse into the air because petroleum jelly is non-permeable. My prediction was correct. This was be However I also stated that leaf 3 would lose as much water as leaf 4 but I was incorrect as leaf 4 lost more water. This was an anomalous result.

In the result there are no patterns or trends.

In the experiment I discovered that if petroleum jelly was put on the underside of the leaf, it would stop more water vapour escaping than if petroleum jelly was added to the top of the leaf or if none was put on at all. This is because at the underside of the leaf are stomata. There is water loss only through stomata. This occurs when heat from the sun causes water to evaporate from the surface of the cellulose wall. The water vapour formed then diffuses into the air. Stomata are found only on the underside of the leaf. When the underside of the leaf is covered in petroleum jelly the water vapour cannot diffuse through it into the air because it is non-permeable. This prevents the loss of water. When petroleum jelly is added to the top of the leaf (or if none is put on the leaf at all) then water vapour inside the leaf can escape through the stomata, which are found only under the leaf.

The explanation is correct because there is proof of this on the graph and in the table of results

Evaluation

There were enough results obtained to draw a firm conclusion. The results were accurate and reliable.

In the experiment however there were anomalous results of all of the leaves. Leaf 1 and 3 should have both lost the same amount of water and leaves 2 and 4 should have lost the same amounts of water. This may have happened because the leaves may have not have had the same amount of water in them at the beginning of the test. Also the leaves themselves may not have had equal surface areas. Also the amount of petroleum jelly may not have covered the whole leaf (this may have given unfair advantage to one of the leaves). The readings were not repeated when any of the values did not fit in with the pattern. The readings, which were taken, were far enough to make a firm conclusion.

However the experiment could have improved. In the experiment the size and mass of the leaves were approximately the same but more accurate measurements could have been such as weighing the leaves at the start on an electro balance (before the petroleum jelly was added) to make sure the leaves had the same mass. Also the perimeter of the leave could have been measured to make sure the surface area was the same. To make the test more accurate it could've been done twice. Also when petroleum jelly was added there may have been gaps in between (so water vapour could have diffused), this should have been checked. To take the experiment further it could have been repeated with different specie of leaf to see if the results were the same.