**STARCH TEST**

(To verify whether light is necessary for photosynthesis)

**Introduction**

This is a sample experiment to verify the conditions which are necessary for photosynthesis. We can verify if sun light is necessary for photosynthesis or not by covering middle part of the leaves with light insulation (aluminium foil).

The insulation is recommended to be pasted on the leaves at sunset time, one night before the laboratory activities. During the night, starch which is produced by photosynthesis in the daytime is converted to smaller water soluble sugar and transported to the root through sieve tubes. Because of this de-starch process, in thin leaves there is no starch stock in chloroplasts at dawn.

Since middle part of the leaves is insulated, the insulated part can not receive sun light while the parts where they are not covered with the aluminium foil are exposed to sun light.

In order to verify whether the light is necessary for photosynthesis, we can check the existence of starch in the insulated parts and un-insulated parts after we expose the leaves under the strong sun at least 2 hours. If we can not find starch in insulated parts, it shows us light is necessary to produce starch.

After we break down the leaves cell’s cell membrane by boiling the leaves, we can de-chlorophyll the leaves by hot ethanol. As the leaves are dehydrated by the ethanol bath, we can soak the leaves in water to make them soft and stretch the leaves on Petri dishes for starch-iodine test. Since it is difficult to make the leaves thoroughly transparent by ethanol bath, the starch-iodine test does not show typical blue-black colour. Usually Students can see very clearly difference between insulated and un-insulated parts.
### SACHS’ EXPERIMENT (PHOTOSYNTHESIS STARCH TEST)

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#### 1. Materials and tools (for 1 student group)

To insulate leaves from sunlight: Green plant which has thin soft leaves planted in the sun. Use approximately 1 cm by 3 cm leaves. If it is possible collect small thin variegated leaves. Aluminium foil and a pair of scissors.

Laboratory materials: A tripod (or a retort stand and a funnel holder), a fire clay triangle, a wood block (if you use the tripod), a spirit burner, a 250ml beaker, a small test tube, a test tube rack, a test tube holder, a pair of forceps (tweezers), a Petri dish, a box of match, a waste match bin, a bamboo stick, a laboratory thermometer.

Chemicals: 3ml ethyl alcohol to de-chlorophyll, 20 ml methyl alcohol (for spirit burner), potassium iodine solution in a dropping bottle.

#### 2. Method

1) Select approximately 1cm by 3 cm green leaves and paste light insulation (5mm width aluminium foil) on leaves at least 48 hours before laboratory experiment.

2) Each group must collect an insulated leaf and a normal leaf.

3) Remove the insulation gently and mark the insulated leaf to identify it later.

4) Make approximately 100ml hot water with a 300ml glass beaker, a tripod stand (or a retort stand and funnel holder), a fire clay triangle and spirit burner.

5) Wait until the water temperature comes up to 70 to 75 degree Celsius then put the leaves in the hot water. Leave them in hot water at least 3 minutes. If it is boiling water it takes about one minute.

6) Take the leaves out of the hot water and put them in a small test tube.

7) Put ethanol in the small test tube (approximately 3cm deep).

8) Put the small test tube in hot water bath until the leaves become transparent.

9) Take the small test tube from the beaker and pour the ethanol to the designated container.

10) Add tap water to the small test tube.

11) Move the leaves on a Petri dish and stretch the leaves with a pair of tweezers.

12) Drop few amount of diluted potassium iodine solution on the leaves.

13) Record the difference between the leaves.
3. Samples of assignment
A) Explain a) to e) why it is necessary to do this experiment.
   a) Paste insulation on leaves at least 48 hours before laboratory work.
   b) Boil the leaves before putting in ethyl alcohol.
   c) Use hot water bath to de-chlorophyll with ethanol.
   d) After de-chlorophyll water the leaves.
   e) Drop potassium iodine solution on de-chlorophyllled leaves.

B) Illustrate the procedure of this experiment with drawings and short explanation.

4. Model answers
A) 
   a) To prevent light from entering that part of the leaf so as to verify whether light is necessary for photosynthesis. During the night the starch will be converted into glucose and transported to the root namely to de-starch the leaf.
   b) To destroy the cell membranes of the leaf to allow entry of ethanol easily.
   c) To avoid explosion or burning of ethyl alcohol and to remove the chlorophyll from the leaves.
   d) To soften the dehydrated leaves.
   e) To check the existence of starch in the insulated area and non-insulated area of leaves.

B) 

5. Note
1) You can also use variegated leaves to check which colour pigment is indispensable to photosynthesis.
2) If you use a grass herbaceous plant, paste insulation one day before the experiment. It takes more than two nights to de-starch the insulated area if you use tree leaves and thick grass leaves.
3) Make level of methanol in spirit burner more than 80% of its capacity.
4) Do not breathe in the methyl alcohol vapour.
5) Do not put flammable items near the burner.
6) Do not come close to the hot water and fire too much.
7) Do not leave the laboratory thermometer leaning on the beaker edge. Always hold with a hand or use a proper retort stand and a clamp.
8) After heating, put the beaker on the table.
9) If ethanol catches fire, stop the experiment immediately.
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1. Draw the leaves you collected, before you remove the insulation.

2. Illustrate the set up to make hot water.

3. Explain how to break down the cell membranes of the leaves to allow entry of ethanol easily.

4. Illustrate how to de-chlorophyll the leaves.

5. Explain how to hydrate the de-hydrated leaves.

6. Draw the final result of the leaves.
   (starch-iodine reaction)
### Sach's Experiment (Photosynthesis Starch Test)

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**1.** Draw the leaves you collected, before you remove the insulation.

![Leaf Diagram](image)

**2.** Illustrate the set up to make hot water.

![Hot Water Setup](image)

**3.** Explain how to break down the cell membranes of the leaves to allow entry of ethanol easily.

This is done by putting the leaves in hot water in a beaker, hence the hot water must have a temperature of about 70° - 75°.

**4.** Illustrate how to de-chlorophyll the leaves.

![De-chlorophyll Setup](image)

**5.** Explain how to hydrate the de-hydrated leaves.

By putting water into a petri dish and placing or putting the leaves into the dish containing water to dehydrate it.

**6.** Draw the final result of the leaves. (starch-iodine reaction)

![Final Result](image)