Photosynthesis: Photosynthesis, Pigments and Starch Accumulation

Chlorophyll is the primary pigment responsible for capturing and facilitating the transformation of sunlight energy into biological energy in the form of ATP. However, plants have a number of accessory pigments that assist with light absorption. Pigments like the carotenoids (carotene and xanthophyll) and phycobilins absorb light energy in regions of the electromagnetic spectrum where chlorophyll cannot absorb and then convey this energy to chlorophyll. In this way plants can efficiently use most of the visible light emitted by the sun.

Plants produce sugars during photosynthesis. These sugars can be used immediately by the mitochondrion, stored in the leaf in the form of starch or transported to storage organs like the plant roots or tubers. In this activity, you will examine leaf pigmentation its relation to starch deposition.

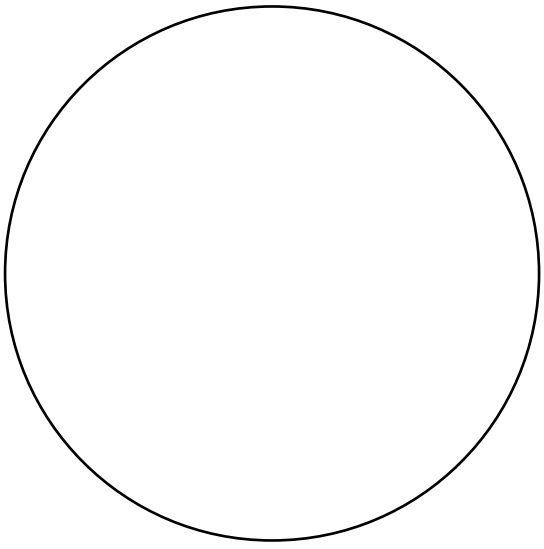
Materials

Variegated coleus preferably coleus with white spots or stripes*
Beakers – 250 mL, 2
Hot plate
Distilled water
Iodine
Petri dish
Tweezers
95 % EtOH

*If variegated coleus is not available, other variegated thin-leaved non-waxy plants could be used. Alternatively, a week to 10 days before lab students can partially cover plant leaves with cardboard masks or colored filters. This is an opportunity to allow students to design independent research questions.

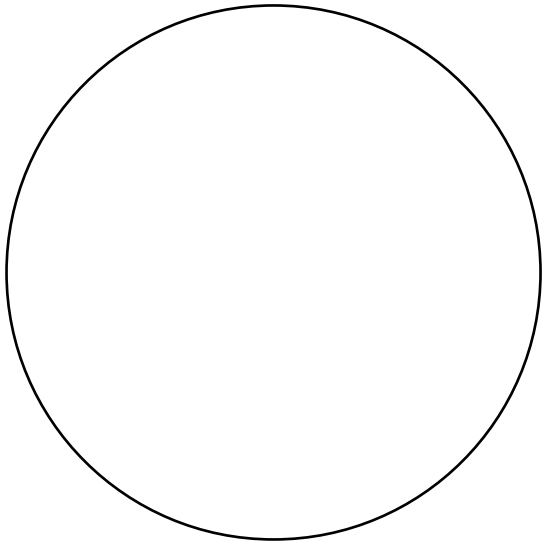
Procedure

1. Remove 1 leaf from a variegated coleus plant. Draw the leaf in color as it appears in the circle below.



2. Fill one beaker half full with water. Place beaker on hotplate and turn hot plate on high. Once the water boils, turn the hot plate down to medium.

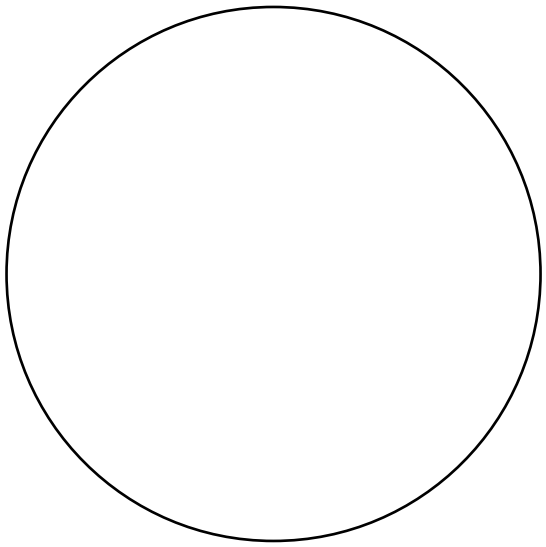
3. Add the leaf to the boiling water. Boil gently for 5 minutes.
4. Gently remove the leaf with tweezers and place it in the petri dish. Suspend the leaf in water. Draw the leaf as it appears after boiling in water.



5. What difference do you notice in the color of the leaf? What color is the beaker

6. Which pigments are water soluble?

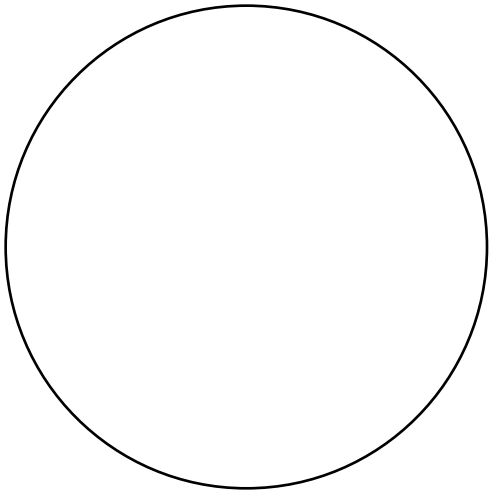
7. Take the second beaker and fill half full with 95 % EtOH. Place the beaker on the hotplate. Turn the hot plate on medium to heat the alcohol. Alcohol is flammable, heat it gently.
8. Add the leaf to the beaker of alcohol and heat it for 5 minutes. Turn off the hot plate.
9. Gently remove the leaf with tweezers and place it in the petri dish. Suspend the leaf in water. Draw the leaf as it appears after heating in ethanol.



10. What difference do you notice in the color of the leaf? What color is the beaker

11. Which pigments are alcohol soluble?

12. Take the other half of the Petri dish and add 20 mL of iodine. Add the leaf to the Petri dish. Remove the leaf after 2 minutes and return it to the petri dish containing water.
13. Draw the leaf as it appears after immersion in iodine.



14. Iodine is an indicator for what biological molecule?

15. Compare the drawing above to the first drawing you made of the fresh, intact leaf. Which pigment colors are associated with the dark blue areas of the leaf after iodine treatment?

16. What does the distribution of blue black color tell you about the areas of the leaf that were actively photosynthetic?

17. Which pigments were associated with colorless areas of the leaf (after iodine immersion)?