

# Colours in Leaves Experiment

## Key Stage 4

**Scheme of work unit:** 3 Green Plants as organisms

**Intended learning:** Investigate and understand the role of chlorophyll in Photosynthesis

### Introduction notes:

- Discuss with children their understanding of what a plant requires in order to grow.
- Describe in detail the process of Photosynthesis, including main points:
- Photosynthesis is the synthesis of triose phosphates, and ultimately starch, glucose and other products, from sunlight, carbon dioxide and water.
- Oxygen is also produced, as a result of splitting water.
- Triose phosphates (G3P) can be used as an immediate food source, or combined and rearranged to form monosaccharide sugars, such as glucose, which can be transported to other cells, or packaged for storage as insoluble polysaccharides such as starch.
- Chlorophyll is vital for photosynthesis. It is a very large molecule that is attached to chloroplasts in leaves.
- Chlorophyll selectively absorbs red/blue light and reflects green light, hence why the vast majority of leaves appear green, in spring/summer.
- The colours in the leaves are pigments. These are coloured molecules that are insoluble in the liquid inside the leaf (though they may be soluble in other liquids).
- When the amount of chlorophyll in the leaf reduces in autumn/winter, the colours of the other pigments in the leaf are observed.
- Carotene is a large molecule found in chloroplasts that absorbs blue-green and blue light. The light reflected appears to be yellow.
- In some trees, the concentration of sugar in the leaf increases. The sugar reacts to form anthocyanins. Anthocyanin is a molecule that absorbs blue, blue-green and green light, appearing to be red/brown in colour.
- NB: Pigments are insoluble in their vehicle, i.e. chlorophyll is a pigment in the leaf, but is soluble in water outside the leaf, so becomes a non-permanent dye.

### Resources required:

- Leaves from 2 different deciduous (colour changing) trees
- 2 large leaves or 4 small leaves per container
- Sample containers
- Parafilm or clingfilm
- Warm ethanol
- Filter paper
- Pencils

## Practical notes

Care needs to be taken to ensure the water is not too warm as to scald the pupils. Acids and bases are irritants, and if eye contact occurs the eye must be rinsed thoroughly.

## Further Work

Devise an experiment in which you can investigate one of the variables which may affect the rate of photosynthesis in plants.

## Answers:

1. Triose phosphates: Ultimately starch, glucose, oxygen and water.  
Light irradiance and wavelength, carbon dioxide and temperature.
2. A pigment is a material that changes the colour of light it reflects as the result of selective colour absorption.  
Because they are insoluble in the vehicle (the leaf). They are only soluble when they are removed from the vehicle.
3.  $6\text{CO}_2 + 12\text{H}_2\text{O} + \text{photons} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + 6\text{H}_2\text{O}$ .
4. Photoautotroph is an organism that is able to synthesize food directly from inorganic compounds using light energy (e.g. the sun), instead of eating other organisms or relying on other nutrients derived from them.  
Chemoautotrophs are organisms that obtain energy by the oxidation of electron donating molecules in their environments. These molecules can be organic (organotrophs) or inorganic (lithotrophs).
5. Two stages of photosynthesis: Light dependant reactions and Light independent reactions.  
Light dependant reactions capture the energy of light and use it to make high energy molecules  
Light independent reactions (also called the Calvin-Benson Cycle) use the high energy molecules to capture carbon dioxide and make the precursors of carbohydrates.