

## Lesson sequence

### 1. Before fieldwork

Locate a clump of nettles at the edge of trees where one side is more shaded than the other. There is a less frequently mown area under the trees at the northern (Euston station) end of Gordon Square which is a particularly useful place to look. Using one clump of nettles spread by rhizomes from a single plant helps to control genetic variation and improves the reliability of the method.

#### Introducing the investigation to pupils

From KS3, pupils will have been introduced to the process of photosynthesis and have some knowledge and understanding of the structure of the leaf (including the role of palisade cells, chloroplasts and air holes).

If there is time show pupils a nettle plant which has been dug up so that they can see the rhizome system and appreciate that the shoots all belong to one plant. Using live specimens of a sun shoot and a shade shoot, or use the photographs on the CD, ask the pupils to list the differences that they notice and to suggest what the two shoots might look like if they are left in the sun for 15 minutes. Live specimens wilt very quickly, particularly of shade shoots, so you may need to rest the shoots in water. Write the differences on the board and discuss how these modifications might help the plant.

#### Fieldwork

Divide the class into groups of 3–5 pupils. Each group lays a tape measure across the part of the nettle clump being sampled (see Fig. 13) so that one end is in the shade and the other end is in the sun. Select the two largest shoots touching the first half metre of the tape (a shade shoot) and the two largest shoots touching the last half metre of the tape (a sun shoot). If possible all the shoots should be flowering or non-flowering as variation in leaf size can occur between flowering and non-flowering shoots. In total the class should sample a minimum of 10 shade and 10 sun shoots.



Figure 13. Transect of a single clump of nettles from sun to shade.

For each shoot sampled, pupils measure the length of the third and fourth internodes. The third internode is the distance between the third and fourth leaves down the stem, the fourth internode is the length between the fourth and fifth leaves.



Figure 14. Numbering of leaves and internodes.

It is important that, when sampling to find leaf area, that all the leaves used are of the same maturity and are fully formed. Any side shoots should be avoided. Once the internodes have been measured, pupils remove the fifth and sixth leaves with scissors and place them into polythene bags. Each group should collect at least two shade leaves and at least two sun leaves.

### 3. After fieldwork Analysis and evaluation

Although pupils can measure the length and width of leaves as a surrogate for leaf area, more meaningful results can be obtained by weighing the leaves.

Photocopy the leaves from each group onto a sheet of graph paper (use a light toner setting so that the lines on the graph paper show). Ask the pupils to trace round the edge of their leaves. Ignore the toothed edge of the leaf (see Fig. 15). Alternatively, if a photocopier is not available, pupils can trace directly around the outline of the leaf, but plastic gloves should be worn.

Cut out the leaf shape and weigh this piece of paper. Then weigh 1cm<sup>2</sup> of graph paper. A balance with a sensitivity of at least tenths of a gram is needed. Use these two figures to calculate the area of the leaf.

$$\frac{\text{The mass of the leaf outline}}{\text{The mass of 1cm}^2 \text{ of graph paper}} = \text{area of the leaf in cm}^2$$

If a balance is not available students can count the 2 mm squares. Squares more than half covered should be counted as a whole square and those less than half covered not counted.

Assuming that 1cm<sup>2</sup> of graph paper contains 25 x 2 mm squares,

$$\frac{\text{The number of squares}}{25} = \text{area of the leaf in cm}^2$$



Figure 15. Outline of a nettle leaf.

Pupils can use the prompt questions (Sheet 3) to link the data they have collected to what they know about photosynthesis, and to consider how appropriate the methods were.