

## Chapter 3 Plant Energy



Plants use energy from the sun to produce their own food and to grow. This process is called photosynthesis. This chapter will suggest activities to help pupils to look at how plants get their power and how we can make use of it.

### Plants as solar collectors

Introduce children to the idea of plants as solar collectors. Plants collect energy from the sun and use it, with water, carbon dioxide and nutrients from the soil, to produce their own food. Look carefully at different kinds of plants. Compare the size and shapes of their leaves.



Take three plants, grown in pots from seed, such as tomatoes or chillies. Treat all three exactly the same, with the same sized pots, measured amounts of water, any plant food, equal temperatures. Put one in a dark cupboard, put one in a shady place, and the other on a sunny windowsill. Observe what happens over a week or two, recording observations on a daily basis. Ask the children to explain their results. They could then do similar experiments varying the other things plants need.



### Map of solar collectors

Make a map of your school grounds to show the solar collectors - the different trees, bushes and other plants. How much of the surface of the grounds is covered in solar collectors? You could use squared paper or dimensions to work out the percentage of the area devoted to energy collection. Then ask difficult questions, such as whether some areas have more than one layer of solar collectors - for example trees with several layers of branches and grass growing underneath.



### Plants store energy

If plants need the light, how do small seeds sown in the earth grow up above the soil? How do bulbs grow, even when you put them in a dark cupboard over winter? Explain that seeds and some plants which have bulbs or tubers (such as potatoes) store energy. They can begin to grow in the dark using their stored energy. Often the parts of plants we eat are the energy stores, such as carrots, potatoes, yams, wheat seeds.

Try growing new plants from old energy stores, such as a carrot top in a saucer, or a potato in a pot of soil.

### Killing weeds

You can use the fact that plants need light to kill weeds. Cover the ground with something that excludes light, such as old sheets of cardboard, carpets or black plastic, to kill off weeds. Compare the effects of excluding light on perennial weeds, such as dandelion and couch grass, and annual weeds, such as chickweed. Why can perennial weeds live so much longer without light? Compare the root systems of the different kinds of weeds. You could grow a dandelion in a jar with a collar over the top to observe the root system.

### Beans in a jar

Children can grow beans in jam jars on a windowsill. They can take measurements of growth for the different parts of the plant and keep a diary of observations about the plant's development. Which part grows first and where does its energy come from? How soon do leaves develop? How fast do different parts grow?

### Investigating trees' leaves

Use mirrors to look up at the canopies of different trees. Mirror tiles can be mounted onto plywood, or hand-held mirrors can be used. These give children a new way of seeing a tree as a series of layers around a central axis. This is a good way to begin thinking about the arrangement of leaves, their shapes and sizes and their orientation. Children can make drawings of what they see in the mirror. They can also think about how much of the area seen in the mirror is sky and how much is covered by leaves. Does this change as the children walk outwards from the trunk?

Other questions to ask about tree leaves are:

- ▶ Why are leaves so thin?
- ▶ Are some leaves better at collecting light than others because of their design? Look at different types and shapes of leaves, shiny and dull leaves, etc.
- ▶ Why do some leaves have holes?

Looking at one particular tree, ask:

- ▶ Are the leaves in one layer around the tree, or are they multi-layered?
- ▶ Do the leaves overlap?
- ▶ What angle are the leaves held at? (Twigs in shade usually hold their leaves horizontally to obtain the most light, but twigs in sun hold their leaves at many different angles.)
- ▶ What sizes of leaves are found where on the tree?
- ▶ Are outer leaves more indented so that inner leaves can receive more sunlight? (Oak is often a good example of this.)

**Fig 15. Killing weeds**

Black plastic sheeting pegged or weighted down over a weedy patch will kill all the weeds.



**Fig 16. Beans in a jar**

Runner beans grow very easily given moisture, warmth and light. A roll of newspaper pushed into a jar with a little water in it traps some bean seeds between the glass and the paper. These will germinate in a few days.



**Plant fuels**

There are two types of plant fuels: renewable and non-renewable. Non-renewable energy comes from the sun indirectly. It has been stored in dead plants which changed into fossil fuels millions of years ago and is now found in rocks in the ground. When these fossil fuels have been used up they cannot be replaced. Renewable energy from plants usually comes in the form of wood or charcoal, which can be replaced by planting trees, but also includes oils. (See page 25.)

Answering these questions will help to build up the idea that trees use their leaves to produce food. If this is the case, what happens in the winter when some trees lose their leaves?

**Lengths of growing seasons and day-length**

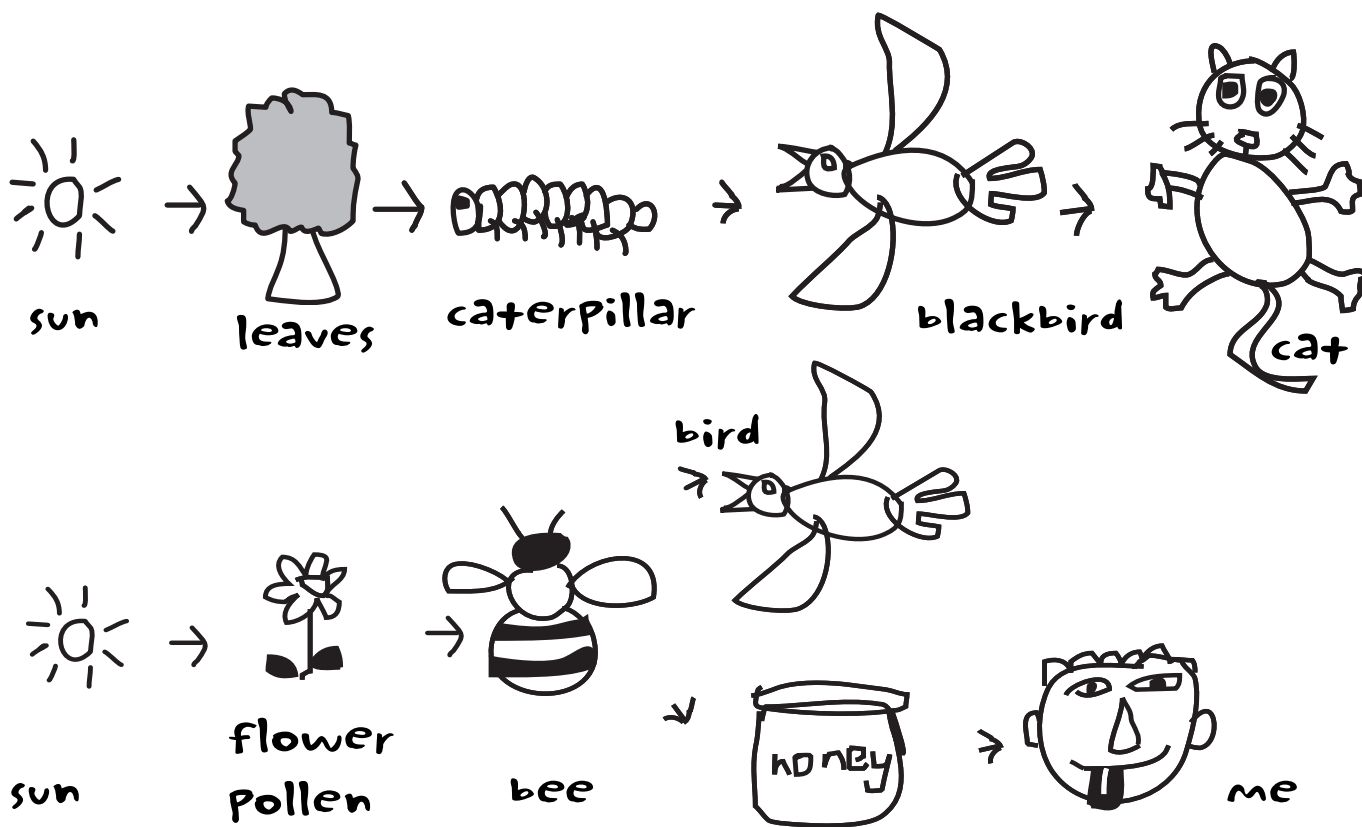
Plants in Britain are affected by the length of the growing season and by day-length. Although the growing season is determined by temperature, this is indirectly related to the Earth's movements in relation to the sun. Day-length affects plant growth too. Ask the children if they can devise an experiment to measure the effects of day-length on plant growth. What other factors will they have to control? How long will the experiment have to run for? Could they artificially control a plant's day-length?

**Plants move towards the sun**

Try an experiment to show this. Take a teaspoon of alfalfa seeds and soak them overnight. Place them on a moist paper towel in a tray or clear jar on a sunny windowsill. After a few days observe and record which way the plants are facing. Move the container so that the plants' leaves are facing away from the sun. Keep watch every half hour. How long is it before the leaves are facing the sun again?

**Fig 17. Plants in energy chains**

A number of everyday examples of energy transfer through food chains can be observed in the school grounds. Children can record their findings as pictograms (see below).



## Plants as food

### Energy chains

Investigate which plants in the school grounds are eaten by which animals. This can be done by a combination of observation and using reference books. Don't forget to include any plants which can be eaten by humans. This can be developed from or into work on food chains. Can you construct some food chains for the school grounds? Food chains are also energy chains. Begin each of these chains with the sun. Ask children how else plants are used for energy apart from as food? This can lead on to work on fuels, such as wood and fossil fuels. (See pages 22 to 24.)

### Composting

Investigate how dead plant materials are broken down by small animals such as beetles and worms. The animals feed on the plants. The plants provide them with energy. Children can even see this process taking place when the animals are micro-organisms, too small to be seen, by making a 'hot' compost heap.

Take a large quantity of different materials suitable for composting, such as mown grass, vegetable kitchen waste, shredded newspaper, animal manure and bedding, mix it all together and put it into a compost bin (about 1m x 1m is ideal). The material should be moist and preferably should fill the bin. Put the lid on and leave it. Measure the temperature of the material every day, or perhaps even twice a day. Use a soil thermometer if possible. The temperature should increase rapidly over the first few days, stabilise for a few days and then begin to fall. It may reach as high as 65° to 70°C.

Once the temperature begins to fall you can mix up the material in the heap, turning that from the sides into the middle to increase the temperature again. The heat is energy given off by the micro-organisms feeding on the plant material. They are actively decomposing the material. Once the heap cools down larger animals such as worms begin their work in the decomposition process.

Once the heap is ready (it looks like pleasant, brown, friable soil), it can be spread on or dug into the ground to feed plants. The compost is a source of energy. Some of the energy in the original plants has been used up by the soil organisms. Some of it is left as soil nutrients to be taken up by plants through their roots.

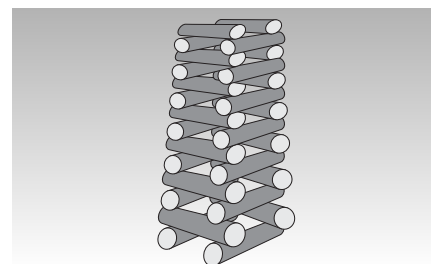
### Fossil fuel audit

Do a 'fossil fuel audit' at school or in pupils' homes. Ask children to brainstorm the different ways in which energy is used at school. Make sure the children know what fuels are and what fossil fuels are. Then ask children to formulate questions they will need to ask to find out about the use of fossil fuels at school: e.g. What fuel is used in the central heating? What fuels are used to make mains electricity? What about teacher's cars? Can the children find a way to estimate how much of each kind of fossil fuel is used in a year?

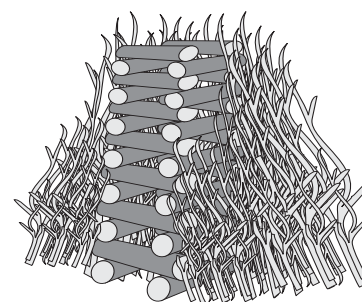
Lead children on to thinking about other ways in which the school consumes energy in the products it uses. Is there any consumption of fossil fuel when they use paper or pens, or plastic containers? Get them to think about the energy used to make things, in manufacture, packaging and transport, etc. They won't be able to quantify this, but it would make an interesting subject for a large wall display showing all the different ways in which their classroom or school uses fossil fuel. You could perhaps use a large photograph of the classroom or school

**Fig 18. Building a charcoal clamp**

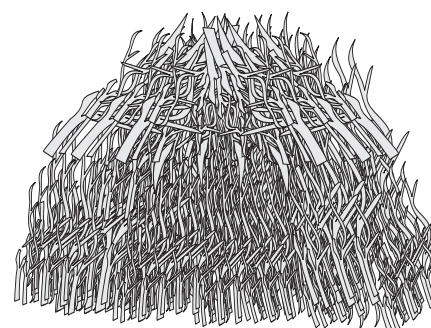
First a central chimney is constructed to allow air in.



Then branches are laid against and around the chimney.



The wood clamp is made larger. More pieces of wood are laid on top.



The finished clamp is covered with soil and grass.

