

## Theme 4

# Using energy

### BACKGROUND

Energy is needed for work. (Work is done when a force makes something move.) Energy exists in many forms: light and heat, for example, and stored energy, such as that stored in food. Energy can change from one form to another. In physical activity, our bodies convert stored energy from food into moving or kinetic energy.

Between the fifth and third century bc the first waterwheel was invented. Early waterwheels had paddles, but by the time of the Roman Empire they had buckets, and this design remained in use into the Industrial Revolution.

Another type of stored energy is stored gravitational energy that something has due to its position above the centre of the Earth. Water collected behind a dam has stored gravitational energy, and when the sluice gate is opened, this changes to moving energy as the water flows.

The first windmills were used in Iran in the seventh century ad. A windmill uses the kinetic energy in moving air to turn its sails. The moving energy is generated by the way air behaves when it is heated. It rises, and air is drawn in to replace the column of rising air. This movement of air is called convection. On Earth, air at the Equator is heated most strongly and this sets up a pattern of winds across the Earth. In addition, large masses of air may gather and become warm or cool depending on their location either in the tropics or near the poles. When these air masses meet, their air swirls together, forming depressions

or cyclones and generating the winds that cause our weather.

When water is heated to 100°C, steam is produced. Steam is not the clouds you see above a boiling kettle, but the colourless gas which escapes from the kettle spout. The clouds of steam are actually water droplets produced when the steam condenses on dust particles in the air. When steam is produced, the volume of the water rapidly expands and pushes on everything around it. In the steam engine, steam drives a piston. In early steam engines the up-and-down movement of the piston could be used for pumping water out of flooded mines. James Watt invented a way of changing the up-and-down movement into turning a wheel. This could then be connected to other machines by belts or gear wheels and led to steam engines being used to power factories, locomotives and ships. The path of energy through a steam engine is from stored energy in the fuel (wood or coal), to moving energy of the steam, to moving energy of the engine components.

### THE CONTENTS

#### Lesson 1 (Ages 5–7)

##### Waterwheel

The children make two waterwheels and compare their efficiency.

#### Lesson 2 (Ages 7–9)

##### Windmill

The children make a model windmill and then consider ways of improving it.

#### Lesson 3 (Ages 9–11)

##### Steam engine

The children examine a picture of a steam engine then investigate the action of the piston. They then make a wheel and cam and discover how the up-and-down motion can be converted into turning a wheel.

### Notes on photocopiables

#### Waterwheel (page 37)

Dimensions have not been included to make the waterwheel instructions more accessible.

#### Windmill (page 38)

The sheet provides the outline of the sail and instructions for construction.

#### Steam engine (page 39)

This shows a Watts steam engine and a balloon pump, which matches one component of the engine. An outline of a wheel and cam is provided, along with pictures of how to assemble the wheel and

