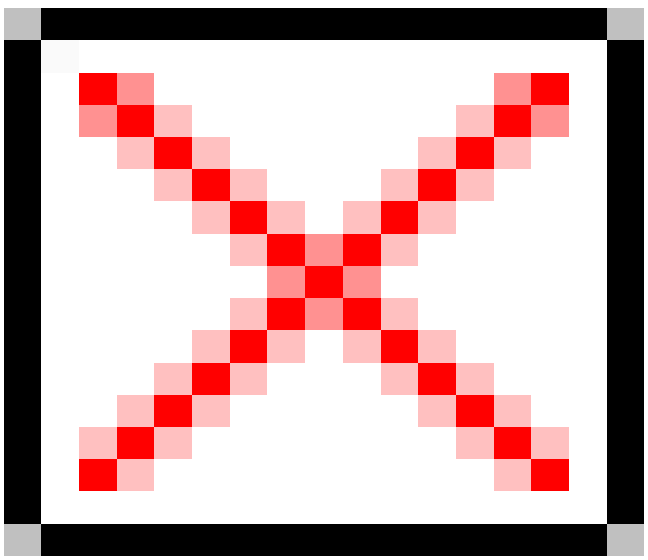
Energy

Energy cannot be seen but we can easily recognise its effect which include growth, movement, heat, light and sound. Anything that moves is said to have kinetic energy and potential energy is any kind of energy that is stored. Energy can be stored in elastic material and chemical bonds of food and fuels. Although it can exist in different forms and change from one form to another, energy is never made or destroyed.

Electricity



Most power stations burn fossil fuels and the heat released is used to turn water into high-pressure steam which drives turbines. Turbines consist of a series of fans, one in front of the other, which drive a shaft when they rotate. At the end of the shafts is a large magnet which is surrounded by a coil of wire inside a generator. As the magnet rotates it causes electrical energy to flow through the wire coil. The electrical energy generated oases along wires or cables which may be buried beneath the ground or supported by pylons above the ground. Cables connect all the power stations into a huge network called the grid which allows electrical energy to be switched from one area to another as demand varies.

Electricity is the most convenient source if energy available and it is used all the time in our daily lives. Most of the electrical gadgets we rely on have been invented in the last century. Before this is used to take a very long time to do everyday tasks such as cook and clean. For instance household washing used to be done using a wooden dolly turned by hand. Agitating the clothes in this was tiring and time-consuming. Moving the wet washing was also hard work and then the water had to be squeezed out using a hand-operated mangle. Nowadays modern washing machines are completely automatic and can heat the water to different temperatures and spin the washing to varying degrees of dryness, all in a relatively short time.

Activity
: How many things at home can you find that use electricity? The kitchen is a good place to start. Cut out p ictures of these appliances from newspapers and catalogues and make a collage.

Fossil Fuels

Fuel is a store of chemical energy, which can be converted into other forms of energy when needed. 80% of the energy used by the modern world comes from burning fossil fuels such as oil, coal, and natural gas. These fossil fuels were formed millions of years ago from the remains of dead plants and animals. When fossil fuels are burned some of the sun?s energy that went into their creation is released again as heat. Be cause of their different chemical structures a certain amount of natural gas gives off more heat than the same amount of oil, and oil gives off more heat than coal.

Road transport is dependent on oil as a source of energy. Crude oil is a mixture of many different chemicals, which can be separated out and split into different fractions in an oil refinery by heating it to higher and higher temperatures. Calor gas, petrol, paraffin and diesel oil can be extracted by this process. All these products are used as fuels.

Activity:
Coal and oil are also used as raw materials to the manufacture of many other products. Investigate what products are made from fossil fuels.

Solar Energy

The sun is made almost entirely of the gases hydrogen and helium. The sun burns 700 million tonnes of hydrogen every second in nuclear reactions producing temperatures of 14,000,000 degrees Celsius at its centre. At this temperature the atoms of hydrogen react together to make helium, releasing vast amounts of energy, some of which reaches the Earth making life possible on our planet.

Only green plants can use this energy directly to make food. Leaves contain chlorophyll, a green pigment which can absorb sunlight and make energy available for chemical reactions. The process of photosynthesis uses energy to make sugar from water and carbon dioxide. Sugar can be converted to starch for storage and is a source of potential energy.

Activity:
The total leaf area of a tree available for absorbing the sun?s energy can be found by tracing its outline onto gr aph paper and counting the number of squares and part squares within the area. Both sides of a leaf absorb sunlight, doubling the area available for photosynthesis. The number of leaves on a branch and the number of branches on a tree can be counted or estimated. Repeat this calculation with different types of tree.

Food Chains

Animals must either eat plants to obtain their energy or eat other animals. When animals eat they create their own store of chemical energy. This transfer of energy from the sun to animals via plants is called a food chain. For example, tadpoles feed on algae, water beetles eat tadpoles, trout eat water beetles and humans eat trout. A food chain suggests that each animal feeds only on one other organism which is usually not the case. Most animals have a varied diet and feed on more than one type of food. A food web traces what all the animals eat and shows their feeding relationships. If these are a large number of different animals and plants involved a food web may be very complex.

Activity:
Build up a picture of a food web of your own by cutting out pictures of individual plants and animals from old w ildlife magazines. You could also trace, copy or draw them from books. Arrange the pictures in a food web, connecting those that eat or are eaten by each other. Make pictures of food webs based on a tree and a pond.

Energy From Food

Humans get energy from carbohydrates, fats, proteins and alcohol. Fat contains twice as much energy as carbohydrates and protein. Energy-containing foods include bacon, bread, sugar, potatoes and rice. Different foods provide different amounts of energy; for instance an apple weighing 100g contains 150kj while the same weight of milk chocolate will provide over 15 times as much energy (2335kj).

By the process of digestion food is broken down, absorbed into the bloodstream and taken to all parts of the body. In whatever form the food is eaten much of it eventually reaches the cells as a sugar called glucose. Combining glucose with oxygen releases carbon dioxide, water and energy. Although our energy requirements depend on body weight and the amount of physical activity carried out it is possible to give a recommended daily amount of energy for different age groups. Girls tend to need less energy than boys.

Age range (yrs) 9-11 girls: 8.5MJ boys: 9.5MJ

Age range (yrs) 12-14 girls: 9.0MJ boys: 11.0MJ

Age range (yrs) 15-17 girls: 9.0MJ boys: 12.0MJ

If too much food is eaten the surplus is stored as fat. People wishing to slim go on a diet by ?counting the ca lories? which reduces their intake of high-energy foods. There are two systems of units for measuring energy, na mely joules and calories.

4.2 joules = 1 calorie 1000j = a kilojoule (kj) 1000kj = a megajoule (mj)

Muscles and Machines

Glucose is made available to the cells by forming a substance called adenosine triphosphate which acts as an intermediary in the transfer of energy. The body stores energy in the liver as glycogen which can be changed into glucose when needed. Some energy is stored as adenosine triphosphate in the muscles themselves. Once the working muscles have used up their own reserves they depend on glucose released from the liver. Exercise uses up energy and the more strenuous it is the more energy is used up. Below is the amount of energy used per hour by different activities.

At rest 252kj (60kcal)

Walking 1260kj (300kcal)

Cycling 1764kj (420kcal)

Jogging 2268kj (540kcal)

A bicycle enables the rider to use energy more effectively. When the rider pushes down on the pedals the force is transmitted from pedals to the rear wheel by a chain. Gears help to transfer the energy and there are different gears for starting off, climbing hills and cruising along. The gear used determines the number of times the rear rotates when the pedals are pushed around once. The more turns the rear wheel makes in one cycle of the pedals the faster the bicycle goes but the harder it is to push the pedals. Low gears help the rider to put a lot of force on the back wheel to get started to go up hill. High gears help the rider to move the bicycle very quickly using relatively little energy.

Activity:
Carefully turn a bicycle upside down and put it into first gear. Push on the pedals to make one complete turn of the chain wheel and count the number of times the back wheel goes round for every complete turn of the pedals. This is called speed ratio. What difference does it make to the speed ratio when the other gears are used? Count the teeth on the chain wheel and on each gear wheel. Can you use any connection between the numbers of teeth on the chain and gear wheels and the speed ratio?

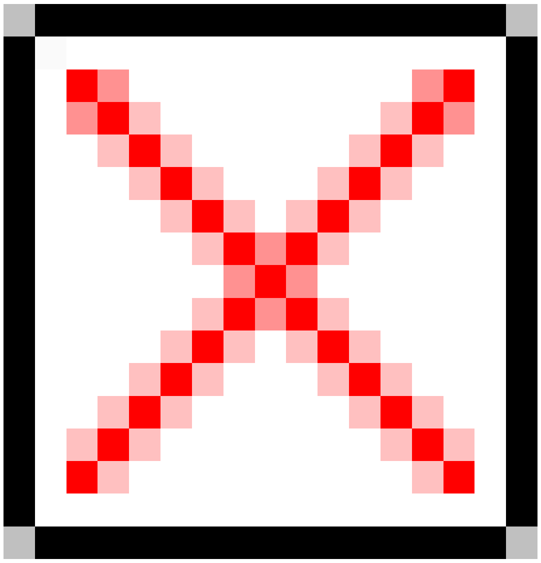
Storing Energy

Elastic materials can be used to store energy. They can be stretched or twisted into different shapes but will try to get back to their original size and shape when the stretching or twisting stops.

The trapped air inside an inflated balloon is a store of potential energy. If the balloon is released it flies through the air as the rubber goes back to its original size and pushes the air out. Potential energy has been changed into kinetic energy of movement. As the air escapes from the neck of the balloon some of the potential energy changes into sound energy.

A spring is given potential energy when it coils up. The kinetic energy used in winding up a clockwork car changes into potential energy in the spring. When free to move, the spring unwinds providing kinetic energy for the wheels.

Batteries



Contrary to popular belief, a battery does not store energy but it is used to make electrical energy when needed. Electrical energy is produced in a battery by the reactions of two electrodes. Each electrode is linked to one of the battery?s metal terminals. When the battery is linked into a circuit, there is a flow of electrons fr om one terminal (negative) through the circuit to the other terminal (positive). This is because the electrode starts to dissolve releasing electrons into the wire of the circuit at the negative terminal. The other electrode also loses electrons from one electrode through the circuit to make up the deficiency at the other electrode. In this way chemical energy is converted into electrical energy.

Some batteries can be recharged by passing electrical energy through them. The electrical energy reverses the chemical reactions that produce the power.

Activity:

A simple battery can be made by using a pile of ten 2p coins interspaced with blotting paper and foil. Cut our s ome round shapes of blotting paper and aluminium foil (a little larger than a 2p coin). Soak the blotting paper in salty water. Place a piece of foil over a 2p coin and a piece of salty blotting paper on top. Repeat these layers to make a small pile. Fix the end of a piece of wire underneath the pile and another on top. If the free ends of the wire are connected in a circuit with a light bulb, chemical reactions in the pile make electrical energy flow and the bulb lights up.

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