ENERGY:

13 ENERGY CLASS ACTIVITIES

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01. WHAT IS ENERGY?

THEORY AT A GLANCE:

Almost everything around us either produces or consumes energy. This energy may be contained in motion, as well as in stationary objects that release energy when they begin to move (e.g. if they fall).

The sun is the main source of energy for the Earth. This energy reaches Earth in the form of rays, which are then converted into numerous forms of energy: for example into the discharge of water through the water cycle, or into life and matter through the photosynthesis of plants, which themselves provide energy to the animals that eat them, and so on.

Note: This activity can be prepared by viewing the animations "What is energy ?" and "Converting energy" on the www.educapoles.org website.

ACTIVITY:
HIGHLIGHTING THE ACTION OF ENERGY

To introduce the idea of what energy is, use a toy that moves by itself when it is wound up, such as a car, a plane with a propeller, a robot, etc.
Highlight the two possible states the toy can be in: inert and in motion. Before winding up the spring, the toy sits inert on the ground: there's no "energy" to make it move. But if we wind up the spring and release the toy, it starts to move: "energy" has set it in motion.

Through the action of winding up the spring, we coil it up and store energy in it, using the energy of our muscles to do so. When we release the spring, the energy is transmitted to the toy in the form of driving energy, which is needed to set the toy in motion. The muscular energy used is converted into motion energy.

You can do the same sort of thing with a bow and arrow or a catapult, etc.

02. THE SUN, WORLD'S DRIVING FORCE

THEORY AT A GLANCE:

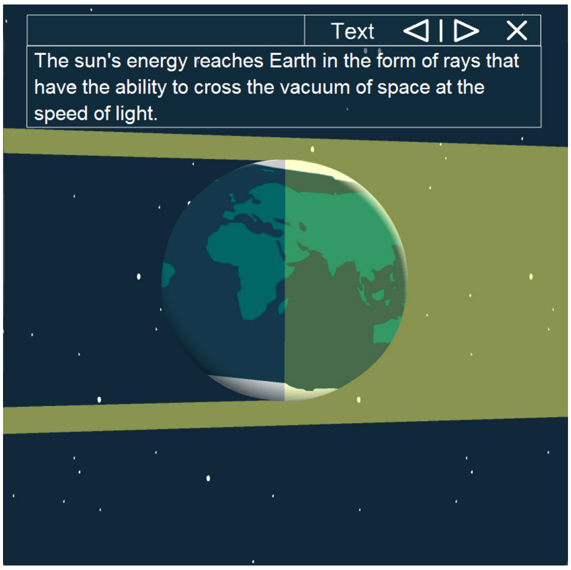
The Earth obtains most of its energy from the sun – and then sends it back into space again through the atmosphere. However, the greenhouse gases contained in the atmosphere hold on to this energy for a short time before releasing it back into space. This is the "natural greenhouse effect", without which there would be no life on Earth. Without it, there would be an average temperature of minus 19°C here, like there is on the moon, instead of the plus 15°C we enjoy at the moment.

The greenhouse effect is the result of a complex and fragile balance based on exchanges between the Earth, the atmosphere and space. One of the factors that controls this is the amount of greenhouse gas there is in the atmosphere. At the present time – right now – the level of greenhouse gas is rising very quickly as the result of activity here on Earth by humans. This is causing the average temperature here to rise and this, in turn, is responsible for what we call "climate change".

Note: This activity can be prepared by viewing the animation "Overall balance of the Earth: the sun, the world's driving force" on the www.educapoles.org website.

ACTIVITY:

HIGHLIGHTING ENERGY FROM THE SUN



Have the children paint two glass jars, one black and the other white. Fill them partly with ice-cubes, put the lids on and place the jars in the sun.
First of all, we see that the ice-cubes melt, which means that the surface of each jar has absorbed energy from the outside: the light from the sun carried energy with it, and this energy is absorbed by the surface of the jars. This light has then been converted into thermal energy by increasing the temperature of the air on the inside – which, finally, has melted the ice.
Second, the ice-cubes melt faster in the black jar. This is because the colour black absorbs more light. The black jar absorbs more energy from the light and heats up the ice-cubes more quickly. The white jar reflects a large part of the radiation from the sun and so absorbs less energy.

03. THE ROUTE TAKEN BY ENERGY, FROM THE POWER STATION TO THE COMPUTER

THEORY AT A GLANCE:

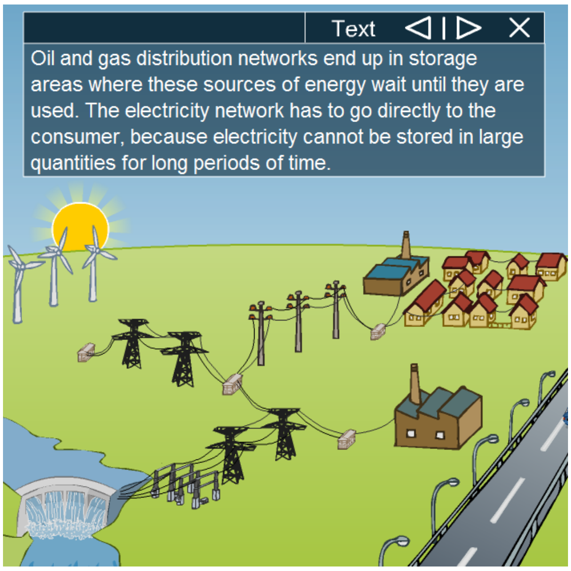
Electricity, which doesn't exist in a usable form in nature, is classified in the "energy vectors" category, as it enables energy to be carried from one place to another.
Now how do we take electricity from the place where it is produced to the place where the energy is going to be used? This requires a great deal of organisation. Energy is carried along what we call "networks": The network that carries electricity is called a "grid". There are also distribution networks for petroleum and gas.

Some forms of energy can be stored, such as oil, gas or hydrogen. But this is not possible for electricity, at least not in large quantities. The energy then has to be adapted to suit what consumers want. For example, petroleum is used to produce heating oil and petrol, etc. The voltage of electricity is adjusted through transformers so that it is able to be used for a variety of purposes (factories, trains, homes, etc.).

Note: This activity can be prepared by viewing the animations "Energy vectors: how we convert natural energy into man-made energy", "The route taken by energy: from the power station to the computer" and "Tracking electricity" on the www.educapoles.org website.

ACTIVITY:

OBSERVING ENERGY NETWORKS CLOSE TO SCHOOL



THE ELECTRICITY GRID

Take a look at the electricity grid close to school: where does the electricity that powers the school come from? (leave the classroom and go and have a look at the transformers or power lines that bring electricity into the school). If possible, use a map to show the children where the nearest power stations are located in relation to the town (dam, thermal, solar or other type of power station).

THE OIL DISTRIBUTION NETWORK

Talk about the petrol station that is nearest the school (if possible, visit it). Working with the children, think about where the petrol came from and how it got there (by truck, for example). Use a map to look with the pupils at where the nearest stores of petrol are located and how it got there (through a pipeline, for example).

04. GREY ENERGY, HIDDEN EXPENDITURE OF ENERGY

THEORY AT A GLANCE:

Grey energy is the energy hidden in a product, i.e. the amount of energy required to extract that product from nature, or to cultivate, manufacture, package and transport it. One object can conceal very different levels of grey energy: for example an apple that is grown locally contains less grey energy than one that is shipped from New Zealand to Europe.

This means that buying a product automatically equates to the expenditure of grey energy. Yet consumers almost never think about grey energy. In actual fact, every household in Europe consumes twice as much grey energy as it does more conventional energy (heating, light, television, etc.)!

Note: This activity can be prepared by viewing the animation "Grey energy: hidden expenditure of energy" on www.educapoles.org website

ACTIVITY:

WHAT TYPES OF ENERGY ARE HIDDEN IN EVERYDAY "THINGS"?

Ask the pupils to select two or three items found in the classroom (e.g. pencil, carpet, coat stand). Take each item and work with the children to retrace every stage of its manufacture, as well as the various types of energy that are used in each of the stages.

Example for a pencil:

Wood

1. growing the tree: solar energy
2. falling and cutting up the tree: depending on the type of machines used: electricity (energy vector) and/or oil (fossil energy)
3. transport by truck or boat (crude oil, fossil energy) or by train (coal (fossil energy) or electricity (energy vector, but from what origin?))

Graphite

1. extraction of graphite in a mine (crude oil for the machines, fossil energy)
2. transport of graphite (same energies as for the transport of wood)

Do the same thing for paint (produced from crude oil and other chemicals), for rubber erasers (made from rubber), for the piece of brass that holds the eraser (made from zinc and copper), etc.Talk about the way all these components are assembled at the factory, plus the packaging and delivering the item to the store.All of these elements put together, represent the grey energy contained in the pencil.

This type of discussion makes the children think about the large amount of energy required to manufacture an object as straightforward and inexpensive as a pencil (or carpet, coat stand, etc.).The group can also think about ways to cut down on this quantity of energy (such as manufacturing locally, for example).

05. HOW DID FOSSIL FUEL FORM IN THE GROUND?

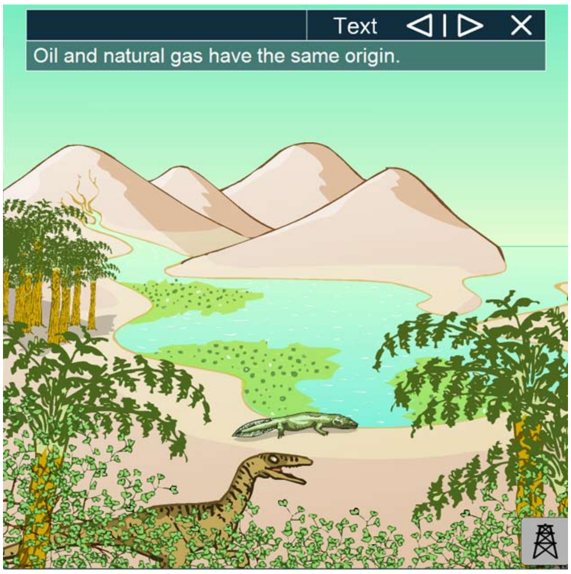
THEORY AT A GLANCE:

There are three sources of fossil energy: coal, oil and gas. These are natural reserves that can be found buried beneath our feet. Formed from organic deposits (plants or microscopic animal matter), all of these sources of energy take several million years to form, and this under very specific conditions. In general, crude oil and natural gas are created from the similar deposits, most often residue of marine plankton, whereas coal finds its origins in plant debris deposited in marshy areas.

Note: This activity can be prepared by viewing the animation "Oil: looking for black gold" on the www.educapoles.org website

ACTIVITY:

UNDERSTANDING HOW CRUDE OIL COMES TO THE SURFACE



After it has been formed, oil "migrates" – in other words, it leaves the rock in which it was formed (called the "source rock") and heads towards the surface through the water that circulates inside the rocks. The following experiment enables the pupils to form their own practical idea of how it happens:

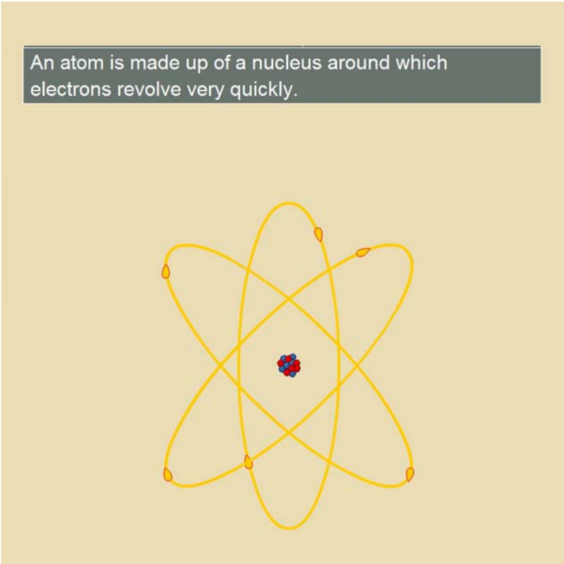
Place a lump of sugar in a saucer. Take some cooking oil (sunflower oil, olive oil, etc.) and pour a little on to the sugar lump. Wait for the oil to seep into the sugar. Then take the lump and drop it into a transparent glass filled with water.

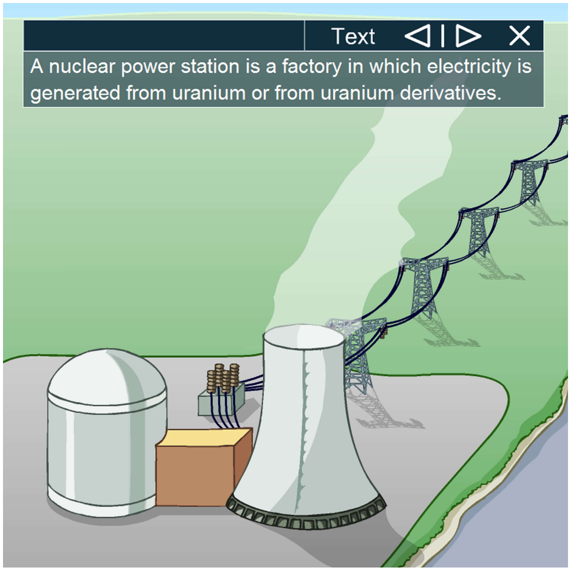
The sugar lump sinks to the bottom of the glass. Once the ripples created by the sugar lump falling into the water have calmed down, drops of the oil can be seen forming on the surface of the sugar lump before floating to the surface.

The sugar lump represents the "source rock" and the cooking oil represents the crude oil. Oil is lighter than water. Now, there is water circulating inside rocks, even at great depths. And when the oil comes into contact with water, it is "carried" upwards on account of the difference in density, exactly the same way as the cooking oil is "extracted" from the lump of sugar.

06. NUCLEAR ENERGY

THEORY AT A GLANCE:





Nuclear energy, which is also called atomic energy, is the form of energy that binds together the constituents of the nucleus of an atom. This energy can be released, mainly in the form of heat, with the disintegration of unstable nuclei (Uranium 235 or Plutonium 239, for example).

Uranium is a radioactive metal that is found in certain rocks. It is made up mainly of two isotopes: Uranium 238 (99.3%) and Uranium 235 (0.7%). First, the uranium has to be extracted from the rock. The uranium 235 is then concentrated by a factor of approximately six before the fuel used in nuclear power stations can be manufactured. It takes around 100 kg of ore to obtain 100 g of enriched uranium, which is an extremely concentrated source of energy (the concentration required for military usage is a great deal higher).

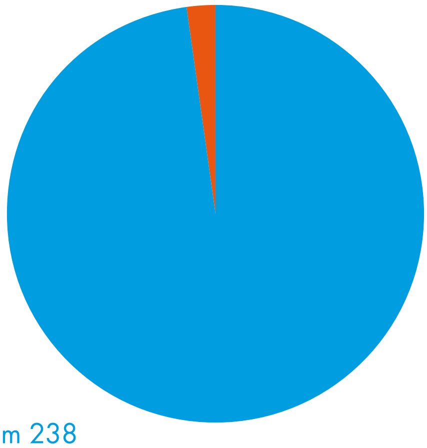
In nuclear power stations, nuclear energy is converted into heat to boil water and, as is the case for thermal power stations that use fossil energy, this drives the turbines that ultimately generate electricity.

The radioactive radiation released during the production of energy or by "spent" fuel (nuclear waste) is noxious, particularly in large quantities. Although the level of radioactivity diminishes over time, nuclear waste remains hazardous for hundreds – perhaps even millions - of years.

Note: This activity can be prepared by viewing the animation "Nuclear energy: when atoms explode" on the www.educapoles.org website

ACTIVITY:

UNDERSTANDING WHY A LARGE AMOUNT OF ORE IS REQUIRED TO OBTAIN A LITTLE LESS THAN 100 GRAMS OF ENRICHED URANIUM



Uranium 238
Uranium 235

In general, the rock (or ore) in which uranium metal is found only contains a very small amount of uranium: more or less 0.5% (or 1 in 200 parts).
To explain this ratio to your pupils, buy a very large tube of Smarties. Choose a particular colour to represent uranium and take out all of the Smarties of that colour except one, which you put back into the tube with the other colours. Before putting the one remaining Smartie back into the tube, use a pen to draw a thin line on it (see the drawing below) to represent the amount of Uranium 235 in relation to the amount of Uranium 238.

Show the pupils the closed tube of Smarties. This represents the rock extracted from the mine. The rock is then taken to a factory, where it is crushed (open the tube and pour the Smarties on to a plate). The different colours of Smarties represent the various components of the rock. But in this case, the only component that the miners are interested in is the uranium (i.e. the Smartie of the colour you have selected), in other words about 1 Smartie in 200. Ask one or two pupils to hunt for the single coloured Smartie representing uranium in the plate, demonstrating the way the uranium is mined.

Then explain that the uranium metal mined is made up of various different types of uranium and that the type needed to manufacture the fuel used in nuclear power stations is only a small proportion of the metal actually mined (0.7%). The thin line drawn on the Smartie represents the amount of Uranium 235 found in the natural uranium metal that is extracted from the rock.

This means that only a small part of this particular Smartie is used to produce the nuclear fuel. In fact, it will be divided into 6 parts and only the 1/6 part including the line on the Smartie will be used. This can be explained by a drawing on the blackboard.

Then make a comparison between the amount of rock mined at the outset (the tube of Smarties) and the amount used (1/6 of one Smartie).

07. BIOMASS

THEORY AT A GLANCE:

The biomass encompasses all living matter (plant life and animals). The three main sources of energy produced by the biomass are wood, biogas and bio-fuels:

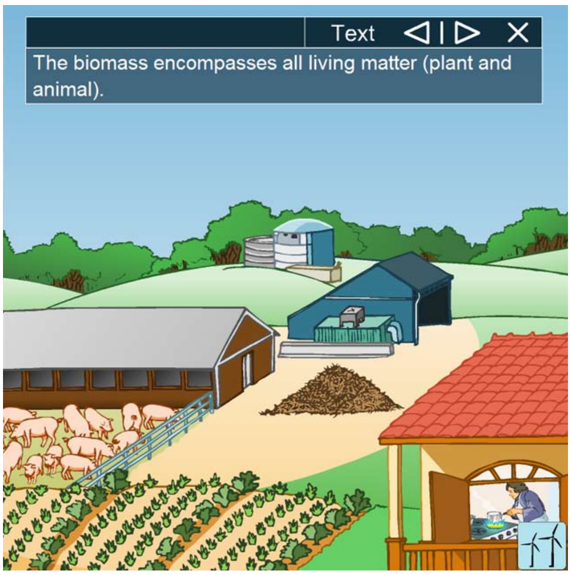
1. Wood is the oldest source of energy used by humans. Whilst it is little used in Europe these days, it remains the number one source of energy for several billion people around the world, who use it for cooking and heating
2. Biogas is produced from biodegradable waste matter. Biogas is like natural gas, but is not a form of fossil energy.
3. Bio-fuels are made from farming products (wheat, rape, corn, etc.). They can be used as a substitute for petrol, heating oil or diesel fuel, or can be blended in small quantities with these forms of fuel.

These sources of energy are renewable as long as the crops are re-sown after they are harvested. The way in which these crops are grown is also important: the use of fertilisers and chemical pesticides, which themselves are produced using crude oil, can dilute their genuine renewable nature (especially for bio-fuels).

Note: This activity can be prepared by viewing the animation "The biomass: biogas" on the www.educapoles.org website.

ACTIVITY:

MAKING BIOGAS



It is possible to make biogas in the classroom, without any danger.
Fill a glass bottle with moist plant matter from the garden. Seal the bottle. Place the bottle close to a gentle source of heat (the sun, a radiator) and allow it to ferment for a few days. Make an observation of the bottle each day: note how the biomass settles slightly and the condensation on the side of the bottle. After a week or so, open the bottle. You will hear a slight hissing sound and a foul smell will be released: the organic matter in the bottle has fermented and pressurised biogas has formed.
Carry out the experiment again using other types of organic matter, such as leftovers from the school canteen.

08. THE WIND, BLOWING FOR OUR BENEFIT

THEORY AT A GLANCE:

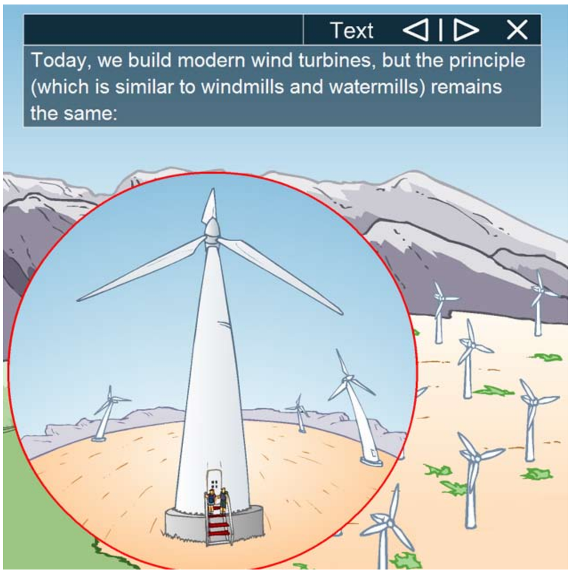
Wind power, created by the force of the wind, is virtually everywhere around us – although not all of the time. As a result, the locations selected for installing the huge power-generating wind turbines on wind-farms depend on the strength and frequency of the winds that blow there.

Just like the sails on the windmills of old, modern wind turbines have blades that are driven by the wind. Transmitted to an alternator, the rotary movement of the blades is converted into electricity. Wind power is an area that is constantly developing from a technological point of view, and there are still numerous other paths we can go down to explore ways of using this source of energy.

Note: This activity can be prepared by viewing the animation "The wind: blowing for our benefit" on the www.educapoles.org website.

ACTIVITY:

THERMAL MOBILES FOR UNDERSTANDING WHERE WIND COMES FROM



Cut out spirals and propeller shapes from a sheet of aluminium foil. When you hang them by a thread over a candle or a radiator, they rotate. How has energy been transferred to make this movement possible?

The source of heat makes the air surrounding it warm and hence lighter than the air in the remainder of the room. This hot air begins to rise and a spiral located in a current of rising air begins to move. This is how wind is generated.

09. WHEN ENERGY CONSUMPTION CAUSES POLLUTION

THEORY AT A GLANCE:

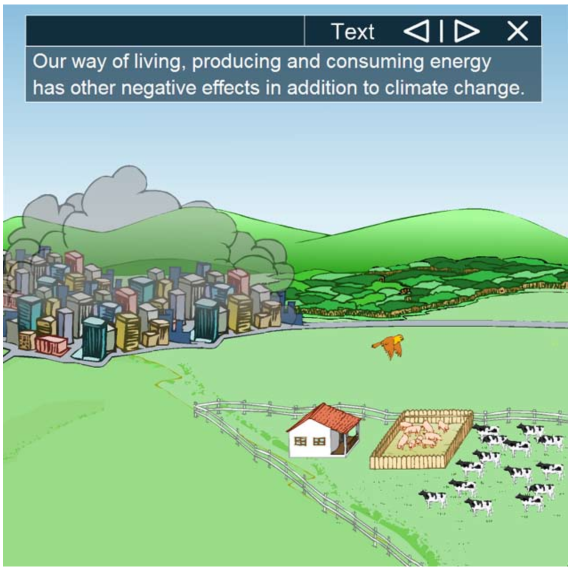
Using some sources of energy pollutes more than others. Making valid comparisons, however, is difficult, because there are lots of different forms of pollution (e.g. the greenhouse effect, acid rain, "bad" ozone, fertilisers and pesticides, radioactivity, pollution of the water table, noise pollution). Also, using certain sources of energy is causing our natural resources to deplete and run out (coal, oil, etc.).

ACTIVITY:

IS THE RAIN REALLY "ACID" ?

When it rains, put a clean bucket outside, away from trees and buildings, and collect at least 20 ml of rainwater.

Here are two ways of finding out whether this rainwater is acidic:



1/
Finely chop some red cabbage leaves and place them in a container. Pour on some boiling distilled water (available from pharmacies) and leave for one hour. Recover the juice of the red cabbage made in this way by pouring it into a graduated container through a strainer. The juice should be a dark violet colour. Pour 20 ml of distilled water into one jar and 20 ml of rainwater into another jar. Put the same quantity of the red cabbage juice into each jar. Compare the resulting colours: if the rainwater turns red, it is because it contains acid and hence is polluted.

2/
Buy some pH test paper from a pharmacy (pH is measured on a scale between 1 and 14. You need pH paper that can measure readings between pH 5 and pH 9).

Take a sample of the rainwater, dip a strip of the pH test paper into the water and measure the pH reading as described in the instructions for using the paper (i.e. comparison of the colours obtained). The normal pH for rainwater is already slightly acidic (around pH 6). If you obtain a result of less than 6, the rain is abnormally acidic!

10. WHAT CONSEQUENCES?

THEORY AT A GLANCE:

People live very differently across the world. For example, someone living in Bangladesh uses an average of sixty time less energy to live than an American. In the same way, how people perceive the notion of "minimum comfort" is not the same everywhere: some people are happy simply to have drinking way or the power to provide light, while others think that it is impossible to live without two cars and the dazzle of bright advertising signs everywhere. These differences are sources of imbalance. The fair thing would be for all people to have access to enough energy to provide them with the same minimum comfort.

It is possible to save energy while maintaining the same level of comfort. The ecological footprint allows everyone to evaluate if we still need to improve or not.

Note: This activity can be prepared by viewing the animation "The ecological footprint, a measure that induces to better consumption!" on the www.educapoles.org website

ACTIVITY:

CALCULATE YOUR ECOLOGICAL FOOTPRINT

Go to the following website: http://www.myfootprint.org/ and complete the questionnaire. It takes about 15 minutes per person. You can have your pupils play one after the other or have them answer each of the questions in turn, so that you get a class "average". Then compare your results with the score from other countries.

You can then go back to some of the questions that appear not to have any link with energy. You will soon realise that everything is linked. For example:

- the surface area your home indicates that there is more or less space to heat
- more energy is required to heat an individual house than to heat a flat in an apartment building
- there is an energy cost involved in bringing water to your home. So by using less water, there is also a saving in terms of energy
- far more energy is required to raise chickens or cows than to grow cereal crops
- producing food consumes energy. If we eat more than we need to, that wastes energy
- every item we buy has required energy to make, pack and transport. So if we simply 'consume' where there is no need, we waste energy.
- leisure activities such as winter sports or skydiving usually require a great deal of motorised transport.

11. SAVING ENERGY, WHEN LITTLE THINGS CAN ACHIEVE A LOT

THEORY AT A GLANCE:

It is possible to save a large amount of energy while still maintaining the same standard of living and comfort. All we have to do is save the energy that we use without it really being of any value for anything.

We all make unconscious little choices throughout the day that might boost or reduce our consumption of energy: at the supermarket, in our bedroom or in the kitchen, etc. The thing is simply to be aware of what we are doing and to change our habits a little, for example by using power sockets with an on/off switch that enables us to turn off electronic equipment totally, rather than leaving them on standby, which uses up electricity.

Note: This activity can be prepared by viewing the animation "Changing our habits: little things that can achieve a lot" on the www.educapoles.org website.

ACTIVITY:

REDUCING ENERGY CONSUMPTION IN THE CLASSROOM

Work with the children to identify everything that could be improved in the classroom to reduce the consumption of energy. For example:

- install power sockets with on/off switches and turn them off every day before going home
- install a container for waste paper to be used for recycling.
- also set up bin bags for aluminium and PET waste (from the soft drinks brought to school by the children for break-time), if they do not already exist in the school.
- install energy-saving light bulbs
- check the temperature in the classroom using a thermometer (to see whether it is overheated or not. 20°C is a good temperature.)
- check to see if there are any draughts in the classroom (coming in through the windows, for example), and draught-proof them if necessary
- switch off the lights when they are not needed.

This activity can also be extended throughout the school.

12. TRANSPORTS

THEORY AT A GLANCE:

Every time we travel anywhere, we consume energy. And some forms of transport use more energy than others, such as cars or planes (per person, per kilometre). Choosing one method of transport to travel rather than another is a very important choice when it comes to saving energy.

Note: This activity can be prepared by viewing the animation "Collective and individual efforts" on the www.educapoles.org website.

ACTIVITY:

VISUALISING HOW MUCH ENERGY IS USED BY A BUS OR PLANE

Line up some small toys on a table: a car, a bus, a motorcycle, a bicycle, a plane and a train. Place and empty 1-litre PET bottle behind each of the toys. Fill the bottle behind the plane to the top.

Start by explaining to the class the notion of energy consumption per passenger, per kilometre. For example: we consume half the amount of energy per person per kilometre when 2 people travel in a car instead of just 1.

The full bottle behind the plane, which is one of the means of transport that uses the most energy (particularly on landing and take-off), represents 100%. The pupils then have to guess how much energy the other methods of transport use per person per kilometre, in relation to the plane.

To do this, each child draws a horizontal line on each of the bottles to indicate his or her estimate. She/he also writes her/his name alongside the line.

When all of the children have had their turn, fill each of the bottles according to the following percentages: car and plane 100% / motorcycle 60% / bus 45% / train 14% and bicycle 0%. Then discuss the various rankings. For example:

- cars may use a great deal of energy, but this is also because we often drive cars alone, with no passengers.
- these figures are averages. So a big motorcycle uses almost as much energy as a car.
- some new cars use less energy thanks to new technologies (hybrid engines, car that run on gas, etc.)
- with planes, a short flight uses more fuel per kilometre than a long-haul flight.

13. CHOOSING OUR FUTURE

THEORY AT A GLANCE:

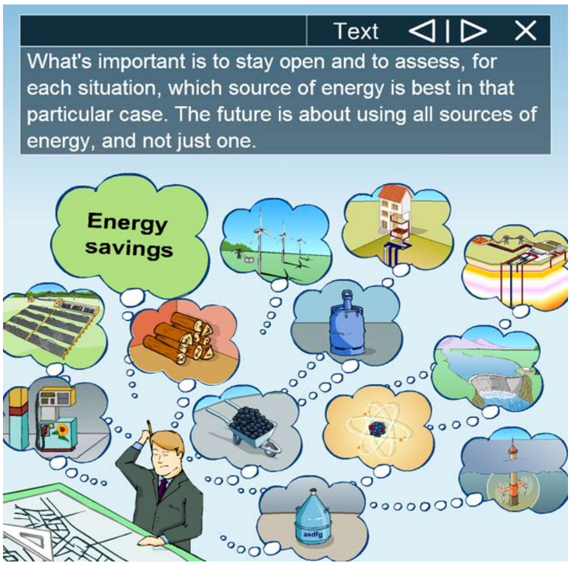
It is only recently that we have come to realise that consuming energy willy-nilly can cause problems. Even today, a part of society continues not to take this into account. However, we are going to have to change this attitude over the next 50 years. This is mainly for 2 reasons:

- the production of oil will soon not be able to keep up with demand, which will increase prices significantly
- climate change will cause major problems locally in terms of adapting to the change (e.g. drought) and our energy consumption is one of its major causes

However, by pooling all of our efforts, we should be able to find solutions without having to change our quality of life too much.

ACTIVITY:

WHAT HABITS CAN WE CHANGE ?



Make a list with the children of all of the improvements they could make in their habits to save energy. For example:

- switching off the lights each time they leave a room
- always switch off the television completely (don't leave it on stand-by)
- don't leave the water running when cleaning their teeth or soaping their hands
- closing blinds or curtains at night (in winter only)
- buying less new clothes / games / etc.
- etc

Then, each pupil chooses an idea from the list and tries to apply it for a whole week. Meet a week later and discuss the experiment. For example: was everyone able to change their habits without any problem? What difficulties did they encounter? Why is it hard to change old habits? Can it cause problems with other people who may not necessarily want to change theirs?