Energy

Energy is part of all human activities: it heats homes, makes cars move, cultivates land, and makes machines do work. The intensive exploitation of the world's energy resources over the past few centuries has brought about an unprecedented rise of living standards. People nowadays are so dependant on the use of energy that they can hardly imagine living without it.

There are various energy sources, but people are seldom aware of the fact that **solar energy** is the original source of all energy in the world and therefore makes life possible today.

Solar radiation penetrates the atmosphere and heats the Earth. The Earth also radiates infrared energy, which is invisible but also transforms into energy. Part of the heat is emitted and lost in outer space. The remaining part of the reflected heat is absorbed and does not leave the Earth, due to the gases in the atmosphere known as "greenhouse gases." These gases are like a blanket covering the Earth, and play a natural role in keeping the Earth warm. Other planets without an atmosphere are much colder, and life as we know it cannot exist there.

Sunlight is a basic component in the process of photosynthesis. It is very important for the existence of plant and animal organisms. Regions with favourable light and heat conditions usually feature a great variety of plants and animals, and the people's living is much easier.

Today, people use different types of energy sources:

- fossil fuels (coal, natural gas and oil);
- nuclear energy; and
- renewable energy resources (water, wind, geothermal energy, biomass, etc.).

Energy production causes serious negative impacts on the environment. The burning of hard and liquid fossil fuel is accompanied by the release of acidic gases, dust, soot and other pollutants. Mining in open pits leads to changes and destruction of the natural landscape. The operation of nuclear power stations carries risks, while the storage and treatment of nuclear waste is still expensive and untested.

The environmental impact of global ecological problems such as acid rains and climate change have been studied for decades now and are becoming better understood by politicians and the public. These negative phenomena are caused to a great extent by the process of energy production.

Although energy can be produced through "cleaner" techniques, using renewable energy sources like the sun, the wind, warm geothermal water or biomass, no method is harmless to the environment, which is why one of the biggest challenges facing us today is how to use energy more effectively in our everyday lives, in industrial production and in rendering various services.

Lesson plan: **Everything needs the sun**

Duration	1-2 class periods
Time of year	Any
Place	Classroom
Materials	Various objects in the classroom, fact sheets
Aims	• To raise awareness that the sun is the main source of all energy on Earth
Methods	Discussion, group work, brainstorming

Part I: Everything needs the sun

1. Ask the class what they think the role of the sun is in the existence of plants, animals and people. Find examples from everyday life that illustrate the need and desire of living organisms for sunshine (e.g. sunflowers turn towards sunlight; cats like basking in the sun; people sunbathe when the weather is fine).

2. Remind the students that the sun is a star at the centre of our solar system. The Earth and the other planets receive energy and light from it. Upon reaching the Earth, the solar energy is transformed into various forms of energy, which is then used in many different ways. Support your examples using the information from the introductory part.

3. Divide the class into groups of six or seven. Ask each group to choose a different object in the classroom (for example, objects made of wood, glass, metal, paper, plastic, leather and ceramics). Explain that every object needs energy to become what it is and to be in the place where it is. At the origin of all forms of energy is the sun. Ask all groups to brainstorm ideas for 10 or 15 minutes about the role solar energy plays in the process of production of the various objects.

Example: A wooden table is made of wood and metal and is painted.

- Wood: First, trees need to grow, which is impossible without sunshine. Cutting, transport and processing of timber require energy. This energy is normally derived from the burning of fossil fuel.
- Metals: Mining, transporting and producing metals is impossible without the use of various machines driven by energy. The machining of metal parts is done with instruments and driven by electric power.
- Paint and varnish are usually obtained from petrol products and their production requires electric power.

- Fossil fuels (coal, petrol and natural gas) are obtained from underground, where they have been resting for millions of years after being transformed from the plant and animal organisms buried there in prehistoric times. The existence of these ancient plants and animals would have been impossible without the sun.
- Electric power is most often obtained by burning fossil fuel or using the energy of water as it travels downward from a higher point. Precipitation carries the water to this higher point as part of the hydrological cycle, a process driven by the sun.
- Other sources of energy like wind generators or solar collectors also take energy from the sun.
- The delivery of the wooden table to the school is carried out by transport vehicles, which are powered by fossil fuels.
- The people who take part in all the stages of production and transport of the table to the school receive energy from food. At the base of all food chains are plants that derive energy from the sun via photosynthesis.

4 Ask one of the groups to present to the class the results from the discussion.

Part II: Forms of energy

1 Hand out copies of the fact sheet Forms of Energy. Focus first on the top half of the fact sheet, which deal with a standard sandwich.

2 Discuss the components of a normal sandwich. Try to trace the process of production for each element and the energy used in these processes. Assist the students, if needed, with the following additional information:

- The sandwich ingredients are bread, cheese and tomato.
- Cereals grow in fields where the work is done by machines that consume energy.
- Breadmaking includes several processes and each of them requires energy, especially heating.
- Cheese is made from milk from domestic animals (cows, sheep) after processing, made with the help of machines and driven by energy, especially for cooling.
- Tomatoes grow and ripen owing to the sun; but their gathering and transport are done with the help of machines that burn fossil fuels.
- People make sandwiches with energy that moves their muscles.

3 Look at the bottom half of the fact sheet Forms of Energy. Look at the different people and ask the students to explain what the people are doing.

4 Discuss the following questions together:

- What happens to the energy, hidden in the firewood?
  (the energy hidden in the burning wood is transformed into heat energy)
- What type of energy do the guitarist and the drummer use and what does it transform into? (muscle energy is transformed into sound energy)
- How does the lantern give light?
  (by transforming the energy hidden in the liquid fuel into light energy)
- How is food cooked?
  (by transforming the energy hidden in the gas into heat, which helps food to cook)
- How does the child his way in the dark?
  (with a torch – the chemical energy of the batteries is transformed into light energy)
- How does the biker start his motorcycle? (by transforming the hidden energy in the petrol into mechanical energy, which drives the bike)

5 Try to think of an object which does not need energy.

Lesson plan: **How to conserve energy**

Duration	2 lessons
Time of year	Any
Place	Classroom
Materials	Fact sheets Conservation of Energy, test What We Know about Energy
Aims	• To raise awareness and create skills for energy conservation
Methods	Sharing of experience, discussion, brainstorming

1 Begin the lesson by turning the light in the classroom on and off several times. Ask the students if they think this activity in any way has an influence on the environment. Explain that many people would think this is an odd question, since light at home is a household matter. What happens at home can be hardly related to the environment.

2 Explain that the production and consumption of electrical power result in an extraordinary amount of pollution. The burning of hard and liquid fossil fuel is accompanied by discharges of acidic gases, dust, soot and other pollutants. The operation of nuclear power stations carries risks, while the storage and treatment of nuclear waste is expensive. Combustion engines release burnt gases. Ask the students to give examples of pollution they have witnessed caused by the production or use of energy (smoke from the chimneys of power plants, gas from the exhaust pipes of the cars, smoke from the fireplace or stove at home).

3 Go back to the example of turning on and off the light in the classroom and explain that from 15 to 20 percent of the energy produced in the country is used for lighting. If every family turned off one lamp at home for an hour it would lead to significant energy savings. This in turn would mean less pollution of the environment and more money in the family budget.

4 To justify these savings, give the following example *(simplify the example for younger students)*:

- Assume that there are 1 million families in your region.
- Imagine that every family turns off one lamp with a 100-watt bulb for one hour.
- This activity will save 100,000 kilowatt hours (kWh) of energy and EUR 10,000 (price for 1 kWh = 0.1 EUR).
- This experiment would allow a small-sized power plant to stop working for one hour, and stop polluting the environment for this time.

5 Hand out copies of the test What We Know about Energy. After the students have completed it, give them the key and discuss the answers. Stress that the production and use of energy have a serious impact on the environment. Everyone can help by using energy sparingly.

6 Divide the class into four expert groups and give each group a different version of the worksheets on How to Save Energy. Give the students 10 minutes to discuss the specific information from the fact sheets on how power effectiveness could be improved. After that a speaker for each group tells the class what simple changes in the daily routine they suggest to conserve energy. Choose a fun way for the students to present the information, such as telling stories, giving demonstrations, miming, interviewing, advertising, etc.

Other activities

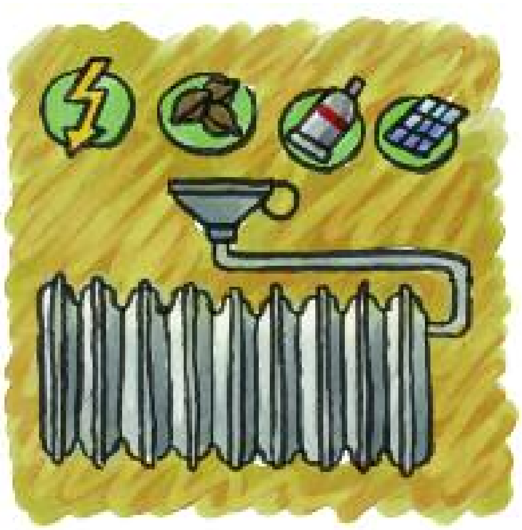
- Ask several volunteers to form a small group and to discuss in front of the class the dilemma How to Make Our Home Warmer.
- Ask the students to work out a plan for saving energy at home, which they have to discuss with their parents. As follow-up ask for feedback from the discussion.
- Make a plan for energy saving in the classroom and do your best to follow it.
- Make copies of the picture on page 132 and hand them out to the students to colour in.

DILEMMA

How to Make Our Home Warmer

Your family moves to a new home which still needs finishing and furnishing. One of your first tasks is to take care of the heating and comfort. How would you prioritise the following options:

- heating your home using electric appliances;
- heating your home with coal and wood;
- find ways to use natural gas in your home;
- improve the insulation of outside walls and the windows;
- install solar panels on the roof;
- make sure all lights and electric appliances have minimum consummation of power;
- other.



TEST

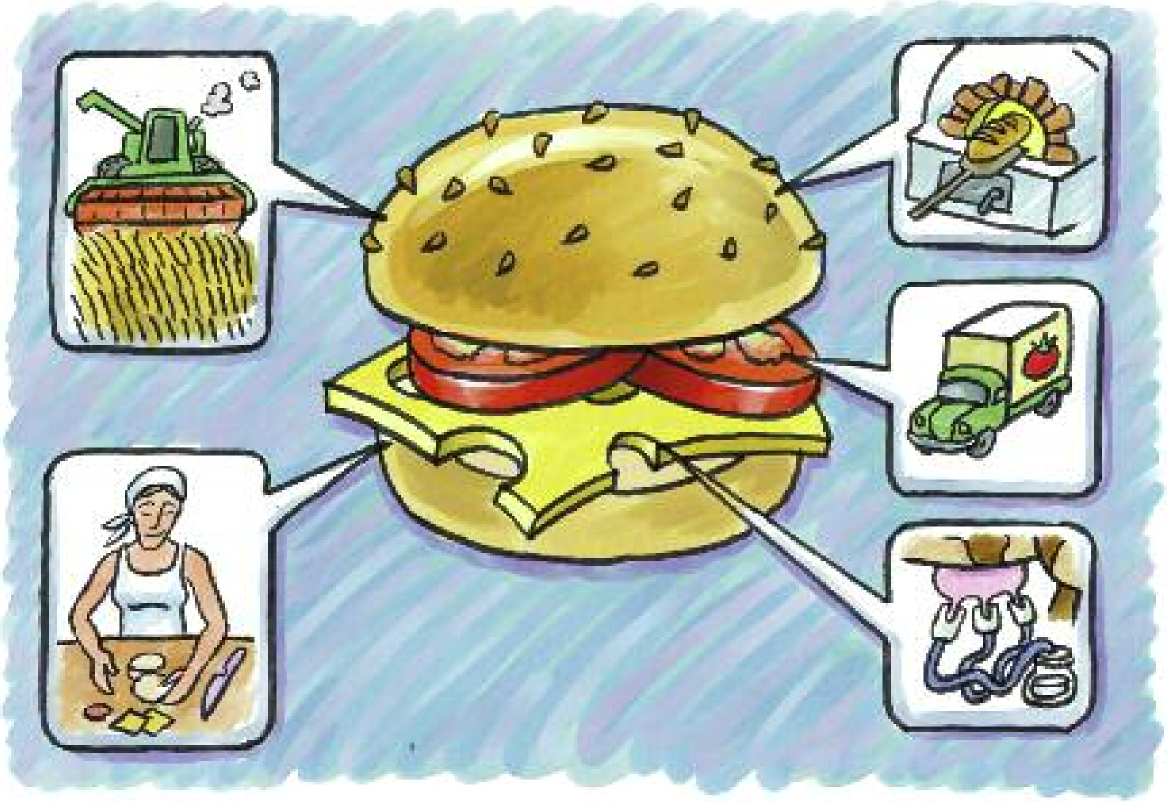
What We Know about Energy

		TRUE	FALSE
1	Solar energy is the origin of all other energy sources.		
2	The biggest power polluter of the environment is solid fuel.		
3	We will never run out of coal.		
4	Burning coal pollutes the environment more than natural gas.		
5	Using renewable sources of energy speeds up the negative changes in the climate.		
6	Households and families can save energy in simple and easy ways.		
7	Insulating the home helps the environment.		
8	Solar batteries and collectors will only be usable in the distant future.		
9	We should not put warm food in the fridge.		

Answer key: 1. True 2. True 3. False 4. True 5. False 6. True 7. True 8. False 9. True

FACT SHEET

Forms of Energy



FACT SHEET

How to Save Energy — at Home

Put heat insulation on the outside of the walls of your house/flat.

Fill in the windowsill gaps.

Improve the heat insulation of the floor.

New buildings in cold climates should have large windows facing south to get a lot of light and heat from the sun during the winter.

The overall effect of this will be a warmer home (by 4-7 degrees Celsius).

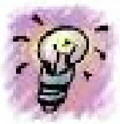
FACT SHEET

How to Save Energy — while Heating

Place heaters (radiators, stoves) under windows so that they can heat the air as it comes in (saves up to 5% energy).

Use automatic thermo regulators, fixed permanently on appliances, which maintains a constant temperature (you save up to 15% energy).

Replace all old and low-efficient heaters (you don't have to replace all at once) with more efficient models (you save up to 5-15% energy compared with the energy before the replacement).



FACT SHEET

How to Save Energy – while Cooking and Cooling

A tightly closed oven door when cooking saves energy (5-7%).

When cooking in an oven its whole capacity should be used, and when possible, cook several dishes immediately one after the other to avoid pre-heating again.

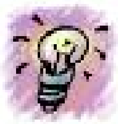
Use pressure-cookers, which save energy (up to 20%) and time.

Use pots whose diameter at the bottom is equal to or bigger than the diameter of the hot-plate (saves up to 15% energy)

The pots you cook in should have even and thick bottoms (unevenness of just 1mm will cost 15% more energy).

Defrost the fridge regularly (saves 1-2% energy).

Do not put warm food or pots in the fridge (saves up to 5% energy).



FACT SHEET

How to Save Energy — while Ironing, Cleaning and Washing

Use an iron with a regulator of the temperature (saves up to 5% energy).

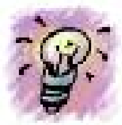
Use steam irons (saves up to 10% energy).

Use the washing machine at its full capacity.

Use automatic washing machines — they are more economical both in terms of water and energy. Always choose the most suitable programme (saves up to 5% energy).

Clean the dust bag of the vacuum cleaner regularly (saves up to 10% energy).

Replace broken hoses of the vacuum cleaners (saves 5-8% energy).



FACT SHEET

How to Save Energy – while Lighting

Decorate the walls in light colours
(saves 2 percent of the energy needed for lighting).

Plant trees at least 5 metres away from building walls.

Always keep windows clean (saves up to 1 percent energy).

Turn off lights when you don't need them.
Have timers or movement sensors to control the outside light, so that it turns off when it is not needed.

Replace incandescent bulbs with compact fluorescent lamps. They are extremely durable (lasting up to 10 times longer than the common bulb). The replacement of a common 75-watt bulb with a 20-watt fluorescent lamp at 10 hours of work per day will reimburse the investment within less than a year.

Don't leave electric appliances on standby. Appliances on standby use power all the time even when they are turned off.