Lesson plan

using the STEAM method of teaching.

Topic: Renewable energy sources (heat pumps for heating and cooling; photovoltaic solar panels, solar thermal panels and wind energy)

Alternative, renewable energy is currently not only a fashionable term, but also a relevant and promising field of energy production.

Increasing energy needs as well as depleting fuel resources and increasing environmental pollution, force mankind to search for ways to use energy that is renewable and not so harmful to the environment. Nowadays already available renewable energy sources are running water, solar energy and wind as well as sea waves and tides plus geothermal heat.

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Wind Energy: Wind energy has been used in various countries since ancient times. In the Middle Ages, windmills were used to grind grain, and nowadays wind is increasingly used to generate electricity. Wind energy, like flowing water, now has the greatest commercial importance in the world. There are many places on earth where strong winds blow. Wind energy is the fastest growing form of all renewable methods of energy. Wind turbines come in many different types and sizes. Diverse turbines are adapted to different wind speeds, but higher wind turbines produce more electricity. In order to produce a larger amount of electricity, wind turbines are often connected to wind farms. The best places for setting up wind farms are hilltops, plains, and sea coasts. More and more wind farms are being installed in the open seas, several tens of kilometers from the coast, because this is where the strongest winds blow. In Lithuania, the most favorable place for wind power plants is the western part of the country. Unfortunately, due to the limited infrastructure of transmission networks, it will be difficult to build a wind farm anywhere.

The optimal height of a wind power plant built for commercial purposes is 30 m, and the distance between the wing blades is 35 m or more. Installing and maintaining such a power plant is expensive, therefore, for economic reasons, a complex of at least 25 wind power plants - a wind park - is usually built in one place. By the way the first wind farms were built in California (USA). And one of the world's largest wind farms is near San Francisco, where 8,000 wind turbines are installed in a small area. Most of the wind power plants are now being built in European countries. Germany is the leader in the use of wind energy. In 2030, such an energy source should provide about 40% of the produced electricity. Like all other types of renewable energy sources, wind energy has both advantages and disadvantages.

Advantages: it does not pollute the environment with harmful substances as well as does not promote the greenhouse effect. The installation of power plants also has little effect on the surrounding ecosystem. In addition the winds are the strongest in winter, when electricity needs are the highest. Plus the construction of wind farms is expensive but the cost of the electricity produced is low. As wind farms are built in rural areas, new jobs are created and farmers can start businesses and increase their income.

Disadvantages: the wind strength is not uniform, and it is impossible to generate electricity when the wind blow is insufficient. And on the contrary, when they are strong for example during strong storms, the excess of it cannot be stored. Moreover wind power plants darken the landscape and also harm people's health with the noise, causing radio and television interference displeasing people living nearby. What is more, many animals leave such places.

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Hydropower: harnesses the energy of water moving from higher to lower elevations. It can be generated from reservoirs and rivers. Reservoir hydropower plants rely on stored water in a reservoir, while run-of-river hydropower plants harness energy from the available flow of the river. Hydropower reservoirs often have multiple uses - providing drinking water, water for irrigation, flood and drought control, navigation services, as well as energy supply. This is one of the most important and widely used renewable energy sources. Currently, the falling water‘s energy is mainly used for building dams and installing hydroelectric power plants nearby. When a dam is built, the water level is higher on one side and lower on the other. A stream of falling water is formed causing turning turbines, and these are generators that produce electricity. Hydroelectric plants are especially suitable for being built in mountains where the slope of the rivers is high. And about 30% of water energy resources in the world are being produced. Countries such as China, Brazil, Russia, and Canada have the greatest potential in this area. There are states where hydroelectric power plants produce all or most of their electricity (100% in Paraguay, 97% in Norway. Many developing countries have great opportunities to use flowing water‘s energy as well. They mainly build small hydropower plants. It is estimated that if all possible resources of flowing water are used, about 40 percent of the world's electricity would be produced.

Advantages: the energy of flowing water is inexhaustible. Hydroelectric power plants are built in sparsely populated areas, they have a long operating time, and the price of the produced electricity and operating costs are low, since no fuel is needed. Electricity generation is considered clean and ponds can store water and reduce the risk of floods supplying water during droughts.

Disadvantages: installation of dams in addition to construction of power transmission lines is expensive and takes a long time. After the construction of dams, water bodies are formed, which sometimes flood a huge area. People living there are being removed to other places and they lose a lot of

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land. Furthermore vegetation and animals are destroyed. Because of the earthquakes' landslides the dam might collapse creating devastating floods in the river valleys.

Wave energy is another form of renewable energy that can be used as an alternative to traditional energy from fossil fuels — finite resources that release harmful carbon emissions into the air when harnessed for energy. Waves, especially when there is a strong wind, produce a lot of energy therefore they can be used to generate energy. Unfortunately, it was proven difficult to create materials that can withstand the destructive force of waves and convert wave energy into electricity. The first wave energy collector is installed in Scotland. Small power plants powered by wave energy are located off the coast of Norway and Japan. The energy produced is used to supply the lighthouses. But after several years of testing these projects were abandoned due to technical difficulties.

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Tidal energy. Since ancient times people have thought about how to harness the energy of tides. Mills were built in areas where water flowed at a speed of 6 km/h during high tides. They used to mill grain, sawed wood and crushed plaster in them. This energy is quite reliable and can be used where the amplitude of the tides is large. The blades of such electric turbines are arranged in such a way that they can be rotated by both rising and falling water. The technique of using tidal energy is proven and pays off but it requires huge funds to be implemented. Tidal power plants are a clean and safe source of energy but they prevent fish from spawning and tidal waters flood swamps. Tidal power plants of various capacities operate in France, Russia, Canada, China, and other countries.

?eothermaI energy is heat energy from the earth—Geo (earth) + thermal (heat). Geothermal resources are reservoirs of hot water that exist or are human made at varying temperatures and depths below the Earth's surface. Wells, ranging from a few feet to several miles deep, can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for use in a variety of applications, including electricity generation, direct use, and heating and cooling. In some places, cold water is pumped into the depths of the Earth through boreholes. It heats up there and rises

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to the surface as steam. An example of the use of geothermal energy is Iceland, where the heat from the depths is used to heat the streets, settlements and greenhouses of the capital Reykjavik. In addition, this energy source is used quite widely in New Zealand, Japan, and Central American countries.

Advantages: renewable and almost non-polluting. It produces a high amount of extracted energy. And the energy is used to heat homes and generate electricity.

Disadvantages: high costs of construction and maintenance of facilities. Power plants and pipelines are at risk because of earthquakes and volcanic eruptions. A number of harmful gasses rise to the surface with the steam as well.

Solar energy is the most abundant of all energy resources and can even be harnessed in cloudy weather. The rate at which solar energy is intercepted by the Earth is about 10,000 times greater than the rate at which humankind consumes energy.

Solar technologies can deliver heat, cooling, natural lighting, electricity, and fuels for a host of applications. Solar technologies convert sunlight into electrical energy either through photovoltaic panels or through mirrors that concentrate solar radiation. Although not all countries are equally endowed with solar energy, a significant contribution to the energy mix from direct solar energy is possible for every country. The cost of manufacturing solar panels has plummeted dramatically in the last decade, making them not only affordable but often the cheapest form of electricity. Solar panels have a lifespan of roughly 30 years, and come in variety of shades depending on the type of material used in manufacturing.

Harnessing the energy provided by the sun is not so easy. It is the easiest to take it for heating - the object built in the sun heats up, so you can even heat water for home use. In order to produce electricity ourselves, we have to use complex mechanisms. One of them is the use of solar cells to generate

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electricity. A solar cell is a device that converts sunlight into electricity. This is allowed by the additive photovoltaic effect. When the material that makes up the solar cell absorbs a photon of the right wavelength, the electrodes in it gain more energy. This allows them to move more freely in the material. The movement of these electrons creates an electric current.

Bioenergy is produced from a variety of organic materials, called biomass, such as wood, charcoal, dung and other manures for heat and power production, and agricultural crops for liquid biofuels. Most biomass is used in rural areas for cooking, lighting and space heating, generally by poorer populations in developing countries.

Modern biomass systems include dedicated crops or trees, residues from agriculture and forestry, and various organic waste streams.

Energy created by burning biomass creates greenhouse gas emissions, but at lower levels than burning fossil fuels like coal, oil or gas. However, bioenergy should only be used in limited applications, given potential negative environmental impacts related to large-scale increases in forest and bioenergy plantations, and resulting deforestation and land-use change. Plant biomass is one of the most significant renewable energy sources and an important part of clean local fuel in Lithuania as well. Such raw materials as sugar (from sugar cane and sugar beet) and starch (from potatoes and grains) and biodiesel produced from vegetable oil (rapeseed, flax, soy, sunflower, etc.) and alcohol (from methanol or ethanol) can be used to produce bioenergy as well.

Air source energy is a type of energy present in nature, renewable and free. Air source energy is defined as energy stored in the form of heat in the air. This is possible because thermal energy can be extracted from the air around us, and for this, we need an air source heat pump. An air source heat pump extracts the energy contained in the air, even when we are at negative temperatures, and transfers this energy for the production of heating and domestic hot water. Furthermore, an air source heat pump is capable of producing cold in our home, even when we are at high temperatures, ensuring comfort throughout the year. The air source heat pumps consist of a thermodynamic cycle that uses a refrigerating gas in its interior capable of being compressed at a very low temperature to extract heat from the exterior air. Normally, air source heat pumps are made up of two parts: an exterior module where the refrigerating circuit is located and an interior module where the control unit and the rest of the elements

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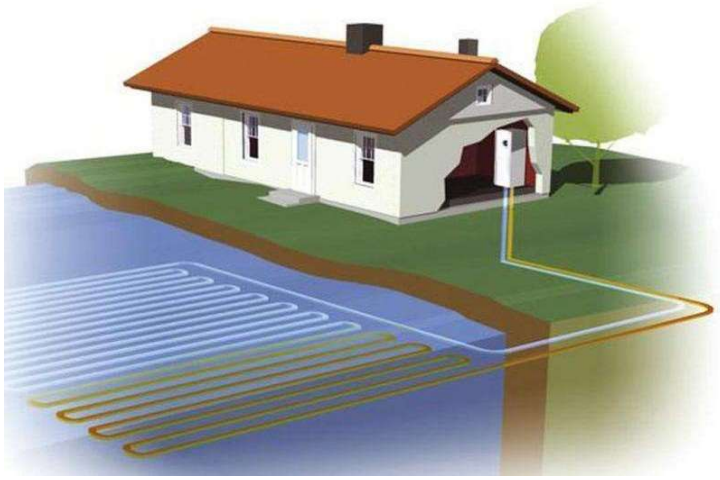
needed in the installation are located, with different combinations.

An aerothermal heat pump has an efficiency of 4 to 1, that is, for each kW consumed by the heat pump, it is capable of producing 4 kW of heat. Thanks to this, the savings achieved in a home are spectacular, significantly reducing the heating bill. The operating principle of the new heat pump is so economical that the amount of electricity used to produce heat energy can be up to 80% less than that of electric radiators.

Heat pumps are machines that can be used to heat buildings and provide hot water using renewable energy sources such as the air, in turn the ground or water. Here's how the heat pumps work, explained in a way children can understand: A heat pump consists of three main parts: an evaporator, a compressor and a condenser. A vaporizer is like a large metal box that is usually located on the outside of a building.



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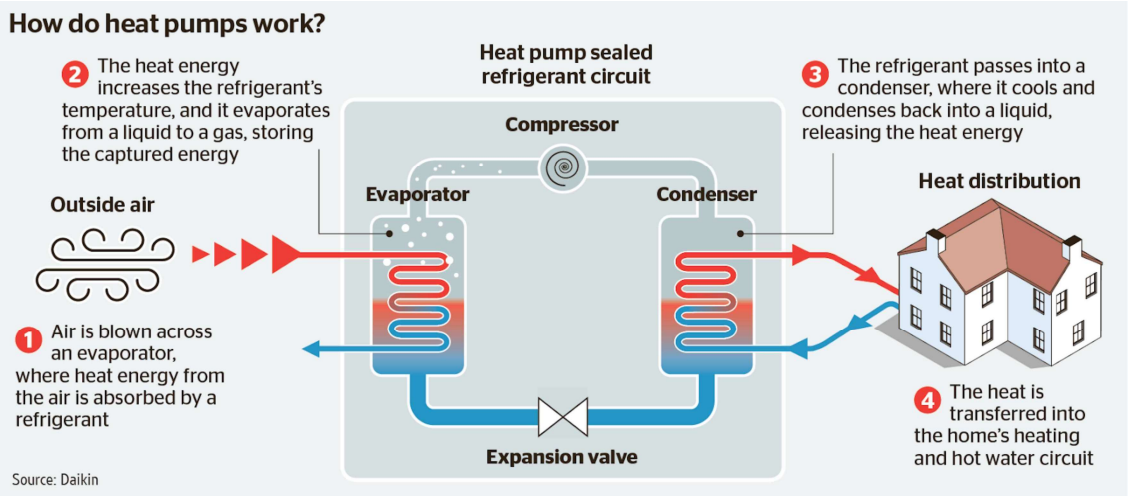

Inside the evaporator there is a special liquid, which is called a refrigerant (freon), which can absorb heat from the air or the ground. Refrigerant starts out as a liquid but turns into a gas as it absorbs the heat. The compressor is like a big pump inside the heat pump. It takes the gaseous refrigerant from the evaporator and squeezes it very hard, causing it to heat up even more. These hot gases then enter the condenser, which is usually located inside the building. A condenser is like a large radiator used to heat a building. The hot gas from the compressor passes through some condenser coils, which are supplemented with cool air or water. As the hot gas moves through the coils, it releases heat that warms the air or water. As heat is released from the hot gas, it turns back into a liquid and returns to the evaporator to start the process all over again. In summary, the heat pumps work by using a special liquid called the refrigerant to absorb heat from the air or the ground. The refrigerant is then compressed, making it even hotter and then is released into the building to heat the air or water. This process is repeated over and over to keep the building warm while providing the hot water's supply as well.

Advantages:

• Energy efficiency: heat pumps are really good at converting the energy they use into heat. This means they can heat buildings and water using less energy than other heating systems such as gas boilers.

• Renewable. Heat pumps use energy from natural sources such as air, earth or water, which are constantly being replenished. This signifies that the heat pumps are a source of renewable energy, which is good for the planet.

• Low carbon emissions: heat pumps do not burn fossil fuels such as gas or oil, so no harmful gases are produced. Instead, they use renewable energy sources that emit very little harmful gases.

• Universal. Heat pumps can also be used to cool buildings, so they are really useful in warm climates or in the summer.

Disadvantages:

• High initial costs: Heat pumps can be very expensive to buy and install. And this means that they may not be affordable for everyone.

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• Depending on location. Heat pumps must be installed where there is sufficient space, a suitable heat source and a heat distribution method. This means that they may not be suitable for every building or location.

• Weather dependent. If it's very cold outside, air source heat pumps can become less efficient, meaning they may not perform as well in very cold weather.

• Maintenance. In order for heat pumps to work properly, they need to be properly maintained. And that can be expensive.

Lesson 1.

Science

Learning objectives and assessment criteria:

Find out what is needed to keep your electrical appliances working.

1. Identify that electrical devices need electricity and that they have a switch, and a cable.
2. Point out that a torch has a body, a switch, a bulb and batteries.
3. Explain how to put the batteries together to make the torch light up.

Explain what forms an electrical circuit and what symbols are used to identify its parts.

1. Identify the parts of an electrical circuit (power source, switch, consumer, wires).
2. Illustrate the parts of an electrical circuit using symbols.

Remember the meanings of the symbols for electrical circuits and then learn new ones.

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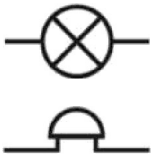
A cord and a battery:

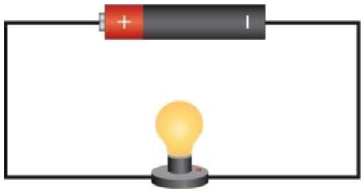
A switch and a motor:

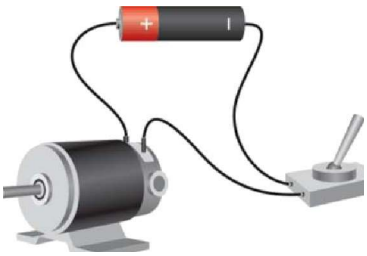
A bulb and a bell:



Symbols for marking the switch:

Analyse pictures. Identifies the parts of an electrical circuit using the meanings of symbols:





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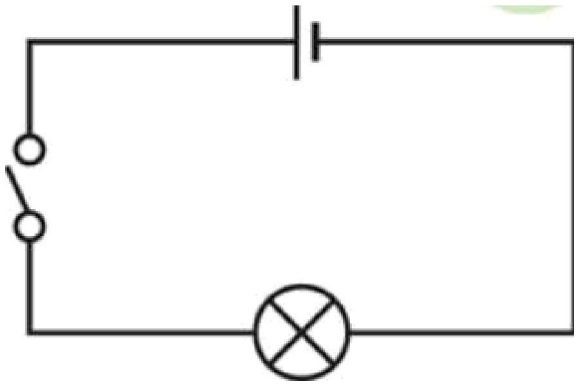
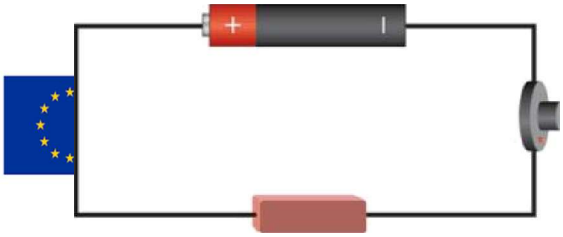
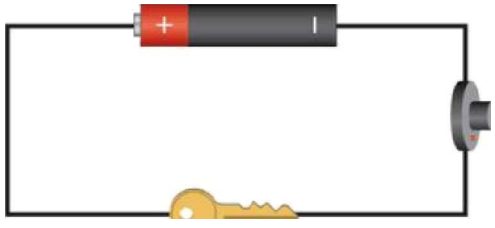
Working in pairs, make the same circuits and represent them in a series of diagrams. Use the diagram to make an electrical circuit and answer the questions:



- In what order did you connect the parts of the electrical circuit?
- Is the electrical circuit closed? Does electricity flow through it?
- Is the electrical circuit open? Can electricity flow through it?

Be familiar with electrical conductors and insulators:
Conductors - materials that conduct electricity. Insulators -
materials that do not conduct electricity.
Investigate and find out which materials are conductors and which are insulators?





At the end of the lesson:

- Be able to describe an electrical circuit. What parts form a circuit?
- Tell what they have learned about the electrical conductivity of materials.

Lesson 2.

What Is Energy Lesson for Kids - YouTube in english. 6-10 years

Apie energiją - Vaikų enciklopedija - YouTube in lithuanian language 6-10 years

Atsinaujinantys Energijos Šaltiniai. - YouTube in lithuanian language . 10-15 years

https://www.youtube.com/watch?v=44Wp3WE1AHs in english 10-15 years

STEAM project.

Electricity from solar energy. Collect data about the electricity produced by the solar power plant (how much electricity is produced in 12 months) Calculate how much electricity the home solar power plant produces per year. The obtained data is shown in a diagram. Calculate the average of electricity produced per month. Present the results to your classmates.

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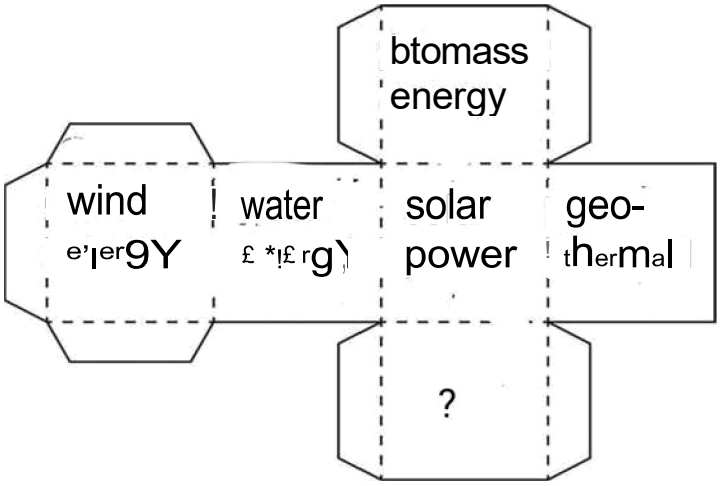
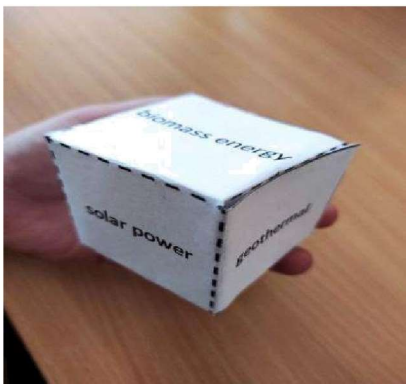
Poster "Renewable energy sources"

The cube which is made during the art lesson is used to review the lesson about renewable sources of electricity.





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