

Theme 2. Energy

Teacher guide - Ages 11-14

Preparation

Review the material and watch the videos. Do some preparation on the topic. Feel free to add any resources or materials you have available to enrich the lessons. Also, check the *Introduction lesson Teacher guide* for useful tips and suggestions for preparing and giving the lessons within a theme.

Learning goals

The students...

- learn about energy resources
- learn what fossil fuels are
- know that burning fossil fuels leads to environmental issues
- know some solutions
- learn about renewable energy resources
- know the advantages and disadvantages of these energy resources
- know what they can individually do to decrease their energy consumption and take responsibility to improve their energy saving habits
- are able to share their newfound information with friends and family

Key Vocabulary

- energy
- energy resource
- fossil fuels
- coal
- natural gas
- oil
- fossilisation
- dynamo
- burning (combustion)
- CO₂ emissions
- alternative (energy) resources
- renewable (energy) resources
- nuclear fuels
- nuclear power plant
- fission



- radioactive waste
- solar energy
- solar panels
- wind energy
- reservoir dams
- turbine
- generator
- energy transition

Introduction

[Slides 3-4]

Tell the following story.

Last night I had the strangest experience! Listen well... Last night I woke up. That's not particularly new, as I often wake up, then roll over and fall back asleep. But last night everything was different.... When I woke up I noticed how dark it was. Not just dark, it was pitch-black. Usually there's a little light from the street light outside, but everything was dark. I sat up in bed and looked outside. The street lights were out. I looked across the street, because my neighbour always leaves the hall light on, but their house was dark too. That was odd. Was there a power outage? Well, I figured I might as well get up and use the loo, but wouldn't you know, the light didn't go on. Neither did it go on in the hallway, nor the living room. Well, I might as well make a cup of tea and have a warm drink while figuring out what was going on... but the electric kettle didn't work. So I wanted to boil some water in a pan on the hob, just use the gas. But, you guessed it, no gas. What on earth was happening? I put on some clothes and went outside. Everything was quiet, but thankfully the sky was starting to brighten up. The sun rose, but the church clock had stopped at midnight. I walked to my car and tried to start it. Nothing. A red light on the dashboard said my petrol was empty. I began to panic. I started to wonder how I would survive without electricity, gas, or petrol. What will happen to the food in the fridge? And my phone when the battery dies? How will I keep my house warm?

Ask the students: *Imagine that this happens to you, what would you do?*

Ask students to discuss this question in pairs or small groups. Afterward, ask a representative of each group/pair to summarise some key points that came up during their discussion.

This lesson is about energy. Which types of energy did I mention in my story? Help prompt them if they can't remember them all. [light → electricity, pan on the hob → gas, car → petrol]

After this, discuss the learning goals of this theme.

Instruction

[Slides 5-9]

Issue

Start with an informative video about 'energy resources'. Introduce the video: *In the last while our energy usage has steadily grown. We need energy for our daily lives. But when we burn too*



many fossil fuels this leads to problems. Which problem is explained in the video? Ask students to share their thoughts about the video.

As a class, complete exercise 1 on the interactive whiteboard.

Coal, natural gas, and oil are fossil fuels. Fossil fuels are natural fuels formed in the geologic past from ancient plant and animal life.

Then complete exercises 2 and 3.

Explain: Coal is ground to a fine material that then is burnt. The heat that is released warms a large tank of water. The steam rising from this tank makes the fan (or turbine) spin which converts the energy into electricity that is sent to the energy grid.

Complete exercise 4.

[Slides 10-11]

Discuss what CO₂ is.

CO₂ is carbon dioxide, a naturally occurring gas in the atmosphere. It is also known as a greenhouse gas. Greenhouse gases trap heat from the sun in the atmosphere and warm the surface of the Earth, which is causing the Earth to heat up. Burning other fossil fuels like oil and natural gas lead to larger CO₂-emissions.

Watch the video.

Tell students about another issue: The fossil fuels that we are using now to get energy are running out. At some point, our reserve of fossil fuels will run out. We will run out of coal, natural gas, and oil. What happens next? How can we collect energy and generate electricity? Will we still be able to charge our phones, cook our food and power our vehicles?

Ask students if they know anything about this topic or if they have heard about this issue before.

[Slides 12-22]

A solution

Watch the video. Explain that for the two problems (too much CO₂ emissions, we are running out of fossil fuels) there are also solutions. Ask students to share their thoughts about the video.

Complete exercise 5.

Explain: Taken together, solar, wind, and water energy are called renewable energy resources. Renewable energy resources are resources that we can continue to use for a long time without causing issues. Renewable energy resources are more environmentally friendly.

Complete exercise 6.

Explain: Radioactive waste is created when we generate nuclear power. This waste is radioactive which is dangerous to the environment, humans and animals. This radiation lasts for thousands of years. For that reason the waste must be very carefully stored. This is done in vats surrounded by cement in steel cylinders.



Complete exercise 7.

Nuclear fuel energy is not seen as a renewable energy resource, because of the limited amount of uranium, as well as the danger the radiation from the radioactive waste poses to the environment.

Watch the video.

Discuss the different kinds of water energy that can be collected. Some countries can use tidal energy as a renewable energy resource, since they are surrounded by the ocean. In mountainous countries they also collect energy from water, but usually by using different methods.

Complete exercises 8 and 9.

Renewable energy is much better than burning fossil fuel. But it's not completely free of pollution. For example: you need materials to build windmills and solar panels. No energy production comes 'at no cost'. All sorts of energy have an impact on nature. Not only, but also CO₂ emission.

Extra info: Solar thermal technologies capture the heat energy from the Sun and use it for heating and/or the production of electricity. Another example of a 'green' energy resource is biomass: renewable organic material and discards (like compost piles) that can be used as an energy resource.

Summarise: Humans have recently started using more and more energy. This has led to problems: the fossil fuels are being used up and burning the fossil fuels is causing CO₂ emissions that are too high. Thankfully there is a solution: renewable energy resources like sun, water, and wind energy. All of these energy sources have advantages and disadvantages.

[Slides 23-24]

What can you do?

The easiest way to do something to help with the larger problem, is to start using less energy. Which energy saving habits can you work on making part of your daily routine? (examples include: turn off lights, turn the tv off instead of on standby, set the thermostat a little lower, removing chargers from the sockets, turning off the sockets).

Even schools are busy finding ways to cut down on their energy usage. Watch the video.

Write energy saving actions that are named in the movie: [solar panels, LED light bulbs, double paned glass (insulating)]. You need this information for the practical assignment.

Suggested related themes

Theme 1 Climate change: *Greater CO₂-emissions create global warming which leads to climate change.*



Theme 6 about agriculture.
Theme 7 about air also relate to greenhouse gases.

Worksheet

[Slide 25]

Have students complete the worksheet. Discuss the answers students come up with. For exercise 1: Ask if any students are able to explain how these energy resources are collected and converted into electricity. For exercise 4: Choose one of the three statements. Have a short debate in class with students for/against explaining their arguments/opinions to each other.

Practical Assignment

[Slide 26]

Have students create a mind map about energy. A mind map is a sort of summary that looks like a word web and is made up of words, short phrases, and drawings. Watch the video to get inspiration for your own mind map. Write the topic 'energy' in the middle of your mind map.

Create three branches in your mind map:

1. Issues
2. Solutions
3. What can I do?

Create your mind map using information learned from this lesson.

Closing

[Slide 27]

Discuss the learning goals and make agreements on how/when they will work on their practical assignment (mind map).

Organise a time during which students present and discuss their mind maps either to the class or the larger student body. Close the lesson with the video.

Outdoor Experience

[Slide 28]

Have students visit a house (or school) that has solar panels. Provide students with a list of questions (below) and have them collect the answers. They should ask these questions to the homeowner or head of school. If this is not possible, they can ask an expert these questions.

Solar Panel questions:

- How is electricity created using solar panels?
- How long do solar panels last?
- Do solar panels create electricity even when the sun isn't shining?



- How many solar panels are required to meet the electrical needs of a household? (or school?)
- Are solar panels damaged when they are rained on or get hailed on?
- How do you maintain your solar panels?
- How much money can you save using solar panels?

Extras

[Slides 29-34]

Game: Hangman & Memory

Exercise 1:

Prepare interview questions for an interview with an energy expert. Come up with three or four serious questions you'd like to know more about.

Tip:

- They must be open questions. (yes/no questions are not allowed)
- Make sure to ask not only about the problems but also the solutions.

Exercise 2

Research the Energy Performance Certificate of your home or school.

Extra video

Materials Required

For the mind map: A4-paper (or larger), pens, pencils, pencil crayons or markers.

For the Outdoor Experience: notebooks or paper, and pens.



Theme 2. Energy

Answer Key - Ages 11-14

Exercise 1

Which other kinds of renewable energy resources are there?

For example:

- Geothermal energy
- Biofuel

Exercise 2

Write three examples of renewable energy resources that were used or invented before 1950.

Examples could include:

- Water powered mills to grind grain for early Egyptians and Greeks
- Photovoltaic energy discovered in 1837 by Eduard Becquere
- Wind powered pumps or ran simple machines
- Hydroelectric power from dams was used as early as the 1800s (linking an electric generator to a dam)

Exercise 3

What does “energy transition” mean?

Energy transition is a phrase that is used when talking about the transition between the use of fossil fuels such as coal, natural gas and oil, and moving towards renewable energy resources such as sun, wind, and biofuel.

What can you do?

Exercise 5

Write three suggestions of actions your school can take.

Individual answers, for example:

- smart regulation of thermostats in classrooms
- school lights on timers
- using a heat pump

