Energy and types of energy

INVESTIGATE

1 What is the main source of energy for the Earth? Do we get energy from this source even at night? Explain your answer.

DISCOVER

What is energy?

We can observe energy all around us. We see it as light, movement and change. We feel energy as heat, and we can hear it as sound.

Throughout history, people have learned how to harness* and transform energy to make it work for us.

2 Complete the sentences.

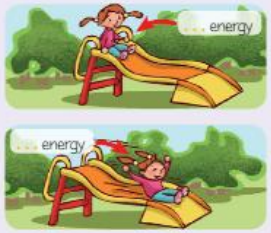
1 The runner gets energy from...
2 The car gets energy from...
3 The plants use energy from...

How is energy transformed?

Potential energy is stored* and can be used when we need it.

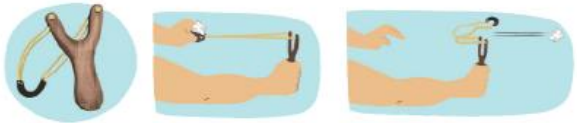
Kinetic energy is energy in movement. Every time something moves, it uses energy. A person running or water flowing in a river are both examples of kinetic energy.

Energy is **transformed** from potential energy to kinetic energy. Potential energy stored in a battery becomes kinetic energy when we turn on a mobile phone. Potential energy stored in our muscles becomes kinetic energy when we run.



3 Identify the types of energy in the pictures above.

4 Explain the sequence in the photos. Identify *potential energy* and *kinetic energy*.



DISCOVER

What are the main types of energy?

Mechanical energy is potential energy and kinetic energy together, associated with position and movement. The planets spinning or an object falling are examples of mechanical energy.

Sources of light give off **luminous energy**. We can see this light. The Sun, a lamp or a candle are all examples of this type of energy. In photosynthesis, plants convert energy from the Sun into nutrients.

Thermal energy is the energy involved in transferring heat from one object to another. We can see its effects when it changes the states of matter, expands or contracts metal, or changes an object's temperature.

Electrical energy is associated with electrical charges and their movement, such as electricity transmitted through cables. Lightning is an example of electrical energy in nature.

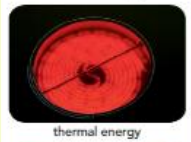
Nuclear energy is energy stored in **atoms**, the smallest type of matter. For example, it is inside the Sun. It is also on Earth in a substance called uranium. Man-made nuclear power plants produce electricity from nuclear energy.

Chemical energy is energy stored in matter. It is usually transformed into heat, light or movement during chemical reactions.

Sound waves transmit **sound energy**, for example when we play a musical instrument.


mechanical energy


luminous energy


thermal energy


electrical energy


sound energy


chemical energy


nuclear energy

5 Give an example of energy from nature.

a luminous energy b thermal energy c electrical energy

EXPLORE

6 Match the actions to the energy transfers.

1 switching on a torch	a electrical → thermal
2 switching on a CD player	b electrical → luminous
3 using a hairdryer	c electrical → sound
4 lighting a fire	d chemical → thermal

7 Imagine we had no way of making or storing electricity and had to do everything manually. What type of energy would we use?

1 2 3 4

Work in groups. Choose a famous scientist for your project.
Suggestions:
- Rachel Carson
- Marie Curie
- Thomas Edison
- Isaac Newton

Energy and change

INVESTIGATE

1 How do you use different types of energy in your home?

DISCOVER

How does energy change matter?

Physical change

When we cut a piece of wood to make a sculpture, we change the physical form of the wood, but the material is still the same.

Chemical change

Chemical changes form new substances. They usually cannot be undone. Baking a cake is a chemical change.

2 Use a type of change above to complete the sentences.

a Burning paper is a ..?.. change. b Shredding paper is a ..?.. change.

3 Classify the photos as physical change or chemical change. Explain your reasoning.

1 chopping vegetables

2 burning wood

3 sewing cloth together

DISCOVER

What types of chemical change are there?

Combustion is a chemical change that occurs when there is a combination of oxygen, fuel and heat. This is called the fire triangle.

Fermentation is a chemical change caused by living organisms like bacteria and yeast. It also happens naturally in sugar, fruit and vegetables. We use fermentation to make bread, wine, yoghurt and other foods.

Oxidation is a chemical change that occurs when a substance combines with oxygen and forms a new substance. An example is rust in metals.

4 Classify the photos: *combustion*, *fermentation*, and *oxidation*.

EXPLORE

5 Do a fermentation experiment.

Hands on!

You need:
- two glass bottles
- funnel
- spoon
- yeast
- sugar
- warm water
- balloons

Method

1. Label the bottles *A* and *B*.
2. In bottle A, add two teaspoons of sugar.
3. In bottle B, add two teaspoons of sugar and two teaspoons of yeast.
4. Add one cup of warm water to each bottle.
5. Gently move the bottles to stir them.
6. Place a balloon on the top of each bottle and wait.

Heat and physical changes

REMEMBER

1 Answer the questions.

1 When we heat water, it becomes water vapour. If we cool the vapour, can we make it into water again?

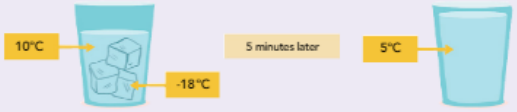
2 When we heat sugar, it becomes caramel. If we cool the caramel, can we make it into sugar again?

DISCOVER

How does heat change matter?

Heat is the transfer of energy between an object and its surroundings.

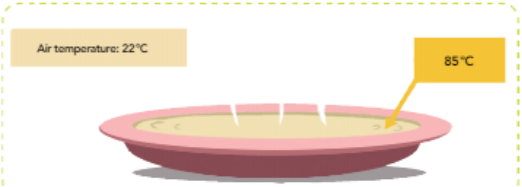
When two objects with different temperatures come into contact with each other, heat is transferred from the object with the higher temperature to the object with the lower temperature.



What does heat do?

- It changes the temperature of an object and/or its surroundings.
- It can change the state of matter between solid, liquid and gas.

2 Copy the picture. Draw an arrow to show the direction of the transfer of heat.



Research the life of your scientist.

- Birthdate and death date.
- Country of origin.
- Biographical information.
- Famous quote.

DISCOVER

What types of changes does heat cause?

Temperature variation is a change in temperature. Putting water in the fridge is an example of this.

Change of state is when matter is changed between the states of solid, liquid and gas. The changes are always physical.

Expansion and **contraction** are also caused by heat. For example, when we heat metal, it expands. When we cool metal, it contracts.

3 Describe what is happening in the images.

EXPLORE

4 At room temperature, why does hot soup get cold but ice cream melts?

5 Classify the changes into *physical* or *chemical*.

LISTEN

6 Answer the questions. Listen and check.

1 What are the gaps on bridges called?
a expansion joints b small gaps

2 What happens to metal bridges on hot, sunny days?
a They heat up and expand. b They get very shiny.

3 What happens to them a night?
a They change colour. b They cool down and contract.

4 Why do the bridges have gaps?
a They allow them to expand and contract. b They change the temperature.

5 Why aren't electricity cables pulled tight?
a Because they need to support birds. b Tight wires can contract and break.

Energy transformation

INVESTIGATE

1 Complete the definitions with the types of energy.

1 energy stored in an object
2 energy in movement
3 energy from sources of light
4 energy from electrical charges
5 energy involved in transferring heat
6 energy stored in atoms
7 energy produced through vibrations

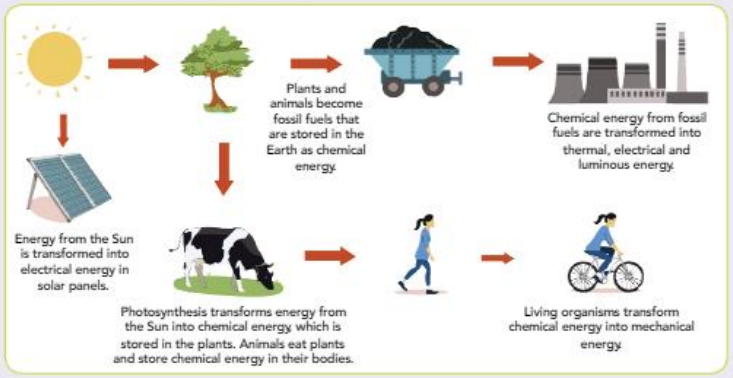
DISCOVER

What is energy transformation?

We can transform energy from one type to another. This process happens when we use energy. Energy is never destroyed. It is just transformed, so the total amount of energy in the universe is constant.

Energy from the Sun

Energy from the Sun is transformed into other types of energy, such as thermal, electrical, chemical and mechanical energy.



2 Which process of energy transformation is natural?

3 Answer the questions.

1 What type of energy does the Sun produce?
2 What happens to the Sun's energy?
3 Why is the amount of energy in the universe always constant?

Find out about your person's contribution to science.
- Name the field of science.
- What scientific advancements did he or she make?

EXPLORE

4 Match the energy transformations to the diagram on page 90.

1 chemical energy → electrical energy
2 chemical energy → mechanical energy
3 solar energy → electrical energy
4 chemical energy → thermal energy

5 Copy and complete a sequence of energy transformation for each object.

? → ? ? → ? ? → ? ? → ?

6 Make a solar cooker. Answer the questions.

Hands on!

You need:
- a wooden box
- aluminium foil
- plastic wrap or a sheet of plastic
- sticky tape
- glue
- scissors
- a straw or small stick
- a plastic cup
- water (room temperature)
- a thermometer

Method
1. Cut a flap in the cardboard box.
2. Cover the inside of the box and the inside of the flap with the foil.
3. Half fill a plastic cup with water. Make a note of the temperature of the water.
4. Put the cup inside the box.
5. Cover the opening with plastic and secure it with sticky tape.
6. Hold the flap open with a straw or small stick.
7. Leave the box in the sun for one hour.
8. Check the temperature of the water again.

1 What do you think is going to happen?
2 Where does the energy come from?
3 Explain the transfer of energy in your experiment.

Sources of energy

INVESTIGATE

1 Identify the fossil fuels.

biomass | coal | natural gas | petroleum | the Sun | water | wind

DISCOVER

Energy sources

Natural resources like sunlight, air, water, fossil fuels, minerals, soil, plants and animals can be classified into **renewable** and **non-renewable sources** of energy.

Non-renewable sources of energy

It would take millions of years to replace fossil fuels like natural gas. Fossil fuels are mainly used to generate electricity, produce heat and power vehicles.

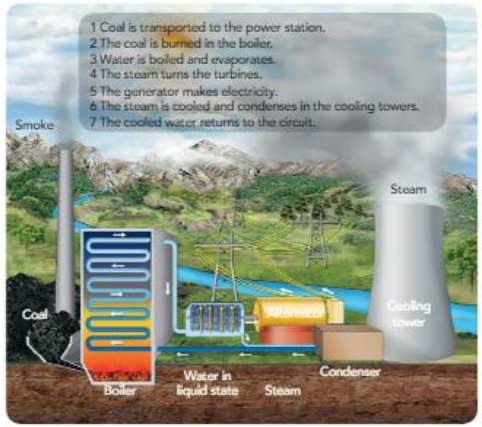
Nuclear energy in a nuclear plant is produced by splitting* atoms of uranium. This releases huge amounts of energy, which are used to boil water and produce steam. The steam turns a turbine*, which produces electricity.

2 Choose the correct description to show the energy transformations in nuclear energy.

1 nuclear → chemical → thermal → mechanical → electrical
2 nuclear → electrical → mechanical → chemical → thermal

3 Look at the chimney and the cooling tower in the picture.

1 Which one produces steam?
2 Which one produces smoke?
3 Which one pollutes the environment?



EXPLORE

4 Discuss the questions with a classmate.

1 Why is the power station near a river?
2 How does the water change state during the process of producing electricity?
3 Why does a coal-fired power station pollute the environment?

DISCOVER

Renewable sources of energy

Some renewable sources of energy are unlimited, such as the Sun, wind, water or geothermal energy. Others can be easily replaced, such as **biomass** (forests and plants). Renewable sources of energy have been used for thousands of years. They are the oldest sources of energy used by humans.

Biomass is chemical energy stored in plants. When it is burned, it is transformed into thermal energy.

Solar energy comes from the Sun. It can be transformed into electrical and thermal energy.

Wind energy comes from the movement of air. It is transformed into mechanical and electrical energy.

Moving water is transformed into mechanical energy by the water wheel.

solar energy

energy from moving water

wind energy

energy from biomass

5 Match the modern examples to the pictures above.

EXPLORE

6 Choose the best places for the types of renewable energy installations.

Choose between:

1 and 2 for wind turbines
3 and 4 for solar panels
5 and 6 for a hydroelectric dam
7 and 8 for a biomass unit

Energy and manufacturing

DISCOVER

Energy and manufacturing

People have used energy in many different ways throughout history. At first, they used animals, then the invention of windmills and water mills allowed us to use the energy from the motion of wind and water. During the **Industrial Revolution**, the invention of engines and electrical motors transformed fossil fuels into thermal and electrical energy for factories and vehicles.

a

b

c

d

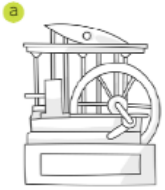
1 Find the pictures for the sentences.

1 The first steam engines were very important for transporting people and goods around the country. They transformed chemical energy and thermal energy into mechanical energy.
2 The first car had an engine that transformed fuel and chemical energy into kinetic energy and thermal energy.
3 The first sewing machines were invented for textile factories. The workers turned a wheel, which moved the mechanism. They used mechanical energy.
4 Steel was very important for the industrial revolution. It is stronger than iron and was used for the railways and for making industrial machines.

EXPLORE

2 Listen and find the pictures. Listen again and make notes.

a



b

c

d

APPLY

1 Do the experiment and answer the questions.

Hands on!

You need:
- a glass bottle with a top
- a straw
- modelling clay
- water
- food dye

Method
1. Half fill the bottle with cold water and add some food dye.
2. Make a hole in the bottle top and screw to the top onto the bottle.
3. Push the straw through the top into the water but not touching the bottom.
4. Seal the bottle top with modelling clay.
5. Hold the bottle in your hands making sure you can still see the straw.

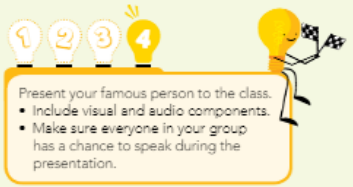
1 What do you think is going to happen?
2 Was your prediction correct?
3 Why do you think this happened?
4 Where do you think the heat came from?

2 Try this activity at home.

Unplug for an hour

Ask your family if they want to participate in an activity at home… completely unplugged.

- Unplug your TV.
- All phones must be unplugged and off (not just on silent).
- Unplug all of your electronic devices. Do not use anything that requires electricity or batteries.
- Do not unplug the fridge (this will be the one exception).
- Turn off all the lights.
- Spend an hour at dusk by candlelight with your family. You can play card games or board games.
- Congratulations! You are helping the environment by consuming less electricity!



Present your famous person to the class.
- Include visual and audio components.
- Make sure everyone in your group has a chance to speak during the presentation.

SUMMARY

1 Classify the changes into *physical* or *chemical*.

2 Match the examples to the types of changes in matter.

1 We heat a metal bar and it gets longer.	a temperature variation
2 We cool the bar and it gets shorter.	b expansion from heating
3 Ice makes water cooler.	c change in state
4 Heat turns ice to water.	d contraction from cooling

3 How can you transform potential energy into kinetic energy in each of the photos? Say which type of energy transformation occurs.

4 Copy the sentences in the correct order to show how electricity is produced in a coal fired power station.

a Water is boiled in the boiler and becomes steam.
b Coal is transported to the power station.
c The steam turns the turbines for the generator.
d The cooled water returns to the circuit.
e The coal is burned in the boiler.
f The steam is cooled and condenses in the cooling towers.
g The generator makes electricity.

5 Explain the fire triangle.

6 Copy and complete the outlines.