





In March 2009, the International Polar Foundation (IPF) introduced its new educational initiative, Class Zero Emission (CZE). The CZE is a live teaching workshop in which a presenter directs fun learning activities. CZE touches on four main themes: climate change, the Polar Regions, polar science & expeditions, and sustainable development. The programme is designed for students ages 10 to 18 from both the Flemish (Dutch-speaking) and Walloon (French-speaking) communities in Belgium.

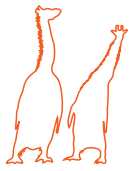
A series of teaching materials have been put together as part of the CZE project, including six teaching dossiers, one CD-ROM and one exercise booklet.

This exercise booklet features a series of handy exercises for students ages 10 to 14 and is modelled on the topics addressed in greater detail during the CZE workshop. The booklet features a whole range of exercises, such as complete the missing words exercises, experiments, games and analysing a text. The exercise booklet is designed to fit into the overall CZE experience, but it can also be used as a standalone teaching tool. Some of the exercises can be done in conjunction with the IPF's flash animations, all of which are available free of charge in the «Multimedia» section of the IPF's educational website, www.educapoles.org.



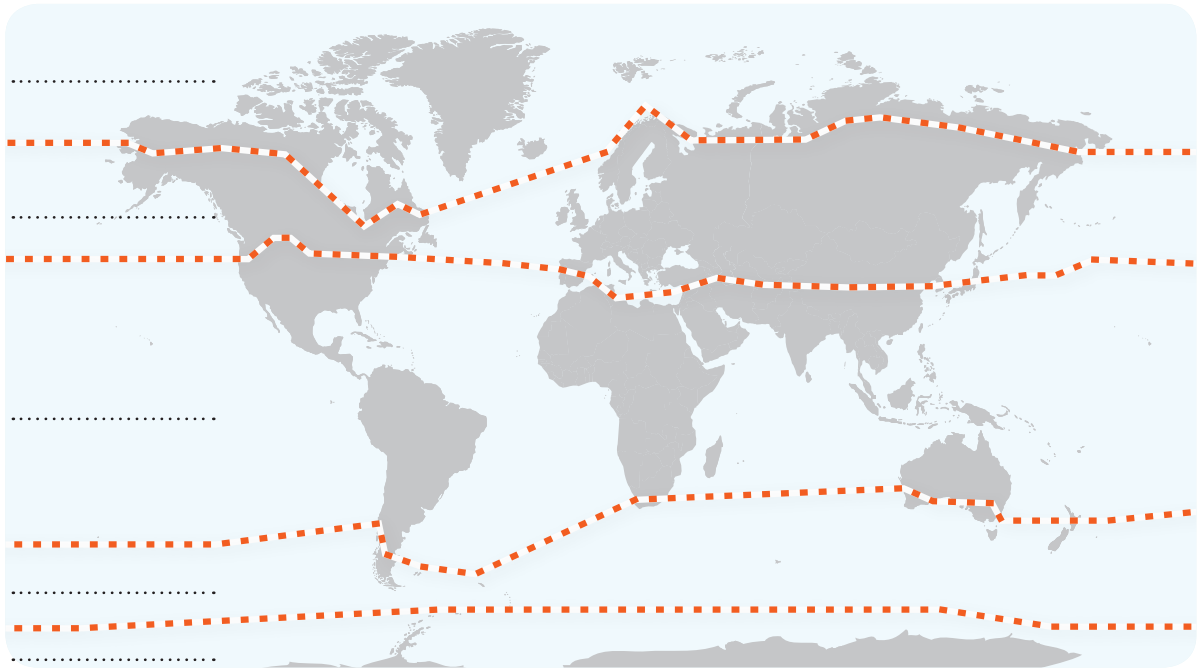
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Climate Change

01 Different climates



Torrid, temperate or frigid climate zone?

- A** Fill in the blanks on the map with the term that corresponds to each climate zone (torrid, temperate or frigid). The same term can be used more than once.
- B** Create a drawing (= key) for each climate zone. Then reproduce it on the map.

Torrid zone Temperate zone Frigid zone

- C** A number of different regional climates can be found within the three major climate zones (torrid – temperate – frigid). Draw a line between each climate and its corresponding climate zone.

- a. Oceanic
- b. Tropical
- c. Polar
- d. Continental
- e. Desert

- 1. Torrid climate zone
- 2. Temperate climate zone
- 3. Frigid climate zone



02 Climate change¹

A Complete the missing words: What is the natural greenhouse effect?

The greenhouse effect is a phenomenon that works in several stages. It starts by the sun emitting in the form of towards Earth. Once it has warmed up, the Earth sends some of the heat back into The rest of the heat is held in by gases found in the atmosphere called They have been given this name because like a greenhouse in the garden, they energy for a while and send it back towards the ground. Without the greenhouse effect, the average temperature on Earth would be..... instead of

The missing words to be inserted into the text are:

-18°C / greenhouse gases / outer space / radiation / natural / 15°C / trap / energy

B TRUE or FALSE? Circle T for TRUE and F for FALSE

- The Earth has always undergone climate change throughout its history. T / F
- Melting icebergs is one of the main causes of current climate change. T / F
- The climate changes each time the seasons change. T / F
- Human beings are suffering from current climate change. T / F
- Human beings are not responsible for current climate change. T / F
- The temperature on Earth has risen by an average of 5.4°C since the beginning of the 20th century. T / F
- The greenhouse effect is a process that happens once a year. T / F
- Greenhouse gases occur naturally in the atmosphere. T / F
- There is a link between the average temperature on Earth and the amount of greenhouse gases in the atmosphere. T / F
- Human beings produce greenhouse gases that are added to the quantity of greenhouse gases that already occur naturally in the atmosphere. T / F

C Additional greenhouse effect

Shown in the picture there are four activities responsible for the additional greenhouse effect created by humans. Find them and write down what they are on the dotted lines.

1
2

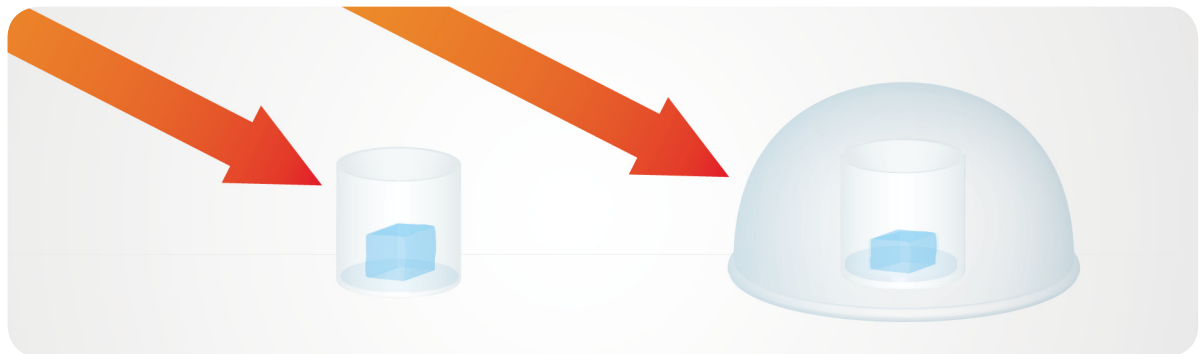
3
4



¹ You can prepare for this exercise by viewing the flash animation «Humankind: Culprit and Victim of Climate Change Today»



03 Greenhouse effect experiment²



What you need:

- 2 small receptacles (such as empty jars or glasses)
- 1 small sheet of glass (or a glass bowl)
- 2 ice cubes

What you do

- Place an ice cube in each of the 2 receptacles.
- Using the sheet of glass (or bowl), cover one of the receptacles and leave the other one uncovered.
- Then place both receptacles near a window so they are exposed to the sun's rays.

Tips

- For the experiment to work, it needs to be conducted on a sunny day.
- Don't use ice cubes that are too large; otherwise they will take too long to melt.
- Keep the receptacles in the sun as long as possible and avoid putting them too close to a radiator, as this can influence the outcome of the experiment.

Observations

A Which ice cube melted the fastest?

.....

B Why?

.....

C What parallel can you draw between this experiment and the Earth's climate?
(Hint: remember the greenhouse effect)


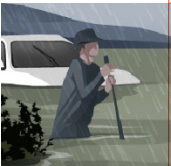


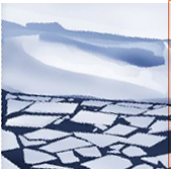


.....

² © : Experiment adapted from a lesson about climate change produced by the IBGE (Brussels Institute for Environmental Management)
This experiment can be prepared by viewing the flash animation «Humankind: Culprit and Victim of Climate ChangeToday»



04 The effects of current climate change on me and the world around me³

The climate is warming. This warming has a number of effects on nature, animals, plants and human beings. Have you ever thought about it before? The table below illustrates some of the effects caused by current climate change. Select four of them and try to imagine what impact these effects will have on you and the world around you.

| The effects of current climate change | Effects on me | Effects on the world around me |
|---|---|--------------------------------|
|  | Rising temperatures | |
|  | Rising sea levels | |
|  | Changes to species' natural life rhythm | |
|  | Displacement of species | |
|  | Melting sea ice | |
|  | More severe drought | |
|  | More frequent natural disasters | |

Polar Regions

05 What does an iceberg taste like?⁴

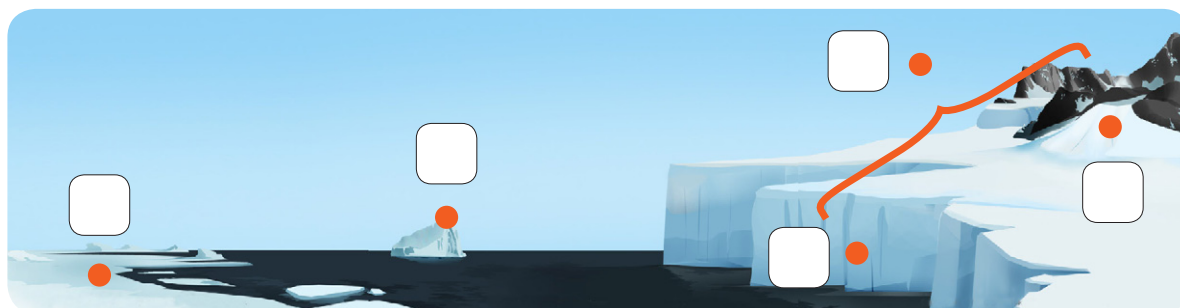
If you answer all of these questions, you will find out what the ice in an iceberg tastes like! Good luck!

A Link each of these words to its corresponding definition:

- a. Sea ice b. Iceberg c. Glacier d. Ice shelf e. Ice sheet

- | | | | | |
|--|--|--|--|---|
| <p>1. Land ice formed by the accumulation of snow on a mountain. The ice then forms a sort of river that flows downhill.</p> | <p>2. Ice formed from frozen seawater.</p> | <p>3. Part of a glacier that reaches the ocean and floats on top of the water.</p> | <p>4. Chunk of ice that has become detached from an ice sheet and floats alone on the ocean.</p> | <p>5. Immense expanse of ice formed from the accumulation of snow that has fallen on a vast expanse of land. Its complaints glaciers, and ice shelf up its edges.</p> |
|--|--|--|--|---|

B Next to each orange dot on this picture, write the letter corresponding to the type of ice depicted (see previous exercise).



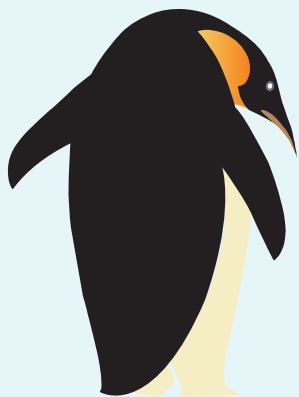
C Draw an arrow on the picture to indicate the direction in which the ice moves on the glacier (see the mountainous region).

D Use your previous answers to **A**, **B**, **C** to answer this question: Does the ice in an iceberg taste salty or not?

⁴ You can prepare for this exercise by viewing the animation «The Polar Regions: The First Areas of the Planet to be Affected by Climate Change»



06 Activity: The life of penguins



Penguins are very unusual birds:

- They can't fly, but they can swim extremely well.
- They live in the Southern Hemisphere, mostly in polar regions .

A Critical thinking skills: How do penguins keep warm?

Imagine you are part of a group of penguins in Antarctica and the temperature is minus 52°C. What technique could you use to keep warm?

Make one or more suggestions.

B Game: How do penguins keep their eggs warm?

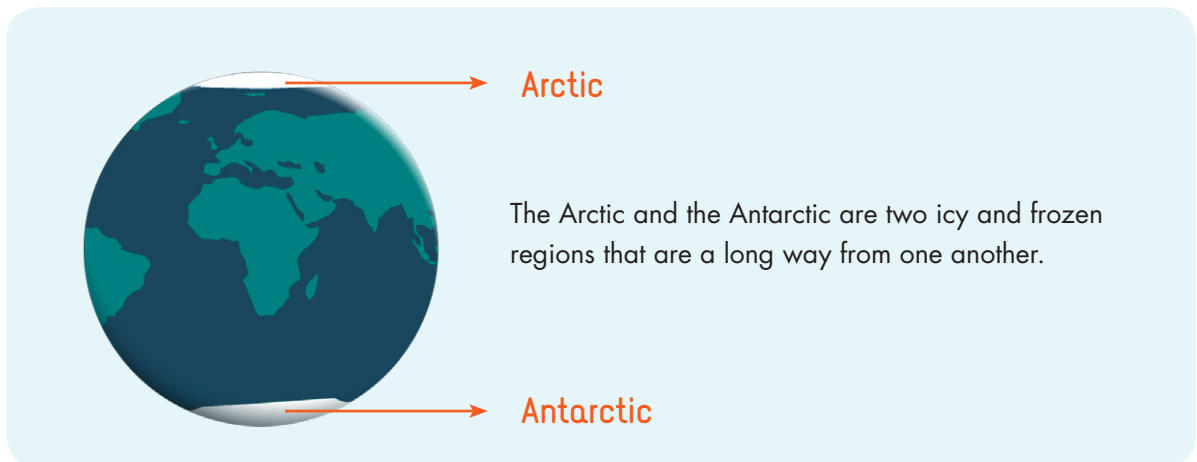
Equipment required: two small footballs

Penguins keep their eggs warm by balancing them on their feet, sheltered under their feathers. But it's not easy. You try it!

- Divide the students into 2 teams
- Each team must form a line, with each team member 1.5m apart.
- The first person in the line puts the football on his/her feet, then waddles forward like a penguin to the next person. The aim is to pass the ball on without allowing it to fall. If the 'egg' falls, it is very likely to freeze!
- Rules of the game:
 - Only the person carrying the ball is allowed to move.
 - The ball must be kept balanced on each person's feet. Using your hands is not allowed!
 - If the ball falls, hands can be used to put it back on the person's feet. But every time this happens, the team loses one point.
- The team that manages to transfer the ball all the way down the line to the final person first wins 10 points.
- The number of points lost each time the ball fell to the ground is then deducted from the total. The team with the most points at the end wins.

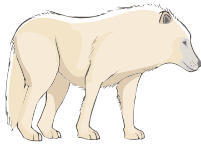


07 The animals that live at the poles⁵



A Amongst the animals below:

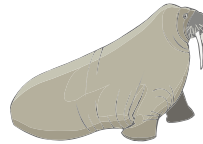
- Circle in blue any animals that you find only in the Antarctic.
- Circle in green any animals that you find only in the Arctic.
- Circle in red any animals that you find in both the Arctic and the Antarctic.



White wolf



Penguin



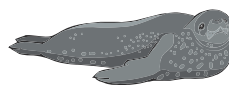
Walrus



Killer whale



Polar bear



Seal



Reindeer



Krill

B Can you draw the food chain for each region (i.e. can you describe who eats whom?)

On a separate sheet of paper, draw a line matching predators with their prey. You can either cut out the pictures of the animals from this page and then arrange them as you like, or you can write their names down to show them in the diagram.

⁵ You can prepare for this exercise by viewing the animations «Polar Bears and Penguins» and «Polar Flora and Fauna»



08 How many species will have died out by 2050?



The Grey Whale and the Humpback Whale,
The Finback Whale and the Sei Whale,
The Sperm Whale, the Striped Dolphin,
The Killer Whale, the Narwhale and the Beluga,

his cousins;

regret to inform you of the death of the

BLUE WHALE

first seen in our oceans 12 million years ago. The species became
extinct in 2036

The blue whale was one of the biggest mammals that ever lived on Earth (20 to 34 metres long, weighing 100 to 190 tons). Only the dinosaurs were anywhere near it in size. This peaceful giant of the seas fed only on krill and small fish. The blue whale was hunted almost to extinction during the first half of the 20th century. In 1967, it was placed on the list of protected animals, enabling it once again to swim freely across the Earth's oceans.

"You will be missed."

The White-Flipped Penguin and the Fairy Penguin,
The African Penguin, the Humboldt Penguin and the Magellan Penguin,
The Adélie Penguin, The Gentoo Penguin and the Southern Rockhopper
Penguin,

his devoted cousins;

and all of the immediate family

have asked us to inform you of the passing of the

GALÁPAGOS PENGUIN

who died, surrounded by close family in the Galápagos Islands, in 2023

Galápagos Penguins lived further north than any other penguin. Their habitat was in the Galápagos Islands, on the Equator. Like all other penguins, Galápagos Penguins were unable to fly, yet they were expert swimmers and divers who lived off fish. Trustworthy souls, they did not mind if human beings came close to them. During the Galápagos Penguins' final years, the introduction of new predators into their territory (wild dogs and feral cats), as well as a lack of food caused by overfishing, pollution and increased human presence, finally proved to be fatal.

We will always remember them.

IN MEMORIAM

LEOPARD SEAL

Died in 2054, in Antarctica

The Leopard Seal was the only species of seal, sea-lion or walrus to feed mainly on warm-blooded animals (penguins, young seals and young sea elephants). The Leopard Seal hunted mostly at sea and could swim at speeds up to 30 km/h. Adult male Leopard Seals could weigh up to 450 kg and measured 3,50 m in length. They were known to live in excess of 26 years.

Farewell, brave Sea Leopard...

With much love and many shared memories,

we say goodbye to the:

WANDERING ALBATROSS

First soared over the seas 13 million years ago – disappeared forever in 2024.

The Wandering Albatross (also known as the Snowy Albatross or White-Winged Albatross) was a seabird in the truest sense of the word because it only ever returned to land to breed. With a wingspan measuring up to 3.5 metres, no other bird in the world had such broad wings. Living up to the astounding age of 80, the Wandering Albatross would produce just one chick every 2 years. Rarely nesting before the age of 7 or 8, these huge birds might wait until they were 15 before mating. Once they had found a mate, it was a lifetime commitment until one of the partners died. The Wandering Albatross was endangered by hazards such as fishermen's nets or long fishing lines, where they could become trapped, often dying as a result.

The Wandering Albatross's last cry will be etched on our hearts forever.

"He felt a great feeling of peace envelop him, the twilight faded and he was engulfed in the mystery of silence..."

The Grizzly Bear and Brown Bear,

The American Black Bear,

The Sloth Bear and the Spectacled Bear,

his cousins;

are all saddened to inform you of the death of the

POLAR BEAR

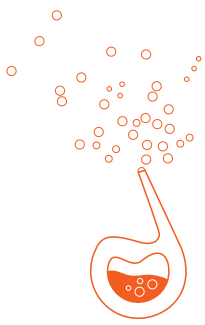
Died in 2032

The Polar Bear was the biggest of all bears. He stood 3 metres tall and weighed between 400 and 500 kg. He had a thick layer of fat and a warm fur coat to protect him from the cold. His favourite prey was seals, which he could smell up to 1 km away. He was truly a champion swimmer; but as the sea ice melted, he was forced to undertake longer and more hazardous swims that often resulted in him drowning. The polar bear was placed on the list of endangered species in 2006.

Anyone who wishes to pay final respects to the Polar Bear can do so by gathering this Monday at sunset by the Arctic Ocean, and share a final thought for this hardest of creatures.

For the time being, of course, all this is just fiction – the product of our imagination. But it is exactly what will happen if we don't take action now! Animals and the environment are in grave danger, and we have to do something about it!

Do some research about your favourite animal and present your findings to the class.

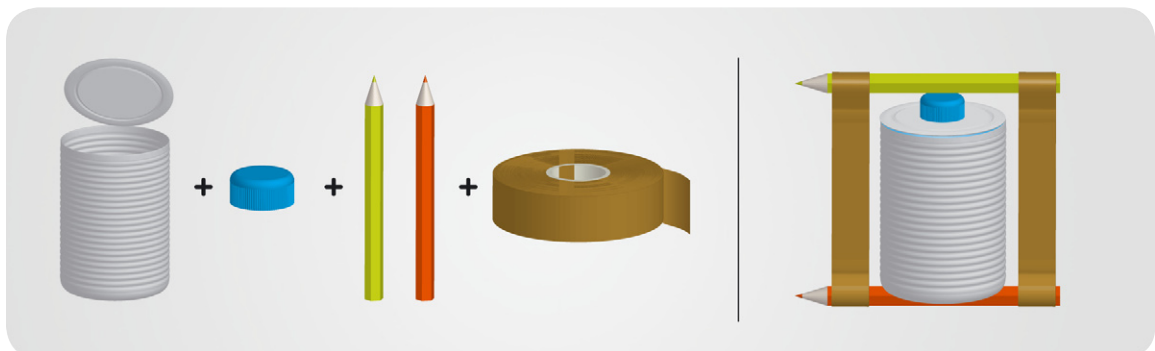


Polar science

09 Is the pencil mightier than the ice?

Is the pencil mightier than the ice?

Do the activity below and find out!



What you need:

- 1 empty tin can with at least 1 cm of the lid still attached
- 1 plastic bottle cap
- 2 old pencils
- 1 roll of sturdy packing tape (or something similar)

What to do:

- Fill the can with water all the way to the top.
- Close the lid of the can and place the bottle cap on top.
- Balance one of the pencils on the bottle cap, making sure that the middle of the pencil is on the bottle cap.
- Place the second pencil underneath the can.
- Ask a classmate to hold the whole structure firmly in place.
- Attach the two pencils at opposite ends of the can to each other by wrapping packing tape around each end of the pencils.
- Put the whole structure in the freezer for a few hours.

Observations:

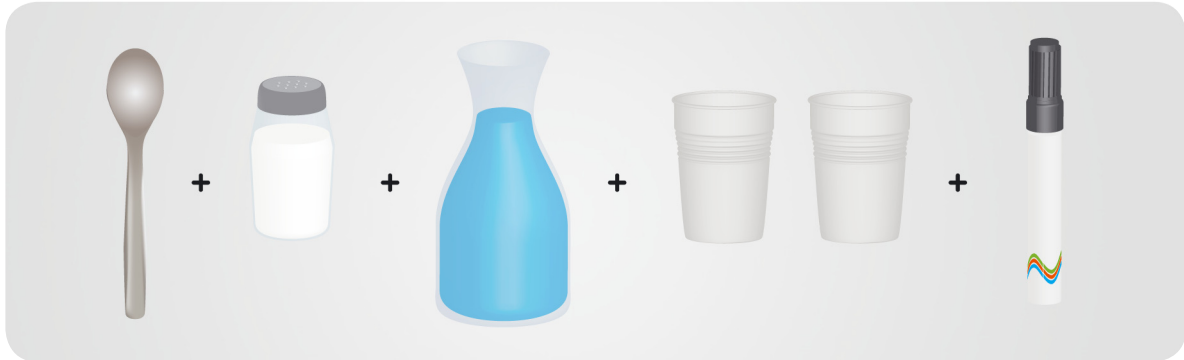
A What happened? How can you explain it?

B Why in your opinion do we bring fragile plants indoors when there is a frost in winter? (Think back to the experiment.)



10 Which freezes first: freshwater or saltwater?

This experiment contrasts how freshwater and saltwater freeze.



What you need:

- A spoon
- Salt
- Water
- 2 plastic tumblers
- A marker pen

What you do:

- Fill the two tumblers with the same amount of water.
- Mark one of the two tumblers with an «S» for salt.
- Add 4 teaspoons of salt to the «S» tumbler.
- Put the two tumblers in the freezer.
- Compare the tumblers every hour for 4 hours and then leave them in the freezer overnight.

Observations:

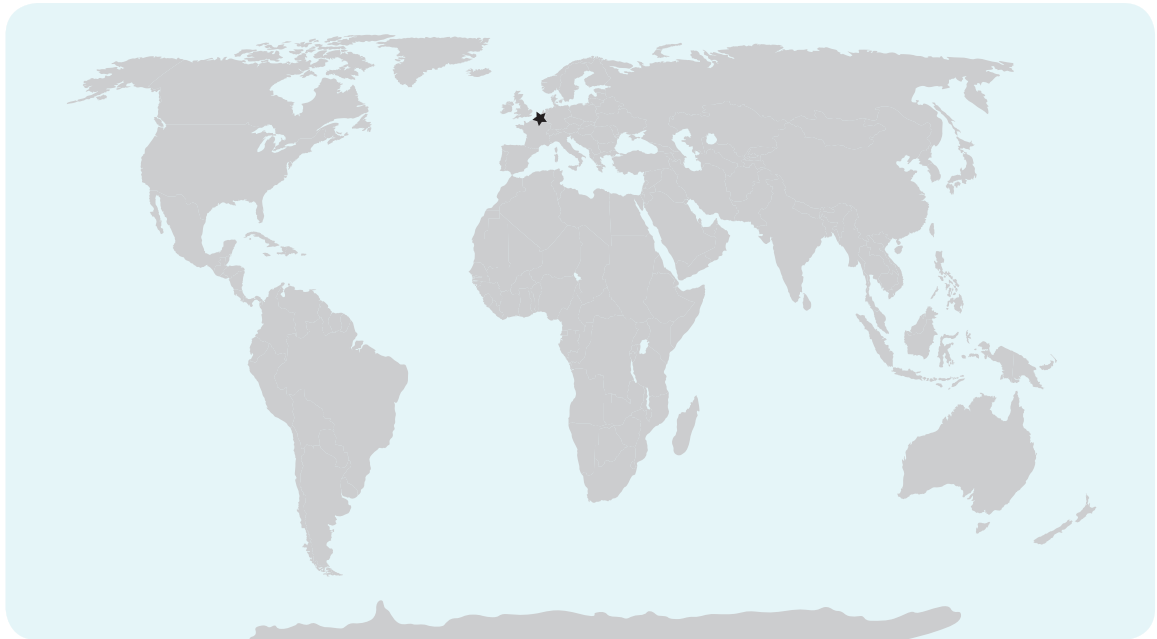
A What can you see happening? How can you explain it?

B Where can you see this phenomenon in nature? Give an example.

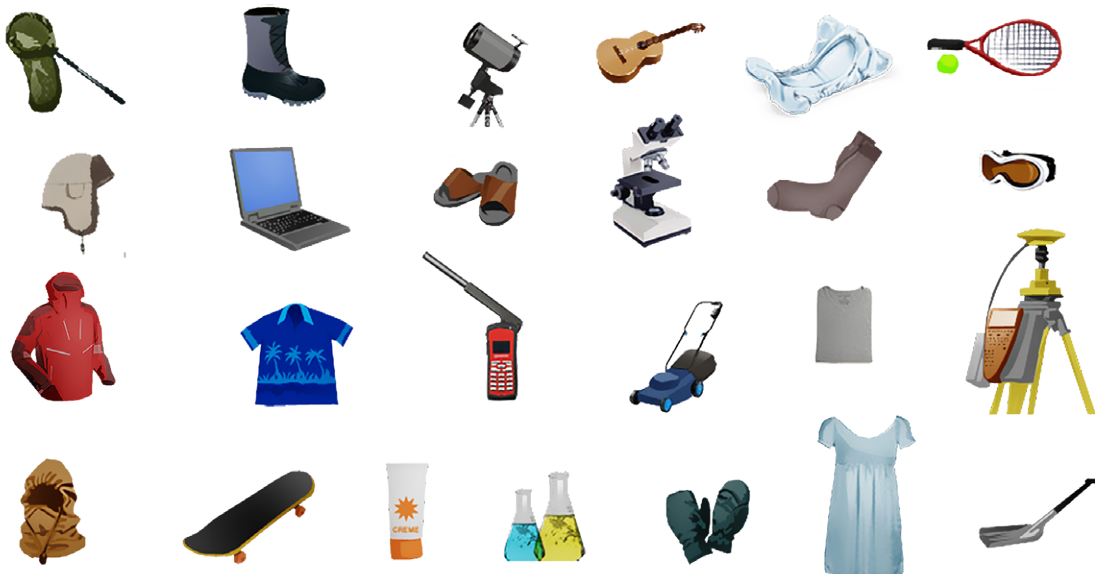


11 Which way to the Antarctic?⁶

- A** When Belgian scientists head for the Princess Elisabeth Station, what route do they take? Using an atlas, trace their route on the map, using Brussels as the departure point and travelling via the Cape of Good Hope in South Africa and the Russian Novolazarevskaya base in Antarctica.



- B** Circle the objects scientists would need to take on an Antarctic expedition



⁶ You can prepare for this exercise by viewing the flash animation «The Polar Regions: One of a Kind Laboratories for Scientific Research»



12 What sort of polar scientist would you like to be?⁷

Find out about the latest vacancies for polar scientists.

From the job advertisements below, choose the one that suits you best.

Great opportunity for glaciologists

Type of person wanted:

If you like ice, then this is the ideal job for you, because you will be spending most of your time working on it. You will be working mainly in the Antarctic and you will be sleeping in a tent.

Skills required:

You must be able to measure the thickness of the ice in glaciers accurately and analyse the speed at which glaciers move. You must also be able to identify the age of a sample of ice using both simple tools and high-tech equipment.

Tools you will be working with:

An ice radar device and GPS system that will enable you to calculate the thickness of the glaciers in the Sør Rondane Mountains (the mountains around the Princess Elisabeth Station), as well as the speed at which they move.

Exciting positions for passionate meteorologists

Type of person wanted:

You enjoy learning everything there is to know about the poles. You will use the Princess Elisabeth Station as your base of operations when you conduct your research.

Skills required:

You have a mathematical mind. You will have to operate a large number of devices and make lengthy calculations.

Tools you will be working with:

Satellite-linked devices that will enable you to keep an eye on the size of the hole in the ozone layer; an automatic weather station to take temperature readings and measure the amount of snow accumulated round the station.

Amazing job for marine geologists

Type of person wanted:

You can't think of anything better than to travel aboard a research ship for a number of weeks to examine the seabed.

Skills required:

You don't get seasick and are able to work as part of a team. You have excellent computer skills and a good knowledge of how geological processes work.

Tools you will be working with:

Acoustic mapping devices for producing maps of previously unexplored areas of the seabed; equipment for gathering samples of marine sediment.

Brilliant base for biologists

Type of person wanted:

You're well-versed in world of ornithology and you would like to find out how small birds survive in the Antarctic.

Skills required:

You love going on adventures on your own. You lose all sense of time when you are observing birds.

Tools you will be working with:

Binoculars, a GPS system and camera for identifying and mapping the location of snow petrels in the mountains around the Princess Elisabeth Station; a small aircraft may also be made available to assist you.

⁷ You can prepare for this exercise by viewing the flash animation, «The Polar Regions: One of a Kind Laboratories for Scientific Research».



Sustainable development

13 From ecological footprint ... to the concept of «zero emission»⁸

Did you know...

- ... that most of what we do (manufacturing and using things, building or throwing things away) uses natural resources, and this has an impact on the Earth.
- ... that it is possible to calculate the ecological footprint of a product, person, country, city, etc., which means you can also do a calculation for your class or school.
- ... that our ecological footprint is measured in terms of the land area (number of hectares of land) we need.
- ... that if you divide all the fertile land in the world by the number of people who live on Earth, each person would be entitled to use 2.1 hectares a year – the equivalent of 3 football pitches.
- ... that if everyone on Earth consumed things at the same rate as a Belgian, we would need 3 planets to survive.

Search the grid carefully for 10 words linked to our ecological footprint and circle them.

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E | B | B | O | C | P | P | A | C | K | A | G | I | N | G |
| F | L | G | A | R | M | A | T | A | L | V | B | W | D | M |
| R | E | E | V | D | F | A | S | R | V | O | O | Q | P | F |
| P | D | N | C | G | I | E | F | B | W | D | U | N | A | E |
| O | X | E | V | T | G | P | I | E | F | G | B | A | S | R |
| L | S | R | B | R | R | E | P | N | M | E | A | T | R | T |
| L | T | G | T | G | V | I | V | K | I | L | N | O | P | I |
| U | U | Y | K | O | I | H | C | O | P | M | D | O | I | L |
| T | X | C | V | E | W | C | J | I | R | M | O | K | V | I |
| I | V | F | R | G | E | H | W | W | T | M | L | J | H | S |
| O | R | F | P | A | P | E | R | T | Z | Y | O | L | F | E |
| N | R | T | J | K | H | N | L | U | U | Z | W | G | B | R |
| I | R | T | W | F | W | A | S | T | E | W | A | T | E | R |

The Princess Elisabeth Station is the first «zero-emission» research station in Antarctica. It emits no greenhouse gases and operates with virtually no harmful impacts on the environment. And if it can be done in Antarctica, it can be done where we live, too! We should all be trying to achieve a «zero emission» lifestyle!

⁸ To calculate your ecological footprint, go to <http://footprint.wwf.org.uk/>



14 Create your own «zero emission» meal!⁹

Did you know...

- ... that you can put products from all over the world into your trolley when you are out shopping.
- ... that transporting all of these products uses up an enormous amount of energy.
- ... that the label on every product you buy tells you which country it came from.

| Ingredient | Country of origin | Distance | Method of transport | Amount of CO ₂ per ton |
|---------------------|-------------------|----------|---------------------|-----------------------------------|
| Potatoes | Belgium | 100 km | truck | 20.7 kg CO ₂ |
| Rice | Thailand | 9249 km | plane | 11154 kg CO ₂ |
| Spaghetti | Italy | 1162 km | truck | 240.5 kg CO ₂ |
| Chicken | France | 826 km | truck | 171 kg CO ₂ |
| Scampi | Bangladesh | 8000 km | plane | 9648 kg CO ₂ |
| Ham | Belgium | 115 km | truck | 23.8 kg CO ₂ |
| Tomatoes | Spain | 1600 km | truck | 331 kg CO ₂ |
| Courgettes | France | 780 km | truck | 161.5 kg CO ₂ |
| Peas | Zimbabwe | 7795 km | plane | 9400 kg CO ₂ |
| Peppers | Canary Islands | 3300 km | ship | 99 kg CO ₂ |
| Carrots | France | 576 km | truck | 119.2 kg CO ₂ |
| Beans | Kenya | 7000 km | plane | 8442 kg CO ₂ |
| Onions | Poland | 1340 km | truck | 277 kg CO ₂ |
| Pineapple | Costa Rica | 6200 km | ship | 186 kg CO ₂ |
| Melon | France | 843 km | truck | 174.5 kg CO ₂ |
| Strawberries | Spain | 1741 km | plane | 2100 kg CO ₂ |
| Bananas | Colombia | 8850 km | ship | 265.5 kg CO ₂ |
| Granny Smith apples | Chile | 13000 km | ship | 390 kg CO ₂ |
| Milk | Belgium | 76 km | truck | 15.7 kg CO ₂ |
| Mayonnaise | Belgium | 103 km | truck | 21.4 kg CO ₂ |

- A** Create three different meals (main course and dessert) by choosing ingredients from this list. Which meal is the most environmentally-friendly? Try to make it as close to «zero emission» as possible!

Example of an almost «zero-emission» meal: veggieburger and chips

Potatoes: Belgium, 100 km, truck, 20.7 kg CO₂
 Mayonnaise: Belgium, 103 km, truck, 21.4 kg CO₂
 Veggieburger: Belgium, 120 km, truck, 25 kg CO₂
 Applesauce: Netherlands, 300 km, truck, 62.1 kg CO₂
 Total amount of CO₂: 129.2 kg

- B** Draw a line between your country and all these countries on a map of the world. How much CO₂ is released into the atmosphere for each of your meal options?

⁹ Source: based on the Klimaatcasino Happy Families Game from Leefmilieu Vlaams Brabant



15 Lucas or Henry: Who is closer to living a «zero emission» lifestyle?¹⁰

Henry and Lucas are both 10 years old, but they live in 2 different eras. The pictures below show their house, their bedroom and their kitchen.

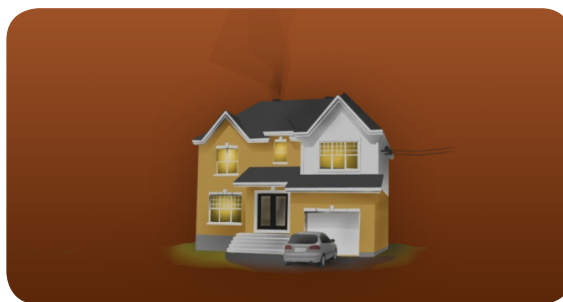
Henri
1930



Lucas
2008



A In the pictures below, circle the objects that consume energy.



- B** Does Henry or Lucas use the most energy over the course of a day?
C What type of energy is used for each object? (e.g. petrol, gas, etc.)

¹⁰ You can prepare for this exercise by viewing the animation «Energy Consumption Today and in the Past».



16 Text analysis: water consumption

Today, there are six and a half billion people living on Earth. Every single one of these people needs water to live, wash, eat, etc. Unfortunately, there is not an infinite amount of drinking water available. In fact, drinking water is a fairly rare commodity and is sometimes called «blue gold». That's because 97% of the water on Earth is saltwater. The 3% of freshwater remaining is used not only as drinking water, but also for making food, manufacturing things, watering crops, and so on.

Amazing as it may seem, just turning on the tap consumes energy, because the water needs to be pumped from its source, then treated before and after use. And all of the energy used has a negative impact on the environment.

We should also remember that fresh drinking water is not evenly distributed everywhere on Earth. While all some people have to do is turn on a tap, many others have to walk up to 20 km to get their water and then carry it home again.

On average, Belgians consume 120 litres of water each per day, whereas someone living in sub-Saharan Africa (i.e. to the south of the Sahara) only use 20 litres a day.

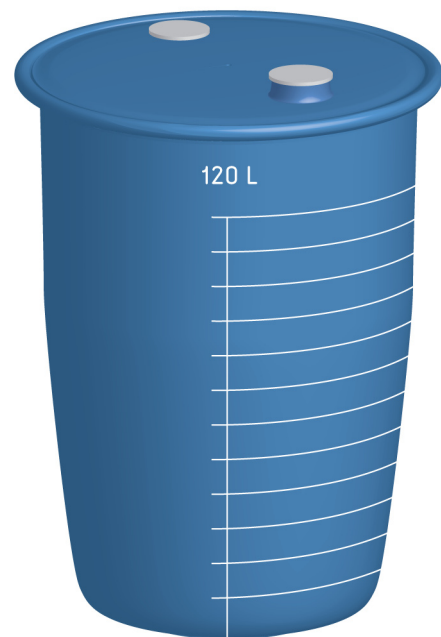
What are these 120 litres of water consumed every day by the average Belgian used for?

43 litres are used to flush the toilet (36%);
38 litres are used to bathe or shower (32%);
16 litres are used to wash clothes (13%);
8 litres are used to do the washing up (7%);
5 litres are used for cleaning (4%);
5 litres are used in the garden (4%);
5 litres are used for food preparation (4%).

A On the tank, mark the various amounts of water needed every day by the average Belgian. This exercise enables you to visualise just how much water you use every day and what you use it for. Better still, it may help you to try and waste less «blue gold»!

To give you an idea:




- 120 litres is more or less the amount of water contained in a full bathtub.
- 20 litres is more or less the amount of water contained in a shopping basket.



Answers

Climate change

01 Different climates

- A** Climates from top to bottom: frigid / temperate / torrid / temperate / frigid
B Example : torrid zone  temperate zone  frigid zone 
C Answers: a2 / b1 / c3 / d2 / e1

02 Climate change

- A** natural – energy – radiation – outer space – greenhouse gases – trap – -18°C – 15°C
B a.T – b.F – c.F – d.T – e.F – f.F – g.F – h.T – i.T – j.T
C Transport / Industry / Agriculture / Housing

03 Greenhouse effect experiment

- A** The ice cube in the receptacle with the sheet of glass (or bowl).
B The heat sent by the sun's rays is retained longer in the receptacle covered with the sheet of glass. Conversely, the heat of the sun's rays can escape from the open receptacle.
C A comparison can be made with the sun's rays that are trapped for a while by the greenhouse gases in the atmosphere. The greenhouse gases in the atmosphere prevent the heat from being reflected back into space immediately.

04 The effects of current climate change on me and the world around me

| Effects of climate change | Effects on me | Effects on the world around me |
|---|---|--|
| Rising temperature | I could do more activities outdoors | The heat may be dangerous for more vulnerable people such as babies or the elderly |
| Rising sea levels | Our bungalow at Ostend might get flooded | Risk of flooding for all regions situated close to the coast |
| Changes to species' natural life rhythm | I notice that the flowers are blooming earlier in the year and blossoms on the trees are appearing sooner | Risk of a gap between the time of the year at which some species appear and their link with other species in the food chain |
| Displacement of species | I could see new species in my area that were never here before | Local species may disappear and move to the north to find a cooler climate |
| Melting sea ice | No direct effect on me, because I don't live in the Arctic | Risk of extinction of species that depend on the sea ice to live, such as polar bears |
| More severe drought | Because lots of people will have less access to water, we will also have to make sure we don't waste any | Increasingly difficult access to water for the inhabitants of some countries in Africa and Mediterranean countries, for example |
| More frequent natural disasters | No effect on me, because I am fortunate to live in a part of the world that is little affected by natural disasters | Many people in the world are under direct threat. They may see their houses destroyed and be forced to take refuge in less hazardous areas |

Polar Regions

05 What does an iceberg taste like?

- A a2 / b4 / c1 / d3 / e5
- B From left to right on the picture : a / b / d / e / c
- C A glacier flows down the mountain.
- D An iceberg comes from the ice sheet, which is formed by an accumulation of snow. So unlike sea ice, an iceberg does not taste salty.

06 Activity: The life of penguins

A



Stand very close together, forming a compact, closed circle (like the penguins in the photo). Stay close together that way for 3 minutes. Anyone in the middle of the group will soon become very warm! The penguins stand close together to protect themselves from the wind and cold. This method is called "the tortoise". The penguins take turns warming themselves up in the centre of the group. This means that it is not always the same penguins that have to endure the cold on the outside of the group. The temperature in the centre of the "tortoise" can get as warm as 30°C, compared with -50°C on the outside!

07 The animals that live at the poles

- A Antarctic: penguins
Arctic: walruses, white wolves, reindeer, polar bears
At both poles: krill, killer whales, seals
- B In the Arctic: Wolves eat reindeer. They live on land. The polar bear, on the other hand, lives on the sea ice and eats seals and fish
In the Antarctic: Killer whales eat prey such as penguins and seals, which feed on fish and krill.

08 How many species will have died out by 2050?

This page can be used as a basis for thinking about the extinction of species: causes (climate change, overfishing, disappearance of natural habitat, reduction in the amount of food available, etc.) and effect (disruptions to the food chain, destabilisation of ecosystems, reduction in biodiversity, etc.). A point of interest is to wonder about the extent to which humans are causing species to die out, and if they will suffer consequences from this. Another suggestion for the pupils is to have them conduct research into the species that are dying out in their own part of the world.

Polar science

09 Is the pencil mightier than the ice?

- A** The top pencil broke! As it froze, the water expanded, which created pressure on the lid. The position of the bottle cap means that most of the pressure is directed towards the centre of the pencil, which explains why the pencil broke.
- B** Because these plants might die when they freeze, as their cells contain a lot of water. When water inside a cell freezes, it expands and bursts the cell membrane.

10 Which freezes first: freshwater or saltwater?

- A** The freshwater turned to ice in four hours, whereas the saltwater (tumbler with the "S") didn't freeze solid at all. Just a few small pieces of ice formed. Saltwater freezes, but it takes far longer than freshwater.
- B** Observing this phenomenon in the real world:
- Formation of sea ice. Seawater is salty and so it does not freeze easily. Unlike freshwater, which freezes at 0°C , the seawater temperature needs to fall to about -1.8°C before sea ice begins to form. When seawater freezes, it expels much of its salt content, which makes the water it leaves behind even saltier than before.
 - Spreading salt on roads, pavements and bicycle paths. Salt helps prevent the ground from freezing, because salty water freezes less easily.

11 Which way to the Antarctic?

A



B

- jacket
- laptop computer
- hood
- boots
- shovel
- satellite telephone
- snow mask
- gloves
- underwear
- microscope
- Erlenmeyer flasks
- sun cream
- socks
- surveying instruments
- telescope
- balaclava (ski mask)

12 What sort of polar scientist would you like to be?

This exercise can be used as the starting point for presenting the various fields of research within polar science. It can also be the subject of a multimedia workshop in which students search for more information on the Internet.

Sustainable development

13 From ecological footprint... to the concept of «zero emission»

Car; energy; paper; packaging; oil; pollution; electricity; meat; fertiliser; wastewater

14 Create your own «zero emission» meal

This exercise gives pupils a simple way of comparing the environmental impact of transporting various types of goods (from different countries transported by truck, plane or ship). They can also come to realise that they can check the origin of a product by reading the label.

Example of a meal very far from the aim of achieving "zero emission":

Scampi (11154 kg CO₂) with rice (9648 kg CO₂), peas (9400 kg CO₂), strawberries (2100 kg CO₂).
Total: 32302 kg CO₂

15 Lucas or Henry: Who is closer to living a «zero emission» lifestyle?

- A** Henry's house: heating / Lucas's house: heating, lights, alarm, car, automatic garage door
Henry's bedroom: lamp / Lucas's bedroom: two lamps, alarm clock, electronic game, computer, radiator / Henry's kitchen: stove / Lucas's kitchen: toaster, radio, fridge, microwave oven, coffee percolator, dishwasher.
- B** Lucas
- C** Henry: coal (heating) / oil (lamp) / wood (stove)
Lucas: oil (heating, car) / electricity (light, alarm, automatic garage door, lamps, alarm clock, computer, fridge, radio, toaster, coffee percolator, microwave oven and dishwasher). Note: most of the electricity in Europe is generated by burning fossil fuels (coal, gas, oil) or by nuclear power stations / chemical batteries (electronic game), produced using electricity.

16 Text analysis: water consumption

