TEACHING DOSSIER 3
ENGLISH, GEOGRAPHY, SCIENCE, HISTORY

CLIMATE CHANGE (PART 1): WHAT IS IT ?

OVER 100 YEARS OF SCIENTIFIC RESEARCH

CLIMATE CHANGE, GREENHOUSE EFFECT, GREENHOUSE GASES, ICE CORES, IPPC

THEORY SECTION

WHAT IS CLIMATE CHANGE ?

DEFINITION

Weather patterns are constantly changing. The science that studies these changes in the short term (a few days) is called **meteorology**. Meteorology examines variations in the weather (clouds, depressions, precipitation, etc.) by using accurate data recorded in the field, such as temperature, humidity, etc. **Climatology**, on the other hand, studies the pattern of weather conditions over the long term, using statistics based on at least 30 years of records. This enables us to define the type of climate for a particular region (e.g. continental, moist tropical, etc.).

The Earth's overall climate and the various regional climates are determined by what is called the "climate system". This is an extremely complex mechanism that involves the entire planet. It's made up of a whole series of interactions between various elements[1]:

- the atmosphere (interaction through wind, the composition of the atmosphere, etc.)
- the lithosphere (the position of the continents, albedo, etc.)
- the hydrosphere (ocean currents, temperatures and composition of the oceans, seas and lakes, etc.)
- the cryosphere (the creation of deep, cold ocean currents, albedo, etc.)
- the biosphere (its influence on the composition of the atmosphere and the oceans).

Many people wrongly think that the atmosphere plays the most important role when it comes to climate phenomena. In fact the Earth's climate depends on a lot more than just the atmosphere; other factors play a key role in regulating the Earth's climate as well.

We speak of **climate change** when the Earth's overall climate or all of the regional climates undergo a change over a long period of time (a minimum of ten years). As the climate is defined by numerous variables, climate change cannot be reduced to merely a change in the average temperature. Change can also involve movements in the average level or variability of precipitation, the winds, average soil moisture levels, etc.

CLIMATE CHANGES IN THE PAST

The Earth has seen a succession of climate changes throughout its history. The climate will usually vary little in a particular region over a period of 100 years. But it may vary significantly over a geological time scale (hundreds of thousands or millions of years). Paleoclimatology is the science that reconstructs the climate of past eras. To do this, scientists use indicators found in sediment or ice[2]. For example, we know today that average temperatures on Earth have in the past been both far warmer and far colder than they are today. From their studies, scientists have been able to determine the main factors that affect the Earth's climate on a geological time scale:

- **The movement of the Earth in relation to the sun** (Milankovitch cycles). The Earth's movement varies very gradually over hundreds of thousands of years and affects the amount of energy the Earth receives from the sun. For example the Earth's orbit around the sun follows an elliptical path that can stretch and retract over time.
- **The composition of the atmosphere.** Some of the atmosphere's components, called "greenhouse gases", have a direct effect on the Earth's climate because they influence the amount of solar energy trapped by the atmosphere (see below). The atmosphere's composition varies as the result of numerous parameters (e.g. gas emissions caused by volcanic eruptions, the capture or emission of gases by plants or the oceans, etc.)
- **The intensity of solar activity.** During periods when activity on the sun's surface is extremely intense, the Earth receives more energy, which has an effect on temperatures on Earth.

1 For more information see the animation "Climate Complexity" available at www.educapoles.org
2 For more information see the animation "The Earth's Climate through History" available at www.educapoles.org

- **The position of the continents**. The continents are moving very slowly (the Earth's tectonic plates are moving). Where the continents are on the globe can affect the major oceanic and atmospheric currents, which in turn can affect the Earth's overall climate.

CURRENT CLIMATE CHANGE

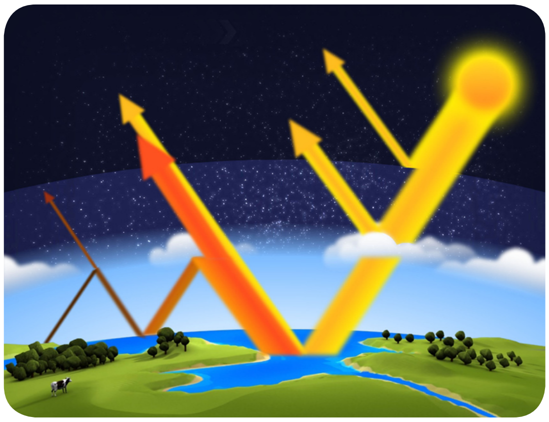
Because the Earth has experienced climate change many times throughout its history, we may well wonder why people are making so much fuss about climate change (also known as "global warming") today. Actually, the climate change taking place today is of great concern because it's happening very quickly. The speed at which this change is happening reduces the ability of numerous species of plants and animals to adapt, which means they may face extinction. Climate change is also different this time because for the first time humans are playing a significant role in the process.

The predominant factor of current climate change is the way the composition of the atmosphere is being modified. To understand this mechanism better, we need to distinguish between the "natural" greenhouse effect and the "additional" greenhouse effect.

THE NATURAL GREENHOUSE EFFECT[3]

The atmosphere is a thin envelope of gas surrounding the Earth, protecting the living beings on the planet in many different ways. It not only protects us from falling meteorites and excessive ultraviolet radiation (thanks to the ozone layer), but it also creates a pleasant average temperature of 15°C on the surface of the Earth due to the greenhouse gases it contains. This is what is known as the "natural" greenhouse effect.

The Earth receives a lot of energy from the sun as radiation in the form of sunlight (which includes all forms of electromagnetic radiation, including visible light). Part of this energy is reflected directly back into space by the atmosphere, clouds or the Earth's surface (see illustration below). The remainder of this radiation is temporarily absorbed before being discharged in the form of heat (infrared radiation). This is where the greenhouse gases come into play. They partly block the infrared radiation, preventing it from escaping back into space immediately. By retaining this energy a little longer, the greenhouse gases help increase the average temperature on the surface of the Earth. In the end, the Earth sends the same amount of energy back into space as it receives from the sun, although not necessarily immediately. The natural greenhouse effect is vital for maintaining a comfortable temperature on the Earth. If we didn't have it, the average temperature would be similar to that on the moon: -18°C.



The greenhouse gases occurring naturally in the atmosphere are mainly:
- water vapour (H_2O), which is formed by evaporation from the ground, plants, rivers, oceans, etc.
- carbon dioxide (CO_2), released by human and animal respiration, the decomposition of dead organic matter or forest fires, for example
- methane (CH_4), emitted mainly by decomposition of organic matter in humid areas (swamps, tropical rainforests, etc.) and animal digestion (ruminant animals and termites in particular)
- nitrous oxide (N_2O), emitted by the oceans and the soil

➥ Figure 1: Explanation of the natural greenhouse effect. Image taken from the animation "Mankind: culprit and victim of climate change today", available at www.educapoles.org

3 For a more detailed explanation of the mechanisms involved see the animations "Mankind: Culprit and Victim of Climate Change Today" and "Overall balance of the Earth: The Sun, the World's Driving Force" available at www.educapoles.org

ADDITIONAL GREENHOUSE EFFECT

Since the beginning of the Industrial Revolution, human beings have released a large amount of various gases into the atmosphere, mainly by burning coal, natural gas and oil. Some of these gases are greenhouse gases. As they accumulate in the atmosphere, they produce an "additional" greenhouse effect, which affects the climate system and increases the average temperature on Earth.

HOW DID WE DISCOVER THE CURRENT CLIMATE CHANGE WAS HAPPENING?

Back in 1896, the Swedish scientist, Svante Arrhenius, developed a complete theory on the greenhouse effect, based only on principles of physics. He then put forward the idea that the burning of fossil fuels by human beings might cause a significant increase in the concentration of CO_2 in the atmosphere, resulting in an arithmetical rise in temperatures. He forecast a doubling in CO_2 levels in the atmosphere over the next 3000 years. Practically abandoned due to a measuring error, Arrhenius's theory resurfaced in the 1950s. The American, Gilbert Plass, then created a climate model using an exciting new invention: the computer[4]. Plass demonstrated that the quantity of CO_2 in the atmosphere could very well have an effect on the climate. He predicted an average rise in the Earth's temperature of 1.1°C between then and the year 2000, resulting from the burning of fossil fuels by human beings (the actual rise was 0.6°C). Beginning at the end of the 1960s, scientists began pointing out that the climate changes linked to this additional greenhouse effect might cause problems for the future.

In 1958, as part of the International Geophysical Year, scientists began taking regular readings of CO_2 levels in the atmosphere at two isolated points on the globe, far from the anthropogenic sources: one in Hawaii and the other in Antarctica. A constant rise in CO_2 levels was confirmed right from the earliest readings. This work has continued on a regular basis through to the present day in Hawaii. It now very much looks as though the doubling of CO_2 levels will happen by the middle of the 21st century – far earlier than Arrhenius thought.

MEASUREMENTS IN THE ICE: 800 000 YEARS OF CLIMATE ARCHIVES

Since 1966, the study of ice cores extracted from the ice sheets has revealed a lot of extremely valuable information. Air bubbles, trapped in the ice at the time it froze, retain all of the information about the composition of the atmosphere at the moment they were trapped in the ice[5]. Because of this, it is possible to measure levels of various gases that were in the Earth's atmosphere long ago. Also, an indicator known as delta O18, which can be detected in the ice, makes it possible to calculate the temperature at the time. In the Arctic (Greenland), ice cores allow scientists to reconstruct climate conditions going back at least 115,000 years. The Antarctic Ice Sheet, which is thicker and hence contains ice that is even older than in the Greenland Ice Sheet, provides us with information dating back 800,000 years. These readings enable us to demonstrate that the present rise in CO_2 levels has been very rapid: a rise of 40% has been recorded since the beginning of the Industrial Revolution alone – and current levels are the highest in the past 800,000 years.

THE CLIMATE SYSTEM: COMPLEX INTERACTIONS

In the 1970s, new data enabled us to calculate the annual world emissions of CO_2 resulting from the burning of fossil fuels. According to readings taken in Hawaii, less than half of the carbon emitted was into the atmosphere. Where was the rest going? It was going into what is called the "carbon cycle." Scientists had known about the carbon cycle for a long time, however numerous studies were done, making it possible to get more in-depth knowledge about the cycle. Carbon is present in each of the components of the climate system: the atmosphere, the lithosphere (in limestone for example), the cryosphere, the hydrosphere and the biosphere. This complex system is kept balanced thanks to the constant exchanges between the various elements (animal respiration, exchange of

4 Also see the animation "Climate Modelling" available at www.educapoles.org
5 For more details, see the animation "Climate Archives" available at www.educapoles.org

gases between the atmosphere and oceans, etc.). When there is an imbalance, such as through the emission of additional CO_2 into the atmosphere caused by human beings, this affects the whole system because part of the additional carbon emitted into the atmosphere is incorporated into the other components of the climate system. This means that the increase in the level of CO_2 that we measure in the atmosphere is merely part of a much larger disruption in the carbon cycle, which affects the way the whole planet operates.[6]. We can now see that this increase is accelerating, which could indicate that the Earth is in the process of losing its natural ability to absorb the billions of tons of carbon emitted every year.

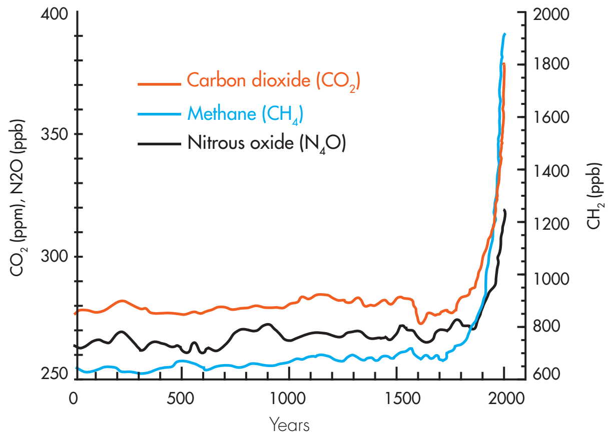


Figure 2: Concentrations of CO_2, CH_4 and N_2O in the atmosphere over the past 2000 years (IPCC, 2007)

OTHER GREENHOUSE GASES

CO_2 is the best-known of the greenhouse gases because it's the main additional greenhouse gas. It was also the first to have been studied. However, since 1975, scientists discovered that there were other greenhouse gases that need to be taken into account, too: methane (CH_4), nitrous oxide (N_2O), tropospheric ozone (O_3), CFCs, as well as others. All of these gases are transparent in visible light and partially absorb infrared radiation.

Human activities have released increasing quantities of these gases, and their concentration in the atmosphere has been rising constantly since the Industrial Revolution (see graph). For example, the burning of fossil fuels for transportation, heating or the production of electricity releases CO_2; the use of chemical fertilisers for agriculture and some industrial processes release N_2O and the intensive rearing of livestock increases emissions of CH_4.

In addition to increasing the amount of greenhouse gases that occur naturally in the atmosphere, human activities also have released new greenhouse gases into the atmosphere that did not exist there previously. Most of these are fluorinated gases, such as CFCs. These gases can escape from refrigeration and air-conditioning systems (e.g. from car air-conditioning units). Finally, some of the gases produced by the combustion of hydrocarbons (fossil fuels used for transportation, etc.) react with gases naturally present in the atmosphere and sunlight to form tropospheric ozone (O_3).

Each greenhouse gas has its own specific properties. For example, CO_2 remains in the atmosphere for at least 100 years, whereas methane only hangs around for about 12 years. Methane is, however, a far more powerful greenhouse gas than CO_2. To make things easier, scientists have come up with an index that allows us to compare the impact of the various greenhouse gases over a given period of time: GWP, or "Global Warming Potential". CO_2 is used as the benchmark for this comparison, which is why its GWP score is 1.

6 For more details, see the animation "Impact of Climate Changes on Oceans" available at www.educapoles.org

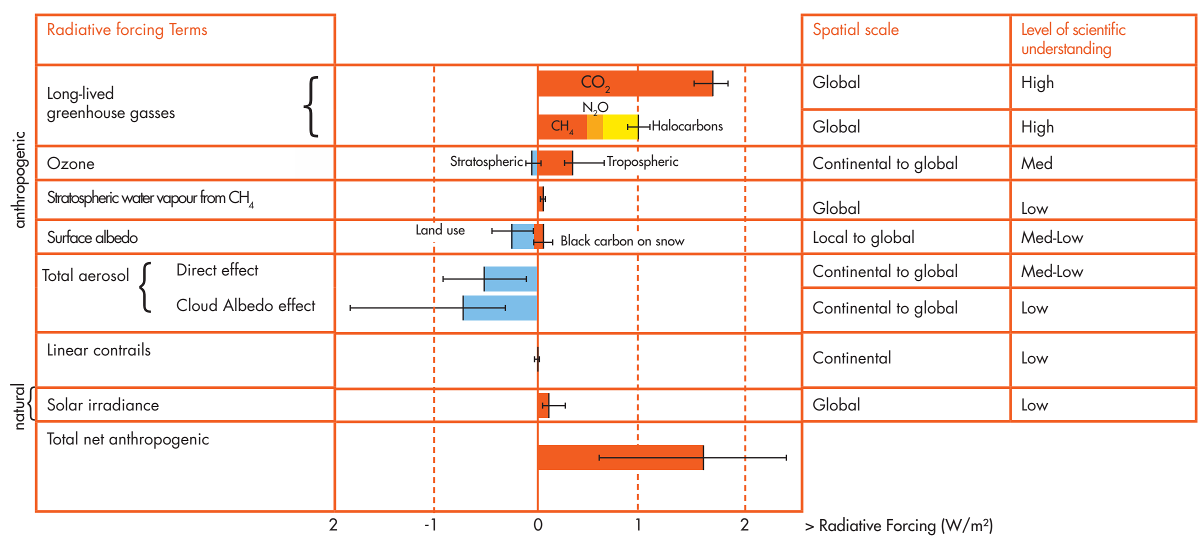
A few examples of greenhouse gases	Approximate time gas stays in atmosphere (in years)	GWP (over 100 years)
Carbon dioxide (CO_2)	100	1
Methane (CH4)	12	25
Nitrous oxide (N2O)	114	298
HFC-23 (hydrofluorocarbon)	270	14800
HFC-134a (hydrofluorocarbon)	14	1430
Sulphur hexafluoride (SF6))	3200	22800

➥ (IPCC, 2007)

ELEMENTS THAT EASE CLIMATE WARMING

Scientists came to realise that climate warming was even more complex than they originally thought. In the early 1970s, they discovered that some factors were actually easing climate warming, such as the fact that aerosols make the atmosphere darker and prevent the sun's rays from reaching Earth and that aerosols also seem to promote cloud formation. Thirty years later, the role of aerosols and clouds in climate warming is still not understood entirely. Following this discovery, scientists also discovered other "cooling" factors such as albedo.

Below is a table taken from the IPCC's 2007 Fourth Assessment Report, which summarises the probable impact of these various factors on current climate change. It shows that the main anthropogenic factor influencing the Earth's climate is greenhouse gas emissions (CO_2, N_2O, CH_4, ozone, etc.). Other factors such as variations in albedo linked to land use, emissions from aerosols, etc., have far less impact. For example, it is estimated that the current level of aerosols in the atmosphere is estimated to reduce solar radiation reaching the Earth's surface by approximately 0.5 W/m², although we don't understand this phenomenon completely at the moment (see figure 3). Regardless, it's clear that human activity is causing global warming, primarily through greenhouse gas emissions: the total anthropogenic impact on the climate corresponds to approximately a 1.5 W/m² increase in the amount of solar radiation reaching the Earth's surface.



➥ Figure 3: Impacts of the various factors influencing current climate change (IPCC, 2007)

WHY IS THIS TOPIC SO CONTROVERSIAL?

Accepting the reality of climate change and the fact that humans are playing a role means that we'll have to re-examine both the way we live and the way we produce and consume things. However before considering any re-examination, some people want irrefutable proof that climate change is really happening and accurate forecasts about what's to come. Yet as we've seen, this is a very complex issue. Science progresses by comparing contradictory hypotheses that must be verified or refuted, all of which takes time. It can take so long that it's hard for the general public to form opinions in such a complex and long-term debate.

FOUNDATION OF THE IPCC

To deal with the issue of climate change, the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP) set up the Intergovernmental Panel on Climate Change (IPCC) in 1988 at the request of the G7. The aim of the IPCC is to analyse and summarise all scientific, technical and socio-economic information available on climate change in a way that everyone can understand. Hundreds of scientists work with the IPCC to enable our political and business leaders to make informed decisions. The IPCC does not conduct any research or collect data; it leaves this to the scientists. All the IPCC does is assemble, analyse and summarise the results of all the recent climatological research.

The IPCC's official publications include issues both where there is a consensus on the issue and when there is still debate within the scientific community, always including any areas of uncertainty linked to the results presented. IPCC reports are considered as a benchmark as they are the result of extensive debate and discussion amongst experts in a field. To date, the IPCC has published four reports: in 1990, 1995, 2001 and 2007[7]. Some "sceptical" scientists sometimes contradict the IPCC's reports in the media; however, most do not question the overall conclusions of the IPCC, although they may have some doubts about the technical details, such as certain methods used to calculate something or the way certain factors were taken into account.

CERTAINTIES AND CONSEQUENCES

Today, scientists have already observed and measured a large number of changes, all showing indirectly that climate change is indeed taking place: increases in average temperatures in most regions and on the surface of the oceans, melting glaciers and sea ice, animal migration and the appearance of some plants in regions where they didn't grow before. Observing everything taking place is a big job and it will take many years before we have a clear, overarching view of everything that is taking place. Nonetheless, despite some grey areas that still need clarification, there is a general consensus that the climate is warming.

Climate models are only able to reproduce all of the variations recorded over the past 30 years if we include greenhouse gases of anthropogenic origin. Natural parameters alone are not sufficient to explain the changes being observed. It is for this reason, along with others, that today the vast majority of scientists acknowledges that human beings are at least partly responsible for current climate change. It's important to remember that while we may be the cause of these changes, we also have the power to make things better by taking action now.

To find out more about the present and future consequences of climate change, read part 2 of this dossier, "Climate Change (part 2): Consequences throughout the World and in the Polar Regions" available at www.educapoles.org.

7 These reports, as well as graphs and other data are available in English and French at www.ipcc.ch

GLOSSARY:

Aerosols: Tiny solid or liquid particles (approximately one micron in size) suspended in the air. They can act as condensation cores for the microscopic droplets of water in clouds.

Albedo: The ratio of the energy reflected by a surface to the energy arriving at the surface. Albedo is expressed on a scale from 0 to 1. It's 0 for a black body, approximately 0.1 for ground covered with vegetation, about 0.8 for fresh snow and 1 for a perfect mirror.

Anthropogenic: Related to human activity.

Biosphere: As part of the climate system, the biosphere includes all the living organisms on Earth and their relationship with each other. Used in another context, this term also includes their interaction with elements of the lithosphere, hydrosphere, and atmosphere.

Climate: Average weather conditions in a particular region (temperature, precipitation, etc.) calculated on the basis of annual or monthly statistics taken over at least 30 years of observations. Climate is characterised both by average values, as well as by variations and extremes.

Cryosphere: All ice present on Earth (glaciers, ice sheets, snow, permafrost, etc.)

Delta O-18: (written: $\delta^{18}O$) Indicator based on measuring the ratio of two different isotopes of oxygen, oxygen 18 (^{18}O) and oxygen 16 (^{16}O) present in a sample of ice. Since the ratio of ^{18}O and ^{16}O isotopes found in snow varies according to the ambient temperature when the snow fell, one can determine the average temperature of past climates.

Ice sheet: Mass of ice covering all or part of a continent. Up to several kilometres thick, ice sheets are made up of snow and ice that has accumulated over tens of thousands of years.When bigger than 50 000 km^2, they are called ice caps.

Lithosphere: Hard, outer layer of the Earth's surface, subdivided into tectonic plates that move against one another.

Ozone: (O_3). In the upper atmosphere, the ozone layer filters part of the sun's ultraviolet rays. This protective layer is threatened by pollution (CFCs). In lower atmosphere, ozone acts as a greenhouse gas and is a major air pollutant that can harm humans, plants and animals. This "tropospheric ozone" (or "bad ozone") is mainly of anthropogenic origin. Tropospheric ozone forms when gases produced by the combustion of hydrocarbons react with gases naturally present in the atmosphere and sunlight.

RESSOURCES:

View the animation "Mankind: Culprit and Victim of Climate Change Today," which explains the greenhouse effect in detail and lists the various greenhouse gases and where they come from. Also see the animation "Biodiversity: Climate Change" and the teaching dossier "Climate Change (part 2): Consequences throughout the World and in the Polar Regions," available at EDUCAPOLES, the educational website of the International Polar Foundation (IPF). The site also features numerous teaching activities.
http://www.educapoles.org (NL, FR, EN)

Dive into in a comic book about climate change! "The Migration of the Ibanes" can be used for classroom activities and as an introductory support tool for educational activities associated with climate change. An accompanying teaching dossier for the comic book and a role-play game are available on our website (Target age group: 8-14 years). And since it exists in four languages (FR, EN, DE, IT), it can also be used for language classes with older students.
http://www.educapoles.org (NL, FR, EN)

Other websites featuring information about current climate change:
http://www.manicore.com/ (FR, EN)
http://www.exploratorium.edu/climate/ (EN)

LEARNING ACTIVITIES

LEARNING ISSUES

The contribution science makes in helping us understand climate change is essential. This dossier helps teachers in making students aware that science is a collection of rational and stringent methodologies that enable us to understand the complex phenomena that govern our universe. Dealing with this complexity is also a way of helping students understand that the entire planet and the creatures inhabiting it are all affected by the changes to the climate currently taking place. As the role of written scientific documents is crucial, it is important to address this topic with the students by having them gather data and present it in various forms (text, tables, drawings, diagrams, etc.), as well as by studying scientific documents designed to communicate with the general public. This serves two primary goals:

- Helping the children obtain a solid understanding of science. Placing the emphasis on the scientific method and various scientific processes (experimentation, observations, systemic approach, data analysis, modelling, simulations).
- Making the students aware that the climate system is highly complex and that with the scientific community studying it, we have been able to prove unequivocally that significant climate change is taking place.

ACTIVITIES FOR THIS FILE

1) READINGS AND RESEARCH ON "WEATHER AND CLIMATE"

Target age group	<12 jaar	Time required	daily measurements and then 60 minutes for activity
Aims	scientific data, use it to make a graph, summarise the information, and distinguish between weather and climate		

Weather section: Find instruments found in a weather station and teach the pupils how to read them. Tell the students to take daily readings in groups (for example, one week per group) and make a graph illustrating certain parameters (temperature, atmospheric pressure, etc.). Then produce a summary of all the groups' results (for example, put the various graphs together to see what happens over the course of a month). If possible, visit a regional weather station or invite a meteorologist to come and speak to the class.

Distinction between weather and climate:

- After reading the two definitions aloud, ask the students to explain in their own words the difference between weather and climate.
- Ask them to find which climatic zone they live in using the map of world climates.
- Link the meteorological observations the students make with the region's climate (Do they correspond to one another? How many readings are needed to determine the climate of a region?)
- After a brief introduction on the consequences of current climate change (warming, increase in precipitation in some places, etc. – consult our dossier "Climate Change (part 2): consequences throughout the world and in the Polar Regions"), ask the pupils to come up with their own "weather forecast" for a day in the year 2020 in your region, using the table of meteorological readings.
- Then ask them if they think they will still be in the same climate zone in 2020. If they don't, ask them which zone they might be in.

2) GREENHOUSE EFFECT EXPERIMENT

Target age group	12-15 years	Time required	45 minutes
Aims	To understand the greenhouse effect better through an experiment		

Depending on the grade level of the students and what they might have been taught about the subject, have them guess or explain the three following situations:

- The container without the plastic film represents the Earth without the greenhouse effect
- The container with the plastic film with holes in it represents the natural greenhouse effect
- The container with the plastic film intact represents the heightened greenhouse effect (with additional greenhouse effect)

3) GROUP ACTIVITY: "WHAT CAN WE DO?"

Target age group	15-18 years	Time required	30 minutes, plus project and follow-up
Aims	To have students (working in groups) think about actions they can take, with the option of doing a project about ways to reduce greenhouse gas emissions		

Depending on his or her preferences, the teacher can encourage the groups to select either larger projects (e.g. awareness campaigns at school, assessment of the school's energy consumption and ways to save energy, etc.) or more personal and individual actions (e.g. turning the thermostat down by one degree at home). The larger projects may lead the students to examine various topics in greater depth (energy, pollution, etc.). Whichever option you choose, do a recap and an assessment in a few weeks' time. This can help show the impact an awareness campaign can have.
When the students undertake large-scale projects, they usually have a major impact, whereas they tend to abandon individual efforts quickly. Unless they're really motivated, it's not easy to make a difference.
Other examples of larger-scale activities:

- Make a list of vehicles that pollute the most and those that pollute the least, as well as a list of the latest "green" vehicles (hybrid cars, hydrogen fuel cell cars, electric cars, etc.). Share your lists with your classmates. Note: ask them to find out how hydrogen and electricity for cars are produced.
- Carry out a study on ozone levels in the local atmosphere (with the help of the local weather station).
- Organise a week devoted to food and the environment at school. Organise lectures and create posters that make people aware not only of the impact that food has on our health, but also on the environment (greenhouse gas emissions, deforestation, transporting goods, etc.).

After a short introduction on the main sources of greenhouse gases, ask the students to indicate for each of the activities on their list which greenhouse gas(es) it would help reduce.

OTHER IDEAS FOR ACTIVITIES

- Set up an experiment illustrating the greenhouse effect, highlighting the factors that make it possible to affect the temperature in a room (insulation, colour of receptacle, double-glazing).
- Conduct experiments that demonstrate the complexity of climate-related phenomena. For example, take temperature readings at different places in the school at different times of the day in order to observe daily variations and the differences in temperature in different places.
- Search the Internet to find the latest figures on greenhouse gas emissions in your country.
  Europe: http://reports.eea.europa.eu/eea_report_2008_5/en/ghg_trends_2008.pdf or
  Belgium:http://www.climat.be/ or http://www.klimaat.be/

WEATHER AND CLIMATE

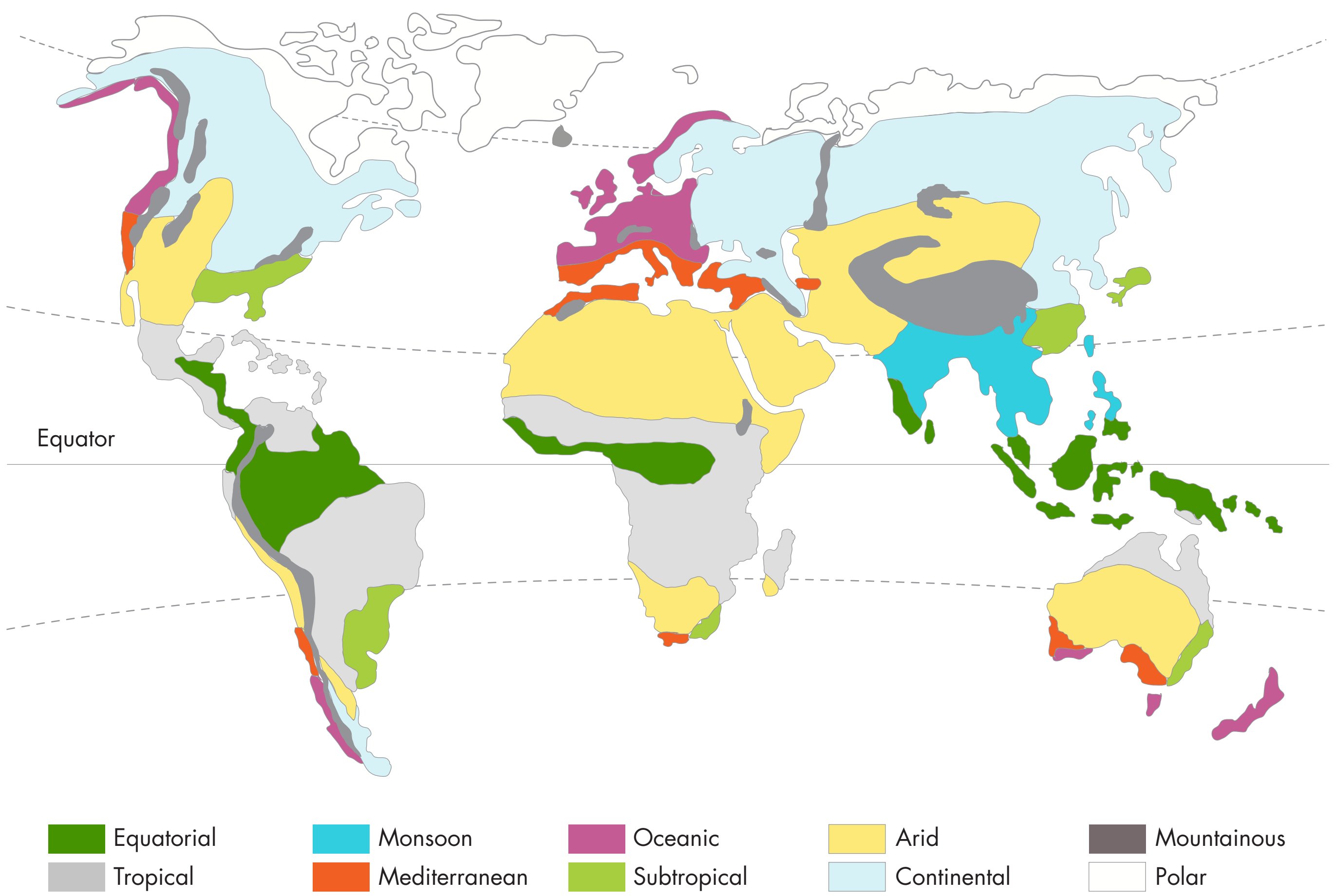
1) WEATHER READINGS

Meteorology is the science that studies the variations in weather events (clouds, rain, snow, wind, etc.). The aim is to understand how these events develop. Use precise data taken in the field such as the temperature, humidity, etc.

Date:										
Temperature										
Humidity										
Precipitation (in cm)										
Wind speed										
Wind direction										
Cloud cover										
Type of weather										

2) THE CLIMATE IN MY REGION, TODAY AND TOMORROW

Climatology is the science that studies weather conditions over extended periods of time in a particular region using statistics based on at least 30 years of readings. This enables us to define the climate of a region.



EXPERIMENTS ON THE GREENHOUSE EFFECT

SIMULATION OF THE GREENHOUSE EFFECT

EQUIPMENT

- 3 large, transparent containers (salad bowls or aquariums will do nicely)
- 3 thermometers
- 3 desk lamps, if there is no sun
- 1 roll of plastic sandwich wrap film

THE EXPERIMENT

1. Fill the 3 containers with the same amount of water (about 2 cm)
2. Attach a thermometer to the inside wall, making sure the bottom end is immersed in the water
3. Cover 2 of the containers with plastic film
4. Make holes approx. 1 cm in diameter in the film covering one of the two containers
5. Place the 3 containers in the sun (or under a 100 W lamp)
6. Observe how the temperature inside each of the containers changes every 5 minutes for 30 minutes and record your observations.

Container 1	Time						
	Temperature						
Container 2	Time						
	Temperature						
Container 3	Time						
	Temperature						

7. Write a report, making sure to include:

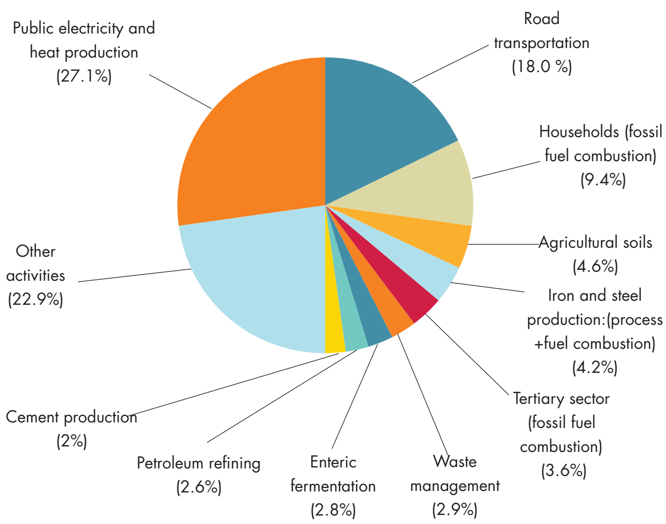
- a graph showing the data recorded (three curves on the same graph)
- an explanation as to why the readings in the three containers were different
- answers to the following questions:

a) How does this experiment mimic the greenhouse effect?
b) What does each of the containers represent?
c) What are the main greenhouse gases?
d) What human actions generate greenhouse gases?

WHAT CAN WE DO?

1) DATA

➥ Share of 2006 greenhouse gas emissions in the EU-27
(Source: European Environment Agency, rapport nr. 5/2008)



In Europe, the majority of greenhouse gas emissions come from the production of electricity and heating, as well as from the transport sector (transportation of people and goods).

Industry also produces a lot of greenhouse gases, either by using fossil fuels to provide factories with power, or by producing them during manufacturing processes.

Other sources of greenhouse gases are air-conditioning systems (in cars and buildings), raising livestock, agricultural fertilisers, etc.

If Europeans maintain current policies and practices, energy consumption in Europe will increase by 26% between now and 2030, and fossil fuels will remain our main source of energy.

2) ANYTHING IS POSSIBLE

Make a list of all the things you could do in your daily lives that might reduce the amount of greenhouse gas emissions you produce. It can include small, everyday actions (e.g. switching off lights), media campaigns (e.g. awareness-raising), and establishment measures (such as setting up a system for recycling waste).

Your list must feature a minimum of 15 different proposals.

3) LET'S GET STARTED!

Out of the suggestions on your list, select 5 that you think you can achieve in your own daily life. Number them 1 to 5. At the top of the list, put the action you are the most motivated about – something you are prepared to do every day.

Then get started! Start doing whatever it is you put at the top of your list – TODAY!