TEACHING DOSSIER 4

LANGUAGES, GEOGRAPHY, ECONOMICS

CLIMATE CHANGE (PART 2): CONSEQUENCES THROUGHOUT THE WORLD AND IN THE POLAR REGIONS

CLIMATE CHANGE, SCENARIOS, THE ARCTIC, ANTARCTICA, VISIBLE EFFECTS (SEA LEVEL RISE, MELTING SEA ICE, MELTING ICE CAPS AND ICE SHEETS, RETREATING GLACIERS, PERMAFROST, BIOSPHERE, WATER STRESS)

THEORY SECTION

Current climate change is a very complex phenomenon (see previous dossier: "Climate Change (part 1): What Is It?", available on www.educapoles.org). Numerous effects can already be observed (see below). However we have the power to influence our own destiny. The personal and political choices we make today and in the coming years will define our future.

VISIBLE CONSEQUENCES OF CLIMATE CHANGE

Current climate change is characterized first and foremost by a rise in the average global temperature on the Earth's surface. The planet warmed by 0.74°C between 1906 and 2005. This may not seem like much, but even this small rise is leading to significant changes.

Scientists' measurements show a global temperature rise, but not in the same way in every region. Generally speaking, it hasn't warmed that much near the equator; however the further away from the equator you go, the greater the warming, with the greatest warming occurring at the poles. Regional warming has been stronger in some places (e.g. North America) and weaker in others (some regions such as certain areas in the North Atlantic have actually cooled slightly). Another visible consequence is that frost-free periods have become longer in the middle and high latitudes of both hemispheres. Spring comes earlier and summer lasts longer.

The rising temperatures cause ocean surface water to heat up as well, which results in more evaporation, especially in the tropics. This water vapour then gets caught up in atmospheric circulation and enters the water cycle. Higher temperatures therefore mean more precipitation, albeit non-uniform in different areas and at different times, meaning some regions have received more precipitation (e.g. South America, Northern Europe, etc.), while others have received less (e.g. the Sahel, southern Africa, the Mediterranean, etc.). Precipitation in all regions is also now more violent than ever before, raising the risk of flooding.

Over the last 50 years, scientists have also recorded a greater number or heat waves in temperate zones such as the 2003 heat wave in Europe.

VARIOUS POSSIBLE SCENARIOS

VARIOUS SCENARIOS

IPCC experts have devised several scenarios for climate change. These scenarios were based on computer-generated models taking many factors into account, one of them being the emission of man-made greenhouse gasses. These scenarios are not predictions, however, but rather possible future outcomes. They form a range of possibilities within which our future almost certainly lies. Thanks to these scenarios, we have been able to identify the major risks linked to increasing temperatures, making it possible to mitigate them. The most optimistic scenario foresees an average temperature rise of 1.1°C by 2100, whereas the most pessimistic predicts a rise of 6.4°C.

THE CLIMATE SYSTEM'S INERTIA

The climate system of the Earth is an extremely complex mechanism that has a certain inertia, which means it is impossible to notice effects of our actions immediately. Even if we stopped all greenhouse gas emissions today, the atmosphere would need at least a century to eliminate them. This is why regardless of the emissions scenario we adopt, our future will be a little warmer than today. Our actions today will determine whether our future over the long term will be more optimistic with only moderate warming or catastrophic with more extreme warming.

SEA LEVEL RISE

WHAT CONSEQUENCES ARE WE WITNESSING TODAY?

Thanks to geological and archaeological observations, scientists have been able to prove that the sea level had hardly changed (not more than 0.1 mm/year) in the 3000 years prior to 1950. Since 1950, sea level has risen by an average 1.8 mm/year, and satellite measurements have shown an overall 3.3 mm sea level rise per year since 1993 - much faster than before! We're already seeing the consequences of this rise**:** humid coastal areas and mangrove forests are decreasing, while coastal erosion and flood-induced damage is increasing.

This rise is essentially due to two phenomena:

1) Thermal expansion: The current rise in temperatures is causing the surface waters of the oceans to warm up. However water takes up more space as it warms (like mercury in a thermometer), which causes sea level to rise.

2) Melting glaciers, ice caps **and** ice sheets: When ice on land melts, the resulting water flows towards the ocean, which causes sea level to rise. Melting sea ice, however, doesn't affect sea level (a full glass of water with ice cubes in it doesn't overflow when the ice cubes melt).

Until now, sea level rise has been due mostly to thermal expansion and only mountain glaciers have melted significantly. Polar ice caps and ice sheets, which hold 99% of land ice on Earth, have only started melting recently (mostly in the Arctic so far).

WHAT ARE EXPERTS PREDICTING FOR THE FUTURE?

As temperatures rise, so will sea level. Thermal expansion of the oceans will continue while additional freshwater from melting glaciers and polar ice caps and ice sheets increases. The IPCC report released in 2007 estimates that sea level will rise 20 - 60 cm by 2100. More precise glaciological studies show that an even greater rise is possible.

More than 50% of the Earth's population lives less than 100 km from coastal areas, which will translate into a considerable toll on human livelihood and significant economic damage. The consequences of sea-level rise will be particularly catastrophic for flat, low-lying areas at or near current sea level. UNEP[1] estimates the consequences of a one-metre rise in sea level will be 145 million people (mostly in poor Asian countries) affected by flooding and about 950 billion dollars in damages, with the poorest countries the most affected. Some of the people living in these low-lying areas will have to be moved to higher ground.

MELTING ICE AND WATER SHORTAGES

WHAT CONSEQUENCES ARE WE WITNESSING TODAY?

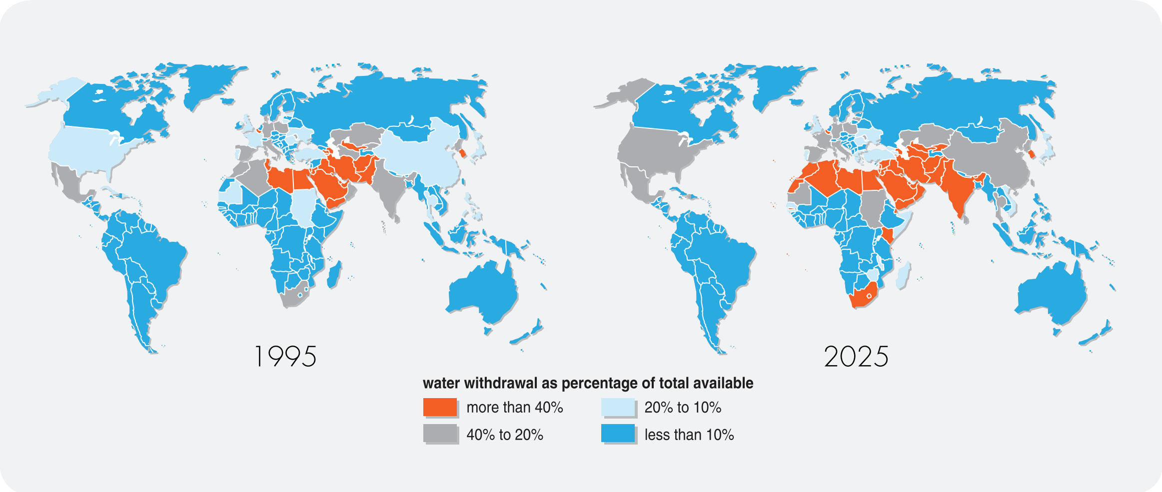
Ecosystems in cold and high-altitude regions are the most sensitive to climate warming. Retreating glaciers, along with diminishing snow cover and ice caps and ice sheets at the poles are due either to rising temperatures or to lack of snowfall. Present measurements show that, globally speaking, ice is melting everywhere on Earth, both in the Polar Regions (see below) and in mountainous regions. Since the end of the Little Ice Age, mountain glaciers in Europe have been retreating - slowly at first - then faster and faster, especially over the last 25 years. Today, measurements show glaciers are retreating all over the world.

1 United Nations Environment Programme

WHAT ARE EXPERTS PREDICTING FOR THE FUTURE?

On the whole, snow cover and glaciers, which are important freshwater reserves for many regions, will either greatly diminish or even disappear within the next century. At first, this accelerated melting will provide additional water to rivers, increasing the risk of flooding. On the medium term, freshwater supplies will decrease significantly.

For example, glaciers in the Himalayas have been retreating very quickly, leading to the formation of lakes at the mouths of the glaciers. This is a great danger to people living in the valleys below; the dams retaining these lakes are on the brink of collapse. However over the medium term, the shrinking glaciers will be providing less water to communities downhill from them. Runoff from snowmelt and mountain glaciers accounts today for 50% of the water feeding nine of the biggest rivers in Asia, upon which 1.3 billion people (in Pakistan, India and China) depend for water.



➥ Figure 1: Increasing strain on freshwater reserves between now and 2025 (Source: GRID Arendal)

Although the amount of available water should be on the rise in some parts of the world by 2025 (e.g. northern Europe and certain humid tropical zones), other regions - mostly in the middle (southern Europe) and low latitudes (Africa) - will see water shortages, thus expanding the planet's arid zones. Access to freshwater will be one of the major challenges for the coming century. Experts believe several hundreds of thousands of people will face significant water stress. Several countries have already put adaptation strategies into place. For example, several desalinisation plants are now being built in Spain, Italy, Greece, Algeria and elsewhere. However desalinisation remains a controversial solution, since the process requires a lot of energy and releases very salty water, a potential threat to the environment. Sensible use of current freshwater reserves remains the best option at the moment.

CONSEQUENCES FOR THE BIOSPHERE

WHAT CONSEQUENCES ARE WE WITNESSING TODAY?

Current climate change has been happening very rapidly[2] and is brutal on both animal and plants species, which have already had their life cycles altered in various ways:

2 To learn more, read dossier "Climate Change (part 1): What Is It ?" available at: www.educapoles.org

1) Physiology

Some animals and plants are sensitive to any change in temperature or level of carbon dioxide. This is true for the Nile crocodile, which is extremely sensitive to temperature changes during its breeding period, since the sex of its hatchlings depends on the temperature of the nest. A rise in temperature could result in an entire generation of the same sex, making further reproduction impossible. Likewise, coral reefs, which are one of the richest marine habitats in terms of biota living there, are extremely sensitive to changes in water temperature. If the water becomes too warm, microscopic algae that live in a symbiotic relationship with the coral are expulsed in a process that "bleaches" the coral before the coral eventually dies[3]. Since 1980, many coral reefs have undergone bleaching. Moreover, the CO_2 the oceans absorb has made it more acidic, which interferes with the ability of many marine organisms to form skeletons or shells.

2) Phenology[4]

The earlier onset of spring and longer summers have immediate impacts on the life cycles of some organisms (when birds migrate, when leaves come out and flowers bloom,...)

3) Geographic displacement of species[5]

Plants and animals have to move as the climate changes. For instance, if annual temperatures were to rise by 3°C in a temperate zone, plants and animals would need to migrate 300 or 400 km to the north or 500 m higher above sea level to remain in climatic conditions they are adapted to. This is why scientists have recently been finding tropical species in more temperate zones where they had never been seen before. This migration has its limitations, however. Mountain species will eventually run out of higher ground to move to, and polar species cannot find colder regions. The same limitation applies to species living on islands or in very specific ecosystems. When migration is not possible, the other option is to adapt to the changing environment. However, all species are not able to adapt quickly to a dramatic change in their environment. Only fast-growing species can develop the micro-changes allowing them to survive. Other species might face rapid extinction.

WHAT ARE EXPERTS PREDICTING FOR THE FUTURE?

Whether a given species survives depends strongly on how quickly climate and environment changes occur. Sudden changes might not give species enough time to adapt or migrate elsewhere. Their chances of survival are further complicated by an increase in the number of droughts and floods. If by 2050 average global temperature has risen by more than 2.5°C, scientists think about one third of all known species will become extinct and whole ecosystems could be threatened. For example, most coral reefs would probably die, depriving hundreds of thousands of people of fish, their only easily accessible source of protein.

CONSEQUENCES FOR THE POLAR REGIONS

Although they are more visible in the Arctic than in the Antarctic, both poles are experiencing the consequences of climate change. Sea ice, ice caps, ice sheets and permafrost are melting. Melting sea ice, which is most noticeable in the Arctic, along with melting land ice could greatly disrupt global oceanic circulation. In fact the Polar Regions play a key role in thermohaline circulation and in the global climate system, since cold deep ocean currents form under the ice before spreading throughout all the oceans of the world[6].

IN THE ARCTIC

On average, temperatures in the Arctic have risen twice as fast as the rest of the world. The area and thickness of sea ice has rapidly thinned over the last years (30% reduction in area in 30 years) - so much that scientists think there might be none left during the summer sometime between 2013 and 2040 (according to various projections).

3 To learn more, watch the multimedia animation "Biodiversity: Coral Reefs" available at: www.educapoles.org
4 To learn more, watch the multimedia animation "Biodiversity: Natural Rhythms" available at: www.educpaoles.org
5 To learn more, watch the multimedia animation "Biodiversity: Migrating Species" available at: www.educapoles.org
6 This subject is addressed in the "Polar Regions» pedagogical dossier and the multimedia animation «Impacts of Climat Change on the Oceans», available at: www.educapoles.org

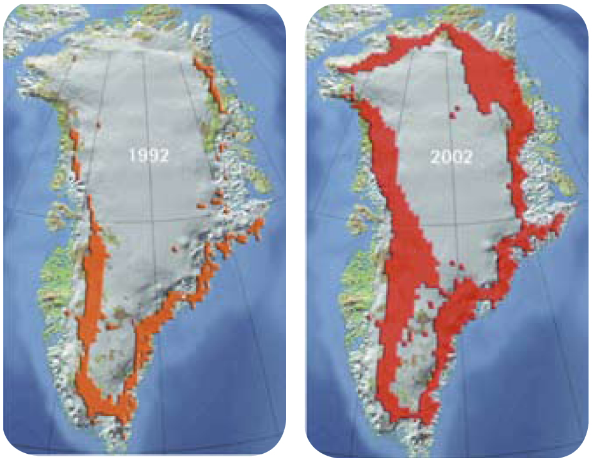


Figure 2: Increase in area of melting zones in the summer on the Greenland Ice Cap. Since 2002, melting has accelerated. (Source: © Clifford Grabhorn, ACIA/ Map)

These changes threaten species that depend on sea ice for their survival. This is the case of certain crustaceans and polar bears, which live on Arctic sea ice. Aside from affecting the ecosystem, an ice-free Arctic Ocean would foreshadow an increase in economic activities in the region (transportation of goods, drilling for oil and minerals, fisheries).

Land ice is also melting. Scientists estimate that the Greenland Ice Sheet is losing 130 km^3 of ice every year, and it only seems to be accelerating. Glaciers are flowing more quickly, the area of glaciers that melts during the summer is increasing and snowfall is not enough to compensate for the volume of ice lost during the summer melt.

Permafrost in the Arctic has also started to melt, causing the soil to sink in some places and damaging man-made structures (houses, roads, pipelines). However huge quantities of methane, a powerful greenhouse gas, are trapped in the permafrost. As the permafrost melts, methane is released, further adding to the greenhouse effect[7] and accelerating climate change. This creates what is known as a positive feedback loop[8].

All these changes have an important impact on the lives of indigenous Arctic peoples. Melting of sea ice makes traditional hunting more dangerous. Landmarks older hunters have traditionally used as guides are disappearing, and the behaviour of plants and animals has changed. Along with warmer summers, some Inuit communities have even begun to see thunderstorms, a phenomenon unknown this part of the world until only recently.

IN ANTARCTICA

The isolation and thermal inertia of Antarctica, which is covered by several kilometres of ice, prevents it from changing as rapidly as the Arctic. Whilst the average temperature in the western part of Antarctica over the last 30 years has risen, on the whole, the rest of the continent has not experienced much change.

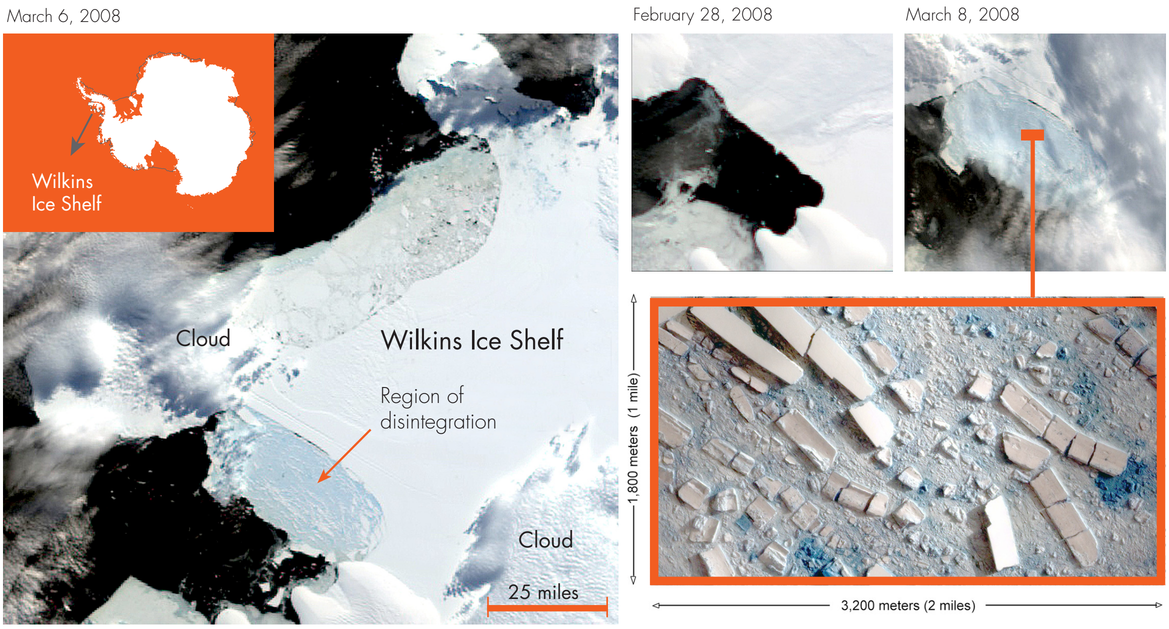


Figure 3: Wilkins Ice Shelf break-up (Source: NSIDC)

7 To learn more read the pedagogical dossier "Climate Change (part 1): What Is It?" or watch the animation "Mankind: Culprit and Victim of Climate Change Today", both available at: www.educapoles.org
8 This is explained in the animation "Climate complexity" at: www.educapoles.org

More noticeable changes have been happening on the Antarctic Peninsula (northernmost part of Antarctica). Several ice shelves are retreating, and six of them have completely disintegrated over the last 40 years - usually in a matter of days or weeks (e.g. Prince Gustav Channel (700 km^2) and Larsen A (2000 km^2) in 1995 and Larsen B (3250 km^2) in 2002). The Wilkins Ice Shelf experienced a break-up event in 2008, losing about 400 km^2 in only 24 hours (see fig. 3), and continued to break up after that. Antarctic ice shelves have lost a total of about 13,000 km^2 of over the last 40 years. This is alarming as ice shelves normally slow down glaciers as they flow towards the sea. For example, after the Larsen B Ice Shelf disintegrated in 2002, the glaciers that had been feeding it began to flow up to eight times faster, allowing a lot more ice to be shed.

Changes in the Antarctic climate have also affected animals. The overall penguin population has plummeted over the past few decades. Some nesting areas and food access sites have been destroyed, and the numbers of krill, a major food source for penguins, have diminished. The number of Adélie Penguins has decreased 65% in 25 years. Although many species are suffering under these climate changes, others such as King Penguins and Fur Seals, are thriving and have seen their populations rise.

WHAT CAN WE DO?

On the whole, experts estimates are pretty worrying. If we act now we could make a difference in the medium term between "bearable" and "unbearable" climate change. A report known as the Stern Report, the first report to look at the economics of climate change, supports this idea. Written by the former vice-president of the World Bank, Nicholas Stern, and released in 2006, the Stern Report concludes that investing just 1% of the world's annual GDP might be enough to stave off more radical climate change without any major ill effects on the global economy; yet staying on a "business as usual" course will eventually lead to a recession that could reduce the world's GDP by 5 - 20%.

We must act today to minimise the damage. This is why 172 countries (except the USA) have signed the Kyoto Protocol, which went into effect in 2005. Thirty-two developed countries have pledged to reduce significantly their CO_2 emissions by 2012. New negotiations have already begun (in Bali in 2007 and in Poznan in 2008) for more long term commitments after 2012. Sadly enough, experts agree that the proposed measures will be insufficient, since they must take other factors (world economy, international politics) into account. But other individual and collective actions are possible (schools, company, residential areas, cities, sports clubs).

For ideas of what you can do, watch one of the following animations at www.educapoles.org: "Things We Can Do" or "Biodiversity: Everyday Things We Can Do", or visit one of the suggested websites under "resources" (see next page).

GLOSSARY:

Biosphere: The global ecological system integrating all living things and their relationships with each other and their interaction with land, water and atmosphere.

Ecosystem: Natural unit consisting of all plants, animals and micro-organisms functioning together in a given environment.

Ice cap / ice sheet: Ice layer covering a large area of land resulting from tens or hundreds of thousands of years of snow pilling up and being compacted into ice, sometimes reaching thicknesses of several kilometres (especially in ice sheets, which are like ice caps but are larger than 50,000 km^2 and can cover entire continents like Antarctica). This ice slowly flows towards outlet glaciers or in some cases ice shelves at the edge of the ice cap / ice sheet.

Ice shelf: Extension of an ice cap or ice sheet over the ocean. It is a floating platform of freshwater ice 50 to 600m thick. Some ice shelves cover huge areas (the size of France) and exist for several thousands of years. Where the ice shelf meets the sea, ice frequently calves off, forming icebergs. Ice shelves respond more quickly to temperature rises than glaciers or ice sheets as they are squeezed between air and water, which are both warming.

IPCC: The Intergovernmental Panel on Climate Change was founded in 1988 at the request of the G7. Its mission is to analyse and comprehensively summarise all scientific, technical and socio-economic information on climate change. Currently 3,000 scientists throughout the world are involved in the IPCC. Website: http://www.ipcc.ch/ (FR and EN).

Little Ice Age: Period of cooling that occurred in Europe and North America from approximately 1580 to 1850. The glaciers in these regions advanced significantly during this period.

Permafrost: Permanently frozen soil found in colder parts of the planet (polar, sub-polar and high altitude regions). Permafrost can be up to several hundreds of metres thick. During summer, permafrost usually only thaws close to the surface to a depth of no more than one metre deep.

Sea ice: Permanent or seasonal ice layer 1 to 4 metres thick made from frozen sea water. This ice is salty, but its salinity decreases as time goes by.

Water stress: Occurs when the demand for water exceeds availability or poor quality limits its use during a certain period of time.

RESOURCES:

Have a look at our last teaching dossier "Climate Change (part 1): What Is It?", as well as our flash animations:

- "Mankind: Culprit and Victim of Climate Change Today", which explains the greenhouse effect in detail and lists greenhouse gases and their sources
- And many other animations such as "Biodiversity: Climate Change", "Ice shelves", "Polar Fauna and Flora", etc.

All these tools are available on EDUCAPOLES, the educational website of the International Polar Foundation (IPF), where you'll also find many learning activities for students.
http://www.educapoles.org (NL, FR, EN)

Have a look at the IPCC's predictions for the impacts that might result from a 1, 2, 3, 4 or 5°C temperature rise in various domains (water, ecosystems, food, coasts, and health):
http://www.ipcc.ch/graphics/graphics/ar4-wg2/jpg/spm2.jpg (EN)

Other websites that can give you ideas of everyday things you can do are:
http://ec.europa.eu/environment/climat/campaign/control/takecontrol_fr.htm (EN, FR, NL)
http://www.worldwildlife.org/climate/whatyoucando.html and
http://www.panda.org/about_wwf/what_we_do/climate_change/what_you_can_do/index.cfm (EN)

LEARNING ACTIVITIES

LEARNING ISSUES

The various studies on climate change and its visible or predictable impacts can make it difficult to understand exactly what's happening. This is why it is essential for students to develop critical thinking skills. This can help them interpret information from different media sources by identifying the source of the information, examining the goals of the parties giving the information and determining its overall reliability.

Focusing on the scientific method will help students better understand scientific data obtained using logical and rigorous methods, hold debates and gain a better understanding of how to construct a scientific argument. It is therefore necessary for students to discover analytical tools used in the natural and social sciences. Finally, it is always good to have the students produce their own documents during a learning activity (take notes, collect data, make graphs, etc.).

ACTIVITIES FOR THIS DOSSIER

1) "WHEN THE ICE MELTS" EXPERIMENT

Target age group	<12 years	Duration	45 minutes
Objective	to familiarise children with the scientific method, distinguish sea ice from ice caps and ice sheets, link the impact of climate change on the cryosphere to sea level rise.		

Try to answer the question as a group (hint: taste them. Sea ice is frozen sea water – it tastes salty). Then conduct the experiments and interpret the results (experiment 1: sea ice). Help the students understand how the experiments are related, the effects of climate change on different parts of the cryosphere (sea ice, ice caps, ice sheets, glaciers) and how this affects sea level. The experiment takes a few moments to set up. You can accelerate it by holding a spotlight close to the ice cubes.

2) "SHOULD WE BELIEVE EVERYTHING WE'RE TOLD?" EXERCISE

Target age group	12 - 15 years	Duration	45 minutes (+ research)
Objective	to develop students' critical thinking skills and teach them the difference between scientific data, interpretations and opinions.		

Answer for part 2: The second text because it is more precise. It cites its sources and emphasises that the figures they mention are only estimates. According to his or her preferences, the teacher can either select the three articles for the third activity or ask the students to choose them (newspapers, magazines, Internet). The teacher can decide the length of the text students write. Following this, the teacher can organise a short debate between the students.

3) "THE INTRICATE WEB OF CLIMATE CHANGE" DIAGRAM

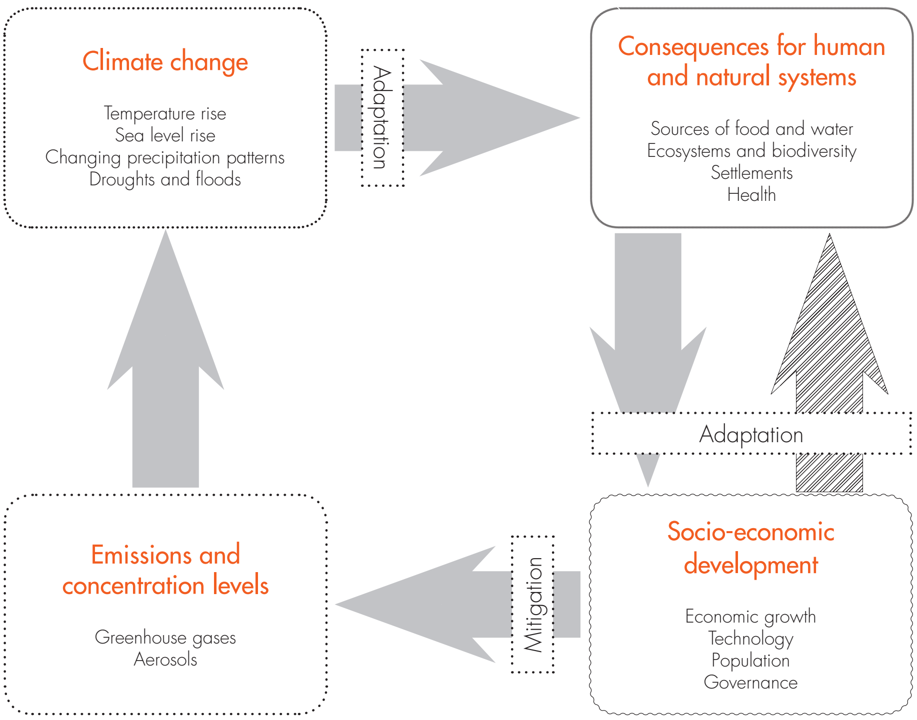
Target age group	15 - 18 years	Duration	30 minutes
Objective	analyze the different ways our society can respond to global warming.		

Explain all of the concepts illustrated in the diagram (see reverse). Students should try to construct the diagram on their own first, using the student's sheet. Ask the students to interpret it and share their interpretations in a class discussion (help them formulate their arguments if necessary). Ask students for examples of adaptation and mitigation strategies.

OTHER IDEAS FOR ACTIVITIES

- Have students watch part of a documentary on the consequences of climate change with the volume turned down. Then ask the students to form groups and make their own commentary to accompany the scenes in the documentary. Have each groups share its comments and discuss them in class.
- Have the students make an audio or video news report on what the average person knows of current climate change and its consequences. Connect these to research documents, such as IPCC reports.
- Have the students do some research at local organisations or scientific institutes to find out what impacts climate change is having on your region.

SOLUTION OF "THE INTRICATE WEB OF CLIMATE CHANGE" DIAGRAM (TEACHER'S REFERENCE GUIDE)



A few definitions:

Adaptation: Altering one's behaviour to survive or function better in a new and changing environment.
Mitigation: Term expressing a decrease, used particularly in reference to taking measures to reduce greenhouse gas emissions while keeping economic impacts to a minimum.
Governance: A way of managing, administrating or governing focused more on the interests of those being managed, administered or governed than the interests of those doing the managing, administrating or governing.

WHEN THE ICE MELTS

MATERIAL:

- 3 identical cylindrical glasses
- 1 soft plastic cup (preferably larger than the glasses)
- 2 ice cubes
- Water
- 1 pair of scissors
- 1 stopwatch

1) BACKGROUND INFORMATION

WHAT'S THE DIFFERENCE BETWEEN SEA ICE AND ICE CAPS OR ICE SHEETS?

Sea ice: Permanent or seasonal ice layer 1 to 4 metres thick made from frozen sea water. This ice is salty, but its salinity decreases as time goes by.

Ice cap / ice sheet: Ice layer covering a large area of land resulting from tens or hundreds of thousands of years of snow pilling up and being compacted into ice, sometimes reaching thicknesses of several kilometres (especially in ice sheets, which are like ice caps but are larger than 50,000 km^2 and can cover entire continents like Antarctica). This ice slowly flows towards outlet glaciers or in some cases ice shelves at the edge of the ice cap / ice sheet.

After reading the definitions, try to answer the following question: how can you know if the piece of ice you see is a piece of sea ice or part of an ice cap or ice sheet?

2) EXPERIMENTS AND OBSERVATIONS

EXPERIMENT N°1:

1. Put an ice cube into one of the glasses, then fill it to1 mm below the rim.
2. Start the stopwatch. Observe what happens every five minutes until the ice cube has completely melted. Write your observations.

EXPERIMENT N°2:*

1. Fill a glass to 1 mm below the rim.
2. Take another glass, turn it upside down and place it next to the glass filled with water, making sure the two glasses are touching.
3. Make a hole in the bottom of the plastic cup to one side with some scissors. Balance the cup right-side-up on top of the upside-down glass so that the part of the cup with the hole is directly above the full glass.
4. Place an ice cube in the cup and start the stopwatch. Observe what happens every five minutes until the ice cube has completely melted. Write down your observations.

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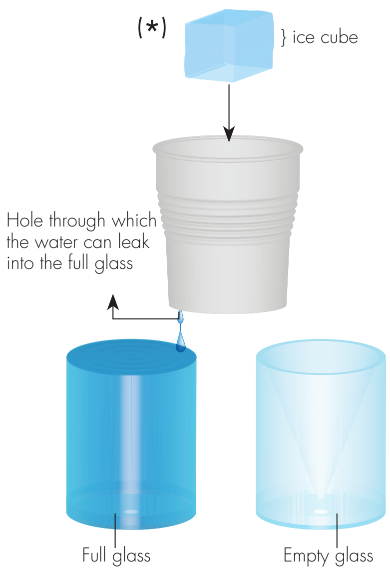

3) CONCLUSION

1. What does each experiment represent?
2. Which one represents sea ice, and which one represents ice caps or ice sheets?
3. Will the melting of sea ice have any effect on sea level? What about melting ice caps or ice sheets?

SHOULD WE BELIEVE EVERYTHING WE'RE TOLD?

SOME THINGS THAT MAY SEEM COUNTERINTUITIVE ARE ACTUALLY TRUE

Some of the data from the map hereunder might seem odd. How could some parts of the sea ice around Antarctica be GROWING while the rest of the planet is heating up?

Northern Hemisphere

Whole N Hemisphere	- 3.2%
1.Greenland Sea	- 10.6
2.Baffin Bay	- 8.6
3.Kara-Barents Sea	- 6.0
4.Hudson Bay	- 5.0
5.Arctic Ocean	- 1.3

Southern Hemisphere

Whole S Hemisphere	+1.2
1.Bellingshausen Sea	- 5.3%
2.Weddell Sea	+1.0
3.Indian Ocean	+1.1
4.West Pacific Ocean	+1.2
5.Ross Sea	+4.8

➥ Figure 1: Regional variation of sea ice area (Source: UNEP/GRID-Arendal, 2007 http://maps.grida.no/go/graphic/regional-changes-in-arctic-and-antarctic-sea-ice)

However counterintuitive this may seem, this is what's happening. The reason is that Antarctica is isolated from the rest of the planet and its enormous, several-kilometres-thick ice sheet has a lot of thermal inertia. However in some regions of West Antarctica, especially on the Antarctic Peninsula, temperatures have risen considerably over the last 30 years and glaciers and ice shelves have been melting. But for the most part global warming hasn't had any noticeable impact on sea ice elsewhere in Antarctica.

If you've heard that the ice in Antarctica is actually growing, it's actually true…in some places.

BUT YOU SHOULDN'T BELIEVE EVERYTHING YOU READ

Which of these texts seems more trustworthy and why?

a. In 2100, climate change will have caused temperatures to rise by 7°C. The sea level will have risen by 50 centimetres, displacing 600 million people.
b. According to the IPCC's 2007 report, the average temperatures on Earth could increase by 1.1 to 6.4°C by 2100, which could produce a sea level rise between 18 and 59 cm. Also by the end of the century the number of people affected by floods each year could reach as high as 420 million.

PRESS REVIEW

Take three articles on the consequences of climate change, each with a different perspective on the issue.
Underline the contradictions between these articles. Then underline, in each text:

1. Scientific data (in yellow)
2. Interpretations (in blue)
3. Personal opinions (in green)

Then write a text explaining:
1. What you learned from the articles
2. Which information seems the most trustworthy to you and why
3. How you explain the diverging views and contradictions in the different articles

THE INTRICATE WEB OF CLIMATE CHANGE

Cut out the different parts and bring the schema back together

Socio-economic development

Economic growth
Technology
Population
Governance

Consequences for human and natural systems

Sources of food and water
Ecosystems and biodiversity
Settlements
Health

Climate change

Temperature rise
Sea level rise
Changing precipitation patterns
Droughts and floods

Emissions and concentration levels

Greenhouse gases
Aerosols