Sheet 02 :
Biodiversity and climate change

A) DESCRIPTION OF THE ANIMATION

This animation deals with the topics of biodiversity and climate change. It lays out the main effects of climate change, i.e. the strengthening of the natural greenhouse effect phenomenon that has been caused by our way of life, and the unprecedented speeding up of rises in temperature compared with the natural periods of warming that have occurred in the past. It also looks at the main consequences of these changes.

Sheet 02 :
Biodiversity and climate change

B) LET'S TAKE A CLOSER LOOK...

1. GREENHOUSE GASES

Gas	Relative GWP / CO2 (100 years)	Approximate lifetime in the atmosphere
Carbon dioxide gas (CO2)	1	100 years
Methane (CH4)	23	12 years
Nitrous oxide (N2O)	298	120 years
Halocarbons	120 à 14800	Up to 50.000 years

The various types of greenhouse gases

Each greenhouse gas has its own specific warming potential that depends on the gas's ability to absorb the sun's infrared rays. Each gas also stays in the atmosphere for a different length of time (the longer a gas takes to dissipate, the greater its ability to generate a warming effect).

Scientists give different values to different gases in terms of their ability to generate a warming effect. Carbon dioxide is given a value of 1 and the other gases are measured against this benchmark.

Using the Global Warming Potential (GWP) index, we can compare the contributions made by the various Greenhouse Gases (GG) to the occurrence of climate warming. The main greenhouse gases emitted by human activities are:

Carbon dioxide (CO2) : this is the main greenhouse gas and is responsible for over 85% of all greenhouse gas emissions in Belgium. CO2 is produced when organic matter is burned – even if it is fossilised (i.e. a "fossil fuel"), like coal or oil.

Methane (CH4) is a gas that has a warming ability 23 times higher than carbon dioxide. Methane is one of the gases released when discharges occur during the process of extracting oil or gas, or from waste dumps. 80% of methane comes from agricultural activities (mainly from rice paddy-fields and the rearing of livestock, such as cows, sheep and goats).

Nitrous oxide (N2O) : this gas is produced from farming activities where (nitrogen) fertilisers or manure are used. 1 kg of nitrous oxide released into the atmosphere has an effect 298 times more powerful than 1 kg of CO2!

Fluoride gases (HFC, PFC, SF6, etc.) and other halogenated hydrocarbons. These gases are often used as refrigerants or propellants (for aerosol cans). Although they only represent less than 1% of greenhouse gas emissions, some of them have a Global Warming Potential that can be 10,000 times greater than the GWP of 1 kg of CO2!

This enables us to understand why it is better to burn off the natural gas that escapes from dumps, rather than allow it to escape into the atmosphere. The gas that escapes from landfill sites is methane (GWP = 23). When we burn this methane, not only does it produce energy that we can use for things such as heating, but the burning process mainly releases carbon dioxide, which has a GWP of just 1!

Sheet 02 :
Biodiversity and climate change

The weight of farming and rearing livestock

Eating a kilo of beef produces more greenhouse gases than driving a car for three hours or leaving the lights on at home…
This extraordinary observation comes from a Japanese study on the CO2 emissions caused by rearing and selling the cows that end up in our butcher's shops. The methane (CH4) generated by a cow's digestive tract is responsible for the majority of the 4500 kg of greenhouse gases that it emits over its lifetime!
There are around 1.3 billion cows on the planet and they give off approximately 300 000 billion litres of methane a year. This represents almost 20% of the methane emissions associated with human activities and is equivalent to the proportion attributed to the natural gas and oil industries…

2. THE KYOTO PROTOCOL

When it was first adopted in 1997, the Kyoto Protocol committed the countries signing the agreement to achieve individual targets that can be enforced by law. Essentially, the various nations agreed to reduce their emissions by at least 5% compared with 1990 levels by 2012. Belgium in fact committed itself to a 7.5% reduction in emissions.

Russia's ratification of the Kyoto Protocol in November 2004 was essential for the agreement to come into effect in 2005, because the Protocol needed to be approved by countries representing at least 55% of greenhouse gas emissions in 1990. Back then, the United States and Russia were producing together 45% of all greenhouse gas emissions. Since the United States refused to ratify the Kyoto Protocol at the time (and still refuses to do so), everything came down to Russia's decision…

3. WHEN THE TIME COMES, WHAT WILL WE DO WITH ALL "CLIMATE REFUGEES"?

Bangladesh represents just 0.3% or 0.4% of the world's total greenhouse gas emissions – less than the city of New York.

Yet this tiny level of emissions will not prevent Bangladesh from becoming one of the major casualties of rising water levels. This is because the country is made up mainly of very low-altitude plains (90% of the country is less than 30 metres above sea level). With the rise in sea levels, we can expect to see massive population displacement as people such as the Bangladeshis seek refuge on higher grounds. So who will be able to accommodate tomorrow's "climate refugees"? The countries bordering Bangladesh will most probably not be able to do so as they already have serious population problems of their own.

Faced with this problem, Professor Atiq Rhaman, founder of the Bangladesh Centre for Advanced Studies (BCAS), has come up with the following solution: "Each country will have to take responsibility for transporting and accommodating a quota of climate refugees that is in proportion to its current and past levels of greenhouse gas emissions."

A study by the United Nations states that between now and 2010 there will be 50 million environmental migrants, whereas the status of "climate refugee" is still not recognised legally by the international community…

Sheet 02 :
Biodiversity and climate change

C) GROUP ACTIVITY TO BE CARRIED OUT IN CLASS

Aims

- To learn how to conduct an experiment and interpret the results
- To learn how to read the temperature on a thermometer
- To highlight the strengthening levels of the natural greenhouse effect and its currently increasing levels
- To imagine the potential effects of climate warming for the planet and our way of life

Equipment

- 3 transparent salad bowls/aquariums
- 3 thermometers
- 3 desk lamps (in case the sun is not shining)
- plastic cling film

Process

Step 1 :

- Pour the same quantity of water into the 3 receptacles (about 2 cm in the bottom)
- Attach a thermometer to the inside wall of each receptacle, ensuring that the end is immersed in the water
- Cover 2 of the receptacles with plastic cling film
- Make holes 1 cm in diameter in the surface of one of the cling films stretched across the receptacles

Step 2 :

- Depending on the level of the pupils and how much has been explained to them, ask them to guess or explain the three following situations to them:
- The receptacle with no cling film represents the Earth with no greenhouse effect (= 1)
- The receptacle with the holes in the cling film represents the natural greenhouse effect (=2)
- The receptacle with no holes in the cling film represents the strengthening of the greenhouse effect (=3)
- Place the 3 receptacles in the sun (or under a lamp with a 100-Watt bulb)

Sheet 02 :
Biodiversity and climate change

Step 3 :

– Ask the pupils to observe the variations in temperature every 20 minutes and to record them in a table like the one below:

Receptacle 1			
Time			
Temperature			
Receptacle 2			
Time			
Temperature			
Receptacle 3			
Time			
Temperature			

Step 4 :

– Ask the pupils how they explain the differences in temperature between the various receptacles.
– Ask them which human activities are producing greenhouse gases.
– Ask them to describe what their daily routine would be like if the temperature were 4 degrees higher (in story or picture form).

D) RESOURCES/ REFERENCES

– The climate is us, WWF Belgium, 2008.
– This file can be downloaded in pdf format from: http://www.wwf.be/_media/BookWWFProf_fr_889149.pdf
– An Inconvenient Truth, a film by Davis Guggenheim, with Al Gore, 2006.
– Witnesses of climate warming: http://www.wwf.be
– Climate coalition:
http://www.coalitionclimat.be
– Also see the database of teaching tools provided by the IDée Network (Information and Distribution of education about the environment):
http://www.reseau-idee.be/outils-pedagogiques/