

MODULE 5: WHAT WILL THE FUTURE LOOK LIKE?

STUDENT ACTIVITY 1-5

The potential for climate to change relatively rapidly does exist. Abrupt climate change has occurred naturally in the past. A gigantic release of methane from below the ocean bed 56 million years ago led to a sudden warming of 6°C in the climate at a time when global temperatures were much higher than now. During the last ice age, collapses in the ice sheet over North America led to the North Atlantic Drift slowing, and the temperature across the North Atlantic dropping some 10°C within decades. Abrupt changes to the climate are called **tipping points**, they are changes that cannot be reversed. An example of abrupt climate change would be the rapid loss of the Greenland ice sheet. However, abrupt changes like this are not likely to occur in the 21st century. The melting of the Greenland ice sheet, which would raise global sea level by about seven metres, is a slow process, it would take many hundreds of years to complete.

An important concern is that the continued growth of greenhouse gas concentrations in the atmosphere may trigger abrupt changes, which become more likely as the concentration of greenhouse gases in the atmosphere increases and temperatures rise. The 'Climate impacts' sheet at the end of this unit summarises the potential impacts of global temperature increases and potential tipping points.

Because of the global climate system any climate change in one place will have an impact everywhere else in the world. People, plants and animals will have to **adapt** to the changing conditions, but the changes will affect different places in different ways.

ACTIVITY ONE

Even if there were to be no more emissions from now on, the gases already in the atmosphere will cause changes to the climate until 2050, so people plants and animals will have to adapt to their changing environments.

1. Study the statements below and think of ways in which people could adapt to changing climate
 - a. Rice, which needs a lot of water to grow, is grown in southern California an area with a low precipitation.
 - b. More cyclones and tropical storms are likely in some areas of the world.
 - c. Seasonal precipitation means that there are some periods of the year when there is a lot of rain and some periods when there is little.
 - d. Extreme weather events are more likely.

As plants and animals adapt to the changes these will have an impact on people too, for example changing migration patterns of animals in the Arctic will affect the indigenous people who live there because they will not be able to follow their traditional hunting routes.

➔ PERSONAL ACTIVITY

Think of ways in which you might have to adapt your lifestyle to the changes in climate where you live.

ACTIVITY TWO

Adaptation may be necessary to cope with the changes to climate, but they are not always desirable. For example people might insulate their home or use less energy in heating in winter and to keep the home cool in summer, but the insulation has to be made and this uses energy. Actions can be taken to **mitigate** (reduce the severity) of the changes to climate through global warming by reducing emissions and increasing the amount of solar radiation reflected back into space.

OCEAN FERTILIZATION

adding huge quantities of iron and other nutrients to encourage the growth of algae and phytoplankton which then absorb carbon dioxide.

ARTIFICIAL TREES

a machine like a tree which can act as a 'carbon scrubber' to capture carbon dioxide from the air.

INCREASING CLOUD REFLECTIVITY

Building a fleet of specially designed wind-powered ships that would spray sea water particles into the atmosphere to make clouds more reflective.

INCREASING REFLECTIVITY

Rooftops and pavements could be painted paler colours to reflect rather than absorb more of the sun's energy (increase the surface albedo)

SULPHUR SCREENS

Adding sulphur particles to the stratosphere in high latitude areas like the Arctic to reflect some of the sun's energy (increase the albedo of the atmosphere).

CARBON CAPTURE AND STORAGE (CCS)

a technique for capturing carbon dioxide as it is emitted from large producers, compressing it into a liquid and transporting it to a suitable storage site where it is injected into the ground.

LIVING ROOFS

Green roofs, living roofs and brown roofs are and will be an increasingly important technology. The ecosystems services that are provided by them will be especially important in regard to a reduction in the Urban Heat Island.

ALTERNATIVE ENERGY SOURCES

Renewable energy sources which do not involve burning fossil fuels are increasingly being developed. Sources such as wind power, hydro-electricity and solar energy are becoming increasingly important.

ENCOURAGING FORESTATION AND PREVENTING DEFORESTATION

Trees absorb carbon dioxide, when they are cut down less carbon dioxide is absorbed and if they are burnt as fuel more carbon goes into the atmosphere.

However each of these measures has its positive and negative aspects, some may not be cost effective, they may use too much energy in their building.

1. For each of the actions described above research their
 - a. cost effectiveness
 - b. effectiveness
 - c. positive effects
 - d. negative effects
 - e. how easy they are to put into practice
2. Write the words in bold on a piece of paper and sort the pieces according to the effectiveness of the mitigation in the shape of a diamond. The one at the top is the most effective, taking into account your findings in the activity above, then put the next two effective measures below the first, then three, then two less effective and the least effective at the bottom you should have used all nine pieces.
3. Discuss your rankings with the class or group

ACTIVITY THREE

Many different groups of people have to adapt and mitigate climate change. These people could be:

- World leaders
- Government ministers
- Local authority officials
- Business people

Look at the statements below

- We are helping people to become tomorrow's creatives, responsible for coming up with ideas on how we live with climate change; and, the engineers and business people who will put these ideas into action. At the very least, these people are going to be tomorrow's voters, having a say on the future of our planet. So, it's our job, to help them believe in their potential to make this happen.
- Climate change is the most important long-term priority for us. It's as important as public health and sanitation was in Victorian times. The public expects local leadership. That is why many areas have signed up to:
 - reducing our carbon footprint by 1.5million tonnes by 2012
 - reducing carbon emissions by 32million tonnes by 2012
 - having an understanding of how climate risks affect our core service delivery, infrastructure, assets and the well-being of local communities.
- We have the most power to make changes happen. We have had many summits to discuss the state of the planet and try to tackle climate change, such as the Rio Earth Summit in 1992. In 1997and 2005, some of us signed the Kyoto Protocol – to reduce the amount of greenhouse gases that they are pouring into the atmosphere. Each country agreed to cut a certain amount of greenhouse gas emissions.
- We bring together different Departments to make sure the need to adapt to climate change is written into all of our policies. We must raise awareness of the need to take action now and help society prepare for more extreme weather. We will provide grants and tax incentives for energy

efficient products such as electric cars and solar panels. We are also working with other countries to help them prepare for the impacts of climate change.

- Here are some climate promises we have made:
 - by the year 2020, we will reduce greenhouse gas emissions by 26-30% (compared to 1990).
 - by the year 2050, we will cut carbon dioxide emissions by 60%.
 - The key thing for us is to see climate change as an opportunity to make money. We need to be quick to respond and predict what people will need. Those of us involved in tourism are monitoring what's happening in skiing and beach areas to figure out where to invest in next. Those of us involved in agriculture are researching drought as well as damp resistant crops; and those of us involved in construction are avoiding investing in low-lying coastal areas and looking into selling water-saving systems such as rainwater harvesting tanks.
1. What other groups of people should be involved in the processes of adaptation and mitigation?
 2. Discuss this statement in class 'The stronger and more timely the mitigation, the less will be the challenge of adaptation' Stern: 'Blueprint for a safer planet'; 2009, p71.

➔ PERSONAL ACTIVITY

Think of an invention that would help one of these groups to fulfil their plans for example using waste from the school kitchen to help to power the school heating system.

ACTIVITY FIVE

1. Lay out the **shape of a tree** in the middle of the floor. This can be done using several pieces of flip-chart paper stuck together and drawing the tree, or using wood or other materials.
2. Write or make a symbol for any **climate change solution**, and add it to the trunk.
3. Write or make symbols for the **positive effects** this will have on the world (drawing on information from modules 3, 4 and 5) and display these as fruit, e.g. reducing greenhouse gas emissions. Add **reasons why** this solution is likely to have positive effects to branches (linking the trunk to the fruit).
4. Think of the **resources** needed to achieve this, e.g. materials, money, skills, and display these as the roots.
5. **Compare trees** with the class. Discuss similarities and differences; the usefulness of tree-shapes in exploring the effectiveness of solutions.

PERSONAL ACTIVITY

➔ Investigate the place where you live. What examples of mitigation against climate change can you find, e.g. solar panels on the roof of a house?

What examples of adaptation can you find, for example people growing different plants in their gardens?

CLIMATE IMPACTS

TEMP						
RISE	WATER	FOOD	HEALTH	LAND	ENVIRONMENT	
ABRUPT, LARGE SCALE						
1°C	Small glaciers in the Andes disappear completely, threatening water supplies for 50 million people.	Modest increases in cereal yields in temperate regions.	At least 300,000 people each year dies from climate-related diseases. Reduction in winter mortality rates in Northern Europe, USA.	Permafrost thawing damages buildings and roads in parts of Canada and Russia	At least 10% of land species facing extinction (according to one estimate) 80% bleaching of coral reefs, including Great Barrier Reef	Atlantic Thermohaline Circulation starts to weaken
2°C	Potentially 20 - 30% decrease in water availability in some vulnerable regions, e.g. Southern Africa and Mediterranean	Sharp declines in crop yield in tropical regions (5 - 10% in Africa)	40 – 60 million more people exposed to malaria in Africa	Up to 10 million more people affected by coastal flooding each year	15 – 40% of species facing extinction (according to one estimate) High risk of extinction of Arctic species, including	Potential for Greenland ice sheet to begin melting irreversibly, accelerating sea level rise and committing world to

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					polar bear and caribou	an eventual 7 m sea level rise
3°C	In Southern Europe, serious droughts occur once every 10 years 1 - 4 billion more people suffer water shortages, while 1 – 5 billion gain water, which may increase flood risk	150 - 550 additional millions at risk of hunger (if carbon fertilisation weak) Agricultural yields in higher latitudes likely to peak	1 – 3 million more people die from malnutrition (if carbon fertilisation weak)	1 – 170 million more people affected by coastal flooding each year	20 – 50% of species facing extinction (according to one estimate), including 25 – 60% mammals, 30 – 40% birds and 15 – 70% butterflies in South Africa Collapse of Amazon rainforest (according to some models)	Rising risk of abrupt changes to atmospheric circulations, e.g. the monsoon Rising risk of collapse of West Antarctic Ice Sheet Rising risk of collapse of Atlantic Thermohaline Circulation
4°C	Potentially 30 – 50% decrease in water availability in Southern Africa and Mediterranean	Agricultural yields decline by 15 – 35% in Africa, and entire regions out of production (e.g.	Up to 80 million more people exposed to malaria in Africa	7 – 300 million more people affected by coastal flooding each year	Loss of around half Arctic tundra Around half of all the world's nature reserves cannot	

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		parts of Australia)			fulfil objectives	
5°C	Possible disappearance of large glaciers in Himalayas, affecting one-quarter of China's population and hundreds of millions in India	Continued increase in ocean acidity seriously disrupting marine ecosystems and possibly fish stocks		Sea level rise threatens small islands, low-lying coastal areas (Florida) and major world cities such as New York, London, and Tokyo		

SOURCE: NICHOLAS STERN, THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW, CAMBRIDGE UNIVERSITY PRESS, 2007 P 57.

