Our warming planet

There's bearly any time left.
The big picture
This chapter is about **global warming**. These are the big ideas behind the chapter:
- Temperatures around the world are rising. We call it global warming.
- Some scientists say it's just a natural change.
- But most say it's mainly due to carbon dioxide, the gas that forms when we burn fuels.
- Global warming will bring disasters such as drought, and famine, and floods.
- We can't stop global warming. But we must try to limit it, before it's too late.

Your goals for this chapter
By the end of this chapter you should be able to answer these questions:
- What do these terms mean?
  - *global warming*  *climate change*  *emissions*
- How may climate change affect our world?
  (Give at least six predictions.)
- What are greenhouse gases, and which can I name? (At least three.)
- Carbon dioxide is the greenhouse gas that concerns us most. Why? And where does it come from?
- When we burn fuels, we affect people in other countries. Why?
- What can I do, on my own, to help reduce carbon dioxide emissions?
  (Give at least four things.)
- What could: i governments do  ii scientists do to reduce carbon dioxide emissions?
  (Give at least two sensible things for each.)

And then …
When you finish this chapter, come back to this page and see if you have met your goals!

Your chapter starter
Look at the photo on page 68. It shows a man dressed as a bear.
What kind of bear?
Why is he dressed like this?
Why did he spell 'barely' that way?
He thinks there's barely any time left. What does he mean?
Saturday 30 April, 2050

Our planet is getting warmer. So what will life be like in 2050? This unit makes some guesses.

Molly, UK
Molly is sitting on the balcony, in her T-shirt and shorts.

It is a perfect morning. The sun is hot, and the sky a brilliant blue. A huge red butterfly flaps by. 'That's new', she thinks. Lots of new insects are appearing these days. Then she hears the familiar whine of a mosquito. It's okay. She has her mozzie spray on already.

She looks out over the farm. The orange trees are a mass of white blossom. Six months from now, she will help her dad pick the oranges. They will pack them into crates, fill up the truck with hydrogen, and head off to Reading, to sell them. She loves going there. She might buy another T-shirt, if she can save up enough. But clothes are so expensive.


She puts it down again. It's all a bit depressing. She will listen to music instead.

Aban and Numa, Kenya
'Wake up, Numa', says Aban. He shakes his little sister. She looks so sad, and tired, that he gives her a cuddle. And then the two of them climb out of the field where they slept.

There is a long walk ahead. Maybe two or three days – he can't tell. It is two days since they left home. They closed the door of the hut and crept out of the village at dawn. They said goodbye to no one. There was no point. The few people left would soon be dead, from thirst and hunger.

He is lucky. He still has the two eggs he cooked in the ashes. And the last wrinkled mango from the tree he had tried so hard to keep alive. It's not much food – but better than nothing.

What will they do when they get to the coast? He is not sure. But he knows they must leave the country. They will try to get to Europe, somehow. He has heard that people there have plenty of water and food.

And so they trudge along. Two small figures on a dusty red track, lit up by the hot morning sun.
**Captain Hanna, the Arctic Ocean**

Captain Hanna stands at the rail of the Arctic Sunrise.

On the deck below, the tourists are out strolling already, lunch over. Some sit on the benches, wrapped in their warm rugs, sipping their coffee.

They are still a few days from the North Pole. With winter nearly over, all the ice will have gone by now. So the tourists can get onto the floating platform. People just love standing there, right on top of the North Pole.

In the distance, he can see a warship. That's a worry. There is so much talk about war, these days. Canada, Russia, Norway, America: all claiming the floor of the Arctic Ocean. And all for one reason: the huge oil and gas wells in there. It's over 30 years since they signed that treaty not to touch them. But it is looking very shaky.

On the left is Ellesmere island. It still has a fringe of winter ice. He scans it with his binoculars. Something catches his eye. A polar bear! Incredible! Unbelievable! He zooms in. It looks half dead, lying there on the ice. And so thin!

He'd better report it right away. That's his orders. With a sigh, he turns back to his office, to put in an urgent call.

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**Did you know?**
- In 2000, there were about 27,000 polar bears on the Earth.
- Over half were in Canada.

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**Did you know?**
- Polar bears need ocean ice, to help them reach their main food: seals.

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**What if...**
- The Earth just kept on getting hotter and hotter?

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**Your turn**

1. Look at Molly's story.
   - In the story, what has changed in the UK by 2050, compared with today? List the changes. One is: Farmers grow oranges.
   - Which of them do you think are 'good' changes?
     Underline these in one colour.
   - Underline the 'bad' ones in another.
   - If a change is good and bad, or if you can't tell, ununderline it in a third colour.
   - Add a colour key.
   - Now discuss your answers with a partner. By the end, you may want to change some of your answers.
   - There's one big reason for most of the changes.
     - What is it? How could it make clothes cost more?

2. Look at the story of Aban and Numa.
   - Why have they left their village?
   - Do you think they will get to Europe? Give reasons.
   - If they do reach Europe, do you think they will find a country to take them in?

3. Captain Hanna's story is set in the Arctic Ocean.
   - Where is that ocean? Which countries surround it?
   - In what ways is it different in 2050 than in 2000?
   - Where is the North Pole? And it is real?

4. Captain Hanna sees a warship. What do you think it's doing there?

5. Captain Hanna has orders to report any polar bears he sees. Why do you think this is?
Our changing climate

This unit is about how our planet is warming up – and what the effects might be.

Getting warmer

The air all around us, here in the lowest part of the atmosphere, is getting warmer.

We know that for sure, because scientists have been measuring its temperature for over 150 years.

This shows the measurements on a graph. Temperatures go up and down – but the overall trend is up.

It is happening all around the Earth. So we call it global warming.

It is happening faster in some places than others.

Is it a good thing?

It might seem good that the air is warming up. No more winter clothes!

But it’s not so simple.

So, what will the future bring?

The years 2001 to 2007 were seven of the world’s eight hottest years, since records began in 1850.

Will it keep on getting warmer? How warm? And how will this affect us?

Scientists say it will keep getting warmer. They can’t say how warm.

Because that will partly depend on us.

But they try to predict what will happen, using computer models.

The next page shows one set of predictions, and some likely effects.

It is based on work by hundreds of scientists around the world.
It could be like this!

Look at the map below. It shows one set of predictions for temperature rise, between 2000 and 2050. The deeper the red, the bigger the rise.

Look at the Arctic region, at the top of the map. It will still be cold there, in 2050. But temperatures could have risen by up to 4.5 °C, since 2000.

Now look at the boxes. They give the likely effects of all this warming.

- Ice in the Arctic and Antarctic will melt. The water from land ice will run into the sea, causing a rise in sea levels.
- Rising seas will drown low-lying coastal places. For example in Bangladesh, which is a low, flat country.
- There will be more violent storms, and more floods.
- There will be more heat waves in Europe and other places – and they’ll kill hundreds of thousands of people.

<table>
<thead>
<tr>
<th>How much temperatures may rise, between 2000 and 2050</th>
<th>Temperature rise (°C)</th>
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- Some places will get much more rain, and some much less, than now.
- There will be millions more refugees, as people flee from floods, or drought and famine.
- Some places that depend on tourists will get too hot. Tourists will stay away.
- Some places will get too hot and dry to grow crops. This will cause famine.
- There may be wars over food and water.
- Other places will attract more and more tourists, as their climates ‘improve’.
- Some places will grow new crops, that they were once too cold for.
- Animals and plants that can’t cope (by moving, or adapting) will die out. (Will polar bears?)
- Diseases will spread, as insects and animals that carry them move to new places.

Your turn

1. Say what these terms mean – in your own words!
   a. global warming
   b. climate change

2. The map above shows how much temperatures may rise between 2000 and 2050.
   a. What age will you be by 2050?
   b. How much warmer might it be then, compared with 2000: i. in the UK? ii. in Spain? iii. on Ellesmere Island? iv. in Russia?
   (Pages 140 – 141 and 71 will help.)

3. True or false? Give reasons.
   A. Climate change will definitely not affect you.
   B. Climate change will have social effects.
   C. Climate change won’t have any economic effects.
   D. Climate change won’t affect the environment.
   E. No one will benefit from climate change.
   F. Rising sea levels won’t affect the UK.

4. Look at those effects of global warming, in the boxes. Which do you think would be the worst one? Why?
What’s causing global warming?

Is global warming only natural? Or is it our fault? Find out more here.

The big argument.
We depend on scientists to tell us what’s causing global warming. But it is a very hard question. And they don’t all agree on the answer:

The Earth has often warmed and cooled before...
So don’t blame humans!
The tilt of the Earth’s axis can change...
...and the Earth can even wobble!
Well, natural causes may play a part...
It’s because we’re filling the air with greenhouse gases.
...long before we got here.
The amount of energy the sun gives out can change.
The Earth’s path around the sun can change.
Any of those can cause global warming.
...but the data proves it’s mostly our fault.
I think it’s ALL our fault!

It’s only natural! No, it’s ALL our fault.

What’s the final verdict?
Arguments still go on. But a large team of scientists from around the world was asked to look at all the data. In November 2007, it reported:

Most of the increase in global temperatures since the mid-20th century is very likely due to the increase in greenhouse gases.

We’re over 90% sure they are the main cause.

Did you know?
Without greenhouse gases, the average world temperature would be about -18°C.

So what are greenhouse gases?
Greenhouse gases are any gases that trap heat around the Earth. Like this:

1. The sun sends out energy, as light and UV rays.
2. These warm the Earth. The Earth reflects some of the energy again, as heat.
3. Some of this heat escapes to the outer atmosphere.
4. But some is absorbed by the molecules of greenhouse gases.
5. They re-emit it in all directions, including back to the Earth.
6. So the air, and Earth, get warmer.

We need greenhouse gases. Without them, all the heat from the Earth would escape. So we could not survive at night, when there’s no sunlight. But now their level is rising fast. So the Earth is getting warmer.
Which gases are they?

These are many greenhouse gases. These are the four main ones.

**Carbon dioxide, CO₂** It’s the one that worries people most. Because it’s the one we are adding to the air fastest.

You breathe out carbon dioxide. Plants and trees take it in. (They also give out some.) It used to be in balance, in the air. But we add extra, every time we burn ...

... coal, oil, and gas (the fossil fuels) and petrol and diesel. Plus we are cutting down forests, so there are fewer trees to take carbon dioxide in.

**Methane, CH₄** This is the ‘natural gas’ piped to homes. Some escapes from oil and gas wells. It also forms in landfill sites, when stuff rots. It’s given off from rice paddy fields. And when cows belch. And when animal waste breaks down.

Methane is far more powerful than carbon dioxide, as a greenhouse gas. But there is much less of it in the air.

**Nitrous oxide, N₂O** It is produced by bacteria in the soil. When we add fertilisers, they produce more! It is a very powerful greenhouse gas – but the level in the air is low.

**Water vapour, H₂O** It forms when water evaporates from the oceans. As the air warms up, more will evaporate. So it will play a growing part in global warming. And we can’t control it!

So the level of carbon dioxide in the air has been rising. Ever since the Industrial Revolution, over 200 years ago. Now it’s rising faster than ever. It is no longer in balance.

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**Did you know?**
- Australia’s cattle and sheep give out about 3 million tonnes of methane a year.
- The world gives out over 25 billion tonnes of carbon dioxide a year, from burning fossil fuels.

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**Your turn**

1. In the past, the sun may have caused global warming (or cooling). How do you think it could do that?
2. The Earth's path around the sun changes over time:
   - more circular
   - more oval

   That could cause a change in climates. See if you can explain why.

3. Look back at that verdict from the team of scientists, on page 74. Do you think it is wise to believe them? Give your reasons.

4. Explain what greenhouse gases are:
   - a in 20 – 25 words
   - b in 10 – 14 words
   - c in just 6 words

5. All these statements are about greenhouse gases. Copy and complete them:
   - a We would die without greenhouse gases, because ...
   - b Greenhouse gases can harm us, because ...
   - c The level of greenhouse gases in the air is ...
   - d The more farming we humans do, the more ...
   - e When we drive our cars, we ...

6. Which greenhouse gas(es):
   - a do you think you add to the air?
   - b do you think we could cut back on?
More about carbon dioxide

In this unit you’ll learn about the things we do, that produce carbon dioxide.

CO₂, the main culprit
Carbon dioxide is the greenhouse gas that is causing most concern – because we pump so much of it into the air.

Carbon dioxide forms when we burn anything containing carbon. Such as:
- coal, oil, and gas (the fossil fuels)
- petrol, diesel, kerosene (obtained from oil)
- things like wood and straw
- ethanol, an alcohol made from crops such as wheat and sugar cane.

We burn all of those things as fuels. Look at these examples.

1. All over the world, we burn coal, oil and gas in power stations, to make electricity for our homes.
2. At home, we also burn gas for heat and cooking. And some people like coal fires.
3. We burn petrol and diesel in car and bus engines.
4. Some cars use a mixture of petrol and ethanol.
5. We burn kerosene in plane engines.
6. Many people in poorer countries use wood as their main or only fuel.

So carbon dioxide is produced in each case.

Different countries, different amounts
All countries pump carbon dioxide into the air, by burning fuels that contain carbon.

But the amount varies a great deal from country to country.

Look at this bar graph. It shows the average amount of carbon dioxide produced per person, in different countries, in 2004. Look at the differences.

Can you guess why a person in Kenya produces so little, compared with a person in the UK?

The figures change from year to year. They are rising fast for China and India, because these countries are developing fast. Lots of new factories are being set up. More and more people are buying cars, washing machines, computers …
The trouble is ...

The trouble is this ...

When we burn fuels containing carbon, the carbon dioxide gas goes into the air. But it does not hang around in one place for long. It is carried away by winds, and spreads through the lower atmosphere. So its warming effect is felt everywhere.

The result is that people in poorer countries, who burn far less fuel than we do, still suffer from the effects of global warming.

Local actions, global effects

So, when you leave the light on in your room, or the TV on standby, you may be affecting someone far away, on the other side of the world. It's an example of local actions, global effects.

People in poorer countries may not be able to cope with the disasters global warming will bring: like floods, and drought, and crop loss. Coping with these could cost billions.

Did you know?

- Oil, coal, and gas together provide about 80% of the world's energy.

Your turn

1 How much do you depend on burning fuels?
   Let's explore.
   a Things I do on a typical school day
      get up
      turn light on
      take shower
      dry hair
      eat cornflakes
      catch bus to school

      Make a list like this for your typical school day.
      Fill in the main things you do.
      (Do you phone a lot? Or go on the computer?)
   b Now underline any activities that depend on burning fuels. Think carefully!
      (For example, turning the light on links you to a power station, where a fuel is burned.)
   c Look at the things you underlined. Where is the fuel burned? Mark the ones where it's burned:
      i where you are (for example, gas in your home)
      ii somewhere else (for example, in a power station)

      Mark them in any way you wish. You could use * and **, for example. Then add a key to explain.

2 Look at your list. Do you depend a lot on burning fuels?
   Draw a scale like this, and mark an X on it, for you.

   How much do I depend on burning fuels?
   1 2 3 4 5
   not at all quite a lot for everything

3 Look at the bar graph on page 76.
   a Which of the nine countries produced most carbon dioxide per person, in 2004?
      See if you can explain why.
   b Which produced least? Try to explain this too.
   c About how many times more did a person in the UK produce, than a person in China?
   d In 2004, China had 1300 million people. The UK had 60 million. Using the bar graph, see if you can work out a rough figure for the total output of carbon dioxide that year for:
      i China  ii the UK

4 Copy and complete these sentences:
   a 'Local actions, global effects' means ...?
   b The burning of fossil fuels is an example of 'local actions, global effects' because ...
So can we stop global warming?

In this unit you'll find out whether we can stop global warming. And if we can't – what can we do?

Can we stop global warming?

No.

We can't stop global warming. Not even if we stop burning fuels right now. The extra carbon dioxide in the air already will cause temperatures to rise by at least 1 °C.

But we can try to reduce the amount of carbon dioxide we produce, to limit temperature rises. It's the best we can hope for.

So, what are we doing? We are burning more fuels than ever. So we are producing more carbon dioxide than ever. So global warming is speeding up.

And here is the big worry. As the world heats up we will reach tipping points, when things suddenly get far worse.

For example, if it gets hot enough, trees will die. So they will stop taking in carbon dioxide. On decay, they will give out carbon dioxide. Its level will shoot up even faster.

And then, one day, it may be too late. Temperatures could rise out of control. Climates would change drastically. Living things could not cope. We would not recover.

We must take urgent action now. What are we waiting for?

From science reports, 2008

So what are our options?

Here are some options. What do you think?

A. Do nothing. Just carry on as we are.
B. Find ways to take carbon dioxide out of the air.
C. Cut back on the amount of carbon dioxide we each produce.
D. Stop some sunlight from reaching the Earth.
E. Stop the world's population growing.

What if...

- it got so hot that all the rainforests died?
- most of our planet got too hot to live on?
Your turn

1. Look at the graph on page 78. It shows world carbon dioxide emissions from burning fossil fuels.
   a. What does emissions mean?
   b. Is this true or false? Give evidence from the graph to back up your answer.
      i. Emissions are rising.
      ii. Emissions are rising faster than ever, since 2000.
      iii. About 5 times more carbon dioxide was emitted in 2000 than in 1950, from burning fossil fuels.

2. Look at each fact below, in turn. Could it help to explain why carbon dioxide emissions are rising? Give reasons.
   a. The world’s population is rising fast.
   b. Many countries that were once very poor are now developing quite fast.
   c. Flights are getting cheaper and cheaper.

3. Think about the options at the bottom of page 78.
   a. Which one do you think is the best?
   b. Which one do you think is the worst?
   c. Write them out fully, in your chosen order, from best to worst.

4. Now give reasons for the order you chose. Like this:
   I put option .... first because ..................
   I put option .... second, because ...........

5. Look at the first photo above. Which option from page 78 have those people chosen?

6. These actions could help to slow down global warming.
   1. Give out free bikes to everyone.
   2. Build more windfarms, for electricity.
   3. Breed plants that will gobble up carbon dioxide.
   4. Don’t turn on the heating. Just put on warm clothes.
   5. Put big taxes on air travel.
   6. Allow homes to have electricity for only 6 hours a day.
   7. Shut down all power stations that use coal, oil, or gas.
   8. Turn off all the town and city lights at night.
   9. Find a way to bury carbon dioxide under the ocean.
   10. Pass a law that women can have only one child each.
   11. Ban international events like the Olympic Games.
   12. Shoot millions of small mirrors into space, to reflect some sunlight away.

   a. Match each action to an option from page 78, using a table like the one on the right.
   b. Which actions above depend on:
      i. scientists?
      ii. the government?
   c. Which two do you think would cause most protest from people? Why?
   d. Which two would you choose first, if you were in charge? Why?

7. Now write a list of things you can do on your own, to help limit global warming. Your answers for question 1 on page 77 may help.