4 Ecosystems
The big picture
This chapter is about ecosystems. These are the big ideas behind the chapter:
- An ecosystem is made up of plants and animals, and their non-living environment (air, water, soil, climate, and so on).
- The Earth can be divided up into large ecosystems, each with its own kinds of plants and animals.
- Climate is the key factor that makes these ecosystems so different.
- Ecosystems are fragile. So we must watch out, or we'll destroy them.

Your goals for this chapter
By the end of this chapter you should be able to answer these questions:
- What do these terms mean? vegetation ecosystem biome decomposer nutrient
- Where on the Earth is the rainforest ecosystem, and what is its climate like?
- In what ways have plants adapted to living in the rainforests? (Give four examples.)
- How and why are we humans destroying the rainforests?
- What is the link between rainforests and global warming?
- Where on the Earth is the tundra ecosystem, and what is its climate like?
- In what ways have plants and animals adapted to living in the tundra? (Give three examples for each.)
- The tundra ecosystem is under threat. What threats does it face? And which one will affect us all?

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

Your chapter starter
Look at the photo on page 52. What is that creature?
Do you think you'd find one like it, near you?
Can you think of a way its colour may help it?
How might those big eyes help it? And those big feet?
Name some animals that do live wild, near you.
Climate and ecosystems

In this unit you will learn what ecosystems are, and how they relate to climate.

Climate regions
The Earth can be divided into regions with different climates.
Page 50 has a map of them.
And these photos are from four of them.

This is a **hot desert**, in the hot dry climate region.
What do you notice about the vegetation (plants)?
What is that strange animal?

Does this look familiar? It is **deciduous forest**, in the climate region with warm summers, mild winters, and rain all year. That’s the region we live in.

**Tropical rainforests** are found in the hot wet climate region – where it is hot and wet all year.
Animals such as monkeys and parrots live here.

This shows **tundra**, in the cold dry polar climate region. The soil below the surface is always frozen.
What animal is that?
They are all ecosystems

The photos on page 54 show four different ecosystems. An ecosystem is a natural unit made up of:

- living things (plants and animals) and
- the surroundings or environment they live in – the air, water, soil, and the climate (how warm or wet it is).

A pond is a tiny ecosystem. A tropical rainforest is a large one.

There are tropical rainforests in over 80 countries. Together, they make up a very large ecosystem. All the hot deserts make up another, and so on. These very large ecosystems are often called biomes.

Why are they so different?

The ecosystems in the photos all are very different – because of the climate. Look at this diagram:

The climate

Climate is the driving force in an ecosystem.
The climate affects …

<table>
<thead>
<tr>
<th>the soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>How thick and rich the soil is depends partly on the climate. Rock breaks down fast into soil in a hot damp climate.</td>
</tr>
</tbody>
</table>

which influences …

<table>
<thead>
<tr>
<th>the vegetation (plants and trees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>It adapts to suit the climate and soil. It grows fast and thick in a hot damp sunny climate, and slowly in a cold dry one.</td>
</tr>
</tbody>
</table>

which influences …

<table>
<thead>
<tr>
<th>the animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>They adapt to cope with the climate, and to feed on the plants, or each other.</td>
</tr>
</tbody>
</table>

So everything in an ecosystem is linked. The plants and animals depend on each other – and on the environment.

You can find out more about two of those ecosystems – tropical rainforests, and tundra – in the rest of this chapter.

Your turn

1. Choose one photo from page 54. Imagine you are there. What’s it like? You can answer like this:

<table>
<thead>
<tr>
<th>I can see …</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can hear …</td>
</tr>
<tr>
<td>I can smell …</td>
</tr>
<tr>
<td>I feel …</td>
</tr>
<tr>
<td>I would like …</td>
</tr>
</tbody>
</table>

2. Explain what this term means. (Glossary?)

a. ecosystem  
b. environment  
c. adapt  
d. biome

3. Look at these two climate graphs. They match two of the ecosystems on page 54.

a. One is for the deciduous forest ecosystem. Which one?

b. Which ecosystem does the other graph match?

4. The living things in an ecosystem depend on each other, and on the environment. See if you can give an example. (One student thought of squirrels/trees/soil.)
The tropical rainforests

Here you'll see how the rainforests grew, and adapted to a hot wet climate.

**The Earth's richest ecosystem**
Vegetation grows well in hot damp places – like tropical rainforests! There you'll find thousands of species of trees and plants. And thousands of species of insects and other animals, that live in them.

**The vegetation**

**Four layers**
The trees and plants of the rainforest form four layers:

1. **the emergents**
   These are the tallest trees, up to 60 m tall.

2. **the canopy**
   It's the thickest layer, where most of the animals live.

3. **the under-canopy**
   It has young trees, shorter trees, and bushes.

4. **the shrub layer**
   Here you find ferns and other plants that grow close to the ground.

**Adaptations**
The vegetation has adapted to get sunlight, and protect itself. Look at these examples.

A. The **emergents** reach sunlight by growing tall.

B. Thick vines called **lianas** reach sunlight by looping around tree branches.

C. Plants called **epiphytes** just perch on high branches. They feed on rain, and nutrients from rotting leaves.

D. Here in the shady shrub layer, plants grow large leaves with lots of chlorophyll, to trap as much sunlight as possible.

E. The tallest trees have big strong **buttress roots**, to stop themselves falling over.

F. Roots don't grow deep into the soil. They spread out near the surface. This way, they can quickly take up the nutrients from dead leaves and animal droppings. (These nutrients are released by the worms and other decomposers.)

**The soil**
The soil is deep. But only the top few inches are much good. Here's why.
When dead leaves and animal droppings fall to the forest floor, they are quickly broken down by insects, worms and bacteria (decomposers). This releases **nutrients**. These are quickly taken up by plant and tree roots, before they can soak deep into the soil.
The animals

Millions of different kinds of animals live in the rainforest. Here are just three:

**The emerald tree boa.** It can grow over 2 m long. At night, it hangs from a branch to catch its prey: rodents, lizards, and small birds.

**The sloth.** Its strong claws allow it to hang from branches. Its hair is filled with green algae (tiny plants) to help it hide among the leaves.

**The toucan.** This bird lives high in the canopy. Its beak helps it feed on fruit, seeds, and berries. It has a loud call, that scares enemies.

Biodiverse

The rainforests are our most biodiverse ecosystem — they have the biggest variety of living things. They cover less than 7% of the Earth’s land, but hold over half the known species of plants and animals. They’re jumping!

Full of treasures

Rainforests gave us fruits like bananas and pineapples. And thousands of medical drugs. Aspirin is a copy of a chemical from a rainforest plant. Many cancer drugs come from rainforest plants. Scientists have studied only a tiny % of rainforest plants, so far. They hope to find many other useful drugs.

Your turn

1. What do you think is the best thing about rainforests?
2. Copy and complete. The glossary may help for some.
   a. The emergents are …
   b. Many leaves have drip tips so that …
   c. Nutrients are substances that …
   d. Roots grow close to the soil surface so that …
   e. The emergents have buttress roots so that …
   f. The plants on the forest floor have dark green leaves all year round so that …
   g. Decomposers are …
   h. Most insects and animals in the rainforest live in the canopy, because …
3. The drawing on the right shows part of a rainforest.
   a. Make a large copy of it. Then copy each sentence from below the drawing into the correct box.
   b. When the trees are cut down, the soil soon becomes useless. See if you can explain why.
4. Do you agree with this person? Explain.
   - Rainforests? Nothing to do with me!
What are we doing to the rainforests?

Here you’ll find out how we are destroying the tropical rainforests.

First, where are they?
The tropical rainforests are in the tropics. (Easy!)
Over 80 countries have some tropical rainforest. But just 10 countries have the giant share: nearly 80% between them.

What's happening to them?
For thousands of years, the rainforests were barely disturbed. The humans that lived in them gathered fruit, and fished, and hunted wild animals. But they did not harm the forests.

Now we are destroying them fast. In ways like these:

- Large areas are being burned, to clear land for farming. Some by poor farmers, to grow food ...
- ... and some by big companies, to set up cattle ranches, or oil palm plantations, to make money.
- Logging companies are big culprits. They cut down trees for timber, for things like furniture and doors.

About half the Earth’s tropical rainforest has now gone – about 8 million square km. That’s an area nearly the size of the USA. Much of it went in the last 50 years. And what's left is in danger.

Read on, to find out about the rainforest in Indonesia.

Indonesia’s rainforest at risk

Look at this photo. Great furniture. Soon, when the guests arrive, great food will be served. And it’s another little nibble from Indonesia’s rainforest.

Logging is rampant in the rainforest there. Some has a licence from the government. But much is illegal. The wood is used for things like furniture, and doors, and windows. Some finds its way to the UK.

The loggers target just the trees they want. But when a huge mahogany or maranti tree is cut down, several others crash down with it.

Logging is not the only link with the photo.

Rainforest is also being cleared to make way for oil palm trees. Their fruit gives palm oil – and we can’t get enough of that. It is used as cooking oil, and in bread, cakes, chocolate, candles, soap, and detergents, for a start.

Now palm oil has another use: as a biofuel. It is being added to diesel, in diesel engines … to help in the fight against global warming.
Once it was rainforest, full of different plants and animals. Now it’s an oil palm plantation.

You’ll find orangutans in the rainforest on two Indonesian islands. And nowhere else in the world! So they are in danger.

Your turn

1 The map on page 58 shows where the rainforests are.
   a It is hot in those places. Why? (Page 48?)
   b It rains heavily in the afternoons, in the rainforests. See if you can work out why. (Page 38 may help.)
   c Europe has no tropical rainforests. Why not?

2 The top 10 rainforest countries are: Brazil, the Democratic Republic of Congo, Indonesia, Peru, Bolivia, Angola, Venezuela, Papua New Guinea, Mexico, India.
   a Make a table with headings like this:

   The top 10 rainforest countries
<table>
<thead>
<tr>
<th>Country</th>
<th>Continent</th>
</tr>
</thead>
</table>

   b Then fill in the countries and their continents. See how many you can do without looking at the map on pages 140 – 141.

3 The bar graph on the right shows how fast the rainforest is being destroyed.
   a Which continent is losing its rainforest fastest?
   b What overall trend does the graph show?

4 There may be a link between the crisps you buy, and rainforest loss. See if you can draw a strip cartoon like the one started here, to show it. (Up to 7 boxes okay.)

5 Now find Indonesia on the map on pages 140 – 141. (It’s near Australia.) Give five geographical facts about it, using the map to help you.

6 These are opinions from four Indonesians. Choose at least two of them, and write replies.
   a Why worry? They are just trees. It doesn’t matter if we cut them down.
   b You buy our wood and palm oil. And then you blame us for cutting down the rainforest. Hypocrites!
   c Indonesia is quite poor. We need to make money from our rainforest if we can.
   d You have cut down most of the forests in your own country. Why stop us?

Key

<table>
<thead>
<tr>
<th>Year</th>
<th>Africa</th>
<th>South America</th>
<th>Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960–1970</td>
<td>5.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
<tr>
<td>1970–1980</td>
<td>6.0</td>
<td>3.0</td>
<td>2.0</td>
</tr>
<tr>
<td>1980–1990</td>
<td>7.0</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>1990–2000</td>
<td>8.0</td>
<td>5.0</td>
<td>4.0</td>
</tr>
</tbody>
</table>
New hope for the rainforests?

Here you'll find out about a new scheme to save the tropical rainforests.

Protesting in vain
Some people have worried about the rainforests for years, and tried to save them. With little success, because ...

The poor farmers deep in the rainforest, slashing and burning it, don’t care. They need land to grow food for their hungry families.

The rainforest countries are mostly poor. They can earn money by selling things like timber and palm oil, to the rich countries.

And meanwhile, we in the rich countries keep on buying things that are linked to the destruction of the rainforest.

For example, Indonesia is quite poor. It owes 59 billion dollars to other countries. It wants to sell as much timber and palm oil as it can, to pay off its debts.

But now… global warming
The air all around the Earth is getting warmer. We call it global warming. Most scientists blame carbon dioxide. This gas forms when we burn coal, oil, gas, wood, and anything else that contains carbon. Then it acts like a blanket around the Earth, keeping heat in.

Global warming is already causing more storms, and floods, and droughts. It will mean disaster for many people. (Find out more on page 73.)

What has it got to do with the rainforests?
Plenty!

Trees take in carbon dioxide from the air. It’s the starting point for all the things they need, to grow.

But if they are burned, to clear the ground for farming or ranching, carbon dioxide is given out again.

And if they are chopped down, the stumps and roots rot. This process gives out carbon dioxide too.

So the rainforests are like a giant store of locked-up carbon. Destroying them releases carbon dioxide. That helps to speed up global warming. So we will all suffer.
A new approach to saving the rainforests
Now there's a new approach to saving the rainforests. Read on!

At last, a happy rainforest story
'It's brilliant' said the minister from the Indonesian government.
'We rainforest countries got together, and came up with a great plan.'
'We have been destroying our rainforests for years. Mostly because
you rich countries want timber and stuff - and we need the money!'
'But with global warming, we will all suffer. Rich and poor. And they
say cutting down the rainforests is making it worse.'
'So here's the deal. We will protect our rainforests from now on. But
you rich countries must pay us to do it.'
'It's only fair. You cut down your own forests centuries ago, for wood
for industry, and to make room for cities and farms. Now you want
us to keep our rainforests, to slow down global warming. We will be
happy to do it, sure. But you will have to pay.'

First payment agreed
In fact the first payment to Indonesia has been agreed already.
The state of Aceh will receive $26 million, over five years, for
protecting two million hectares of rainforest.

Most of the money will go to local villages, for things like schools.
and health centres, and sustainable farming. But only if they can
prove that trees are not being cut down.

So forest wardens, and satellites, will be watching.
From news reports, January 2008

Your turn
1 What is global warming? Why is it bad news?
2 Copy and complete:
a Carbon dioxide is ...
b Rainforests take in carbon dioxide for ...
c Rainforests give out carbon dioxide when ...
d The more carbon dioxide there is in the air ...
3 You are the man in photo A. They offer you money
to look after the rainforest, not cut it down.
How do you feel about that? Tell us!
4 Satellite images can be used to guard the rainforest.
F is a satellite image. It shows part of a rainforest.
See if you can work out what these are:
a the thick brown wavy line
b the dark green area
c the lighter green area
d the other brown shapes
e the white fluffy things
5 You live in Aceh, in Indonesia. You are in charge of
protecting the rainforest. How will you do it?
Photos D, E and F may give you ideas. Try to think of
others too. Then write an action plan, as bullet points.
6 Oil palms grow fine on worn-out land. Farmers don't
need to chop down rainforest.
a Name your favourite sweets (or crisps, or biscuits,
or soap, or shampoo).
b They almost certainly contain palm oil. How would
you feel if rainforest was cut down for it?
c How could you check?
7 Suppose all the rainforest countries are paid to protect
their rainforests. Name all the groups who will benefit.
(Will animals benefit? Will you?)
The Arctic tundra

Here you will find out what, and where, the Arctic tundra ecosystem is — and how living things have adapted to living there.

What is the Arctic tundra?
The Arctic tundra is the ecosystem that lies up around the North Pole:

What is it like there?
- Winters are long, cold and dark. The average temperature is around –30 °C. By mid-December it is dark all day.
- Summers are very cool (3 to 12 °C) and short, but with long hours of daylight. By mid-July it is light for 24 hours a day.
- It is dry. There is less than 25 cm a year of rain or snow.
- There are harsh, biting winds.
- It is so cold that most of the soil is frozen hard all year. It is called permafrost. But the top layer thaws for 2 or 3 months every summer. Then plants grow quickly, covering it in a green carpet.
- There are no trees. Their roots can’t grow down into the permafrost.
- When it does rain, or the top layer of soil thaws, the water can’t soak away through the permafrost. So bogs, streams, and ponds appear in summer.

Plants of the tundra
The tundra is a harsh place. Even so, it is home to many species of plants and animals. (But not nearly as many as in the rainforests.)

Plants need warmth, and sunlight for photosynthesis. So how do they cope with the climate in the tundra? Like this:
- They have adapted to carry out photosynthesis at low temperatures, in low light — even when covered with snow!
- They grow low to the ground, and close together, for protection from the cold and wind.
- The growing season is short, so they grow fast. Some send out underground stems or runners that sprout new plants, instead of waiting to form flowers and seeds.
Animals of the tundra

The animals of the tundra include:

- **carnivores** or meat-eating animals, such as brown bears and Arctic foxes
- **herbivores**, such as musk ox and reindeer (caribou), that feed on plants
- birds and insects.

Here are some ways animals have adapted to the harsh climate:

- Many have a thick outer coat of coarse waterproof fur, to keep them dry. And an inner coat of fluffy hair to trap heat.
- Many build up a thick layer of fat, ready for winter.
- Short legs, tails and snouts help to cut down heat loss.
- Some move in the winter. The birds fly south to warmer climates. Reindeer move to where they can find lichen, their winter food.

Look at these examples:

- The brown bear has a thick coat. It grows a thick layer of fat for winter. It digs a den and stays inside for the coldest months.
- Musk oxen have thick shaggy coats, with fluffy hair underneath. Short legs help to reduce heat loss. They huddle for warmth and safety.
- The Arctic fox has shorter legs, tail, ears and snout than British foxes, to reduce heat loss. Its thick coat goes white in winter, to help it hide.

**Your turn**

1. **a** Name five countries with tundra. (Pages 140 – 141?)
   **b** Which country has the world’s largest area of tundra?

2. This climate graph is for the town of Barrow, in the tundra in Alaska. (It is marked on the map on page 62.)
   **a** In which month does the top layer of soil start thawing?
   **b** Which months are the growing season for plants?
   **c** In which month are you likely to find most water in ponds and bogs? Explain.
   **d** In which month does all the permafrost thaw out?
   **e** In which months does snow fall?
   **f** Musk oxen dig under ice and snow for food, with their hooves. In which months do they need to do that?
   **g** Tundra swans leave the tundra in October, flying south. They are back again by mid-May. So what sort of temperatures are too low for the tundra swans?

3. **a** So why is it so cold in the tundra?
   **b** Why does it stay bright 24 hours a day, in July?
   **c** Why does it stay dark 24 hours a day, in December? Unit 3.9 will help, if you get stuck.
Humans in the Arctic tundra

Here you’ll learn about the people who live in the Arctic tundra, and what they do there.

Who lives there?
Bitter cold, biting winds, frozen ground, months of darkness. How could anyone live in the Arctic tundra? About 4 million people do!
There are two main groups of people:
♦ the indigenous people, whose ancestors have been there for thousands of years.
♦ descendants of people who arrived much later. (Lots of new people arrived in the last 30 or 40 years.)
The second group is about nine times larger than the first.

The indigenous people of the tundra

The first arrivals
The first people arrived in the tundra about 10,000 years ago. They were hunter-gatherers, like all our ancestors. There was plenty to hunt: woolly mammoth, reindeer, bears, musk ox, seal, walrus, and fish in the icy rivers. In the summers, they gathered berries and seeds.
They lived a nomadic life, always on the move. They lived in rough shelters. They dried meat and fish, to store for the winter. They wore animal skins and furs to keep warm.
Then, perhaps around 7000 years ago, they began to herd reindeer for meat and milk. They moved around with them, looking for pasture.

The indigenous people today
Today, about 400,000 descendants of those early settlers still live in the tundra. There are many different groups. (The list on the right gives some.) They all speak different languages.

A Nenets girl with her two puppies, outside her chum (tent) in the Russian tundra. Her family herd reindeer. When the reindeer have eaten all the grass under the snow, the tent is packed up, and the family move on.

Some indigenous people of the tundra
♦ In Canada and the USA:
  Inuit
  Inuvialuit
♦ In Greenland:
  Inuit
♦ In Scandinavia:
  Sami
♦ In Russia:
  Nenets
  Even
  Sami
  Selkups

Did you know?
♦ The indigenous people of the tundra find the term ‘Eskimo’ insulting.

A reindeer herder in the Russian tundra. One herder may look after over a thousand reindeer. The reindeer will be sold to meat factories.
How their lives are changing
Life is changing for the indigenous people.

- Many still live by hunting and fishing. But instead of sleds and spears they now go by snowmobile, use guns and fishing rods – and live in houses.
- Some still live in tents, moving with their reindeer. But they send their children to boarding school, to make sure they get a good education.
- Many live in tundra towns and cities. They may find work in factories, or on oil fields, or on fishing boats. (They often find it hard to get other work, because they did not spend much time at school.)

The later arrivals
Here are some of the later arrivals:

- In the 17th and 18th century, fur traders and trappers arrived, and missionaries, and whalers, and people looking for gold.
- People moved in to ‘run’ the tundra for their governments.
- In the last 40 years or so, oil and mining companies have arrived, looking for oil, and gas, and metal ores. The tundra is rich in these – and it has not all been explored yet.

Settlements in the tundra
Most people live in scattered villages, towns, and small cities.

Some towns started as trading posts, set up by the fur traders. They swopped things like knives, kettles, and alcohol, for animal furs. Then they sold the furs for high prices, back home in Europe.

Some started as fishing centres.

But the largest settlements grew because of oil, and mining. Norilsk, in Russia, is one of the largest tundra cities. (Population 130 000.) It began over 70 years ago as a prison camp, for prisoners sent to work in the nickel mines. It is still a centre for mining and smelting metal ores – and one of the most polluted cities in the world.

Your turn

1. The Arctic tundra covers an area of about 12 million square kilometres. About 4 million people live in it.
   a. Work out the population density there. (Glossary?)
   b. The population density in the UK is 248 people per sq km. Write a short paragraph comparing the population densities in the UK and the tundra. Make it interesting!

2. a. What does the term indigenous people mean?
   b. Name one tribe of indigenous people of the tundra.
   c. The indigenous people do not grow crops. Why not?

3. Look at the first photo on page 64. What do you think the family does for light, water, and heating?

4. Some things are much more difficult in the tundra than in the UK. See if you can say why this might be extra difficult:
   a. disposing of sewage
   b. building a new house
   c. going to school in winter
   d. mining
   e. being a police detective

5. You have just been offered a new job: working for a newspaper, in the Canadian tundra. The pay is good. Write an e-mail to your cousin, telling her about the job offer, and why you will / won’t accept it.
Tundra under threat

The tundra ecosystem is in danger. Here you'll find out why.

Under threat – from what?
The Arctic tundra is a harsh, frozen place. But it is also fragile. The ecosystem is in danger, thanks to …

- hunting
- extraction of oil, gas, and metal ores
- and, last but not least, global warming.

Hunting

Hundreds of years ago, hunters hunted just for the food they needed. But as the trade in fur and skins grew, more and more animals were hunted for these too. Some were hunted to danger levels.

Today, some tourists travel to the tundra to hunt, for sport. Small planes fly them to remote places.

At the same time, fishing boats trawl the seas off the coast, scooping up the fish that seals, polar bears, and other animals depend on.

Many species are now at risk, because their numbers have fallen so low. They include wolves, musk oxen, polar bears, grizzly bears, seals, sea lions, and walruses. So they are protected by law. You may be allowed to hunt some – but only if you buy a permit.

Extraction of oil, gas, and metal ores

The tundra is rich in oil, gas, and metal ores. And companies are keen to get their hands on them.

In Alaska, USA

Oil is big business in Alaska, USA. The oil fields are in the tundra. The oil is carried off by a pipeline called the Trans-Alaska pipeline. It is 1300 km long, and runs across the tundra to an ice-free port. (Look for Alaska on the map on page 140.)

Because of the permafrost, much of the pipe is above ground. Where it's buried, it is insulated, to make sure it does cause the permafrost to melt.

Oil leaks from the pipeline from time to time. People worry about this. And they worry that drilling might start in the Arctic National Wildlife Refuge, in Alaska. This area has oil, but is protected from drilling for now.

In Russia

In the Russian tundra, reindeer pastures have been taken over for mining, and oil and gas production, and new towns to support these.

The air, land, and water are polluted by toxic waste from mining and smelting. That's bad for the people and animals.

New roads are built on a thick layer of gravel, up to 2 metres thick, to stop the permafrost from thawing. That makes it hard for the reindeer to move around. All this is causing conflict with the reindeer herders.
The biggest threat of all: global warming
As you saw on page 60, the air around the Earth is getting warmer. We call it **global warming**, and it could destroy the tundra.

Most scientists blame carbon dioxide, from all the fuels we burn. They call it a **greenhouse gas**, because it traps heat around the Earth.

**The big thaw**

'It's a crazy house,' says Eva. 'Nothing straight. We tried propping it up but that didn't work. We're going to have to move out sometime soon.'

And indeed it does look crazy. The walls are tilted. Opening and closing doors is tricky. Put something in the cupboard, and it slides away.

Why? Because the permafrost under the house is thawing.

Scientists say much of the tundra permafrost will thaw, thanks to global warming. Homes, schools, hospitals, roads ... all will be affected.

**Melting ice at the coast**

The ice along the coast is melting too. So animals like the polar bears, that eat fish, have to swim further for their food. And they have less ice to live and breed on. Their numbers will fall even further.

**The news gets worse**

The permafrost is packed with dead, deep-frozen vegetation. When it melts, the vegetation will rot. If it rots near the surface, where there is oxygen, vast amounts of carbon dioxide will be released.

But if it rots deep in soggy ground, where there is no oxygen, methane will form instead. And methane is a much more powerful greenhouse gas than carbon dioxide.

Either way, the result is the same. Global warming will speed up. And give even more storms, floods, drought, and famine, around the world.

*From news reports, 2008*

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**Your turn**

1. Look at the first photo on page 66.
   a. How do you think the man is feeling?
   b. How do you feel about what he has done? Why?

2. Think about those three threats to the tundra. Then arrange them in order of importance, biggest threat first.

3. a. Do you agree with this person? Say why.
   b. Do you think they will stop? Give your reasons.

4. When permafrost thaws:
   a. some results are local. Try to give two examples.
   b. some results are global. Explain.

5. If the permafrost thaws deep down, lakes and ponds will disappear. The tundra will become very dry. This will be a disaster for the reindeer herders.
   a. Try to explain why lakes and ponds will disappear.
   b. Why would the tundra then become a very dry place? (Check out page 62!)
   c. Why would that be a disaster, for reindeer herders?