

THE ENVIRONMENT AND US

STUDENT'S BOOK



**A social science module in simplified
English for Myanmar adults**

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The Environment and Us was first written in November 2007. For this October 2010 edition, the Climate Change chapter (previously called Global Warming) has been revised to include important new information. All other chapters remain unchanged.

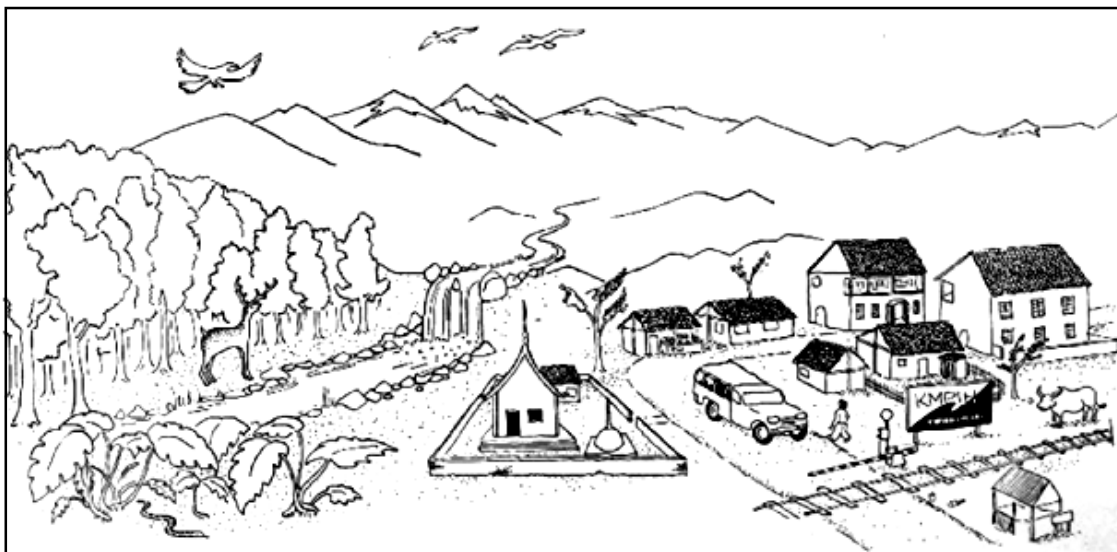
1. Introduction

Brainstorm: What is in your environment? Write down as many things as you can that are part of the environment around your classroom.

Environment is a huge idea. It is everything around us. When people talk about the environment, they are usually talking about the **natural environment**. The natural environment is the land, sea, air, water and all living things.

Towns and villages are also environments. Everything made by people is called the **built environment**. The built environment includes many things such as houses, computers and plastic bags.

What about ideas, knowledge, religion, beliefs and languages? This is called the **social and cultural environment**.



Activity: Look at this picture. List the things that are part of the natural environment. Now list the things that are part of the built environment. What do you think is part of the social and cultural environment?

Exercise: Put these words under the headings below.

an elephant, education, a television, a tree, a coconut, rain, Buddhism, Pa'an, the Bay of Bengal, planet earth, a bamboo pipe, a caterpillar, Kachin State, a water buffalo, soil, a village head, Mon language, Shwedagon Pagoda, a pencil, gold, electricity, a shark

natural environment	built environment	social and cultural environment
an elephant	a television	education

Discussion: What is more important to your community: the physical, built or social and cultural environment? What is less important? Why?
Can we survive without any of these environments?
What do we need to survive?

These different types of environments and everything in them are connected in many ways.

Activity: What are the relationships between the things in the table? Draw lines in the table between things that are related. What do you find?
e.g. *Bamboo needs rain, many rural schools are built of bamboo, education happens in schools*

Discussion:

If Mon language disappeared tomorrow, would anything change?
If frogs disappeared tomorrow, would anything change?
Would the earth survive if there were no human beings?

2. Waste

Key Words

waste (n) - things that are left after you use something, e.g. *If you smoke a packet of cigarettes, the empty packet becomes waste.*
to consume (v) - to use food, energy and resources.
to get rid of (v) - to throw away, send away, take out something you do not want, e.g. *Get rid of those smelly old shoes!*
population growth (n) - the increase of a population.
to decompose (v) - the breakdown of natural materials into the earth.
household (adj) - about a house where people live.
industrial (adj) - about using resources to make things people use like motorbikes. Industrial waste is the waste from industry.

Activity: List all the waste you have made in the past week. Is all the waste necessary? Does everyone in the class have the same amount of waste?

Waste is anything we do not want and therefore get rid of. An empty packet of noodles, a rotten banana, a broken glass bottle, and an old chair are all examples of waste. Every year, more and more waste is thrown away around the world. In many countries, there are mountains of waste. They are growing bigger every year. This is a threat to water and air. There are three reasons why waste is growing:

1. Population growth. The world population is growing every day. More people = more waste. But the amount of waste made is very different around the world. Rich countries make a lot more waste than poor countries.

- 2.** People are **consuming** more. We need to consume to live. But there is a big difference between needs and wants. We need rice and vegetables, some clothes and a dry place to sleep. But many people want cake, coffee, cigarettes, expensive clothes and televisions. This makes a lot of waste.
- 3.** A lot of waste does not **decompose** easily. This is because so much waste is unnatural. Many products are made from chemicals developed by science and technology, such as plastic and polystyrene. These chemical wastes can take a very long time to decompose. They pollute the soil, air and water.

Discussion: Is waste increasing in your community? Why? Are the three reasons for increased waste true for your community?

Types of waste

Household waste: Lots of the waste around your community is household waste. Household waste comes from things you consume every day like food. Now there are huge amounts of household waste in the world. This is a problem of consumerism. In rich countries, people consume a lot more than their basic needs. And a lot of their needs and wants are wrapped in plastic. In New York, a person makes more than four times the amount of household waste as a person in Yangon.

Types of household waste:

paper plastic glass wood food metal batteries

Industrial waste: In rich countries, more waste comes from industry than anywhere else. One reason for this is the growing demand for new things. Because consumerism is growing, industry grows to meet the demand. Industrial waste is more dangerous than waste from other areas because many industries use toxic chemicals. Every year, 300 – 500 million tonnes of toxic waste flows into rivers, lakes and the sea from industry.

Types of industrial waste:

chemicals plastic machinery computers
metal paper

Exercise: What are the main differences between household waste and industrial waste?

Discussion:

- What is the best way to get rid of household waste?
- Can you think of any problems with plastic?

☠ Plastic and POPs ☠

Key Words

POPs (n) – Persistent Organic Pollutants are dangerous chemicals that stay in the environment for a very long time.

dioxins (n) – a dangerous type of chemicals. They are POPs made by industries and by burning some plastics.

toxic (adj) – something that is dangerous and can make somebody sick or kill them.

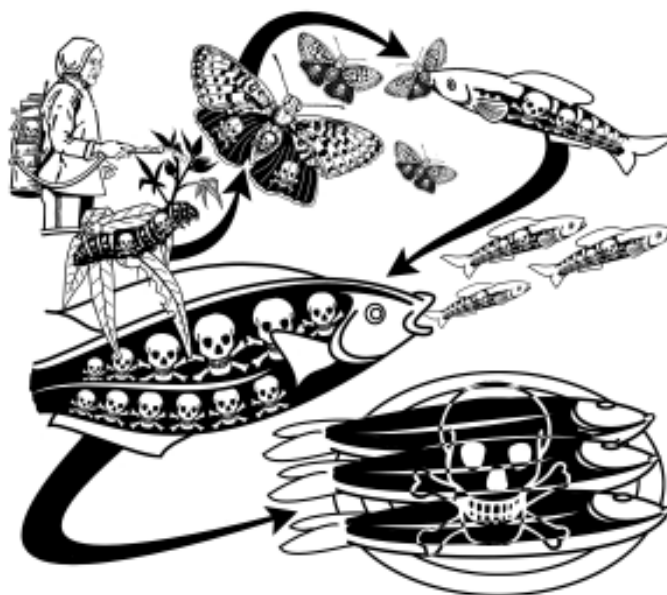
immune system (n) – the system in people's bodies that protects them from diseases.

A lot of household waste is plastic. Plastic is made to last for a long time. This is one of the reasons it is so popular. But this is also its biggest problem. When you bury plastic in the ground, it stays in the environment, slowly releasing the chemicals it is made from. Some plastics contain chemicals that never break down. They stay in the environment and can travel long distances. Chemicals from some plastics travel up the food

chain. These chemicals that stay in the food chain and in the air are called **POPs**. POPs are now banned in many countries in the world but they are still made in India and other Asian countries.

For example, when a person eats a chicken that has eaten chemicals that contain POPs, they are also eating those chemicals. This is a serious health problem. Plastic that has POPs in it can cause cancer and other health problems.

Exercise: What is happening in this picture? Talk about it in pairs.



Burning plastic is a lot more dangerous than burying it. When you burn plastic, dangerous chemicals are released into the air. Some of these chemicals can be POPs. This is a serious type of air pollution. People and animals breathe them in and they go into plants and the soil. Burning some plastics also creates

dioxins. Dioxins are some of the most **toxic** chemicals in the world. They are deadly for people. They can cause cancer and destroy people's **immune system**. They can also make it difficult for some people to have children.

Brainstorm:

- a) Make a list of things made of plastic.
- b) Then think of other things you can use instead of plastic.

Making Less waste: the five Rs

- 1. Refuse:** Don't take it. Don't make it. Consume things that don't make waste. Refuse plastic bags.
- 2. Reduce:** Make or use less. How can you make less waste? Ask shops to make things using less waste. Use other packaging - banana leaves or bamboo - instead of plastic.
- 3. Reuse:** Use it again in the same way. If you have plastic or other waste, keep it. Use it again and again. Take it with you when you go shopping. Use bottles and cans again and again.
- 4. Return:** Give it back. If you take plastic bags or other waste, give it back to the shop when you've finished with it. Ask the shop to reuse it.
- 5. Recycle:** Make something new. Look at the waste you've collected over the week. Can you make anything new with it? Be creative. When you use old clothes for cleaning, you're recycling. Instead of throwing things away, try and recycle waste.

Activity: How can you make less waste in your community? Use the five Rs to think of things people can do to make less waste. Put your ideas on a poster.

Case study: Rubbish Recycling Programme

Aung Ko is the programme coordinator:

"We had noticed a lot of plastic lying around the village. In 2000 we had a discussion about it. In our village, it is difficult to get the materials to make rope. Traditionally, people make rope from the bark of a tree, but this type of tree does not grow everywhere. So people make rope from plastic or nylon - old mosquito nets, scraps of cloth to weave into rope. So we thought we could use all the plastic around the village. So we started this project."

Activity: Look at these pictures. Guess what they are and what they are made from.



Activity: Now match these explanations with the correct picture.

- a) "We get plastic bags, and iron them flat. Then we cut them into strips and weave them to make rope."
- b) "We also make baskets by this method."
- c) "One type of fence we make from 1 litre plastic oil bottles. Bamboo fences last only one or two years. Plastic fences last for hundreds of years."
- d) "The fish can fences don't last as long as the plastic ones. But they last longer than wood or bamboo fences."
- e) "We also use plastic bottles to make windows."
- f) "We can use large metal tins to protect water pipe taps from small children. The children like to turn the taps on, which wastes water. We make locked covers for the taps from these tins."
- g) "We cut up large plastic petrol drums and use them as lettering on signs."

Discussion: How does the Rubbish Recycling Programme benefit the environment? How does it benefit the community?

Activity: Make something out of rubbish. Collect rubbish from your community and try and make something useful out of it.

Review:

1. What is waste?
2. What types of waste are there?
3. What are some of the problems with waste?
4. What are some solutions?
5. What are POPs? Why are they dangerous?



3. Ecosystems, biodiversity and resources

Key Words

ecology (n) - the science of how everything in the environment is connected.

interaction (n) - how things relate to each other.

interdependence (n) - things needing each other to survive.

ecosystem (n) - a system made up of an interdependent community of living and non-living parts of the environment.

to adapt (v) - to change to fit into a different situation or environment.

energy (n) - power for things to live and move.

species (n) - a grouping of animals or plants that can breed together, e.g.

Tigers are a species of cat.

coral reef (n) - an environment under the sea in shallow areas near land, where there are many different species.

habitat (n) - the environment where a plant or animal lives.

extinction (n) - when a species of plant or animal is destroyed forever.

dinosaur (n) - a type of animal with cold blood that lived from 230 to 65 million years ago.

mammal (n) - a group of animals that drink milk from their mothers breast when they are young, e.g. humans, dogs, pigs, bears.

reptile (n) - a group of animals with cold blood e.g. snakes, lizards.

amphibian (n) - a group of animals that can live in water and land, e.g. frogs.

What is an ecosystem?

People have only started to understand the relationships between things in the environment in the last few decades. This new science and way of thinking is called **ecology**. Ecology is about understanding how everything in the environment works together. A system with **interactions** and **interdependence** between living things (birds, trees, plants, elephants) and their non-living environment (rivers, mountains, valleys, rocks, chemicals) is an **ecosystem**. This can be as big as a rainforest or as small as a drop of

water. Ecosystems have a natural balance so many living things can survive together. Plants and animals live in an ecosystem because they have **adapted** to it.

There is no border between ecosystems. They often overlap - ecosystems are interdependent with each other. For example, a stream is an ecosystem. If it flows through a forest, it becomes part of a forest ecosystem. Earth is made up of many interdependent ecosystems.

Food webs

One way of understanding how ecosystems work is by looking at how living things get **energy**. When one living thing eats another, energy is being passed on. This link is part of a **food chain**. Animals higher up in the chain find it harder to get energy. This is because energy is lost as it goes up the chain. When food chains are put together, they make a **food web**.

Energy in a food web comes from the sun. Plants take energy from the sun and use it to change carbon dioxide (CO₂) into energy plant-eating animals can eat. CO₂ comes from the soil, water and air. Plant-

eating animals eat plants. Bigger meat-eating animals eat smaller animals. This is how energy gets used. Living things in a food web can either be **producers** or **consumers**. Producers are things at the bottom of the food web like plants. They produce energy. Consumers are things higher in the food web, like birds. They consume energy. **Decomposers** are things like mushrooms and worms. They eat what is left from dead animals and plants. They then put the energy back into the soil for plants to use again. Energy therefore goes through a food web in a circle. It is used over and over again.

Activity: What is happening in this food web?
 Label the different living things and decide whether they are producers or consumers. Make 5 sentences about what is happening in the food web.



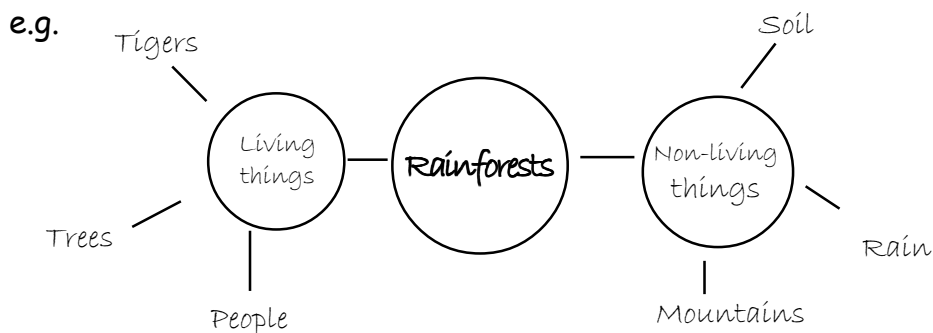
Activity: Make a food web about caterpillars.
 What would happen if all caterpillars were killed tomorrow?

Activity: Draw your own food web. Explore your local area and see how many living things you can find. A food web needs a plant, a plant-eater, an animal-eater and a decomposer. Are some living things more important than others?

Every living thing needs air and water so they are central parts of an ecosystem. When big changes are made to a river, such as building a large dam, an ecosystem can be badly damaged or even destroyed.

This is because all living things are interdependent with their non-living environment. Ecologists want all living things and physical environments to be looked after for the future of life on earth.

Mindmap: What types of ecosystems can you think of in Myanmar? Draw mindmaps in your book.



Biodiversity

Guess: How many different species are there on earth?

Biodiversity of species means the number of different species in an area. Biodiversity is richest in rainforests and **coral reefs**. There can be more than 3000 different species on one coral reef.

Biodiversity is being destroyed very quickly. This means life on earth is being destroyed. The main reason biodiversity is being destroyed is **habitat** loss.

Check the meaning

Biodiversity is richest in rainforests and coral reefs.

What does this mean?

- a) There are a lot of different species in rainforests and coral reefs.
- b) There are a lot of expensive things in rainforests and coral reefs.

Species per country

	Myanmar	Thailand	Bangladesh
Plants	7000	11,625	5000
Mammals	300	265	125
Birds	310	285	166
Reptiles	262	338	112
Amphibians	80	103	23

Many species of plants and insects in Myanmar have not yet been recorded.



Species **extinction** is now happening faster than at any other time since **dinosaurs** became extinct. Every day, 137 species become extinct. That adds up to 50,000 every year.

Biodiversity is important for people. We get medicine and food from plants and animals. Species are disappearing so quickly, we do not even know what we are losing.

Check the meaning:

Species are disappearing so quickly, we do not even know what we are losing.

What does this mean?

- a) We do not know that we are losing species because most people live in cities and towns.
- b) We do not know all the species that are being lost, what effect this will have on the earth and what scientific information the species can give us.

People are an important part of biodiversity. They are the only species that can change and destroy the environment in a large way. They are also the species that can care for the environment. Some people think the environment needs protection from people, but

people are an interdependent species within ecosystems. They can help protect biodiversity. Many communities have been protecting biodiversity for thousands of years. Maybe the problem is how communities choose to live and use the environment.

Exercise:

- a) How is biodiversity important for your community?
- b) What are the main causes of extinction?
- c) What are some things you can do in your community to help protect biodiversity?

Natural Resources

A natural resource is something people take and use from the physical environment. Examples are water, iron, animals and trees. Rivers are important natural resources. If communities use a river to get water for cooking and cleaning, that river is a resource. How people use natural resources is one of the most important environmental issues. **Natural resource management** is the way resources are used, who uses them and how they are looked after.

Renewable resources are things that grow back or reproduce like plants, animals, water and wind. Some renewable resources are in danger because

they are over-used. Many forests are dying because too many trees have been taken from them. They do not have time to grow back. This can also change or destroy the ecosystems they are part of. When people destroy an area of forest to grow food, all of the animals living in the forest need to go somewhere else to find food, water and shelter.

Non-renewable resources never grow back. Once non-renewable resources are taken from the earth, they cannot be replaced. Important non-renewable resources are oil, coal and natural gas.

Brainstorm: What natural resources are there in your community?
Which are renewable and which are non-renewable?
What are the three most important resources in your area.
Are any of these in danger from being used too much? Why?

Review:

1. In your own words, explain *interdependence*, *ecosystem* and *biodiversity*.
2. Give an example of an ecosystem in your local area and what it contains.
3. Explain one thing people can do to help protect biodiversity.
4. What are renewable and non-renewable resources?
5. List 5 natural resources in your community.

4. Water

Key Words

sustainably (adv) - using something in a way that allows it to be used again and again into the future.

polluted (adj) - dirty.

freshwater (n) - water without salt.

wetlands (n) - area of land that is always flooded and has special plants and animals.

body of water (n) - place where water is found, e.g. sea, lake, river.

Water is one of the world's most important resources. Every living thing needs water to survive. Water is all around us: in the sky, the soil, our bodies and the many rivers, lakes and oceans of the world. Water is a renewable resource when used

sustainably. But in many places, it is not used carefully. As a result, lakes, rivers and oceans around the world are **polluted**, over-used and even dried up. The rich biodiversity in water-based ecosystems is under threat.

Discussion:

- a) *Water is the world's most important resource.* Do you agree?
- b) What do you and people in your community use water for? Think of as many examples as you can.
- c) What problems could you face if you do not have enough water?

Brainstorm: What are the main **bodies of water** in Myanmar?

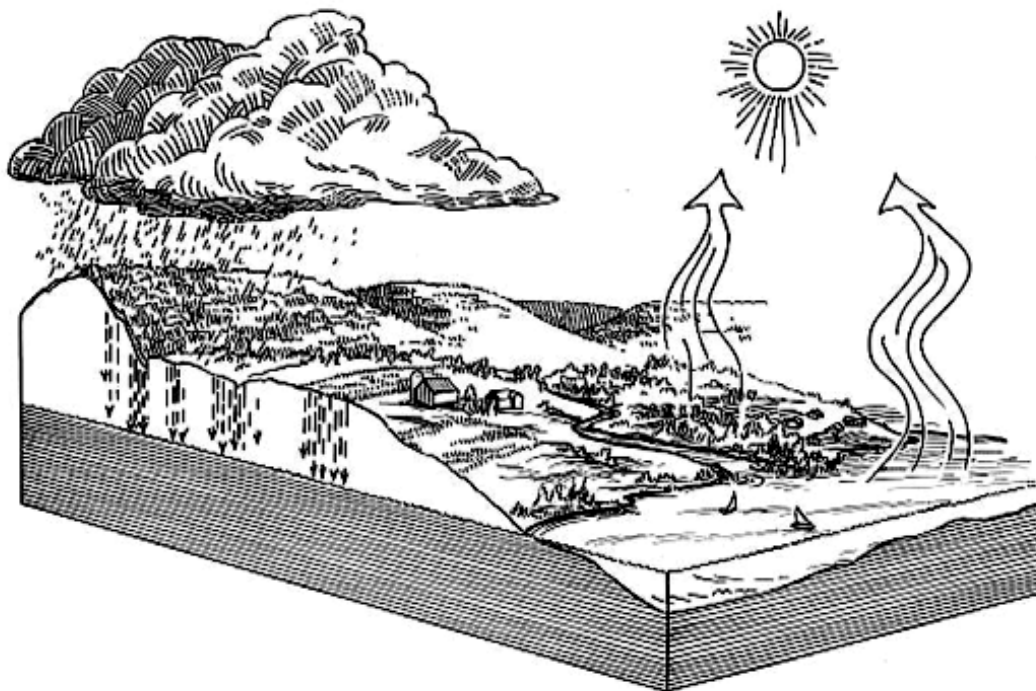
Water Facts: True or false?

<p>1. Water covers more than... a) 2/3 of the earth's surface. b) 1/3 of the earth's surface</p> <p>2. Out of all of the earth's water... a) 77.5 % is saltwater. b) 97.5% is saltwater.</p>	<p>3. How much of the world's freshwater is kept in rivers, lakes and wetlands? a) 0.01% b) 2.3% c) 0.1%</p> <p>4. The rest of the world's freshwater is kept... a) in the sea. b) in ice, snow and underground.</p>
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The water cycle

Water is always changing. The same amount of water always stays in the world but it moves around. It is sometimes liquid, sometimes solid and sometimes gas. The system of water moving and changing is called the water cycle.

When water turns into gas, it rises into the sky and becomes clouds. When it gets cold, it turns into rain and falls to the ground. Then it turns to gas and rises into the sky again. When rain falls, it flows into rivers and lakes. Rainwater keeps the world's freshwater systems alive.



Water is a renewable resource but only a limited amount of it is renewed each year in the water cycle. In Myanmar, 1046 km³ (cubic kilometres) of water is naturally renewed each year. This figure is the

amount of water that flows into rivers from rainwater and underground. If more water is taken than what is sustainable for a river system, rivers and all the species living with them are damaged.

Freshwater systems

- catchment** (n) - area of land that catches rainwater and puts it into rivers
(also called **watershed** in American English)
- downstream** (adv) - where the water in a river flows.

Freshwater supports all living things on the earth's surface. Land and water are connected in a natural system called a **catchment**. Catchments are the areas of land that support rivers, streams and lakes. They do this by catching rainwater and water from melted snow and draining it into rivers. Water flows downhill so catchments usually start on the slopes of hills or mountains. As water flows downhill, it gets faster and joins streams. These turn into big rivers like the Ayeyarwady, Chindwin or Mekong. Rivers like the Ayeyarwady have lots of catchments. Eventually rivers flow into the sea or lakes.

We all live downstream from someone and others live **downstream** from us. Catchments and rivers

are a system. If people in one village throw a lot of plastic into a river, villagers downstream might find it in their drinking water. If one village takes lots of water from a river, there might not be enough for villages downstream. This can be an especially big problem in the dry season.

Rivers do not stop at international borders. What happens to a river and its catchment in one country will effect all the countries the river flows through. Many rivers are international. The way rivers are used by communities can therefore be international issues. For example, the Mekong River catchment is 805, 604 square kilometres in six countries. It is an international river.

Research: What are Myanmar's international rivers? What other countries do they flow through? Where do they start? Where do they flow? Draw a map of one of these rivers.

Rivers, lakes and wetlands contain many different habitats with rich biodiversity. Myanmar's freshwater ecosystems are the home of more than 300 different fish species. Fish are an important source of protein for many people all over

Myanmar. But biodiversity of freshwater species is in danger. 20% of freshwater species in the world are now **endangered** or extinct. This is a much greater number than species living on the land or in the sea.

Activity:

- What species live in your local streams and rivers? List as many as you can.
- How can biodiversity in freshwater systems be protected?

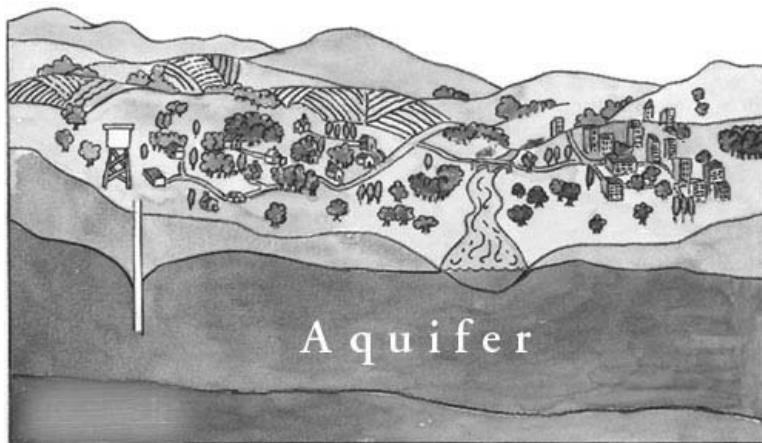
Groundwater

- groundwater** (n) - water that is underground.
- aquifer** (n) - a natural place underground where groundwater is stored.
Layers of rocks and minerals protect aquifers.
- pesticide** (n) - chemical that kills insects.
- fertiliser** (n) - chemical that helps plants grow.

Discussion: Where does the freshwater used by your community come from? Does drinking water and water for agriculture come from the same place? Is it used sustainably?

97% of the world's freshwater is stored underground. It is called **groundwater**. When it rains, water slowly soaks through the soil, rocks and minerals into huge underground storage systems called **aquifers**. Groundwater plays an important role in freshwater systems and the water cycle. Many of the world's rivers, lakes and streams are supported by groundwater. This includes very big rivers like the Yangtze. Groundwater is slowly released from aquifers over time and goes to the surface. It then mixes with rainwater and flows into rivers and streams. This is very important in the dry season. Without groundwater, some rivers would not flow all year.

Groundwater renews itself very slowly. Groundwater usually stays in aquifers for 1400 years. Water usually stays in rivers for only 16 days. So groundwater is a renewable resource but it has to be used carefully.



Groundwater is very important for people. All around the world, more and more people get their water from underground. In Asia, big cities like Jakarta and Dhaka rely on groundwater. 80% of people in India rely on groundwater for drinking. Most of the world's groundwater is taken for agriculture.

Another problem is pollution from chemicals. When we use **pesticides** and chemical **fertilisers**, these chemicals soak through the soil into groundwater. Because groundwater can stay in aquifers for so long, the chemicals stay there too.

Exercise: In your own words, explain three problems with groundwater.

Water crisis

Key Words

irrigation (n) - putting water on crops.

privatisation (n) - when governments sell industries or services to businesses.

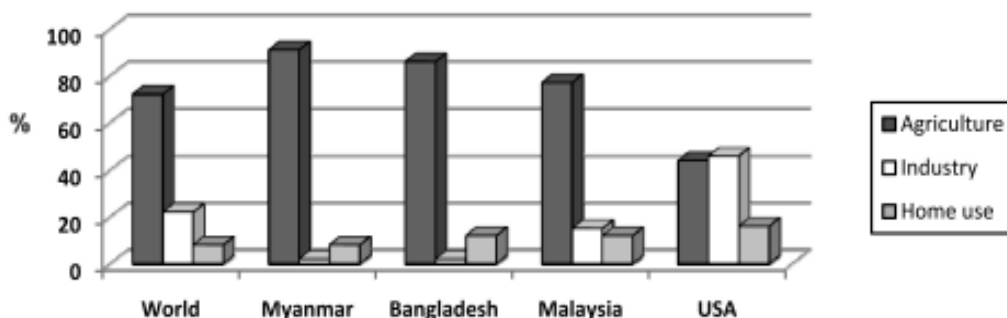
profit (n) - money you get by selling something. *Ma Ma bought a duck for 1000 kyat and sold it for 3000 kyat. She made a 2000 kyat profit.*

There is enough freshwater for three times the world's population if it is used carefully. But in many places around the world, people do not have enough water. This is a global crisis. The problem is how water is used and who has control of water. The way water is used is very unequal.

People need 30-50 litres of water every day. An average person in the USA uses 500 litres every day.

Most of the water in the world is used for agriculture. Industry also uses a lot of water. This is how water is used in the world:

People need 30-50 litres of water every day. At least 5 litres for drinking and cooking and 25 litres for washing and showering. But for many people this is not possible. An average person in Cambodia



Exercises:

1. What does the graph tell you about water use in the world?
2. What are the main differences between Myanmar and the USA?
3. Why are there differences?

Nearly all the water used in agriculture is for **irrigation**. Some crops use a lot of water. The amount is very different for different crops. How much water is used to grow the food you eat?

Water needed for 1kg of food	
potatoes	1000 litres
rice	3450 litres
chicken	4600 litres
beef	42,500 litres

Water used in industry	
1 tonne of newspaper	180,000 - 200,000 litres
1 car	450,000 litres
1 tonne of aluminium	1,340,000 litres
1 tonne of plastic	10,100,000 litres

Industry uses huge amounts of water.

Water use in industry is growing every year because industry is growing.

In some places, access to water is being made more difficult because of **privatisation**. All over the world, governments are selling their water companies to big businesses. Water is then sold back to local people for **profit**. Vandana Shiva is an Indian ecologist. She says the water crisis is caused by business and that business has no solutions to the problem. She says the problem is inequality.



Discussion:

1. What sorts of foods are best to save water?
2. How is water controlled in your community?
3. Is water used equally by different people in your community?
4. What are some of the reasons water access is not equal in the world? How many reasons can you think of?
5. Why does Vandana Shiva talk about inequality as a problem? Do you agree? Why/Why not?

Activity: Are there any stories about water in your local culture? Ask people in the community. Write down the story. Draw pictures too, if you like.

Key Words

Oceans

livelihood (n) - the way people get food and make money so they can live.

Brainstorm: Write down as many words as you can that are related to the ocean. Have you been to the sea? Can you describe it? If you have never been to the sea, what do you think it is like?

Most of the earth's surface is covered by oceans. Oceans are a very important part of the many ecosystems that support life on earth. Oceans control the world's weather. Most of the water that turns into gas in the water cycle comes from the ocean. So through the water cycle, oceans are very important for freshwater systems. People have many important relationships with the ocean. The ocean has been feeding communities and taking their waste for thousands of years. Like all ecosystems, the world's oceans and the life within them are very carefully balanced and sensitive to change. Even though oceans are so big, they can be easily damaged.

Many of the world's ecosystems are in oceans. These ecosystems are rich in biodiversity, just like ecosystems on the land. So far, we have information about 250,000 different species living in the oceans. Ocean biodiversity is richest in coral reefs. They are like rainforests of the sea. Southeast Asia's coral reefs have more biodiversity than all the world's coral reefs together. Most of Myanmar's coral reefs are in the Mergui Archipelago in Southern Myanmar.

Coral reefs are important to people because they provide food, medicine and natural beauty. Because many people in Myanmar and Southeast Asia live near the coast, coral reefs are important for local culture and **livelihoods**.

Discussion:

1. How is your community connected to the ocean?
2. Does your community benefit from the ocean?
3. Why are coral reefs important?

Fish and fishing

Key Words

overfishing (n) - when too many fish are being caught.

fishery (n) - place where fish are bred for business.

diet (n) - what people mostly eat.

fisher (n) - a person that catches fish.

trawler (n) - a fishing boat that uses a big net.

Fish are one of the ocean's great renewable resources. They provide the main source of protein to more than one billion people. But like other renewable resources, they have limits. Now many fish species are taken out of the sea faster than they can be replaced. This means their numbers fall every year and they are in danger of extinction.

Limited numbers of fish + too much fishing =
overfishing

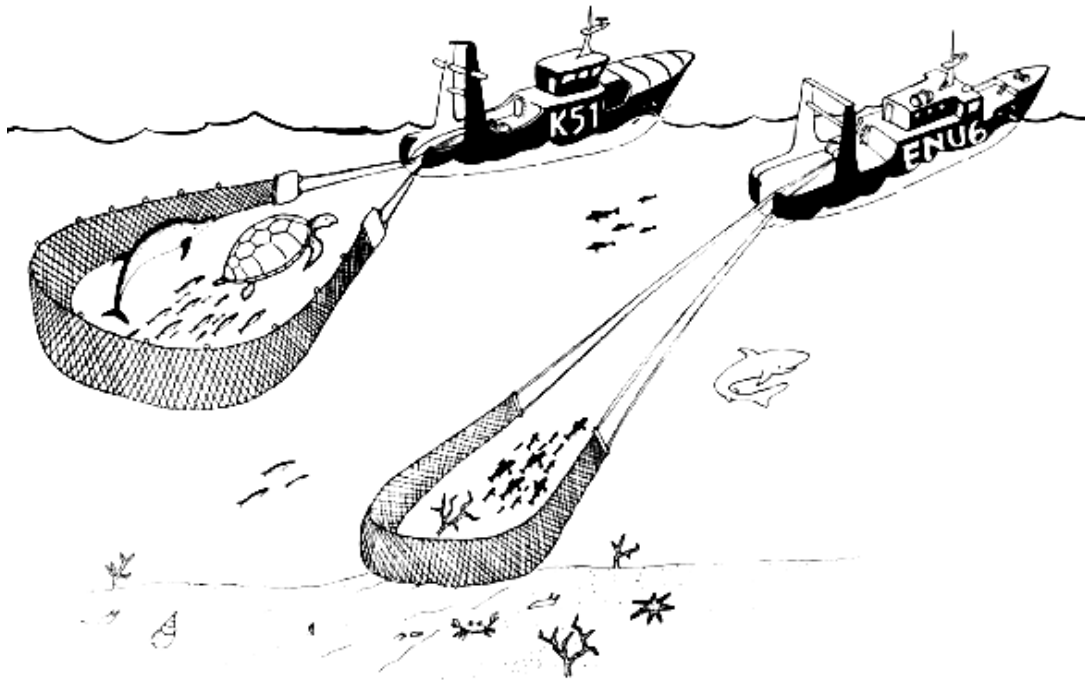
Over 70% of the world's **fisheries** are fully fished or overfished. Fishing needs to be sustainable. All through history, people have fished and fish are important for people's **diets**. But now a lot of fishing is for big business trying to make a lot of profit. Fishing used to be done on a small scale for families and communities. Now a lot of fishing is done for export overseas and is worth billions of dollars every year. Big businesses catch many more fish because of new technology.

This is because of the new technology Japanese **fishers** use. They have computers to find where fish are, and freezers so they can go far into the ocean for a longer time without their fish going rotten. Some fishers use dynamite. They put it into the sea and the explosion brings fish to the surface. Many fishers use **trawlers**. They are boats that drag huge nets through the sea catching all the fish in an area.

Some trawlers looking for shellfish pull up everything on the bottom of the sea, including coral and other plants. A lot of coral reefs are destroyed by trawlers. A big problem with trawlers is that they catch everything. Fisher might be only looking for two or three types of fish but their nets catch birds, turtles, dolphins and many fish species that the fishers do not want. Most of these species die and become waste. This is a common example of a destructive fishing technique.

In 1995, 301,000 Japanese fishers caught 6.7 million tonnes of fish.

In India, 6 million small-scale fishers only caught 5 million tonnes of fish.



Different types of trawlers

Thailand is the world's biggest exporter of fish. Thai fishers catch nearly 3 million tonnes of fish a year from the ocean. This is worth billions of dollars for the Thai economy.

Who should be able to decide what happens to oceans? In international law, governments usually

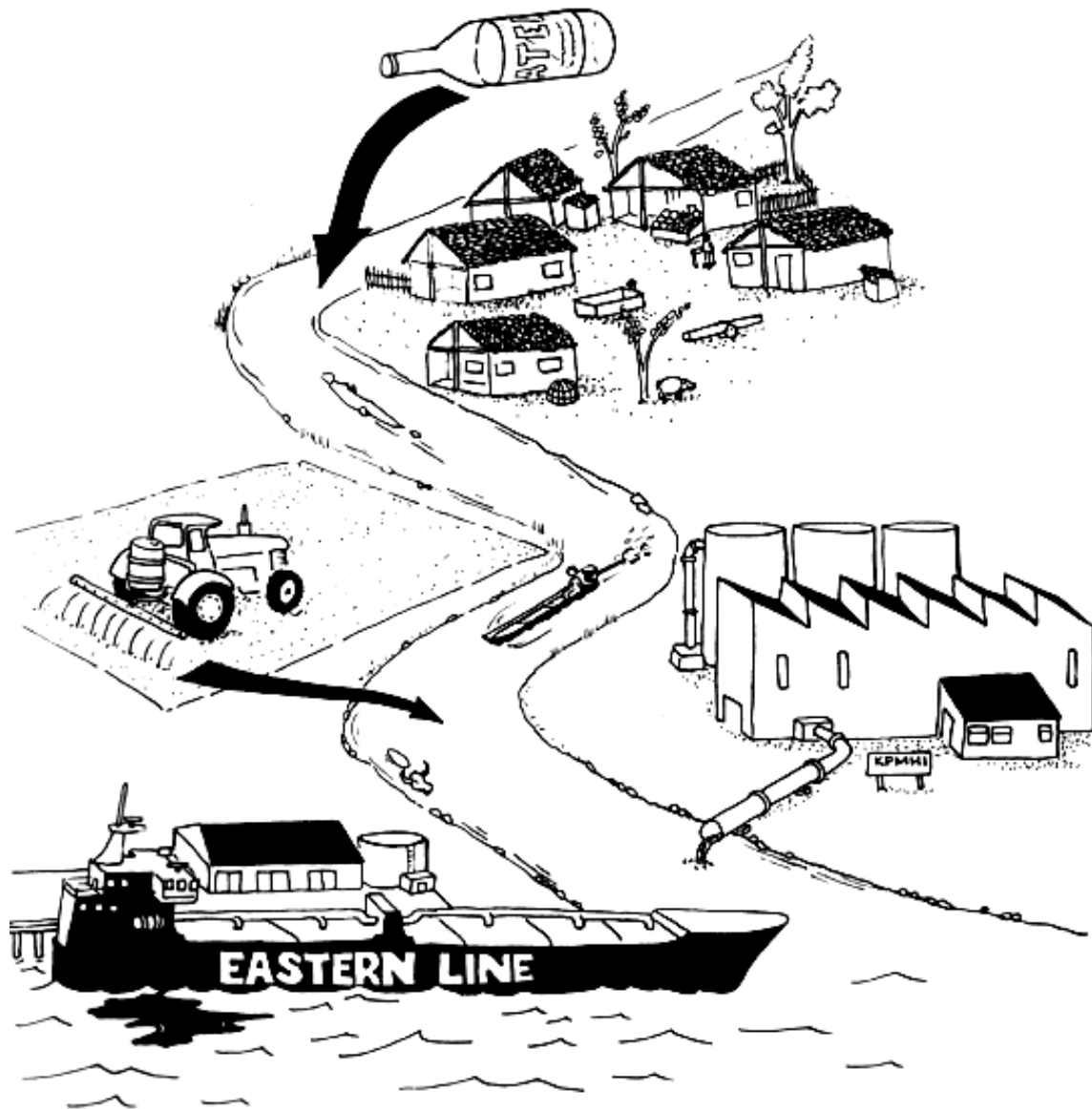
have control of the sea up to 370 km from the land. Outside of that, the sea is called international waters. Inside a country's waters, they have full control of anything in the sea. The area closest to the land usually has the most fish and it is where most fishing happens. Because of this, these waters are in extra danger of overfishing.

In your own words: What are the main problems with trawlers? Use the picture as a guide.

Discussion: What problems can overfishing cause for small-scale fishers? What are some ways fishing can be made sustainable?



Land pollution = Sea pollution



Lots of **waste** from the land and sky go into the sea. Before industry, waste was natural and the sea broke it down. Now large amounts of chemical waste is going into the sea, destroying ecosystems and biodiversity. The land and sea are closely connected through rivers. If you throw a plastic bottle on the ground, rain often

carries it into river systems and then into the sea. It can be carried thousands of kilometres so even if you live far from the sea, what you do can damage it. And once in the sea, plastic bottles stay there for 450 years. The picture above shows some common ways the sea is polluted by what happens on the land.

Exercises:

1. Look at the picture. How is water being polluted?
2. How do things people do on land affect the sea?

5. Forests

Key Words

rainforest (n) - a thick forest that gets more than 1.8 metres of rain every year.

tropical (adj) - from the hot, wet areas of the world, between 0° and 15° from the equator.

subtropical (adj) - from the warm areas of the world, between 15° and 40° from the equator.

Discussion:

1. What are forests?
2. Why are they important?
3. If someone decided to cut down every tree in Myanmar, how would it make you feel? Why?

There are many different types of forest in the world. Types of forests are named according to three things:

1. Climate. Forests in Myanmar are **tropical** or **subtropical**.
2. Rainfall. Forests can be dry or wet. This depends on how much rain there is. If a forest gets more than 1.8 metres of rain per year, it is called a **rainforest**.
3. Landscape. Examples of these in Myanmar are **mountainous forests** and wetland forest.

Activity: Look at the map of Myanmar. Where are these types of forest found? Draw lines showing the different climates and landscapes.



Rainforests

Key Words

canopy (n) - top layer of a rainforest.

vine (n) - long, thin plants that grow up other plants or rocks.

fern (n) - a type of plant with many leaves but no flowers.

litter (n) - waste that plants (or people) leave behind or drop on the ground.

erosion (n) - how soil is slowly lost by water and wind.

global warming (n) - the increase in the average temperature of the earth.

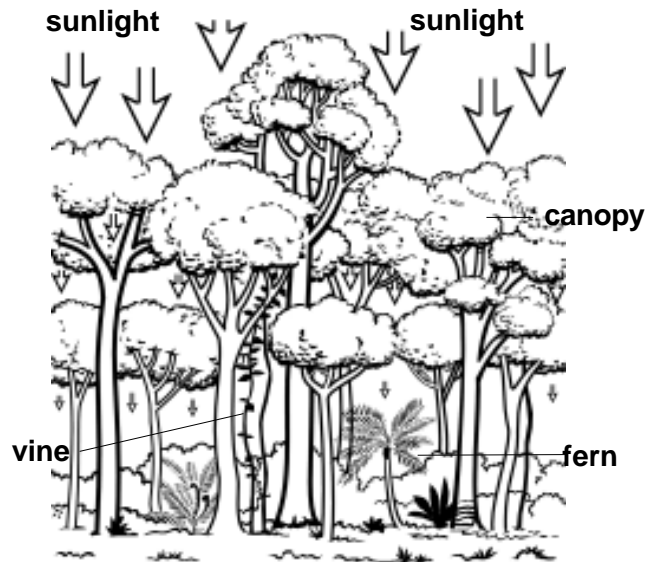
Brainstorm:

1. What species are in a rainforest?
List as many tree, plant, animal and insect species as you can.
2. Which of these species are most important for rainforest ecosystems?

Scientists think there are around 30 million species of plants, animals and insects in the world's rainforests. That's about half of the world's species. Rainforests are therefore very important for world biodiversity. Most of Myanmar's tropical rainforests are in Southern Myanmar. Rainforests are the oldest ecosystem. Myanmar's rainforests are between 70 and 100 million years old.

Rainforests are complicated ecosystems. Trees are a very important part of rainforests. They are often very straight, tall and close together. Because they are close together, trees compete for sunlight. In a rainforest, many trees are a similar height. The top of the trees are like a roof which covers everything below. This is called a **canopy**. Water flows down from the leaves to the many **vines**, **ferns** and other plants under the canopy. Rainforests are very wet. This is because there is a lot of rain in areas where there are rainforests. Rainforests keep water very well because they are very thick and the canopy protects everything underneath from the sun.

People used to think that rainforests are rich because the soil is rich. Many people destroy rainforests for agriculture because they want to use the soil. But very soon the soil becomes dry and cracked. Soil in rainforests is very rich because of rainforest ecosystems. The top of the soil is **litter** from plants and decomposing animals. It is only there because of the rainforest. If you destroy the rainforest, the soil is also destroyed.



Very little sunlight reaches the ground

Uses of forests

control of floods water soil weather communities biodiversity

..... Forests play an important role in the global climate. They keep a lot of carbon within the forest. When a forest is destroyed, the carbon goes into the air and adds to **global warming**.

..... Forests are a key part of the water cycle. A lot of water goes into the sky from trees. Forests are important parts of catchments. They store water and release it slowly into streams and rivers.

..... Forests protect soil from **erosion**. Trees shelter the soil from wind and rain and tree roots stop soil from moving.

..... The way forests and soil take water helps stop flooding. When forests are destroyed, rainwater often floods villages and other land in the area.

..... Forests are a habitat for more than half of the world's species. They are the richest habitats on earth.

..... Forests provide food, shelter, medicine, firewood, hardwood for building houses and materials for making clothes, baskets and other useful things.

Exercise: Match the benefits of forests with the explanation.

Discussion:

1. How does your community benefit from the forest?
2. What local foods and medicines come from forests?

Forests and communities

remote (adj) - far from towns and cities.

community forest management (n) - how communities use forests and how they look after them.

Around the world, millions of people get their livelihood from forests. Forests are also part of the culture and religion of many people. Many forest communities have great knowledge about their local environment and know how to use forests in a sustainable way. The forest also benefits from small forest communities because they care for the area and protect it. It is important to keep and respect local knowledge about forests for the future.

Forests cover 35% of Rakhine State. Many communities are part of forest environments. Local communities have a lot of knowledge about how to find food and medicine in forests. For

example, Rakhaing State has more than 50 different types of rice. Knowledge about these types of rice is kept by local communities. They use many different plants and types of food in their diet. This is possible because they have a lot of knowledge about local biodiversity and they use it in a sustainable way. In Thailand, many types of rice have been lost. One reason is because people go to the city and forget about forest food. Rakhaing people also take medicine from the forest. One reason is because there are no clinics in **remote** areas. Another reason is because some people prefer local, natural medicine. They trust their own medicines more than medicines from outside.

In your own words: What are the main parts of rainforest ecosystems?

Group work: Talk to older people and find a story from your culture about forests. Make a poster presentation in small groups. What information does it have about forests and the local environment? Does it have a message about how to look after the forests? Does it have a message about how to use or not use the forest? Talk to the class about what you found.

Communities have rules about how to use and protect the forest. This is called **community forest management**. Many forest communities in Myanmar have special rules about how different forests can be used. This is to protect forests and use them sustainably. Part of Kayin community forest management is *au ti kertaw ti, au kaw kertaw kaw*. This means 'live with the water, care for the water, live with the forest, care for the forest.' This is a basic rule for forest and water conservation that promotes respect for the natural environment.

Here are types of protected forest in Kayin community forest management:

Community forest

All the trees are protected. This is very important for forest conservation. Community forests are near the village and give shelter. Things in the forest are for the whole community, not for the benefit of one person.

Sacred forest

These are important for religion. It is said to be where spirits stay. Sometimes dead people are buried there. This forest is also protected.

Catchments

All land in catchments is protected. No animals, plants or trees can be taken.

Activity: Is there a system of community forest management in your local area? Ask older people in your community about how land is used, different types of forest, what can be taken, how much and what cannot be taken. Write a report.



Deforestation

Key Words

deforestation (n) - clearing forests for wood, land or other purposes.

commercial logging (n) - cutting down trees to make money.

teak (n) - a type of large hardwood tree.

tourism (n) - the business of people visiting places and doing things on holiday.

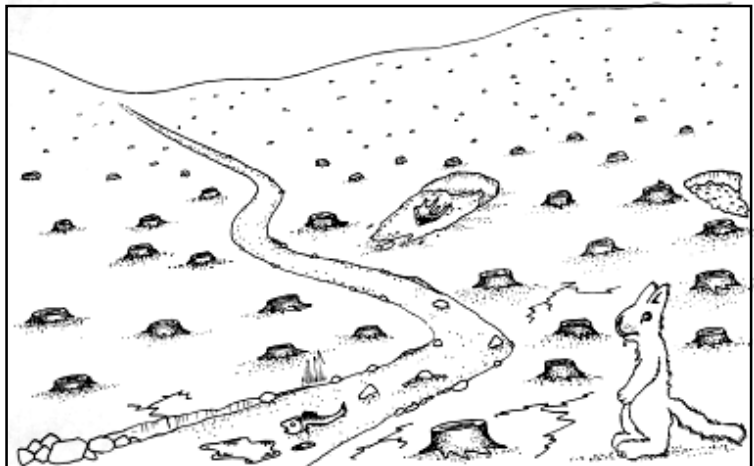
Deforestation is happening very quickly all over the world. It is a big problem in many parts of Myanmar, Thailand, China and Lao. The main reasons for deforestation are **commercial logging** and development projects. Between 1990 and 2000, Myanmar lost 14% of its forest, India lost 32% and Thailand lost 26%.

Activity: Make a graph about loss of forests.

Commercial logging is the main reason Myanmar's forests are disappearing. Myanmar's forests are logged to make timber products like furniture and paper.

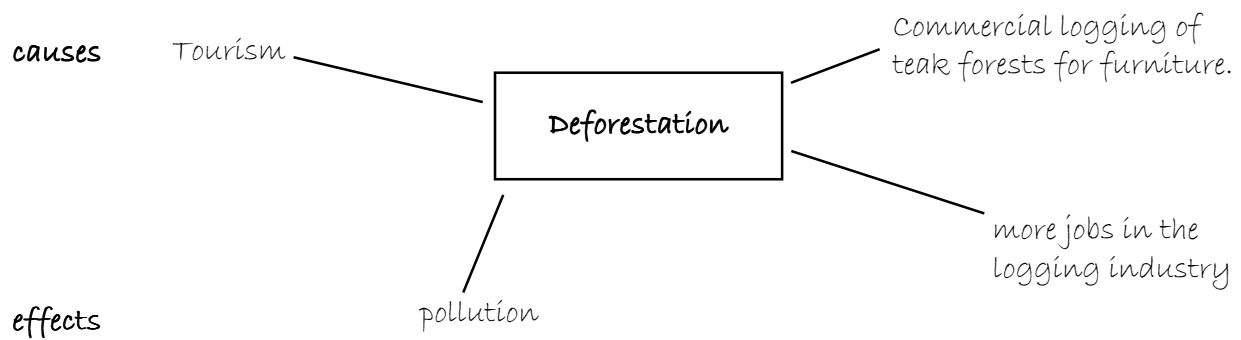
The most expensive timber is **teak**. Teak is a strong and beautiful type of wood. Many people in the world want to make things out of teak, but natural teak forests only grow in Southeast Asia and South Asia. Teak is now an endangered species. Once a teak tree is cut down, it takes a very long time to grow back. Myanmar has the largest number of teak forests in the world. Myanmar's teak is famous because the quality is very high.

A lot of logging in Myanmar is illegal. Logging can be illegal for many reasons, e.g. companies cut down more trees than they are allowed, or they cut down endangered tree species.



Brainstorm: Why is teak popular? List all the things you can make from teak.

Activity: Complete the chart. Some information is in this module. Think of some new information too.



Case study: Community Forest Groups

Community Forest Groups are trying to solve some of the problems of deforestation. They are also trying to protect forests for the future. One of the ways of doing this is **reforestation**. Reforestation means growing new forests in places where forests have been destroyed. This is a lot more difficult than just planting trees. Forests are complicated ecosystems. The diversity cannot be returned once it is destroyed, but planting many important trees helps other species return.

Communities need to know which species to plant, how to plant them and in what system. So the Community Forest Groups hold workshops. Environmentalists from many villages come and learn how to do reforestation.

Exercise: How do Community Forest Groups help the environment?

Discussion: What needs to be done in your community to help protect forests?

6. Energy

Key Words

fossil fuels (n) - fuels made from dead plants and animals that have been buried underground for millions of years. They are taken out of the ground and burnt for energy.

natural gas (n) - a fossil fuel found underground and burnt to make energy.

oil rig (n) - a building in the sea used for taking oil from under the sea.

pipeline (n) - a long pipe used to transport natural gas or oil to factories.

Energy is the power that makes things work. Everyday actions like cooking rice, using electricity to light your house or listening to the radio all use energy. Modern industry depends on energy. Energy comes from heat and movement, e.g. the flow of rivers, wind, fire and the heat of the sun.

Here are two scientific laws about energy:

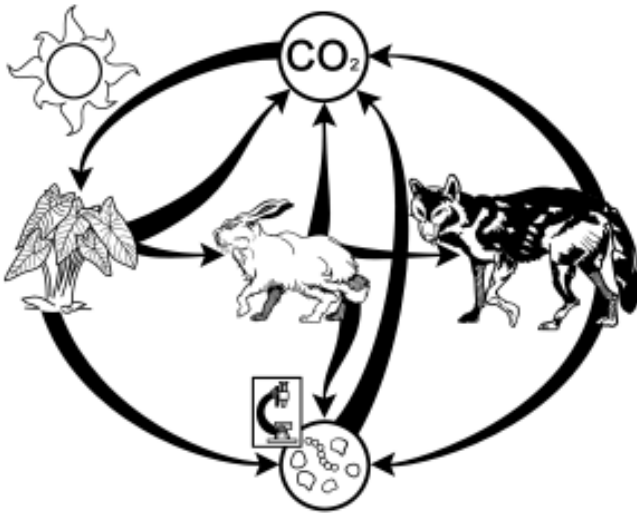
1. Energy cannot be made or destroyed. It can only change from one form to another.
2. Every time energy changes form, some of it is lost.

Brainstorm: How many things did you do yesterday that used energy? What are the main things energy is used for in your local community?

People get energy from resources. Like all resources, it can be renewable or non-renewable. At the moment, most energy sources used in the world are non-renewable. The most common source of non-renewable energy is **fossil fuels**. The world economy is organised to use fossil

fuels. Most machines in industry and transport need oil. Fossil fuels come from carbon in plants. When plants take energy from the sun, they also take carbon to make energy that living things can use. This is called the **carbon cycle**. It is like a food web but looks at how carbon moves around.

The carbon cycle



1. CO_2 moves from the air into plants and then back into the air as oxygen.
2. Carbon moves into animals when they eat plants.
3. Carbon goes into bigger animals when they eat smaller animals.
4. It then goes back into the air as CO_2 when animals breathe.
5. When plants and animals die, the carbon goes into the ground.
6. As dead animals and plants get broken down, carbon gets stored in the ground.

When plants die, they get buried in the ground and the carbon gets trapped under rocks. Over millions of years, the carbon changes its form. It becomes coal, oil or natural gas. Now people are taking huge amounts of fossil fuels out of the ground very quickly. We are burning them for

energy. When they are burnt, the carbon dioxide goes into the air. There is now much more carbon dioxide in the air than there was 100 years ago. This has put the carbon cycle out of balance.

Some sources of renewable energy are firewood, wind and rivers.

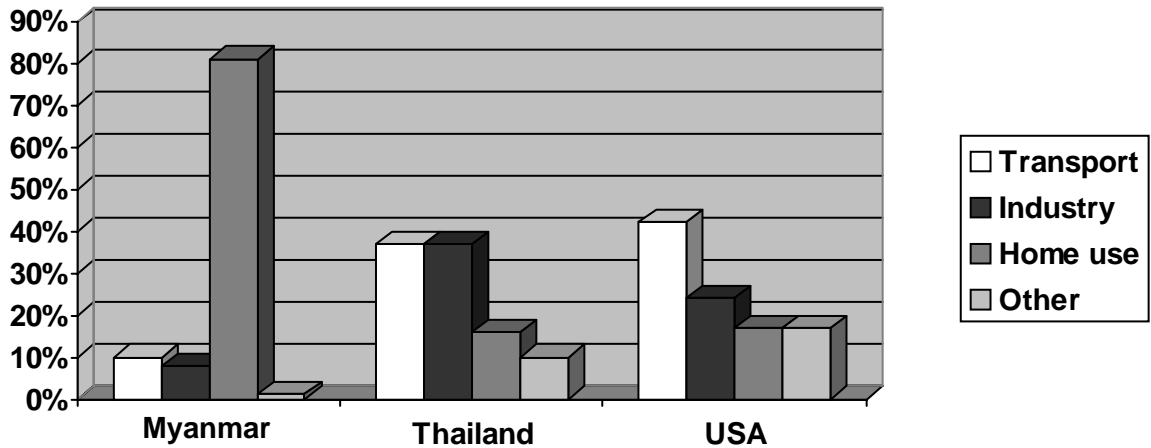
Exercises:

1. Fossil fuels are always forming in the ground. Why are they called non-renewable?
2. In your own words, what effect does the burning of fossil fuels have on the environment?
3. Are any fossil fuels used in your community? If so, what types and what are they used for?
4. What types of renewable energy are used in your community? What are they used for?

Energy use

Energy use is not equal around the world. Rich countries have about 20% of the world's people but use about 80% of the world's energy. Many poor countries like Myanmar do not have enough energy for their population. But they still sell lots of energy resources to rich countries.

How energy is used in different countries



Discussion: What are some reasons for the differences in the graph?

Amount of oil used (per year)

Myanmar: 11,435,000 metric tonnes.
 Thailand: 49,904,000 metric tonnes.
 USA: 1,475,404,000 metric tonnes.

Population

Myanmar: 42,510,537 million
 Thailand: 64,265,276 million
 USA: 290,342,554 million

Activity:

1. Make a graph showing the amount of oil used by Myanmar, Thailand and the USA.
2. Now work out the amount of oil used per capita in each country. Per capita is the total amount of oil divided by the population. It is an estimate of how much oil one person uses.
3. Make another graph about oil use per capita. What do you find? Why do some countries use more oil than others?

Oil and natural gas

Oil is the most important source of energy in the world economy. It makes up 32% of the world's energy. But like many resources, it is not available around the world equally. While people in Myanmar sometimes do not have enough, the US uses more than 25% of the world's oil. Since there is little oil in the US, most of its oil needs to be imported.

Around 22% of the world's energy comes from **natural gas**. Oil and natural gas are often found together under the ground. Around half the world's oil and natural gas are under the sea. People think that in the next hundred years, all the world's oil and natural gas will be finished.

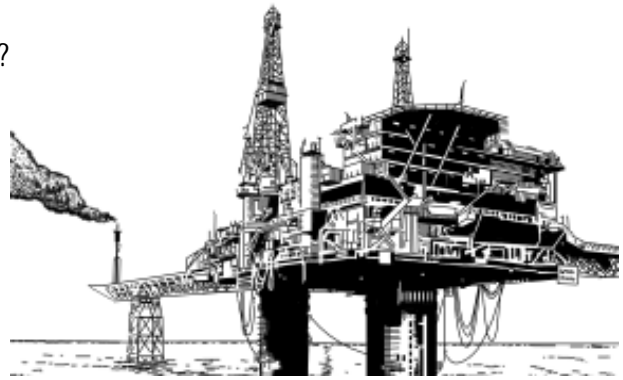
To get oil from underground, people drill. To take oil or natural gas from under the sea, an **oil rig** needs to be built. When oil is under the sea or in a remote place, **pipelines** are used to transport it to factories for it to be cleaned and prepared so that it can be sold. This often causes problems for people and the environment. Myanmar has a large amount of natural gas and oil under the Andaman Sea and the Bay of Bengal. International companies, together with government, are now making money from selling this gas. Oil and gas drilling cause a lot of pollution. Oil and gas often spill into the sea from ships and onto the land from pipelines. This can poison living things (including people).

Exercise:

Where do oil and natural gas come from?
How are they taken?

Discussion:

What might change when all the oil and natural gas is finished?



An oil rig in the sea

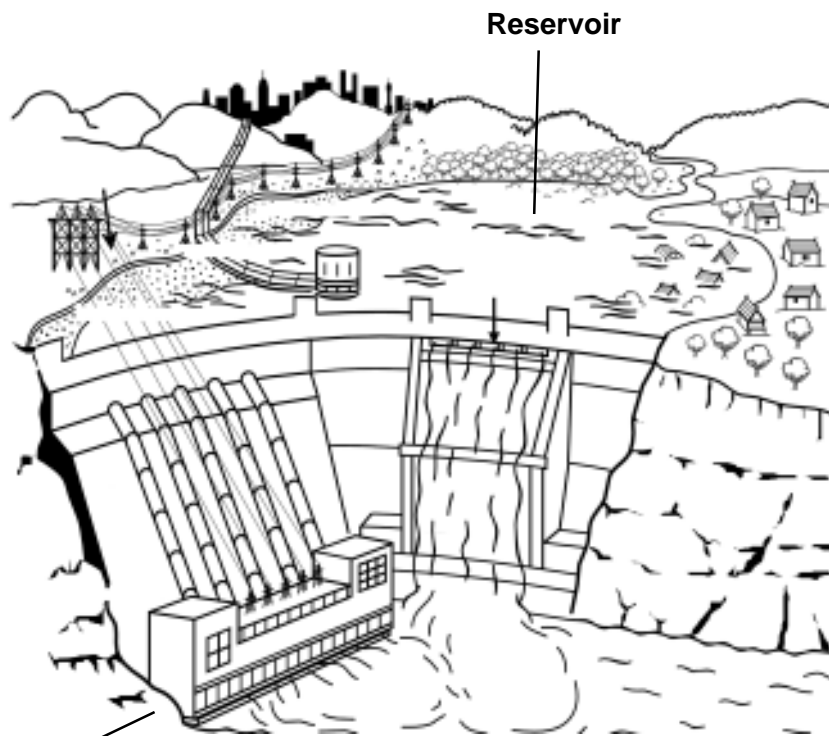
Key Words

Hydroelectric dams

hydropower (n) - energy from water.

to generate (v) - to make electricity.

World Bank (n) - an organisation that lends money to governments for development.



Power house

Hydroelectric dam

Hydropower is power from water. It is a source of renewable energy. A lot of hydropower comes from large hydroelectric dams. Building a dam involves putting a big wall across a river to stop the river from flowing. The pressure of the water makes a

wheel in the power house spin very fast. This **generates** electricity. Dams are also used to provide water for crops and people and to control flooding. Many dams are built for more than one reason, e.g. for electricity and for water for agriculture.

Exercise: How are hydroelectric dams a source of renewable energy?

Brainstorm: What are the problems large dams can cause? What are the benefits?

benefits	problems

Firewood

One of the oldest sources of energy is wood. Wood is cut and burnt or made into charcoal. Firewood is a renewable source of energy. This is because new trees can be planted to replace the ones cut down. Firewood can easily become unsustainable though, as it can take a lot of wood to cook food and keep people warm. However, it depends how the wood is used. When it is turned into charcoal, 70% of the energy is lost. This is therefore not an efficient source of energy.

Case study: Family Firewood Program

Villages in Kayah State rely on firewood for energy. A lot of logging in Kayah State is for firewood. This causes low water in streams which makes farming very difficult. Now many villages are in the Family Firewood Program.

Every family in a village grows 10 trees. They are used for firewood for the year. Families usually grow trees around their house. This has been important for saving forests.

Discussion:

1. Do you use firewood? If so, where does it come from?
2. How is this resource managed in your community? Can you cut down any tree? Are there limits?
3. How can firewood be conserved? List some ideas.
4. What are inefficient ways of using firewood? List some examples.
5. Is the Family Firewood Program sustainable? Explain your answer.

Review:

1. How is energy generated?
2. Explain renewable and non-renewable energy. Give some examples.
3. Why is energy important?
4. Describe three energy problems and give possible answers. At least one problem should be about your local community.
5. Explain two ways people in your local community can save energy.

7. Climate change

Brainstorm: What is climate change?

What are some of the causes and effects of climate change?

Climate is the normal weather conditions in a place. For example, the climate of Southeast Asia is hot, and has a wet season and a dry season. The climate in England is much cooler, with lots of rain and snow in the autumn and winter.

Climate change is simply the changing of the earth's climate. There are two types of climate change: natural and human-made. Before learning about this topic, it is important to understand the greenhouse effect, and how it affects the climate.

The greenhouse effect

Key Words

atmosphere (n) - a layer of gases surrounding the earth.

absorb (v) - to make something become part of something, to take something in, e.g. *The towel absorbed all the water.*

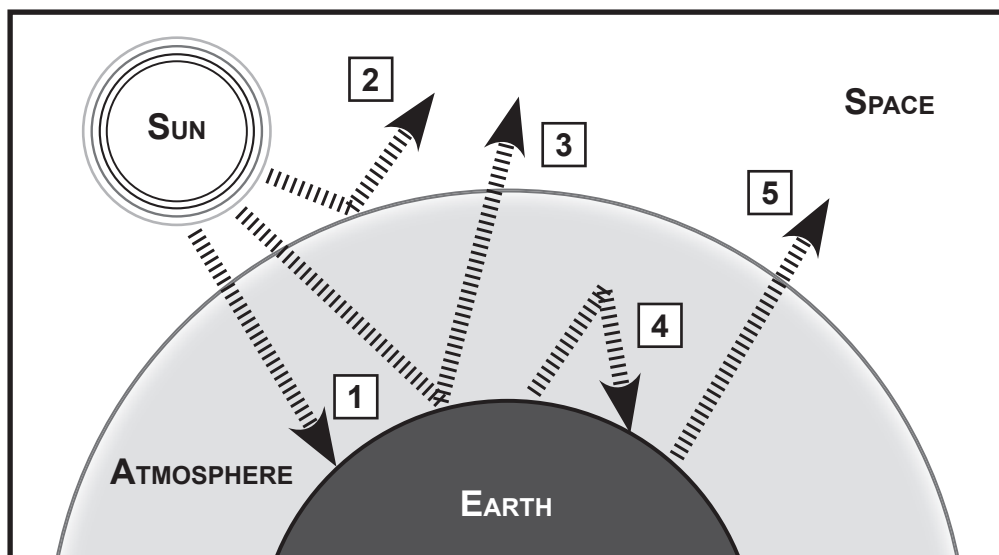
reflect (v) - to throw back from a surface.

trap (v) - to stop something from escaping or getting free.

The earth is covered by an **atmosphere**, which allows all the plants and animals to survive. In addition to the air that we breathe, the atmosphere contains natural gases called *greenhouse gases*, such as water vapour, carbon dioxide, methane and nitrous oxide. These gases **absorb** a lot of heat, so not all of the sun's energy is **reflected** out of the atmosphere. This is called the *greenhouse effect*. Without the greenhouse effect, the average temperature of the earth would be about minus 18.5 degrees Celsius (-18.5°C).

Activity: Look at the diagram, and match the numbers with the statements below.

- a - Some of the sun's heat is reflected into space off clouds.
- b - Heat from the sun, in the form of radiation, gets through the atmosphere. This causes the earth to warm up.
- c - As the earth warms up, some heat gets back into space through the atmosphere.
- d - Some heat is reflected back into space off the surface of the earth.
- e - Some heat is **trapped** near the surface of the earth by the planet's natural greenhouse gases.



Exercises:

1. Is the greenhouse effect a good thing or a bad thing?
2. What would happen if there was no greenhouse gas?
3. What would happen if there was too much greenhouse gas?

Natural climate change

Key Words

- ice age** (n) - a time when global temperatures decrease and ice covers large parts of the earth.
- particles** (n) - small pieces of rock and dust.
- orbit** (n) - the movement of an object around another object, usually in space.
- solar activity** (n) - the amount of energy the sun gives out.

The climate of the earth sometimes changes, becoming warmer or colder. For example, between 100,000 and 10,000 years ago there was an **ice age**. Ice covered most of North America, Britain and northern Europe. At this time, it was possible to walk from Britain to the rest of Europe. Between 10,000 and 8,000 years ago, the temperature rose, the ice melted and sea levels rose. Britain became an island about 6,500 years ago.

There are many natural causes of climate change. Three causes are volcanoes, the orbit of the earth around the sun, and the behaviour of the sun itself.

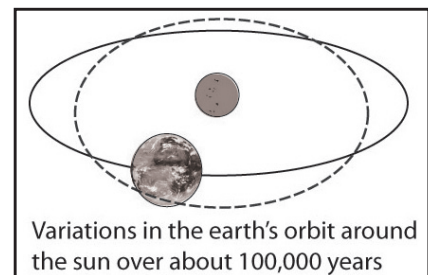
Volcanoes

Exploding volcanoes throw gases and **particles** into the atmosphere. When this happens, less heat from the sun can get through the atmosphere and the earth cools. Volcanoes also release carbon dioxide into the atmosphere when they erupt. This can make the earth hotter through the greenhouse effect. The effects of large volcanoes on climate can be powerful but usually only last a few years.



Earth's orbit around the sun

The earth goes around the sun but its **orbit** is not always circular. Over about 100,000 years, the earth moves closer to the sun then further away. When this happens, the earth becomes hotter or cooler. The effects are slow but powerful. Scientists think that the orbit of the earth is one of the main causes of ice ages.



The sun

The sun burns hotter and cooler at different times. Scientists know that **solar activity** has an effect on climate, but they don't know exactly how much.

Exercises: Decide if the sentences are true or false. If false, correct them.

1. In the past, the climate of the earth didn't change.
2. The earth's orbit around the sun affects its climate.
3. Volcanoes can make the earth hotter or cooler.
4. The effects of volcanoes last a very long time.
5. Less than 20,000 years ago, North America, Northern Europe and Britain were in an ice age.
6. The earth's orbit has a slow but powerful effect on climate.
7. Scientists don't fully understand how much solar activity affects our climate.

Human-made climate change

Key Words

standard of living (n) - how well people live: their income, how much they can buy, quality of healthcare, etc.

estimate (v) - to guess using the information you have.

glacier [glay-sheer] (n) - a large, slow-moving river of ice in the mountains.

drought [draut] (n) - a time when there is not enough water to grow crops.

heat wave (n) - a time of unusually hot weather.

Over the last 100 years or more the earth has been getting warmer and warmer. This change is called *global warming*.

Last century the average temperature of the earth rose by 0.6°C , and 19 of the 20 hottest years ever recorded have happened since 1980. Scientists believe that by 2100 the planet will be between two and five degrees hotter than it is now. This change may seem very small, but it can have big effects on people and the environment.

Almost all climate scientists in the world agree that global warming cannot be fully explained by natural causes. The main cause of the increase is human activity, especially burning carbon-based fuels and destroying forests.

Burning fossil fuels

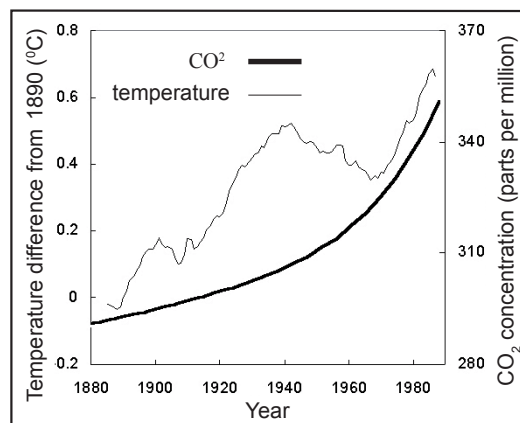
In the past century, the activities of humans have led to a huge increase in the levels of greenhouse gases, especially carbon dioxide (CO_2).

Carbon dioxide is produced when we burn fossil fuels, such as coal, natural gas and oil. More industry, production of electricity, and the use of motor vehicles has resulted in huge amounts of fossil fuels being burnt.

The rapid growth of the human population, together with improved **standards of living**, is one reason for the increase in the burning of fossil fuels. As the human population continues to rise, and development raises the standards of living

for more people, the burning of fossil fuels will continue to increase.

Global temperature and carbon dioxide concentration 1880-1990



Deforestation

About half of the world's tropical rainforest has already been cut down for timber or burned to clear land for farming. Every year, about 120,000 km² more is destroyed. For comparison, Kachin state is just 89,000 km².

Trees absorb a lot of carbon dioxide from the air and turn it into oxygen. Deforestation reduces the amount of trees on the earth, and therefore reduces the absorption of carbon dioxide. Also, when trees are burned or decompose, the carbon that they store is released into the air as carbon dioxide.

Some scientists **estimate** that deforestation is responsible for 20-30% of global warming.

Exercises: Explain how the following affect the temperature of the earth.

1. Improved standards of living
2. Deforestation

Exercises: Use the graph to answer these questions.

1. What is the relationship between temperature and CO₂ concentration?
2. Between 1920 and 2000, how much did the earth's temperature increase?
3. From 1960 to 2000, about how much did the CO₂ concentration increase?
4. During which years did global temperatures decrease by 0.5°C or more?

Exercises: Explain the difference between global warming and:

1. the greenhouse effect
2. climate change

The effects of climate change

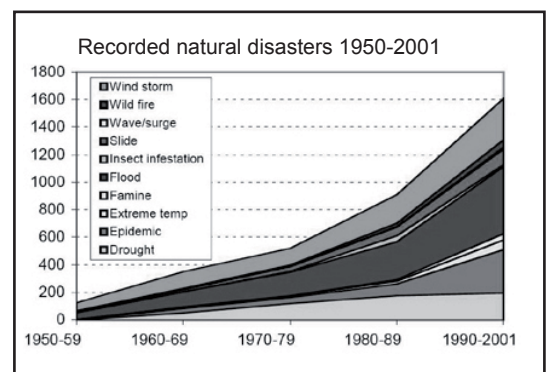
Discussion: Look at the photos of flooding in China in 2010. Do you think human-made climate change was the cause? How do you think this is possible?



Climate change is starting to affect the earth and the things living on it, including people. The following are some of the main impacts happening now and predicted for the future.

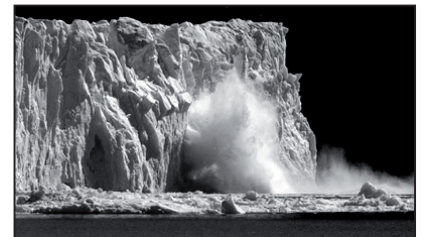
Natural disasters

Droughts, floods, violent storms and **heat waves** are probably becoming more common. In 2010 alone, nine countries recorded their hottest day ever. (Myanmar's was on May 12 in Myinmu, Sagaing Division, which reached 47°C). Natural disasters have always happened occasionally, so we cannot say that climate change causes all of them, but there are more being recorded than ever before. The graph shows the number of natural disasters recorded each year from 1950 to 2001.



Melting of the ice caps

Ice caps reflect the sun's energy out of the earth's atmosphere and reduce warming from the greenhouse effect. But the ice cap at the north pole is decreasing by 9% every ten years because of global warming, so more heat is being absorbed by the earth. This could cause further increases in temperature, which could cause faster melting of the ice caps, and so on.



Melting of glaciers

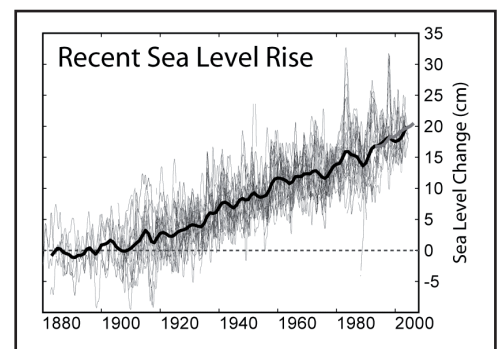
Glaciers are also melting. Loss of glaciers could have a major effect on the water systems of several countries, especially in Central Asia and South America.

Warming of the sea

The increase in global temperature is warming the sea. Changes in sea temperature can damage sea ecosystems because some plants and animals can't live in warmer water. This can lead to extinction of species and the destruction of coral reefs.

Sea level rise

When ice caps and glaciers melt, they run into the sea; and when sea water warms, it expands. Because of this, the sea level has risen by about 20 cm since 1990, and by 2100 it could rise by up to 59 cm. If sea levels rise, large areas of low-lying land could become covered with water, including areas of Bangladesh, Holland and the Ayeyawaddy Delta. Over 630 million people live less than 10 metres above sea level, and much of this land is used for food production.



Changes in food production

Changing climate affects the crops that a country can grow. Some areas that are now too cold to grow a lot of crops, like northern Russia and Canada, may have better food production. Many hot developing countries could find it very difficult to grow food. In Sudan in Africa people have already left some places because they can't farm the land any more.



Increased risk of disease

Warmer climates make it easier for insects like mosquitoes to live. More people could be at risk from diseases such as malaria and dengue. The number of people getting dengue in Southeast Asia and South America has increased in recent years. The UN estimates that climate change will put an extra 3.5 billion people at risk of dengue by 2085.

Biodiversity affected

Some scientists estimate that 15% to 37% of all species will become extinct because increased heat will change their habitat and their breeding too much. One species affected is sea turtles. Turtle eggs laid in cold places become male, and eggs laid in warmer places become female. Because the temperature is rising, there are too many females and not enough males, so the population is decreasing fast.



Forest fires

Hot, dry weather increases the risk of forest fires. They can destroy wildlife and buildings, and sometimes kill people. The smoke can cause health problems many miles from the fire. Also, CO₂ from fires contributes to climate change. In February 2009, fires in Australia killed 173 people and destroyed over 4,500 km² of forest and farmland.

Economic impacts

The economic impact of climate change will probably be mostly negative. Some cold countries could make money from better agriculture and save money on heating costs. However, even a small rise in temperature will damage hot countries, and most countries will probably suffer in the long term. For example, it will be harder to grow most crops, natural disasters will cause expensive damage to cities and crops, and many people will have to move away from flooded areas. Some economists estimate that world economic growth will be reduced by about one fifth (20%), and some say climate change will cost \$150 billion of damage per year between 2010 and 2020. The impact will be worse on hot, developing countries than on cooler, richer ones.

Exercises: Answer the questions in your own words.

1. What is causing sea level rise?
2. What problems can sea level rise cause?
3. Was climate change the cause of cyclone Nargis?
4. How might food production be affected by climate change?
5. Who might benefit from climate change, and why?
6. Who do you think will suffer the most from climate change, and why?

Discussion: Which changes could become serious problems for your country? Which could become serious problems for your community?

Activity: Choose one of the changes. Make a cause-effect chain about it, e.g.

ice caps melt > sea levels rise > land is flooded > people can't use land > people have to move to cities > cities become more crowded > diseases spread faster

Adaptation versus mitigation

Key Words

adapt (v) - to change something so it is suitable for a new situation.

mitigate (v) - to lessen (reduce) a problem.

drainage (n) - a system for getting rid of extra water.

power station (n) - a place where energy is generated.

irrigation (n) - a system for putting water on crops.

emissions (n) - waste gases released into the air.

Exercise: Look at the pictures. Which one shows mitigation of climate change and which one shows adaptation?



There are two main ways to respond to climate change. The first is to **adapt** to it. We accept that it is happening, and change the way we live so that it is not such a big a problem. We can:

- build walls around cities that are near the sea
- improve **drainage** of water in cities
- change the type of crops we grow to suit the new climate in each area, and develop seeds that can be grown in many types of climate
- improve **irrigation** of farmland in dry areas
- move away from places that suffer from regular floods and droughts
- send supplies, such as food and water, to people living in places with low rainfall or frequent droughts or other extreme weather events.

Some people think we should *only* adapt - we should not try to stop or reduce climate change. It would be extremely expensive to stop it, and many people would have to completely change

their way of life. They say it is not very likely we will stop it or reduce it by very much, so we should spend money on adapting to it instead.

Discussion:

Which ideas do you think will work? Why?

What problems do you think there may be with these ideas? Identify one problem with each of these ideas and, if possible, suggest solutions.

It is unlikely that we can ever adapt to the worst effects of climate change:

- If there is a serious storm or flood, it is almost impossible to stop it damaging buildings, people and crops, even with very strong defences and good drainage systems.
- No type of crop can grow in places with very frequent droughts or floods.
- Irrigation is expensive and sometimes farmers would have to transport water a long way.
- Many people in areas with frequent floods and droughts do not have anywhere else to live.
- Moving can be extremely expensive, especially if millions of people have to move at the same time. If people move, it can cause conflicts with the people and environment in the place where they resettle.
- Supplies can be difficult (sometimes impossible) and expensive to organise.

Most adaptation methods are expensive and need good management. Richer, well-governed countries will be able to adapt more easily than poorer, badly-governed ones. Most scientists and environmentalists think we should adapt because the CO₂ we have already produced will make the

world warmer, even if we reduce greenhouse gas **emissions** and deforestation. However, most of them also think that adapting is not enough. They think we must **mitigate** the effects of climate change. We must act now so that the world does not continue to get hotter and hotter.

Discussion: Do you think we should adapt, mitigate or both in response to climate change? Think about your community and the rest of the world.

Mitigating climate change

To mitigate climate change, we must reduce the amount of greenhouse gas in the air. There are lots of ways to do this, including:

- Birth control**
- Reducing deforestation**
- Using alternative energy**
- Carbon capture and storage**
- Reducing energy use per person**

Exercise: Put the headings above in the boxes below.

<p>1. _____ If we stop cutting down so many trees, more carbon dioxide will be absorbed. We could also do <i>reforestation</i> - planting trees to replace the ones we cut down.</p>	<p>2. _____ The main cause of climate change is the burning of carbon-based fuels. There are more environmentally friendly ways of getting energy. These include solar, wind and wave power, and hydroelectric and nuclear power.</p>
<p>3. _____ Newer power stations can catch carbon dioxide before it is released into the air. Then it is put somewhere safe, such as under the ground, so the carbon cannot escape. This can reduce CO₂ emissions by 80-90% compared to ordinary power stations.</p>	<p>4. _____ The population of the world is increasing very quickly. By 2050 it will probably be over 9 billion, compared to 6.7 bn in 2007, and these people will use a lot of energy. If we reduce the number of people being born, less greenhouse gas will be produced.</p>
<p>5. _____ If we reduce the amount of energy we use, there will be less CO₂ released into the air. We can:</p> <ul style="list-style-type: none"> - walk, cycle or use public transport instead of driving. - turn off lights, TVs, computers and vehicle engines when we are not using them. - use fans instead of air conditioning, and wear warmer clothes instead of turning on heaters. - recycle our waste, such as bottles, cans and bags. 	

There are many ways of mitigating climate change. Some of these require only individuals and companies to make the choice to live in a more environmentally friendly way. But some

are too expensive or too difficult for individuals to do. To successfully mitigate climate change, governments must also take action to reduce greenhouse gas emissions in their countries.

Exercise: What do you think are the advantages and disadvantages of each one? Think about cost, technology, politics, culture and personal choice.

Exercise: Identify three small changes you can make to your everyday life to help reduce climate change. Compare your ideas with others.

Group work: Create a climate change plan for your community. Identify issues and find solutions. You should explain whether they are mitigation or adaptation, and why they are the best solutions to the issues.

Into the future

Key Words

summit (n) - a meeting of governments to discuss an important issue.

emit (v) - to give out, to release into the atmosphere.

emissions (n) - waste gases released into the air.

emitter (n) - something or someone that emits.

ratify (v) - to make an international agreement part of national law.

aid (n) - money and help given by countries to other nations.

Exercises: Look at information below about the top five **emitters** of greenhouse gases and answer the questions.

On average, a person in a developed nation **emits** more greenhouse gases than someone in a developing nation. Here are the top five emitters of greenhouse gases and the amount of the total global **emissions** they create:

- China - 17%
- USA - 16%
- European Union - 11%
- Indonesia - 6%
- India - 5%



1. If people in developed nations generally emit more than people in developing nations, why is China the number one emitter of greenhouse gases?
2. Why do you think India creates less emissions than the EU, even though the population of India is higher?
3. What will happen if China and India keep developing but don't reduce their emissions?
4. Who should reduce their emissions most - developed countries or developing countries? Why?

How we fight climate change in the future will probably be decided in **summits** like Kyoto, the G8 summits and the Copenhagen conference of 2009. These meetings try to reach an agreement over global emissions. The most important issues at these summits are usually: who should reduce their CO₂ emissions, by how much, and how soon?

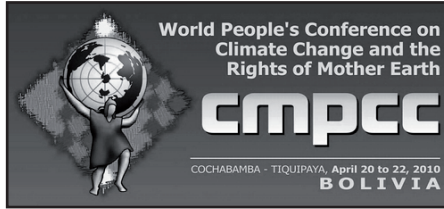
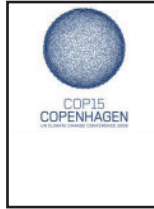
The Kyoto Protocol

The first climate change agreement was the Kyoto Protocol. It took eight years to reach an agreement and in 1997 in Kyoto, Japan, 160 countries agreed to reduce emissions by 5.2% by 2012. It was **ratified** by 55% of the countries and

became law on 16th February 2005. Countries are now trying to find an agreement to follow Kyoto that all nations are happy with but there are disagreements between richer and poorer countries about emissions. Kyoto says that developing countries like China, India and Brazil don't have to reduce emissions. The USA did not ratify the protocol because it thinks it isn't fair that developing countries don't have to reduce emissions. China says that richer developed countries should solve the problem because they produced lots of carbon dioxide when they were developing. China and the USA are the biggest emitters of CO₂ so it is important that they agree on how to fight climate change.

Discussion:

1. Why do you think it took eight years to get enough countries to ratify the protocol?
2. Do you think the Kyoto Protocol is a fair agreement? Why/Why not?
3. Do you have any better ideas about who should and shouldn't reduce their emissions?



Recent climate talks

In 2007 at the UN climate change conference, 180 countries met to discuss what will happen when Kyoto ends in 2012. In 2008 at the G8 summit leaders tried to find an agreement that China and the USA were both happy with. At G8, world leaders agreed that we need to cut emissions by 50% by 2050 and that each country should set its own targets. Environmentalists and leaders of developing nations said it wasn't enough. In December 2009 leaders met in Copenhagen and tried again to reach an agreement. European leaders hoped that the conference would force countries to make large reductions to emissions.

Many people think Copenhagen failed. A plan to reduce emissions by 80% by 2050 was cancelled, and a plan to stop temperatures rising by more

than 1.5°C was changed to 2°C. Poor countries said rich countries weren't doing enough to fight climate change. Richer countries did, however, promise US\$30 billion in **aid** to help developing nations adapt to climate change and prevent deforestation. The US, EU, Japan and Russia all agreed to cut emissions by 15-30%.

One country unhappy with Copenhagen was Bolivia, and in April 2010 Bolivia held The World People's Conference on Climate Change. The leaders of that conference want rich countries to do more and keep reducing their emissions.

There is no easy solution to the problem of climate change because every nation wants the best for its people and its business. Activists disagree with this and say the only solution is one where all countries work together to find a global solution to a global problem.

Discussion:

1. Are countries right to protect their own people and businesses before they think about the whole world? Why/Why not?
2. Should the rest of the world try to reach an agreement without China and the USA?
3. What do you think will happen if no agreements are made in the near future?

Here is what leaders and climate experts said about the Copenhagen conference:

- A. The head of China's delegation said: "The meeting has had a positive result, everyone should be happy."
- B. Bolivian president, Evo Morales, said: "The meeting has failed. It's unfortunate for the planet."
- C. EU Commission President said: "I will not hide my disappointment."
- D. John Ashe, the chairperson of the Kyoto talks, said that the agreement made at the conference "falls far short of the mark." (they agreed on too little)
- E. John Sauven, executive director of Greenpeace UK, said: "The city of Copenhagen is a crime scene tonight."

Exercises:

1. Look at the comments above. For each comment, decide what the person meant, and why they said what they did.
2. Choose any leader in the world. Write him or her a letter saying what you think their country or organisation should do about climate change. Support your argument with reasons and evidence from this chapter, and your own.

8. Development, people and the environment

Key Words

rural (adj) - outside towns and cities.

expert (n) - someone who knows a lot about something.

shifting cultivation (n) - farming where part of a forest is cleared to grow crops. When the crops have been taken, the area is left so the forest can grow back.

hybrid seed (n) - a seed made by businesses by mixing different seeds together. This is so crops will grow faster and be bigger. Often hybrid seeds need chemical fertilisers and pesticides to grow well.

generator (n) - a machine that makes electricity.

Exercise: Try and answer these questions:

1. What is development?
2. How does development affect rural communities?
3. How does development affect the environment?

Development means many things to different people. It is about trying to make people's lives and communities better. Development can be **top-down** or **bottom-up**.

Top-down development:

Government and international organisations



Community

Bottom-up development:

Government and international organisations



Community

Some types of development work in a process from old to modern. Some development workers think that modern ways of doing things are better than old ways of doing things. **Experts** from rich countries come to poor countries to make things modern.

Old → Modern

This is top-down development. Experts and government people decide what is best for communities. Expensive technology is used and experts are needed to use it.

Many communities and ecosystems have been destroyed in the name of development. Projects like

dams, pipelines and big roads often make big problems for the people they are meant to help, although sometimes they benefit lots of people too. Many people have also become rich from this type of development. Thailand and Singapore have been following this type of development.

Exercises: What is top-down development? What is bottom-up development? Explain in your own words.

Rural communities

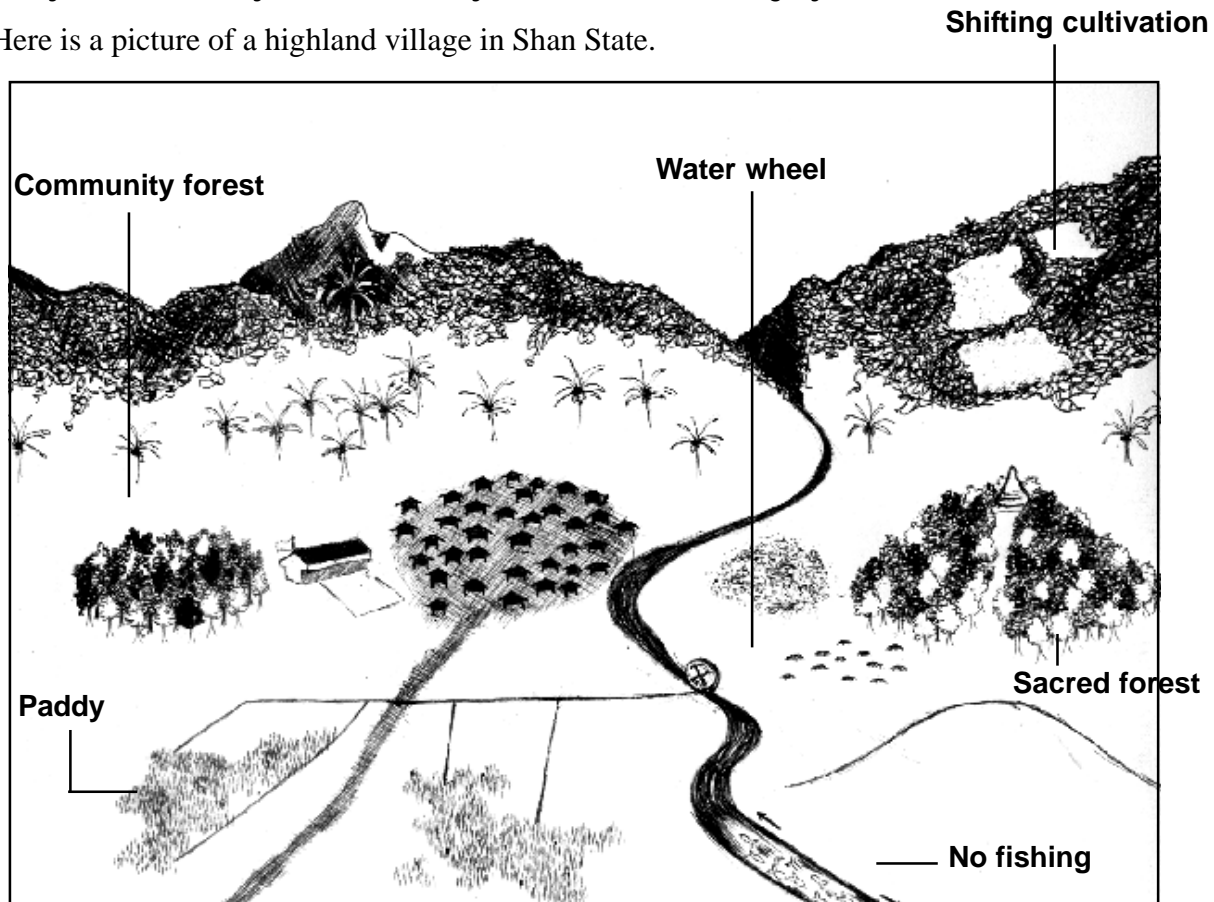
Most people in Myanmar live in rural communities. Rural communities are therefore important for development.

Brainstorm: What was your village like 100 years ago?

Make a list of how agriculture worked and what technology people used.

Now make a list of what your village is like now. What are the main changes? If you have always lived in a city, think about a village you know.

Here is a picture of a highland village in Shan State.



Here are some of the villagers talking about their issues:

"There are 36 houses in our village. There's a lot of forest around. The community forest is a good place to go when it's very hot. We also teach our children about plants and the environment there."

"Rivers are very important for Shan people. We always build villages near rivers. It is the most important thing. The river gives us fish to eat, water to drink and water for our paddy fields. One kilometre of the river near our village is protected. Nobody can take fish from there. This gives the fish a chance to breed so there are always many fish in the river. We use a wooden wheel to push water into the fields. It needs to be turned by hand so it's hard work."

'We have a primary school here, but no high school. When children finish eighth standard, they have no chance to attend school, unless they go to the city.'

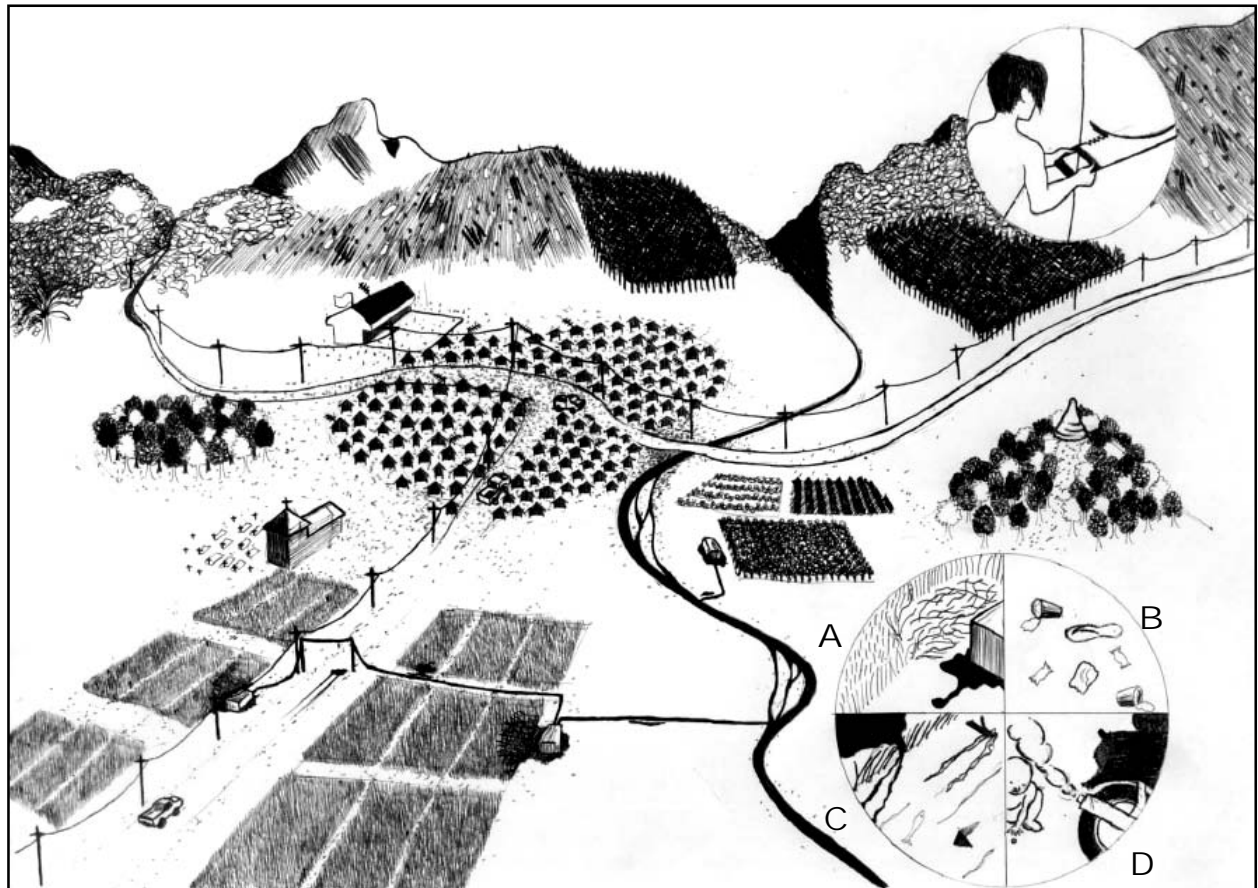
"We do **shifting cultivation** in the hills around our village. Every year, we grow plants on one of the seven fields. The other six fields are left alone and forest grows on them. We grow beans, tea leaves, sugarcane, cheroot and other crops. As forest grows in the other fields, we can find medicine, vegetables, animals and wood."

"Every house has a small garden. We grow mustard, cabbages, spring onions, chilli and pumpkin. All the villagers share food from their gardens."

"Every five days we go to the local market. It's in a bigger village nearby. We trade our crops for crops grown in other villages. It's also great for meeting people and hearing news from other villages. We carry our crops to the market by cart."

'Many young people go to the city, and don't come back here. The city has more jobs for them.'

Here is the same village ten years later:



Here are some of the villagers talking about their experiences with these development programs:

'Our community forest is smaller now. People from the authorities came and told us we have to use more land for crops.'

'We're not allowed to practise shifting cultivation anymore. The authorities say that it's a waste of land. They make us grow crops in all the fields every year. Now there is much less forested land. When we did shifting cultivation, forests were always growing again. We're having many problems with the soil too. The soil is old and dry and producing less food.'

'There's a new road through the village, connecting us to other villages. There is more pollution from the cars and motobikes. However, now there are more economic opportunities for young people, as they can travel to other places to work.'

'An NGO gave us 5 generators to pump water from the river to the fields. The pumps are less work than our old water wheel, but the petrol is expensive, and causes pollution. Now, we can listen to the radio and watch videos more, and school students can do their homework at night.'

Key	
A	Petrol from the generators pollutes crops
B	There is a lot of rubbish on the ground
C	Petrol from the generators pollutes the river
D	Traffic pollution

'The authorities have taken control of a teak forest near our village. The trees are as old as time. They said it's now protected by law. We're not allowed to use the forest now. But some businesses are cutting down the trees secretly. We used to look after that forest. Now some villagers are also secretly taking wood from there for firewood and building. They do that because there's not enough forest any more.'

'The authorities said we have to modernise our agriculture. They gave us **hybrid seeds** and special chemical fertilisers and pesticides. The insects keep finding new ways to eat our crops though. The crops were big at first but the soil is now very weak. Hybrid seeds only grow once so every time we want to plant, we have to buy more seeds. We also need to buy a lot of fertiliser and pesticides. We don't make a lot of money so we have to borrow. We have a lot of debt.'

'Now we have a lot of rubbish - things like plastic and aluminium that we never had before. A lot of it we burn. The batteries are a problem - they make the soil bad.'

Activity: Is this development process top-down or bottom-up? Explain your answer.

Activity: List the good effects of the development programs on the village.

Activity: Think about the problems in the village. What caused them? How could they be solved? For example:

problem	causes	solutions
<i>Rubbish - people throw out batteries, which make the soil bad.</i>	<i>People don't have any use for old batteries.</i>	<i>Use batteries that you can re-charge and recycle.</i>

Discussion:

Would the village be different if the community controlled the development process? How?

Development alternatives

There are many different ideas about development. Some of these ideas are bottom-up. Some are a mix of bottom-up and top-down.

Bottom-up development projects are usually small-scale. All decisions are made in the community. People in the community build the projects instead

of using experts. If experts are needed, they often teach local people. Local knowledge is respected. Bottom-up development is often ecologically sustainable. Small-scale projects only have a small impact on the environment. One aim of this type of development is self-sufficiency.

Roleplay: You live in this village. The state authorities have offered US\$15,000 for development programs. The village is having a meeting to decide what to do. What development programs do you want? What are the benefits and problems for people and the environment? Decide which things are most important. Think about what you have learnt in this module and talk about development, energy, emissions, water, waste and forest issues.

Resource management

Many of the environmental problems in this module are problems related to natural resource management. Would anything change if communities were more involved in decision making? What would change if governments, businesses and development organisations listened to communities?

Project: Find out about natural resource management in your local area or somewhere you know well. Write a report in small groups. Try and answer these questions: Who decides how natural resources are used in your local area? Are they the best people to manage resources, or should other people be involved? Find some problems with how resources are managed in your area. Find some good things about how resources are managed in your area. How could resources be better managed?

Additional reading 1

The largest poisoning in history

Key Words

UNICEF (n) - United National Children's Fund.
arsenic (n) - a type of poisonous chemical found underground.
sore (n) - a place on the body with an infection.

In the 1970s, some international aid organisations were worried about diseases in drinking water in Bangladesh. Most people got their water from rivers and streams. A lot of drinking water had bacteria in it and very young children would get sick and sometimes die. **UNICEF**, the Bangladeshi government and some other international aid organisations decided to dig wells so they could use groundwater instead.

They thought that groundwater was clean and much healthier than water from rivers. They did not know that soil and rocks around the aquifers in the area were naturally rich in **arsenic**. They dug more than one million wells but never tested the soil or water to see if it had arsenic in it. Digging so many wells pushed arsenic into the aquifers, poisoning the water. And people started drinking it.

In the early 1990s, some villagers from West Bengal, India went to hospital. They had big **sores** all over their skin. A researcher from a Calcutta university found out that they had arsenic poisoning. Many people in Bangladesh were going to doctors and hospitals with the same health problems. Arsenic poisoning causes large skin sores, skin cancer, brain problems, breathing problems and bladder, kidney and lung cancer.



Now thousands of people have died. In Southern Bangladesh, the World Health Organisation believes that one in every ten deaths is from arsenic poisoning. It took a long time to realise the problem because arsenic poisoning takes about 15 years before you can see and feel it. When people found out where the arsenic poisoning was coming from, it was too late.

In 2000, Bangladesh's population was 125 million. Of that number, up to 77 million people live in places where some wells have arsenic. They are all in danger from arsenic poisoning. This is one of the greatest environmental disasters in the world. And it is the biggest poisoning in history.

Exercises

1. What does this story tell you about the relationship between human health and the environment?
2. How could arsenic in groundwater affect ecosystems and biodiversity? Give examples.

Additional reading 2

Fishing rights in Myanmar waters



Governments can make a lot of money selling the right to fish in their country's waters. In March 2004, the government sold a Thai company called Siam Johnson and Co. rights to fish in Myanmar waters. The agreement was for 500 boats.

They are allowed to catch as many fish as they want. The government will get nearly \$300 million over five years from the deal. Under the deal, Thai boats have to be big, weighing more than 100 tonnes each. This is because the government charges money according to the size of the boats. The bigger the boats, the more money the government will get. There is no limit on the type of trawlers they can use or how big their nets can be.

Discussion

1. What effect could this deal have on saltwater ecosystems and biodiversity around Myanmar?
2. What effect could this deal have on local Myanmar fishers?
3. Should anyone control the sea? If so, who? How should decisions like this be made?

Additional reading 3

Pak Mun Dam: community action for the environment

The Pak Mun River is the largest tributary of the Mekong. It supports many local people who rely on the river for their livelihoods. The river is rich in biodiversity with around 265 different fish species. In the late 1980s, the Thai government decided to build a dam on the river to make hydroelectric power. People said the dam would be terrible for fish. Despite this, the Pak Mun Dam was built in 1994 with money from the World Bank. 248 households were moved because of the dam. It flooded a large area of land. Sixty to eighty percent of the fish disappeared from the river. The change in water levels and loss of biodiversity has affected around 20,000 people.

Thongcharoen Srihadham is from a village affected by the dam: “Before the dam was built, our livelihoods were supported by the resources provided by the Mun River. We did not need to pay for food, because we could get everything from the river and the forest.”

“After the dam was built, everything changed. The dam blocked the fish and destroyed the [river ecosystems]. We became poorer and had no food from nature. Many of our relatives had to move to Bangkok to find work. Our families and communities were destroyed. We started getting new diseases.”

Villagers have been protesting against the dam from the beginning. In 1999, 5,000 villagers occupied the dam site. They started a village called Ban Mae Mun Man Yuen No 1 or Long-lasting Mun River Village No 1. They say they will stay there until the dam is closed forever.



The Pak Mun Dam

Discussion:

1. What are the main problems caused by the dam?
2. What are the benefits?
3. Do you think the villagers are right to protest? Do you think they will make a difference?



Additional reading 4

Darfur: the world's first 'climate change war'?

Darfur is a state in western Sudan. Since February 2003, the region has suffered civil war between different ethnic groups. On one side of the conflict are the Sudanese government military and Janjaweed militia, who mostly come from the Arab Baggara tribes. On the other side of the conflict are the Sudan Liberation Movement (SLM) and the Justice and Equality Movement (JEM), who mostly come from the Fur, Zaghawa and Massaleit ethnic groups. In 2003 the SLM and JEM accused the Sudanese government of favouring Arabs in Darfur, and ignoring black Africans. The war started when they started to attack Sudanese government forces.

The UN estimates that up to 450,000 people may have been killed in the conflict. Most of the dead are civilians. The Janjaweed militia in particular has been accused of genocide – the deliberate destruction of an ethnic, religious or national group. Reports from the area have described how soldiers regularly visit villages, rape the women and girls, kill people, and destroy the houses. Over 2.5 million people have been displaced from their homes and many now live in refugee camps in neighbouring Chad and the Central African Republic.

Although the conflict is between different ethnic groups, many people argue that the problems in Darfur have been partly caused by climate change that has resulted from global warming.



In the last 40 years, an environmental crisis has been developing in Darfur. The amount of rainfall has decreased by about 30%, meaning that more and more agricultural land has become desert. The lack of rain has also created a severe water shortage, and the region has suffered famine on several occasions because farmers can't produce enough crops. Settled farmers (who stay in the same place) and pastoralists (who move their animals from place to place) have found themselves in conflict because the amount of fertile land has decreased. Also, the population has been squeezed into a smaller and smaller area by the growing desert. This has caused overpopulation.

These environmental problems have created and worsened divisions between ethnic groups and people with different ways of life.

Similar environmental problems are happening in many parts of Africa and many people worry that similar wars will break out in these places. They fear that the world now faces an era of 'climate change wars'.

Exercises: Are these statements true or false?

1. Most of the 450,000 people who have been killed in the Darfur conflict are civilians.
2. Many people argue that climate change is the only reason for the problems in Darfur.
3. Over the past 40 years, the amount of rainfall and fertile land in Darfur have increased.
4. Many people fear that more wars will be caused by climate change in the future.

Discussion: What, if anything, does the situation in Darfur tell us about the relationship between people and the environment?