

# Wonderful Water

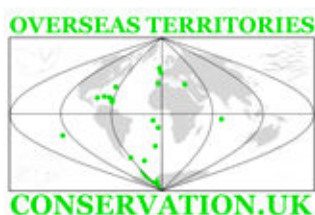
An Environmental Education Programme

A Watery World

Mangrove Ecosystems in TCI

5. Climate Change and Mangroves

*Pupils' Text*



TCI  
Education Department



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## An Environmental Education Programme

### A Watery World

### Mangrove Ecosystems in TCI

## 5. Climate Change and Mangroves

### Pupils' Text

This environmental education programme has been produced by the UK Overseas Territories Conservation Forum (UKOTCF) and the Turks and Caicos Department of Education.

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The project was developed from an original idea by Mr Edgar Howell, Director of Education, Turks and Caicos Islands, and these materials developed by a team co-ordinated by Ann Pienkowski, Environmental Education Co-ordinator, UKOTCF. In particular, thanks to Bryan Naqqi Manco for his input to this unit.

It is hoped that through the teaching materials developed for this project, students in TCI will gain a greater understanding of the importance of the water ecosystems in TCI, and the need to conserve these.

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## Objectives

You will:

- Learn about climate change and how it affects the environment.
- Find out how human activities are speeding up climate change.
- Find out how climate change affects wetlands, including mangroves
- Find out how climate change could affect people's lives

## What is climate change?

Climate is the general weather in one place over a long period of time. So it is not what the weather is like today, it is the average weather over many years. Scientists have noticed that over the last 100 years the general climate of the earth is changing, it is getting warmer. Changes in the earth's climate are nothing new. Fifty million years ago there was no ice at the north and south poles. But 18,000 years ago during the Ice Age much of the earth was covered in ice.



So, if climate change is nothing new, why does it matter that it is happening again? It matters, because it is happening very quickly now, and the activities of people are causing it.

These photos, taken in 1941 and 2004, show that the Muir Glacier in Alaska has retreated more than 12 km (7.5 miles) in 63 years. This is one example of how fast global warming is taking place.

Many plants and animals cannot adapt quickly enough to the changes.

When the sea temperature gets too warm, the algae which live within the coral disappear and the coral turns white. The algae photosynthesise and provide the coral with vital food. Without the algae, the coral eventually dies.



The changes are causing severe weather effects which affect people, like more storms and hurricanes.

**Hurricane Ike,  
Providenciales, 2008**



### **What are Greenhouse gases and the Greenhouse effect?**

Greenhouse gases are responsible for the greenhouse effect. The most well known greenhouse gas is carbon dioxide. Other greenhouse gases are methane, carbon monoxide, sulphur dioxide, nitrous oxide and water vapour.

Life on earth actually needs some of these greenhouse gases to survive. Plants need carbon dioxide to make their own food (photosynthesis), and the plants in turn produce oxygen which all life needs.

Greenhouse gases also keep the plant warm enough for life to exist. This is because the greenhouse gases form a protective layer in the earth's atmosphere that stops all the sun's warm bouncing back into space.

### **Why is this a problem now?**

Hundreds of years ago there were no cars, planes, buses, electricity or power stations. Then scientists discovered electricity and invented the engine. Both of these needed to burn fossil fuel, like oil, coal and gas.

The carbon found in coal came from the carbon dioxide that the trees living 300 million years ago used when they were alive, during photosynthesis.



## The Greenhouse Effect

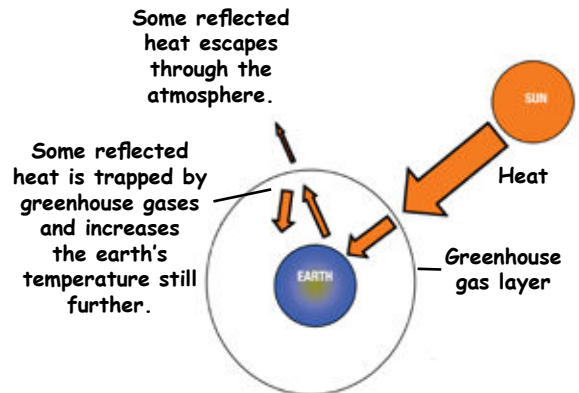
When we burn fossil fuels, like coal, oil and gas, they produce fumes which contain a lot of carbon dioxide and other greenhouse gases. Where do all these fumes go? Up into the sky and they keep going up into the atmosphere until they can rise no further. They form a kind of gassy blanket around the earth.

What happens next is similar to what happens in a greenhouse. In a greenhouse:

1. The sun shines through the glass and warms up the inside of the greenhouse, helping the plants to grow and the tomatoes to ripen.
2. The heat can't escape out of the glass roof again.
3. It slowly but surely gets hotter and hotter in the greenhouse until someone opens the door or night falls.

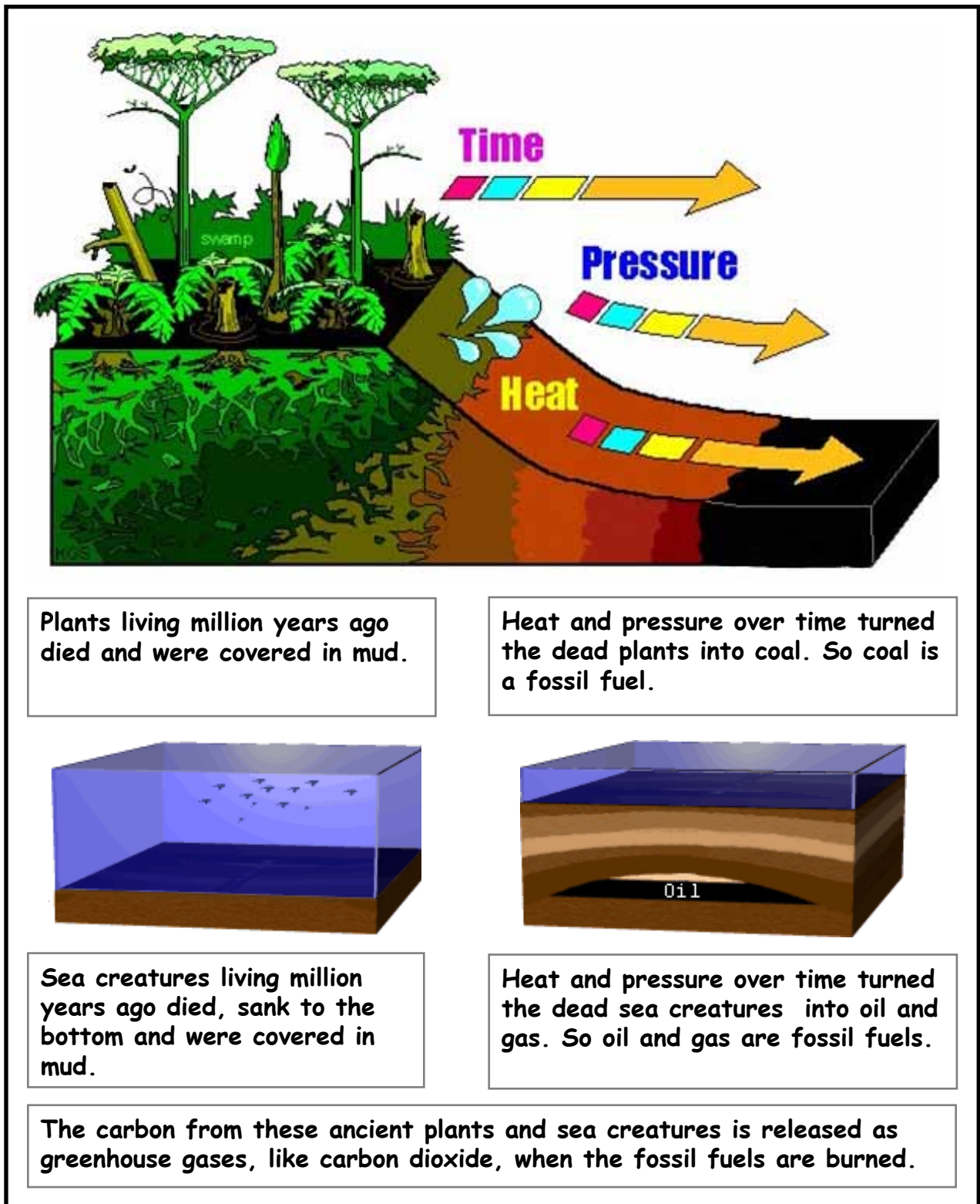
Well the same sort of thing is happening to Earth!

1. The sun shines through the layer of gases (which act like the greenhouse roof) and provides Earth with the light and heat it needs for all the plants and animals to survive.
2. When it reaches the ground, the sunlight is reflected back up into the sky as infra-red waves.
3. In the past, most of these rays used to travel up and up beyond the atmosphere, out of harm's way.
4. Now, however, the thicker layer of greenhouse gases absorbs more of the heat on its way back through the atmosphere, and reflects much of it back to Earth.
5. The heat is then trapped between the layer of gases and the ground, just like in a greenhouse. This means that the air gradually heats up more and more.

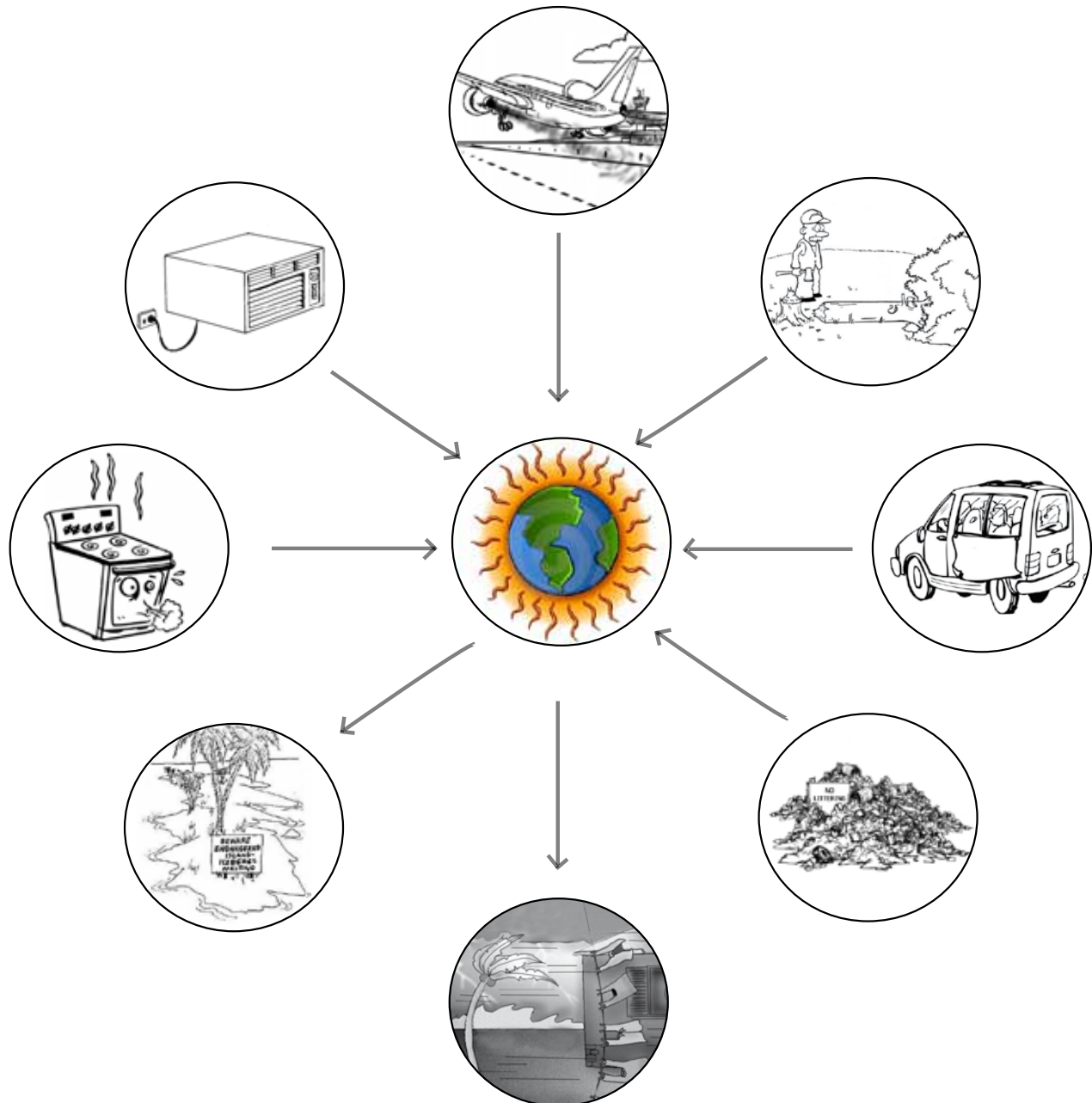


The carbon found in oil came from prehistoric and microscopic sea creatures and plants living millions of years ago. Many of these tiny sea creatures had shells, which are made of calcium carbonate. The minute plants would have used carbon dioxide during photosynthesis, just like the prehistoric trees. When these microscopic plants and animals died, they sank and got squashed under the sea floor. The pressure and heat of squeezing turned the carbon in their remains to liquid oil or gas.

This period in the earth's history is called the carboniferous period, because the coal, oil and gas that was formed then is full of carbon.



There are many more people in the world now, all using electrical devices and transport powered by engines. Industry uses a lot of energy to make the things we use everyday, and which we take for granted. When we burn coal, oil or gas to make electricity or run engines, carbon dioxide or carbon monoxide is released into the air.



**This diagram shows some of the reasons for global warming, and what the effects in TCI could be.**





There are more animals in the world to feed all these people. They produce greenhouse gases as well as meat and milk. Cows constantly burp methane while they chew the cud.



We produce a lot of rubbish. Methane is produced by the bacteria which rot all the organic rubbish down.



We have chopped down a lot of forests, and deforestation continues rapidly. Much of the carbon dioxide which the tree has used while it is growing is released back into the atmosphere, by burning the tree, or the tree rotting away.

Fewer trees mean that less of the carbon dioxide in the air is being used.

So, people's actions are releasing more greenhouse gases into the atmosphere, and reducing the number of trees which could use up carbon dioxide.

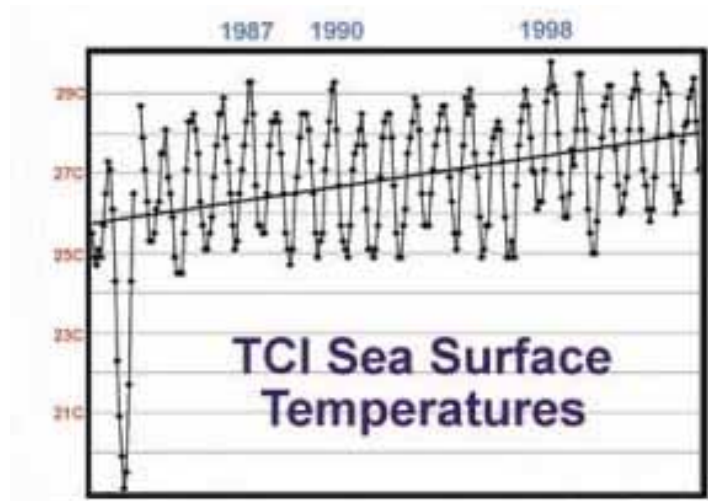
More greenhouse gases means that more of the sun's heat stays within the earth's atmosphere and planet earth is getting hotter.

Warmer air temperatures lead to more water evaporation which eventually causes more heavy rainfall in some parts of the world, but severe drought in other parts of the world.



The warmer air is causing the ice caps at the North and South Poles, and the glaciers on the high mountains, to melt. In higher temperatures water expands. Both of these effects are causing sea level rises.

This graph shows how the sea surface temperatures are rising around the Turks and Caicos Islands. As sea temperature rises, the sea water expands, so sea levels rise too.



The Turks and Caicos Islands, like many other parts of the world, are low-lying. Even a small rise in sea level is likely to cause low areas to be flooded, and freshwater areas replaced by saltwater. This will have a serious effect on people who live here.

The problem of too much carbon dioxide in the atmosphere is made worse by warmer sea temperatures. Water is good at absorbing carbon dioxide, but becomes less good as it heats up, which means that as the seas warm up due to global warming, more carbon dioxide is released from the sea into the atmosphere.

Another effect of this climate change is an increase in the number and intensity of hurricanes.



**Grand Turk just after Hurricane Ike, 2008. The photo on the left shows the height of the flooding, and the one on the right a similar area after the water has subsided, with hurricane debris in the salina.**

In September 2017 TCI was hit by 2 very severe hurricanes, Irma and Maria, Maria coming just 2 weeks after Irma. Irma, a category 4 caused a lot of damage; Maria, a category 5, was the strongest hurricane to ever hit TCI. All of the islands were badly affected, but some of the worst damage was on Grand Turk, Salt Cay and South Caicos. Fortunately no-one was killed. Recovering from such devastation takes a long time, and costs a lot of money. The increasing frequency and severity of hurricanes is an indication of climate change. Mangroves play a key role in protecting against storm surge and erosion.

Below are some photos of the damage caused by Hurricane Irma, and a satellite image of Hurricane Maria, with the eye approaching TCI.





## What about our mangroves?

Climate change, global warming, could cause:

- Rising sea levels which could flood mangrove forests and kill species like Black and White Mangroves. Mangrove forests require stable sea levels for long-term survival.
- Increased freshwater flooding from storms and hurricanes which could also kill the mangroves.
- More severe storms which could uproot our mangrove forests.

Hurricanes Hanna and Ike in September 2008 damaged many of the mangroves, recovery is very slow, and could take many years. After Hurricane Hanna and Ike, the sea surge went as high as 2.6 m (measured at the Red Mangrove area in Grand Turk). The sea surge was aggravated by gusty winds that carried sands and other debris, thus increasing the damage to the mangroves. South Creek on Grand Turk was badly affected.



**Man o' War Bush, Middle Caicos was very important for breeding Magnificent Frigate Birds. This bush was destroyed by Hurricane Ike.**



**Mangroves on Salt Cay damaged by Hurricane Ike**

The long term effects of Hurricanes Irma and Maria are not known. In the short term, many of the outer cays, like Big Sand Cay, lost all their vegetation. These are important breeding areas for seabirds. The effect of Hurricane Irma on the Caicos Bank can be seen by comparing these two satellite images:



**Before Irma**



**After Irma**

**Hurricane Irma caused massive movement of the sediment in the Caicos Bank.**

We have learnt how important mangroves are, so the loss of our mangrove ecosystems would be tragic.



## How can we tackle climate change?

We can all try to reduce the amount of energy generated from fossil fuels that we use.

However, protecting our natural environment will also have a positive effect on reducing the amount of carbon dioxide in the atmosphere.



**Dead mangrove stumps and eroding shoreline, one year after this area was polluted by oil from the Deep Horizon oil spill.**

Mangrove forests have a very important role to play. They protect coastlines from erosion and flooding during storms and hurricanes. They remove carbon dioxide from the atmosphere during photosynthesis, and store it.

Sadly, destruction of mangrove forests continues. Over half of the world's original mangrove forests have already been destroyed.

**This map shows a proposed development in Abu Dhabi. Why do you think it is called Mangrove Village?**

