



Glenlola Collegiate School

excellence through commitment, contribution and caring

1.7B

**Ecological relationships
& energy flow**

**WATCH THIS VIDEO
AND MAKE NOTES
ON A WHITEBOARD**





**SHARE YOUR NOTES
WITH YOUR PAIR AND
MAKE ONE SET OF NOTES**

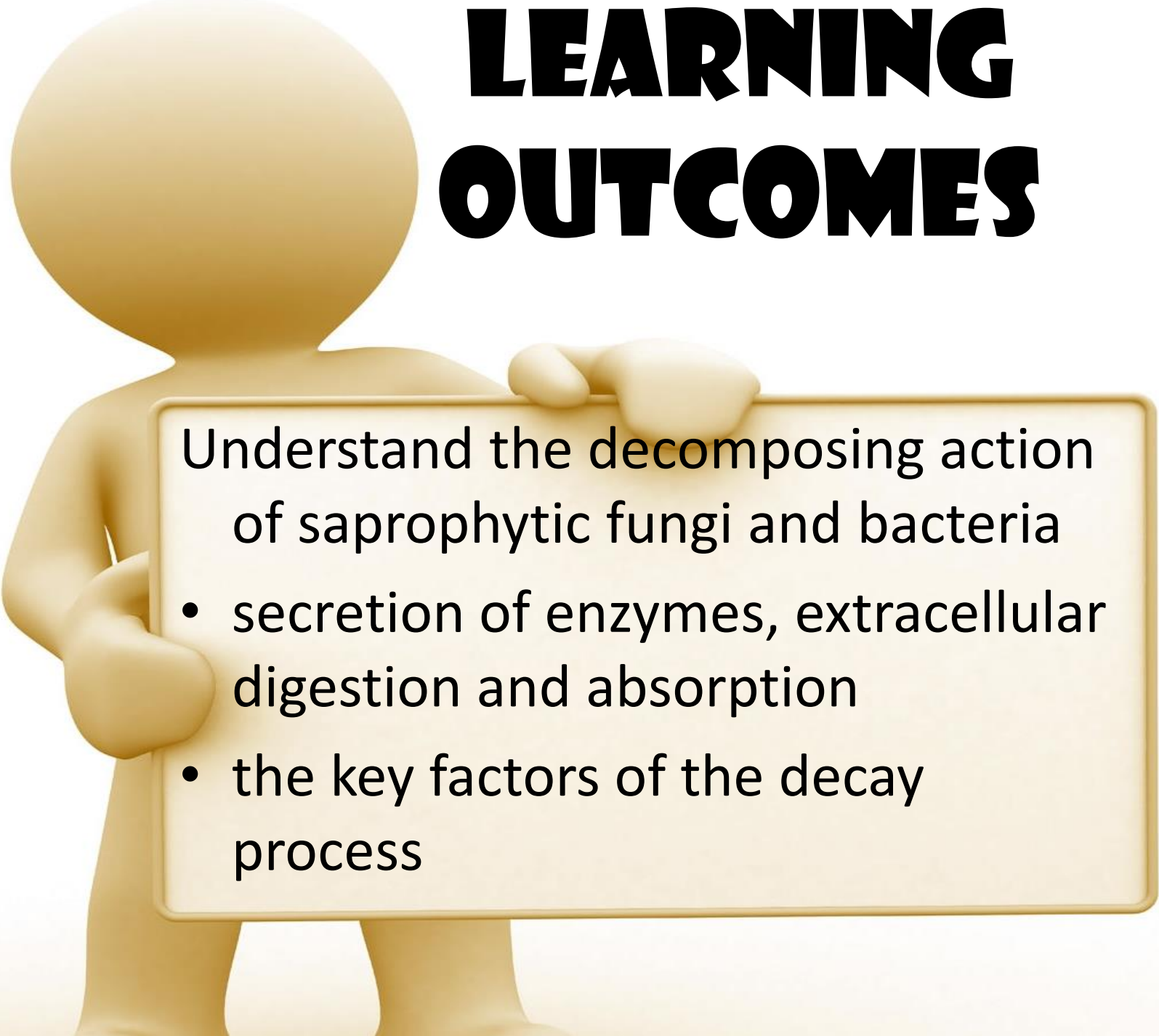
**SHARE YOUR NOTES
WITH ANOTHER PAIR
AND MAKE ONE SET OF NOTES**

USE THE GROUP NOTES TO

1. **DESCRIBE** *what you saw happening*
2. **EXPLAIN** *what you saw happening*

SHARE GROUP ANSWERS

LEARNING OUTCOMES

- 
- Understand the decomposing action of saprophytic fungi and bacteria
- secretion of enzymes, extracellular digestion and absorption
 - the key factors of the decay process



this bread mould is a fungus



**this onion
is being
broken down
by bacteria**

DECOMPOSITION

Bacteria and fungi are examples of **decomposers**.
Decomposers break down dead organisms.

Decomposers are important to an ecosystem because **they return nutrients to the environment.**



DECOMPOSING ACTION OF SAPROPHYTIC FUNGI AND BACTERIA

- Decomposers carry out **SAPROPHYTIC nutrition**.
- Saprophytic bacteria and fungi **secrete enzymes** into the soil or dead organism.
- The enzymes break down (**digest**) the organic material and then it is **absorbed** by the bacteria or fungi.
- Because this occurs outside the animal cells it is known as **extracellular digestion**.

**WHAT DO THE
DECOMPOSERS
USE THE
ABSORBED
NUTRIENTS FOR?**

The decomposers use the absorbed nutrients
for

**RESPIRATION
AND TO PRODUCE
NEW CELLS**

**WHAT DO THE
DECOMPOSERS
NEED FOR
RESPIRATION TO
OCCUR?**

GLUCOSE & OXYGEN

**WHAT DO THE
DECOMPOSERS
RELEASE FROM
RESPIRATION?**

**WATER &
CARBON DIOXIDE
& ENERGY**

**WRITE AN
EQUATION FOR
RESPIRATION**

**GLUCOSE +
OXYGEN →
WATER +
CARBON DIOXIDE
+ ENERGY**

**WHAT HAPPENS
TO THE
CARBON DIOXIDE?**

**RELEASED FROM
THE CELLS INTO
THE AIR**

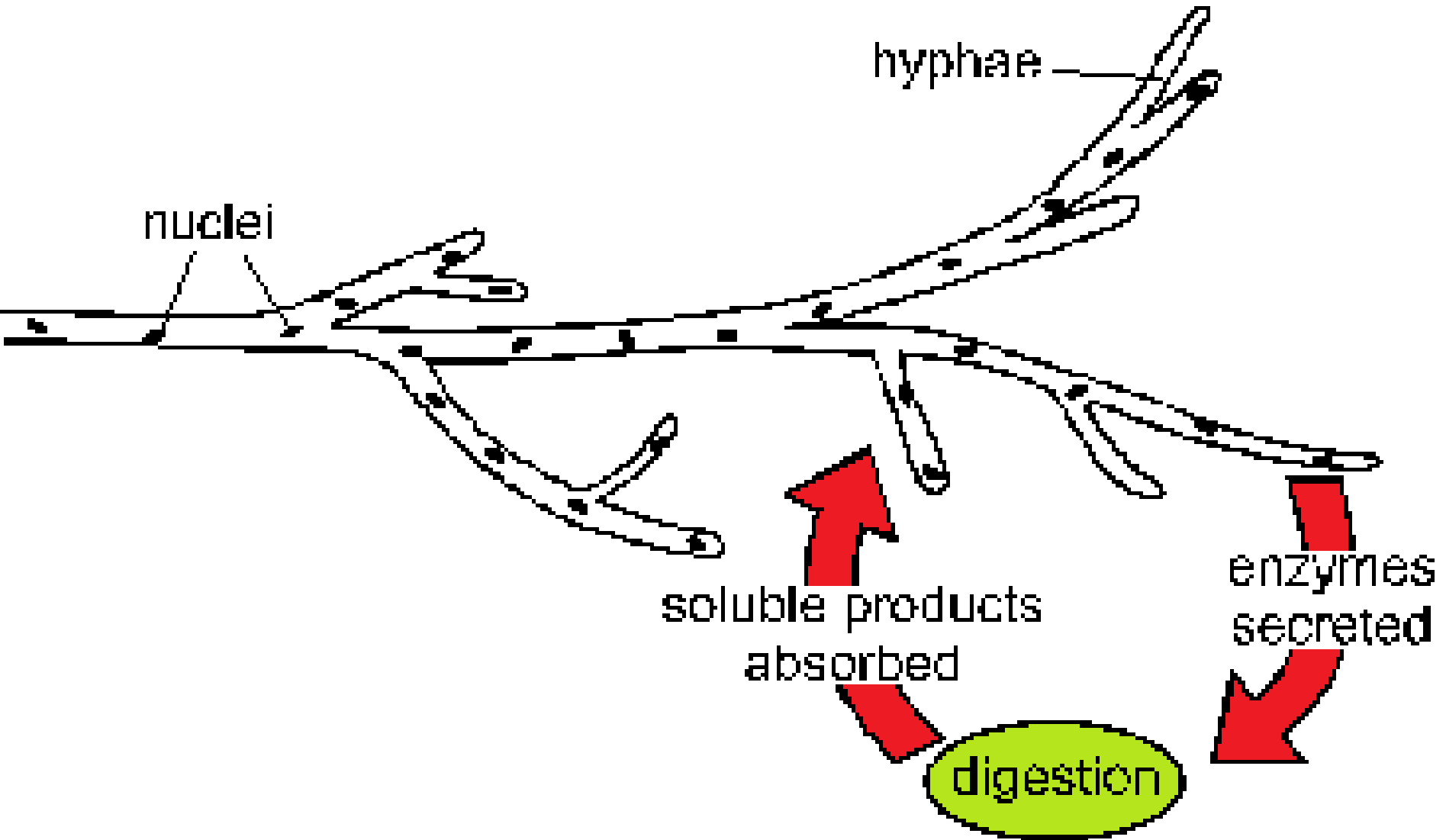
**WHAT HAPPENS
TO THE
WATER?**

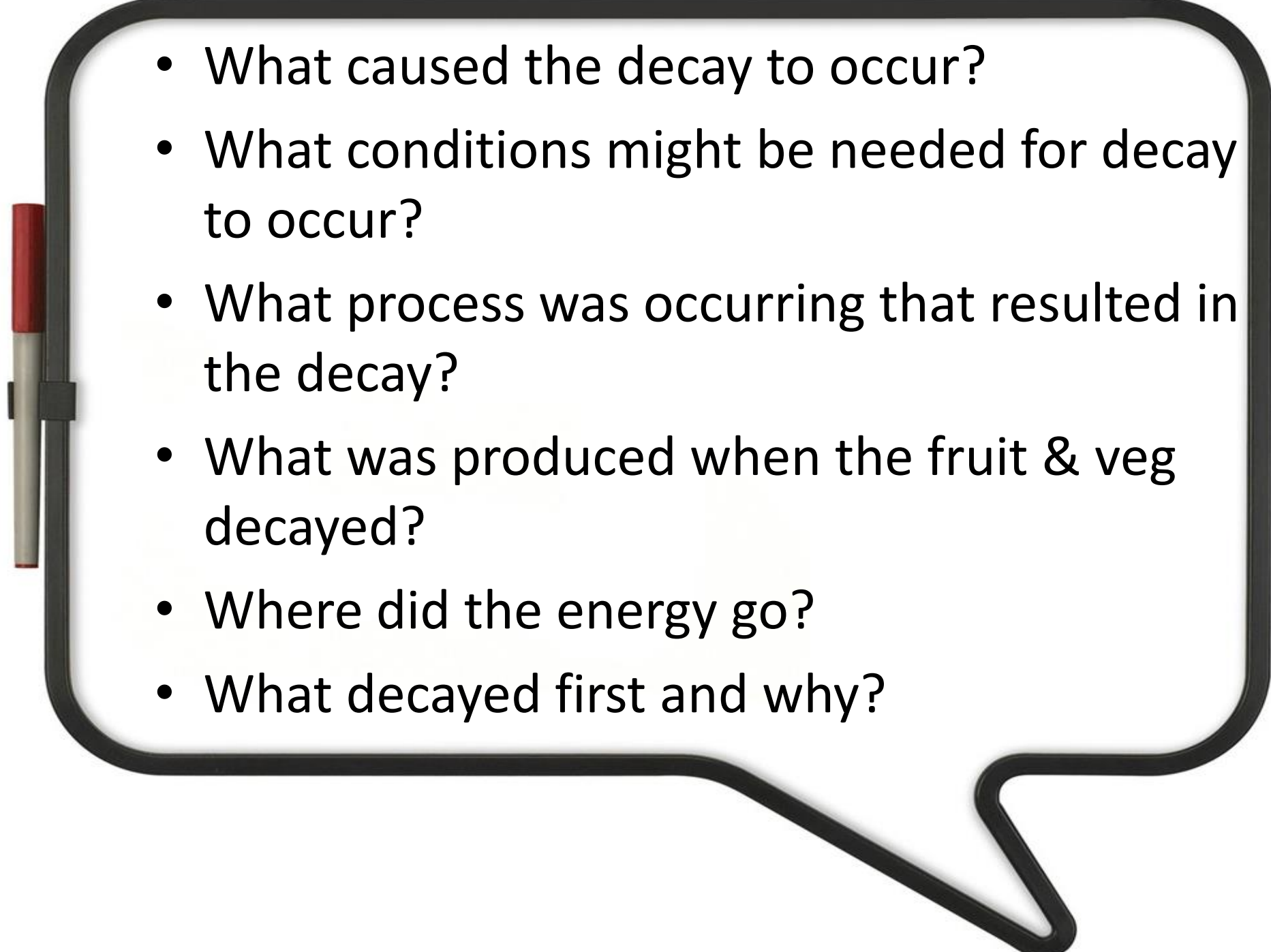
**USED BY THE CELLS
AS A SOLVENT, AS
PART OF THE
CYTOPLASM AND IN
CHEMICAL
REACTIONS**

**WHAT HAPPENS
TO THE
ENERGY?**

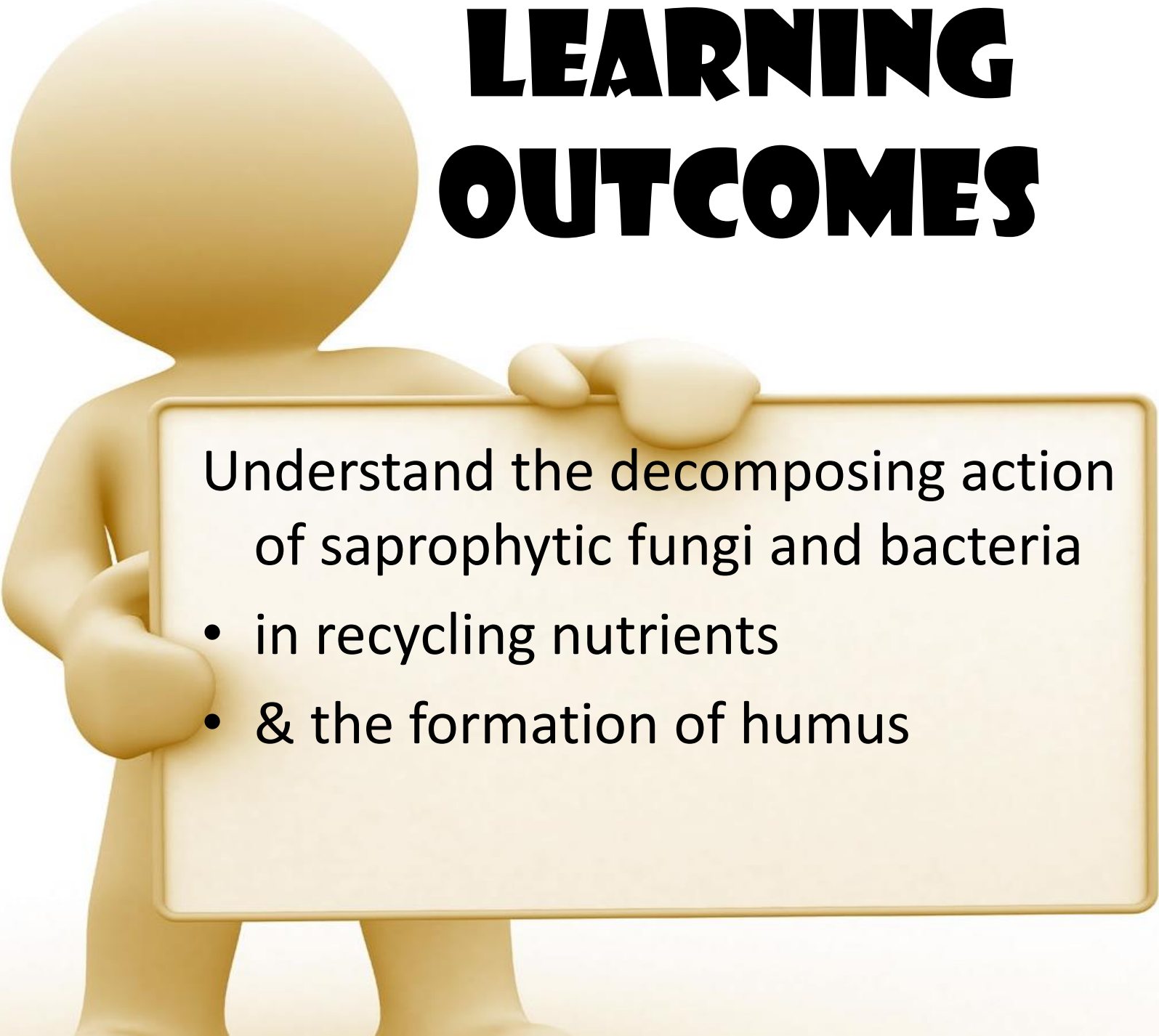
**USED BY THE CELLS TO
CONVERT THE
ABSORBED NUTRIENTS
INTO CARBOHYDRATES,
FATS FOR STORAGE AND
PROTEINS FOR
GROWTH.**

EXTRACELLULAR DIGESTION - A REMINDER



- 
- What caused the decay to occur?
 - What conditions might be needed for decay to occur?
 - What process was occurring that resulted in the decay?
 - What was produced when the fruit & veg decayed?
 - Where did the energy go?
 - What decayed first and why?

LEARNING OUTCOMES

- 
- A 3D rendered orange character with a large head and small body, holding a rectangular sign. The character is positioned on the left side of the frame, with its right hand resting on top of the sign and its left hand holding the side. The sign is white with a thin orange border and contains text.
- Understand the decomposing action of saprophytic fungi and bacteria
 - in recycling nutrients
 - & the formation of humus

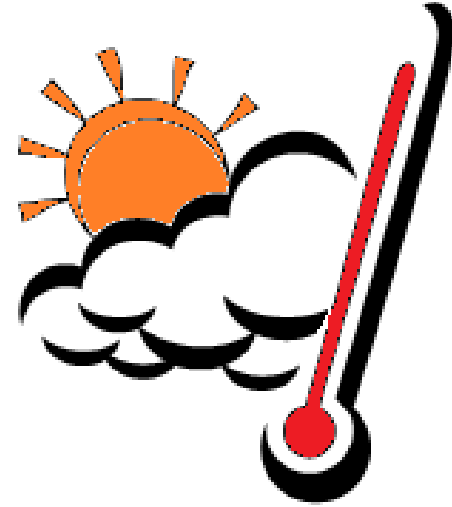
FORMATION OF HUMUS

A close-up photograph of a person's hands holding a large quantity of dark, rich, crumbly soil. The soil is piled in the palms and fingers, showing its moist and sticky texture. The background is a blurred blue fabric, likely a shirt. The lighting is bright, highlighting the texture of the soil and the skin of the hands.

Humus is the organic content of the soil formed from decomposing plant and animal material. It can be used as a **fertiliser**. It is dark and sticky and gives the soil good '**crumb structure**', which helps the soil to hold on to water.

Decomposition takes place more quickly when conditions are optimum. These include:

A warm temperature



Adequate moisture

A large surface area



Detrivores such as earthworms and beetles break up detritus (dead material) increasing the surface area.



Give two reasons why large, flat tropical plant leaves will decompose much more quickly than Norwegian pine needles.



bear thoughts

The background of the slide features two cartoon-style brown bears standing upright on a green field. They are facing each other as if in conversation. The field is dotted with small yellow and orange flowers. In the background, there are rolling green hills, a few dark green trees, and a large, bright yellow sun with an orange glow in the upper right corner against a clear blue sky.

- <http://www.dvolver.com/live/movies-881590>

Watch the movie.

You are the expert in the second scene.

Your task is to produce a brief script describing and explaining what happens to leaves that fall in the autumn



http://www.bbc.co.uk/schools/gcsebitesize/science/add_gateway/greenworld

Chose: Decay - bacteria and fungi

Detritus feeders

Decomposers



Long-horned beetle holes



Bark beetle engraving



Carpenter ant galleries



Termite and carpenter ant work



Dry rot fungus



Wood reduced to powder

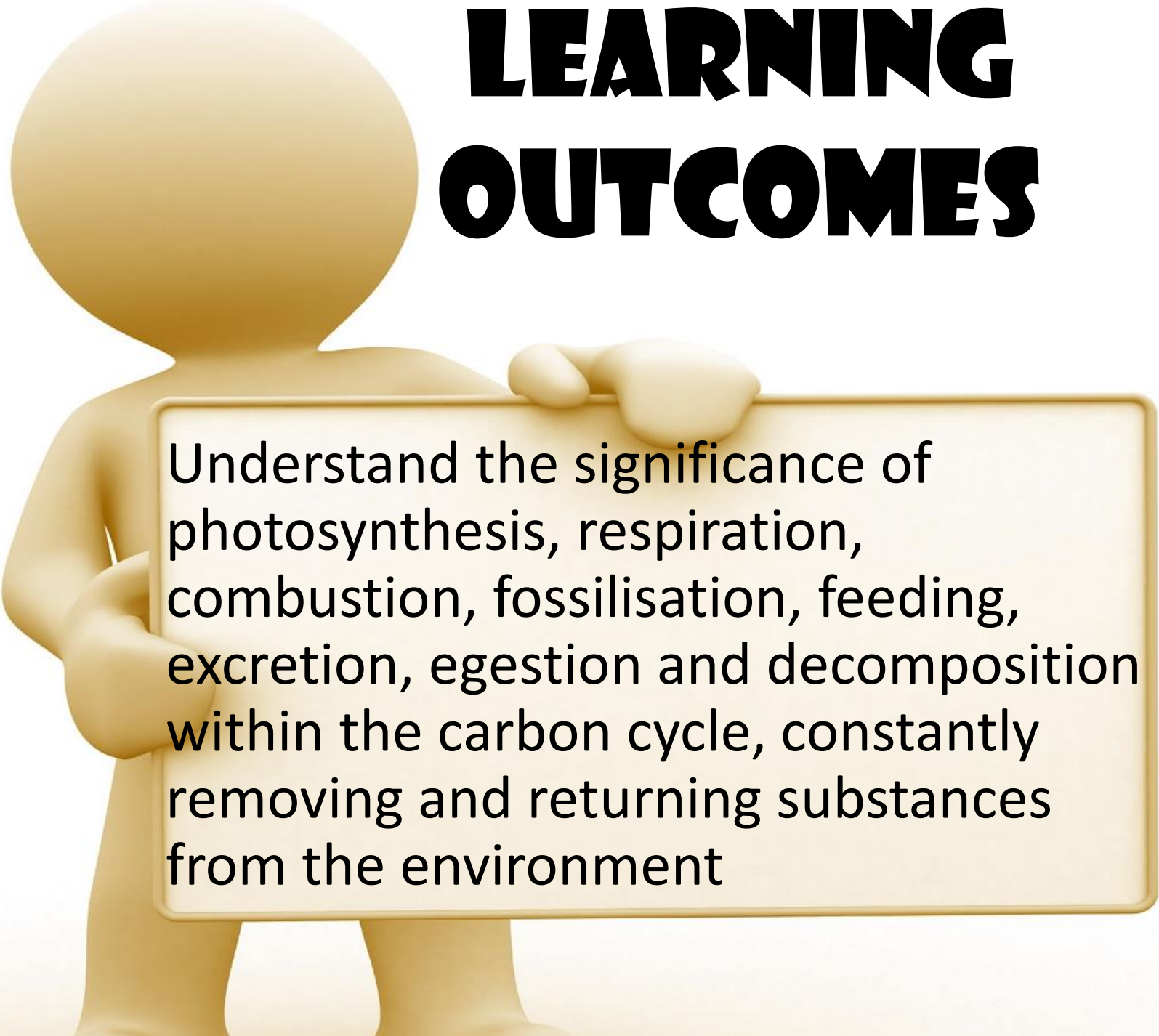
Mushroom



Time progression →

Powder broken down by decomposers into plant nutrients in soil

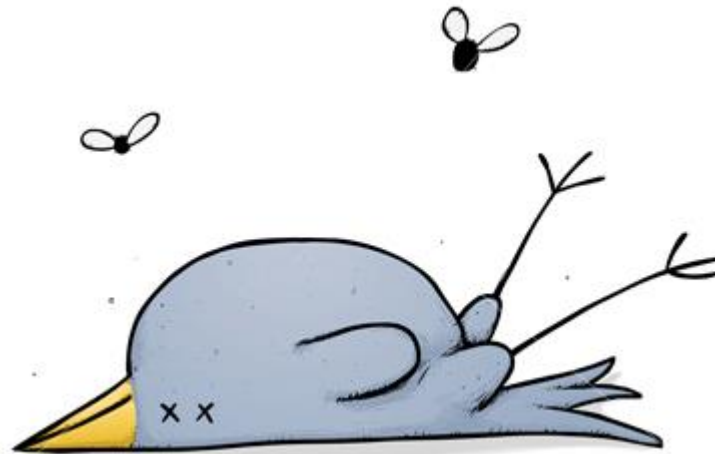
LEARNING OUTCOMES

A 3D rendered yellow figure, resembling a stylized person, is holding a large, light-colored rectangular sign with rounded corners. The figure is positioned on the left side of the frame, with its right hand resting on top of the sign and its left hand supporting it from the side. The sign contains text describing learning outcomes related to the carbon cycle.

Understand the significance of photosynthesis, respiration, combustion, fossilisation, feeding, excretion, egestion and decomposition within the carbon cycle, constantly removing and returning substances from the environment

DECOMPOSITION & RECYCLING

Decomposition is important in the recycling of nutrients, such as **carbon** and **nitrogen**, found in dead plants and animals and their waste.

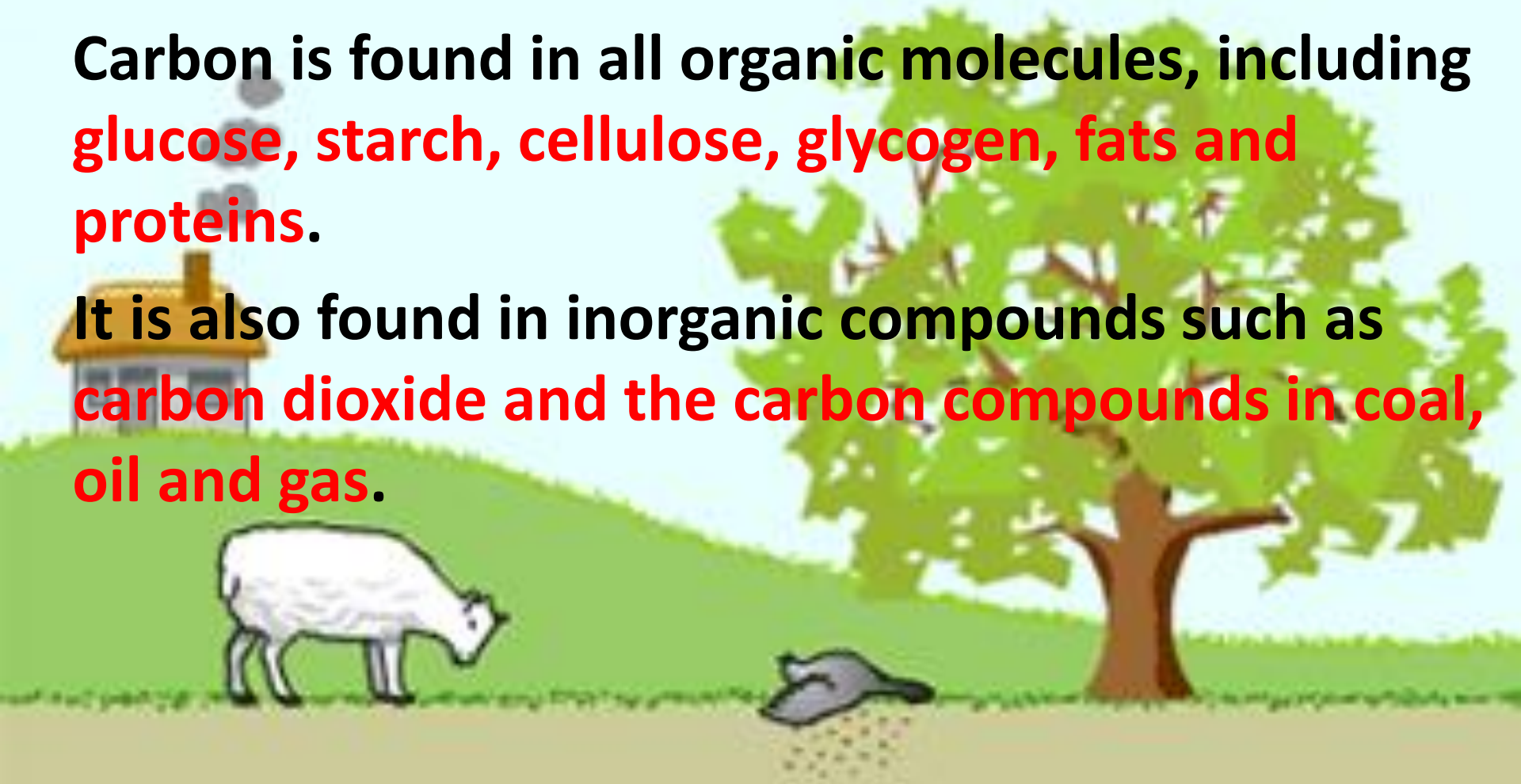


CARBON CYCLE



Carbon is found in all organic molecules, including **glucose, starch, cellulose, glycogen, fats and proteins.**

It is also found in inorganic compounds such as **carbon dioxide and the carbon compounds in coal, oil and gas.**



ACTIVITY

- ARRANGE THE LAMINATED CARDS ON A3 OR POSTER PAPER AND DRAW ARROWS TO MAKE LINKS BETWEEN THE CARBON COMPOUNDS FOUND IN AN ECOSYSTEM
- NAME THE PROCESSES THAT CHANGE THE CARBON COMPOUNDS FROM ONE FORM INTO ANOTHER AND LABEL THESE ON THE ARROWS

AIR

contains the
carbon compound

CARBON DIOXIDE

PLANTS

take in carbon dioxide from the air
and make

carbon containing compounds eg

GLUCOSE &

STARCH

ANIMALS

Eat plants and other animals and make carbon containing compounds eg

**GLUCOSE, FATS
& PROTEINS**



DECOMPOSERS

Feed on dead plants and animals and
release

CARBON DIOXIDE

when they respire

FOSSIL FUELS

contain
carbon compounds eg

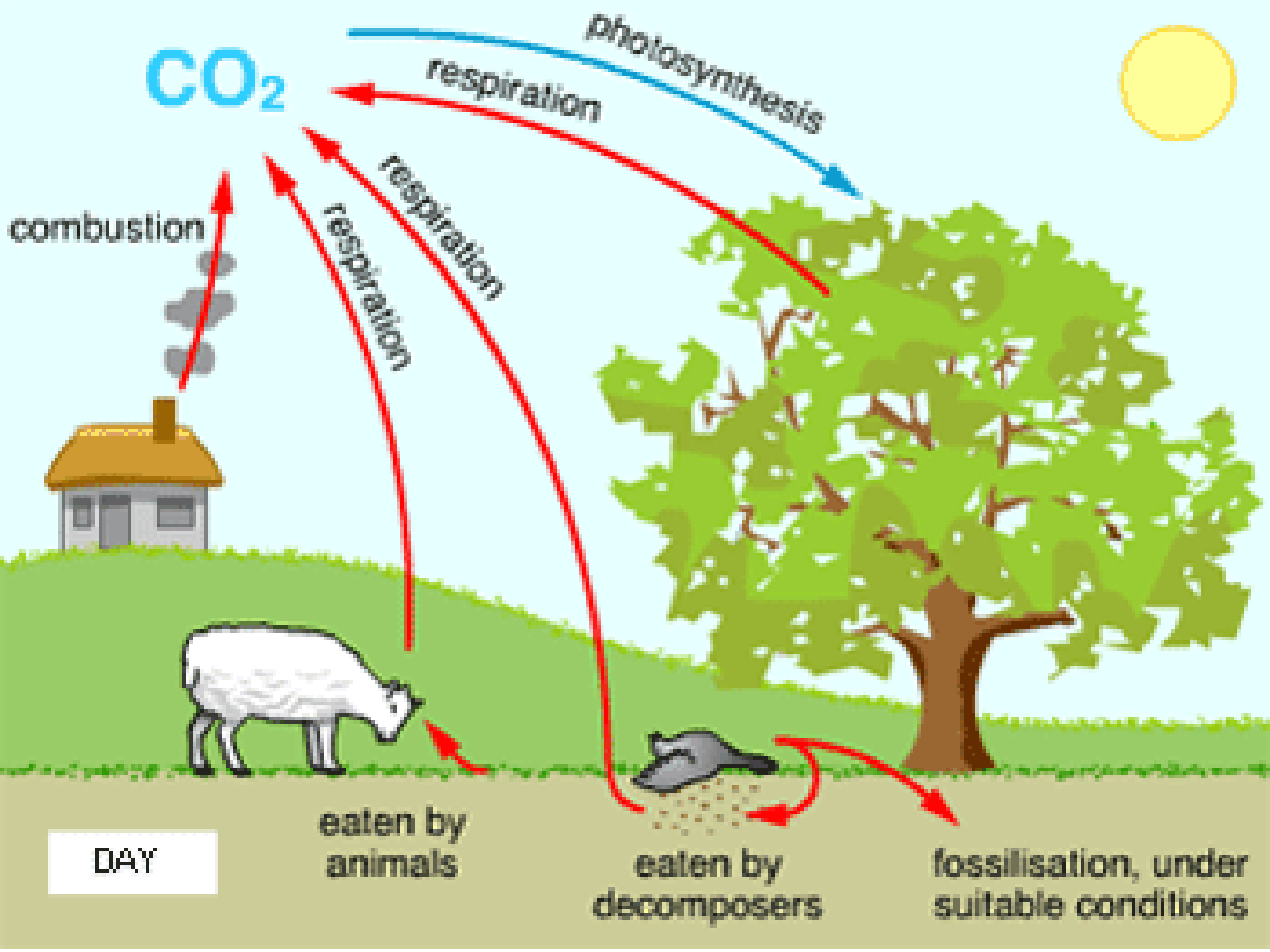
**COAL, OIL &
NATURAL GAS**

They release carbon dioxide during
combustion

DESIGN A CARBON CYCLE POSTER

USE THE GCSE TEXT BOOK, YOUR GROUP
ACTIVITY AND/OR THE INTERNET TO
PRODUCE A CARBON CYCLE POSTER FOR
YOUR NOTES.

SOME EXAMPLES ARE INCLUDED ON THE NEXT
SLIDES



CO_2

photosynthesis

respiration

combustion

respiration

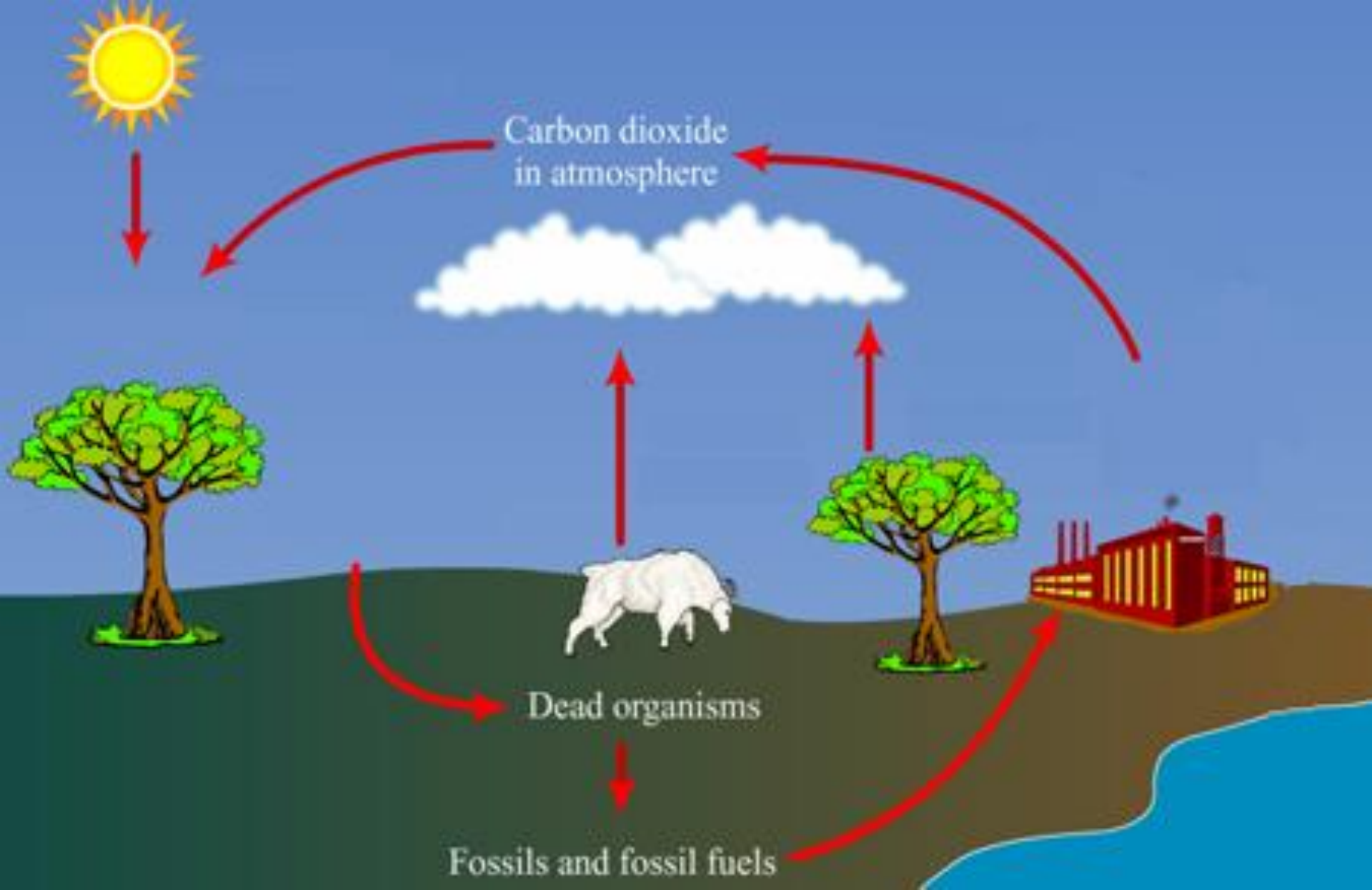
respiration

eaten by animals

eaten by decomposers

fossilisation, under suitable conditions

DAY

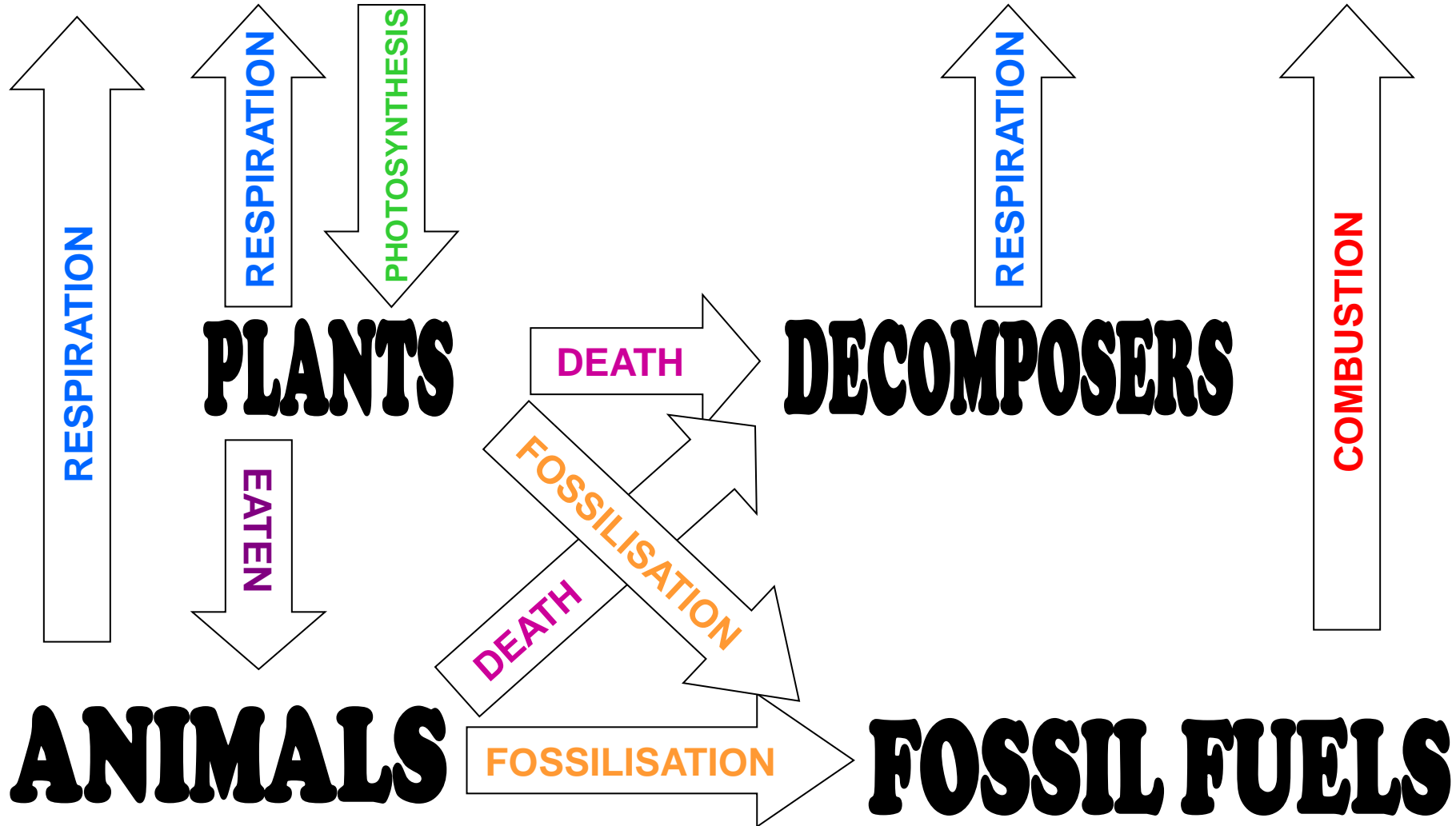


Carbon dioxide
in atmosphere

Dead organisms

Fossils and fossil fuels

carbon dioxide in air

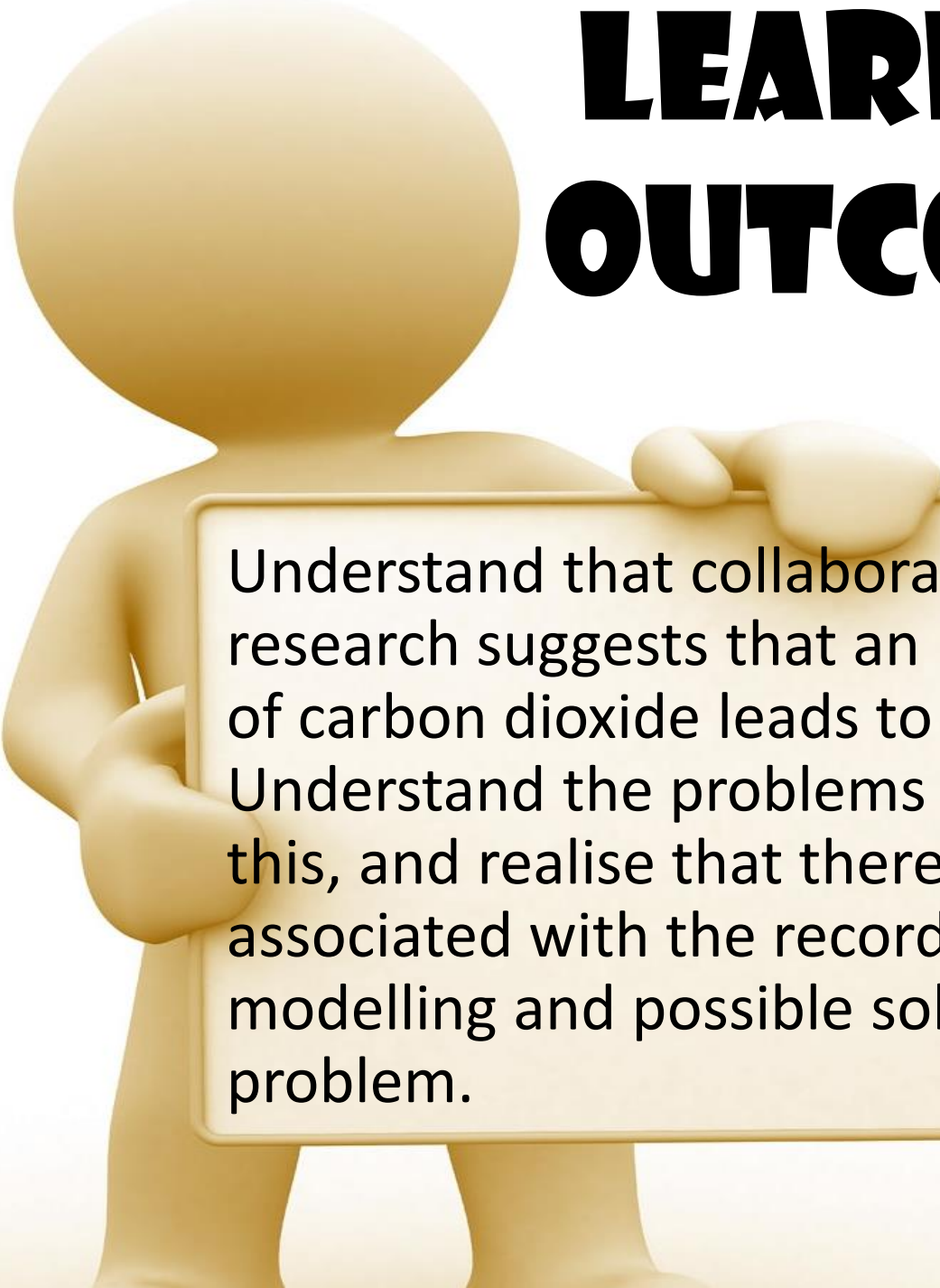




http://www.bbc.co.uk/schools/gcsebitesize/science/add_gateway/greenworld

Chose: The carbon and nitrogen cycles

LEARNING OUTCOMES

A 3D rendered orange character with a large head and small body, holding a rectangular sign with rounded corners. The character is positioned on the left side of the frame, with its right hand resting on top of the sign and its left hand holding the bottom edge. The sign contains text about collaborative scientific research and global warming.

Understand that collaborative scientific research suggests that an increase in levels of carbon dioxide leads to global warming
Understand the problems associated with this, and realise that there is controversy associated with the recording, sources, modelling and possible solutions to this problem.



video

CARBON DIOXIDE & THE GREENHOUSE EFFECT

Carbon dioxide, methane and water vapour in the Earth's atmosphere trap **solar radiation**. This causes the atmosphere to act as an insulator, keeping the Earth warm.

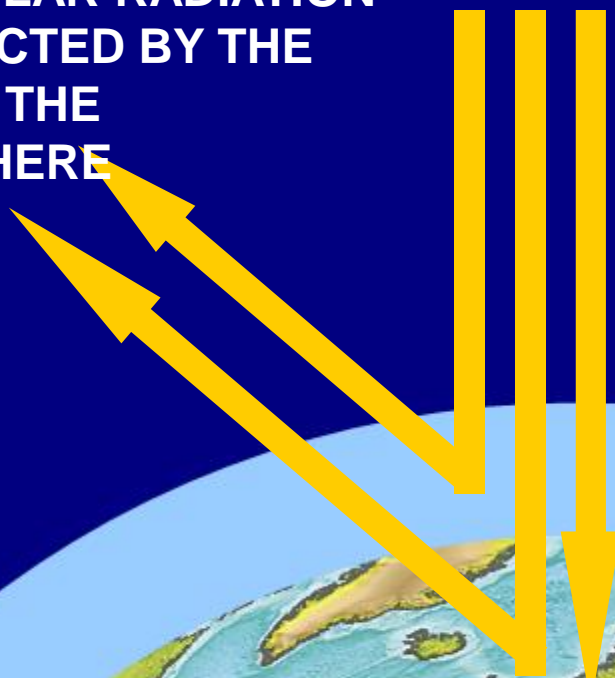
This '**greenhouse effect**' is necessary for life as we know it.

1 SOLAR RADIATION IS EMITTED BY THE SUN



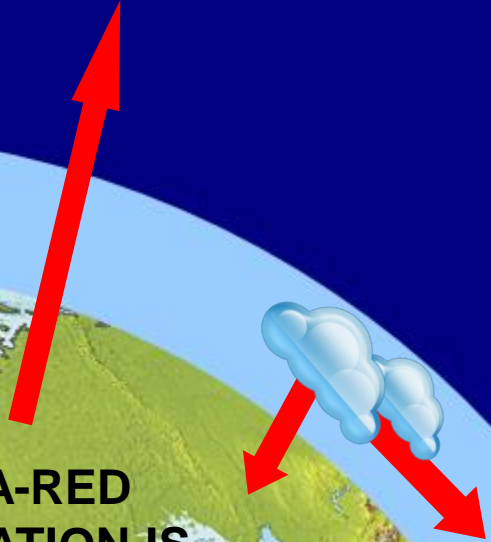
5 Some of the Infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules (CO₂, CH₄) and clouds. The effect of this is to warm the earth's surface and the lower atmosphere

2 SOME SOLAR RADIATION IS REFLECTED BY THE EARTH & THE ATMOSPHERE



3 ABOUT ½ OF THE SOLAR RADIATION IS ABSORBED BY THE EARTH'S SURFACE AND WARMS IT

4 INFRA-RED RADIATION IS EMITTED FROM THE EARTH'S SURFACE



THE LINK BETWEEN CARBON DIOXIDE LEVELS AND GLOBAL WARMING

The problem in recent years has been an *increase in the concentration of gases that contribute to the greenhouse effect, including carbon dioxide, methane gas and water vapour.*

Two main changes have contributed to the rise in carbon dioxide levels and therefore carbon cycling on Earth:

- 1. Increased combustion of fossil fuels** has added more carbon dioxide to the atmosphere;
- 2. Increased deforestation** has removed many forests, meaning that less carbon dioxide is taken out of the atmosphere by the process of photosynthesis.

INCREASING CARBON DIOXIDE LEVELS

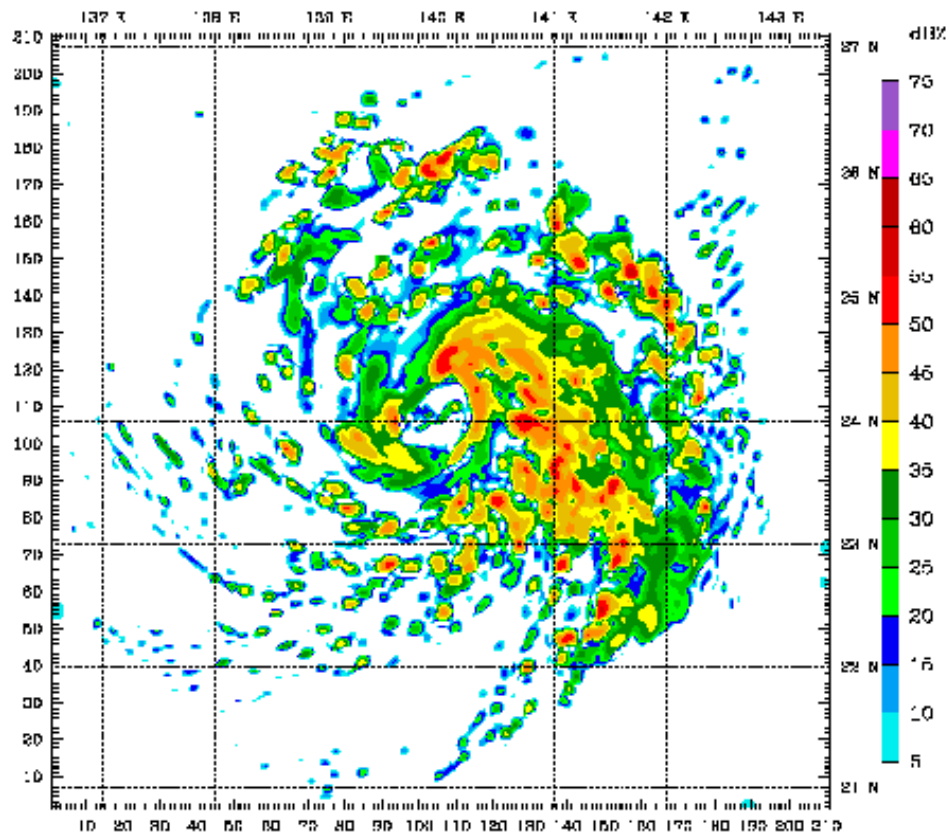
*The changes mean that the carbon cycle has become unbalanced and has led to an enhanced greenhouse effect, known as **global warming** i.e. **a rise in the average temperature of the Earth's surface.***

EVIDENCE FOR GLOBAL WARMING

Collaborative scientific research between scientists in many different countries has recorded changes in CO₂ levels in the atmosphere. One method of showing this is by measuring the CO₂ levels in **ice cores** collected from polar ice caps. It is possible to analyse the air trapped in the ice thousands of years ago, to determine its composition.



Another method used is **computer generated climate models**. By inputting different amounts of carbon dioxide in the atmosphere, it has been possible to produce the same changes as has been observed in the real world.

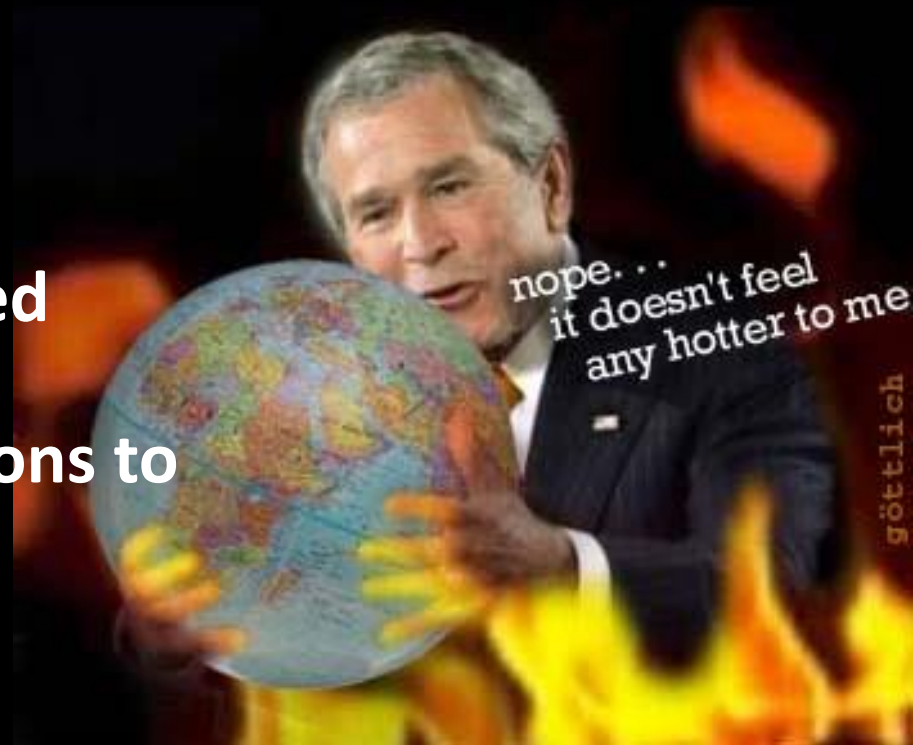


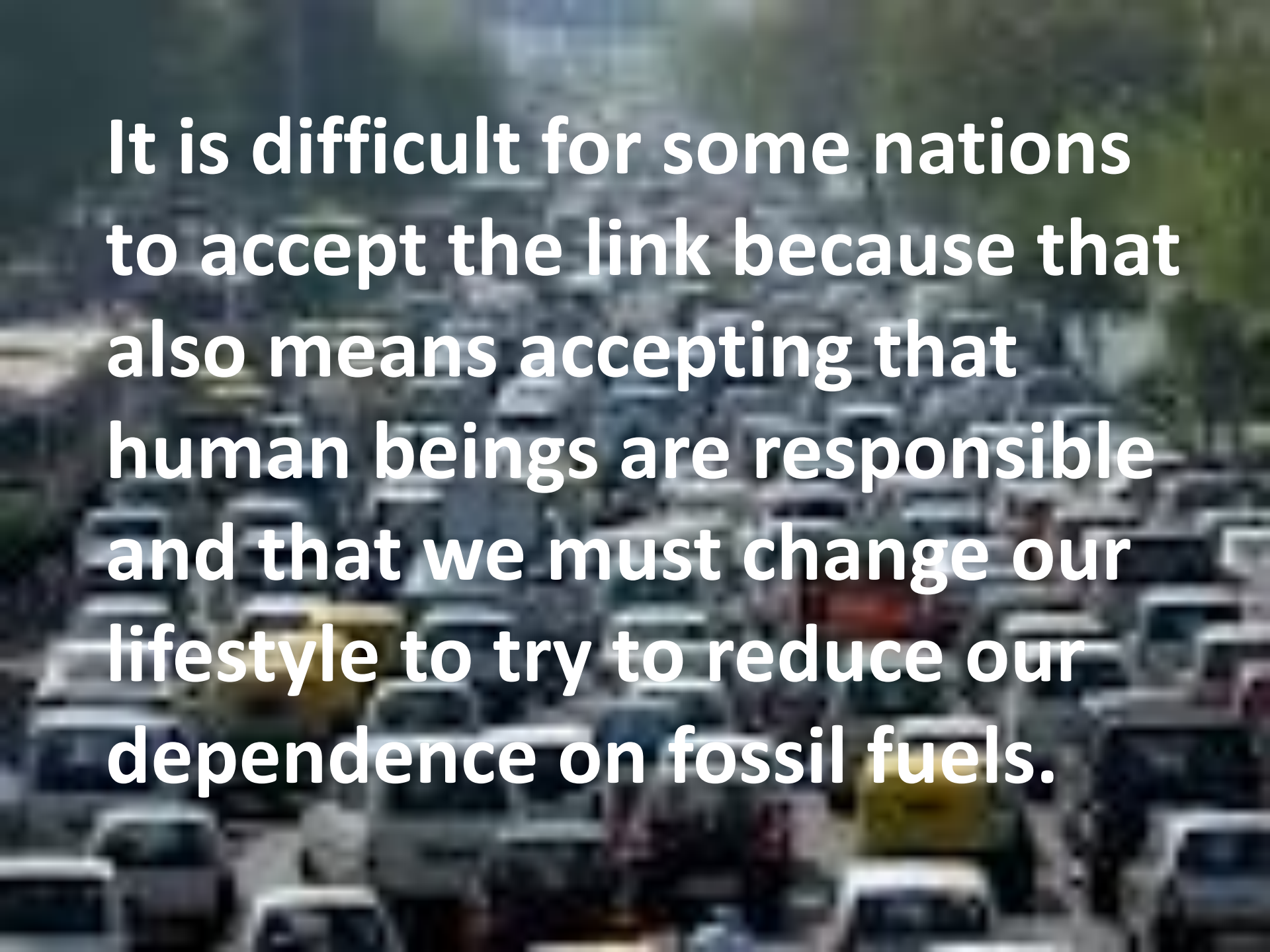
EVIDENCE FOR GLOBAL WARMING

Scientists have been highlighting the increase in carbon dioxide levels for many years and have been attempting to persuade Governments to take global warming seriously.

There is controversy associated with the recording, sources, modelling and possible solutions to the problem.

It is only recently that many politicians and people have accepted that it is the increase in carbon dioxide levels that are causing global warming.





It is difficult for some nations to accept the link because that also means accepting that human beings are responsible and that we must change our lifestyle to try to reduce our dependence on fossil fuels.

correlation & cause

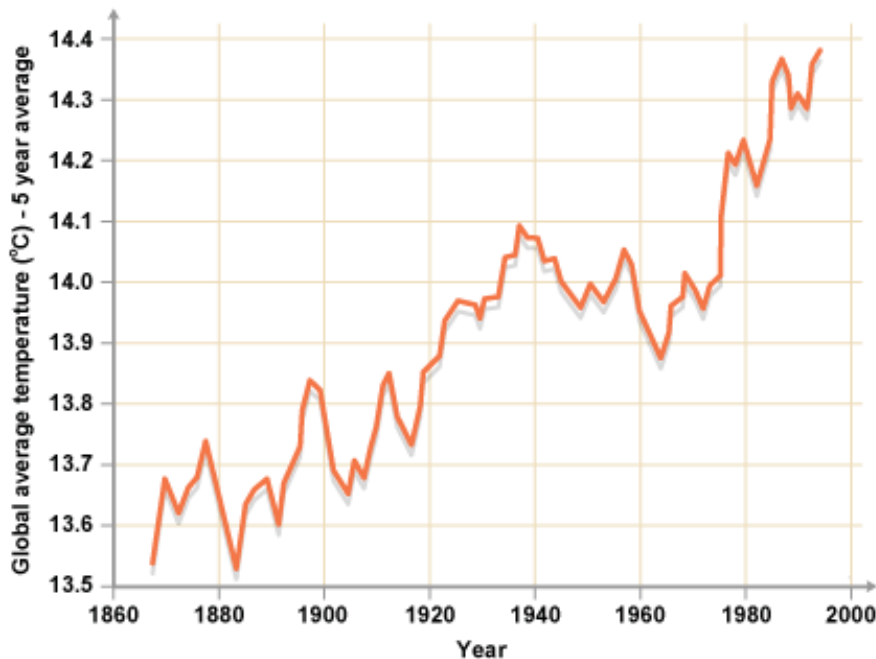
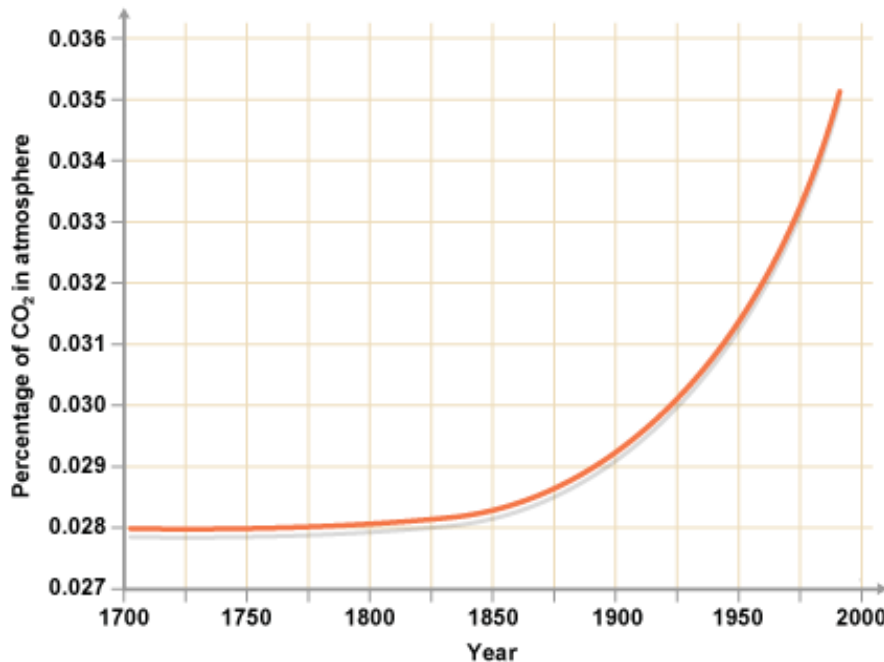
Compare the 2 graphs

Are the changes reported significantly large?

Are they properly matched in terms of the times over which they are reported?

Do you think the 2 graphs match well enough?

READ THE INFORMATION IN YOUR BOOKLET THAT EXPLAINS CORRELATION BETWEEN 2 FACTORS Highlight the factors and outcomes of global warming.



EFFECTS OF GLOBAL WARMING

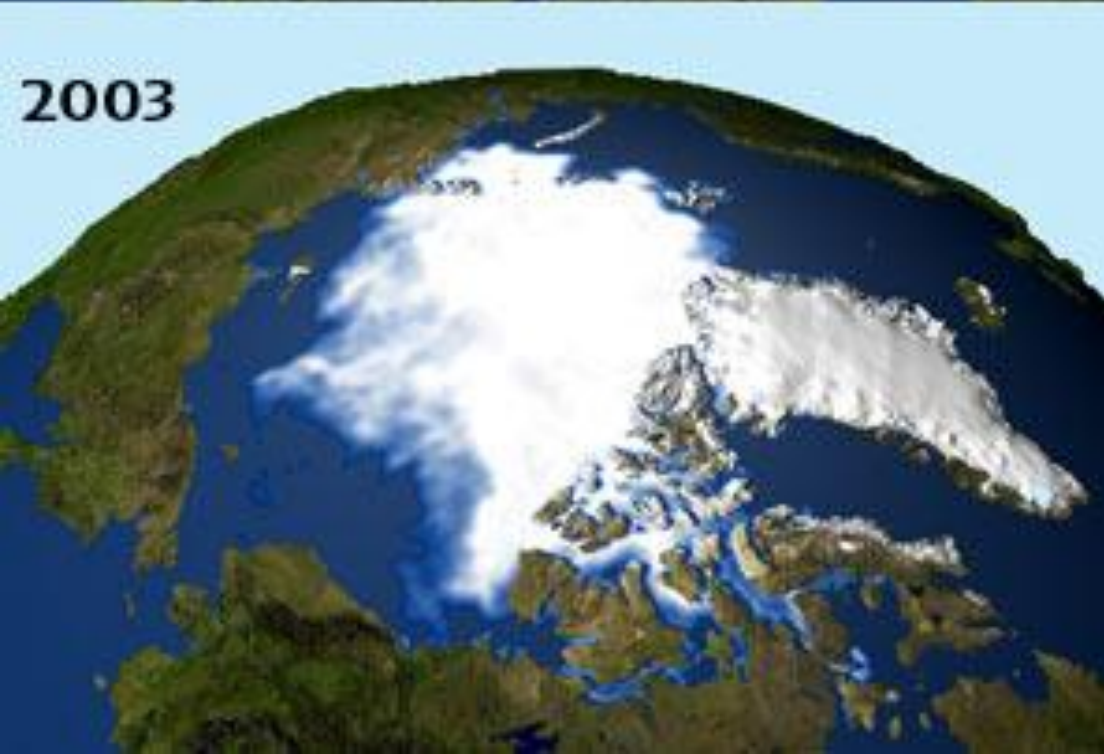


The warming of the atmosphere causes:

- Climate change: more weather extremes such as droughts and severe storms (Belfast 2014)



a lorry blown over by high winds NI Jan 2014



- Melting polar ice and the thermal expansion of sea water may cause sea levels to rise and flooding of low-lying coastal areas.



how does that affect wildlife?



GOOD NEWS! AT THE
CURRENT RATE OF GLOBAL
WARMING WE SHOULD BE
ABLE TO JUST SWIM OVER
THERE AND EAT HIM IN
UNDER FIVE YEARS...!

SEA-LEVEL
RISE



- Increased flooding (Belfast 2014)



NI 2014

**food shortages, price increases,
more imports and therefore
transport costs... fuel usage... CO₂
increase
spread of disease as sewers overflow**

how does this affect crop production?



- Increased desertification

reducing the effects of global warming

video



IF THE VIDEO DOESN'T PLAY, LINK FROM EITHER OF THESE



REDUCING GLOBAL WARMING

EXPLAIN IN YOUR OWN WORDS how the following actions ***COULD REDUCE GLOBAL WARMING:***

- Planting more trees
- Reducing deforestation
- Burning less fossil fuels by using alternative fuels
- becoming more energy efficient.



THINK, PAIR SHARE

Points to note

TREES: more PS, more CO₂ uptake from atmosphere; decrease atmospheric CO₂ levels

DEFORESTATION: more trees for PS... less machinery, less fossil fuels burned, less CO₂ emitted

ALTERNATIVE ENERGY SOURCES: solar/wind... do not release CO₂ in production of electricity, less combustion of fossil fuels, less CO₂ emitted

ENERGY EFFICIENCY: cycle/walk instead of car/ not run hot tap / energy saving appliances (light bulbs...) less energy wasted so less elec needs to be produced by fossil fuels, less CO₂ emitted

**HIGHER
TIER**

LEARNING OUTCOMES

Understand how scientific evidence informs local government about the need to implement policies to bring about:

- reductions in carbon emissions
- increases in renewable energy
- changes in agricultural practices

GOVERNMENT INITIATIVES TO REDUCE GLOBAL WARMING

- Governments must work at international and national and local levels in order to tackle the problems of global warming.



INTERNATIONAL:

Reducing carbon emissions

- **Agenda 21** is an action plan of the **United Nations** (UN) related to promoting sustainable development and was an outcome of a conference on the environment held in Rio de Janeiro, Brazil, in 1992.
- It is a recommendation for action to be taken globally, nationally, and locally by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment.

LOCAL: North Down Borough Council




Scientific evidence of human effects on the environment informs our local government about the need to implement policies such as:

- Reductions in carbon emissions;
- Increases in renewable energy

Changes brought about by NDBC in recent years include:

providing 'brown bins' to households to increase composting and 'blue bins' for recycling paper, some plastics and metal cans

Fortnightly bin collections to reduce combustion of fuels



Building a wind turbine at Balloo to provide energy to run the recycling Centre and Council offices.



<http://www.bbc.co.uk/bitesize/quiz/q54961804>

Print off your answers and staple them into your homework booklet

**HIGHER
TIER**

LEARNING OUTCOMES

Understand the role that microorganisms have in the nitrogen cycle, to include nitrogen fixation, nitrification and de-nitrification (knowledge of the names of specific bacteria is not required) and apply this to different growing conditions

the nitrogen cycle

**4 DIFFERENT BACTERIA
ARE INVOLVED**

The nitrogen cycle

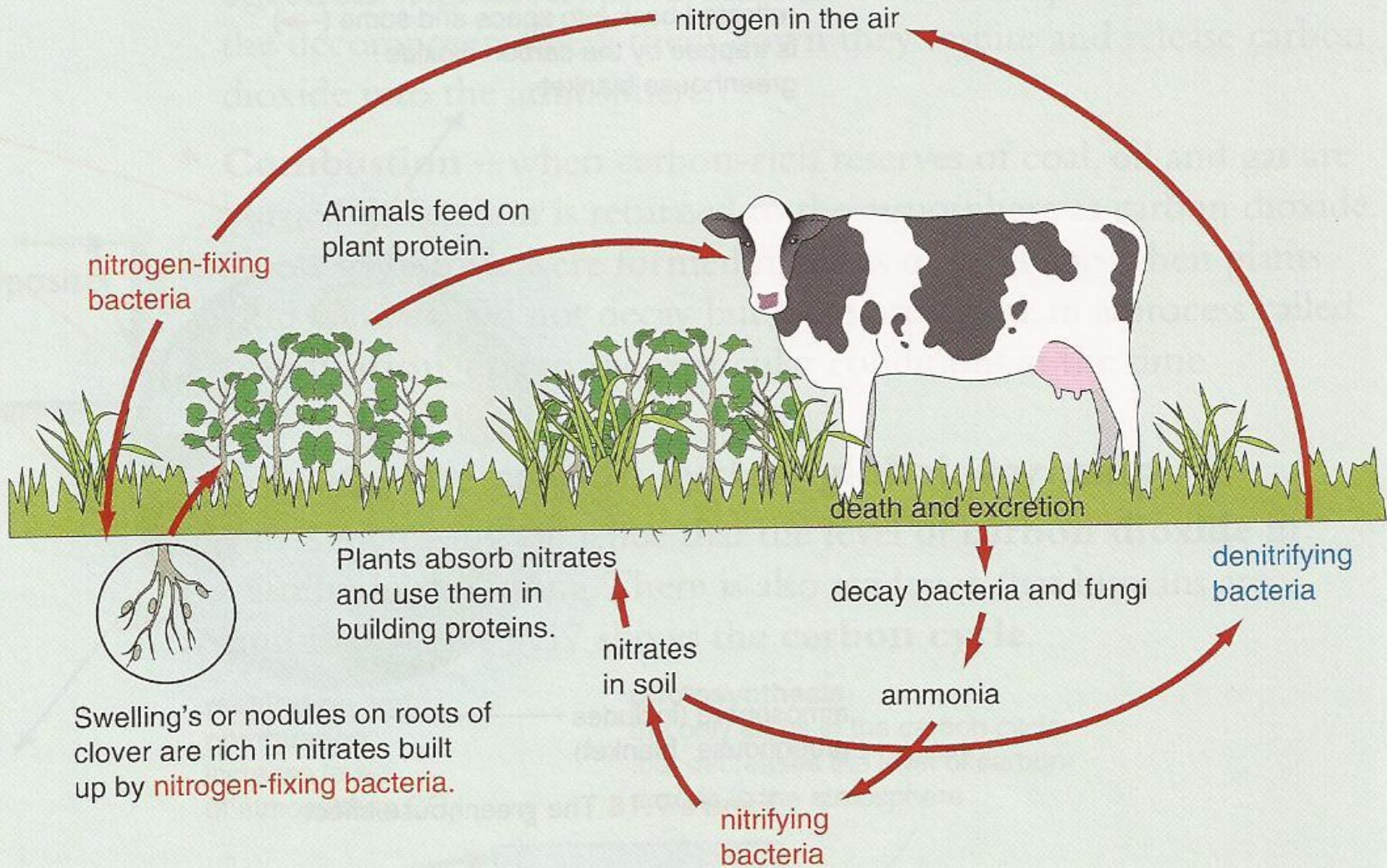


Figure 7.19 The nitrogen cycle

BACTERIUM	PROCESS	WHERE FOUND	SUBSTRATE	PRODUCT
NITROGEN FIXING BACTERIA	NITROGEN FIXATION	soil & root nodules of legumes	nitrogen gas	nitrates & amino acids
DECAY OR PUTRIFYING BACTERIA	DECOMPOSITION	aerated soil	N containing compounds, amino acids & proteins, in urine & dead plants & animals	ammonia
NITRIFYING BACTERIA	NITRIFICATION	aerated soil	ammonia	nitrates
DENITRIFYING BACTERIA	DENITRIFICATION	waterlogged & compacted soils without oxygen	nitrates	nitrogen gas

ACTIVITY

- In pairs decide which numbers represent the 4 different bacteria
- Can you name the processes happening at the other numbers?
- Check your answer with QR code scanner



nitrogen gas
in the air

nitrogen compounds
in crops

proteins
in plants

proteins
in animals

nitrogen
compounds
in fertilisers



8

6

1

2

3

7

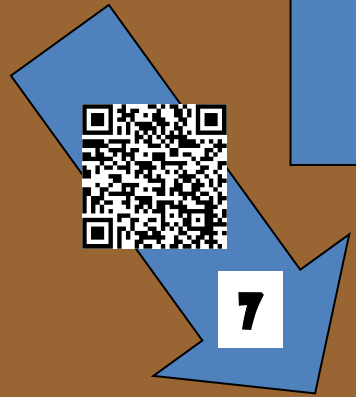
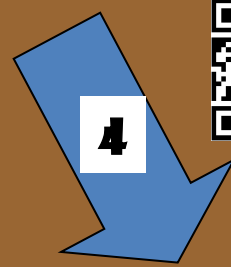
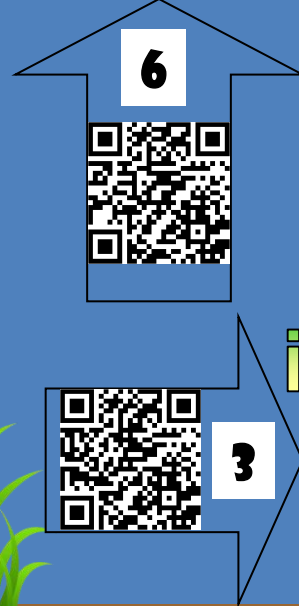
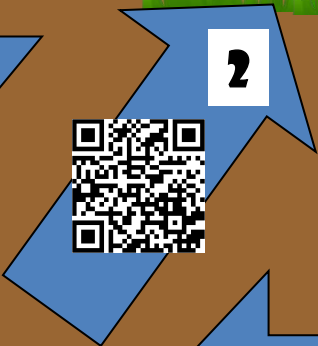
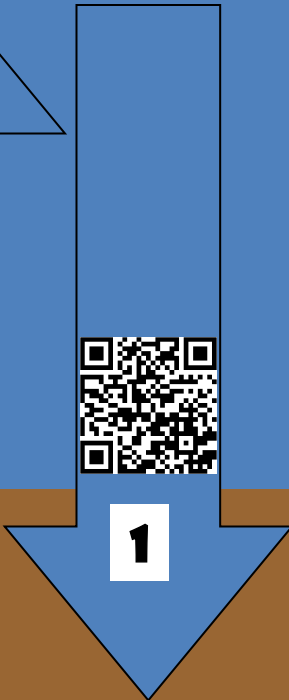
4

4

5

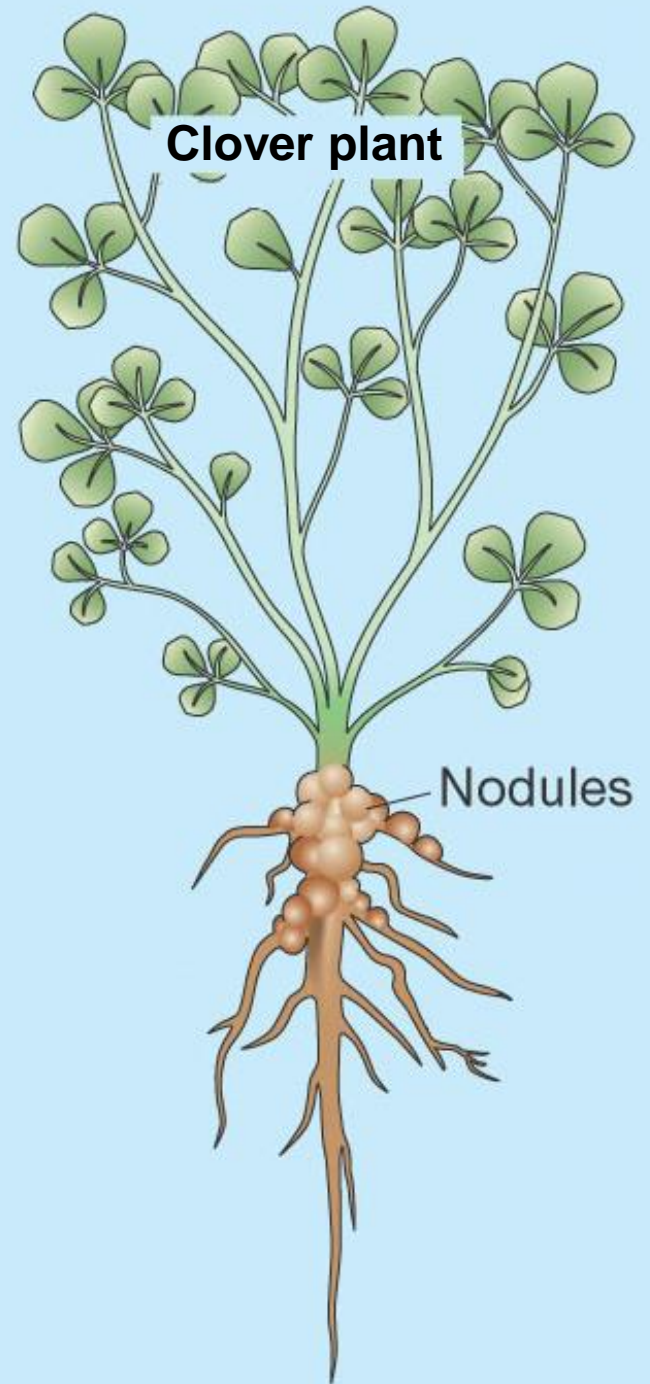
nitrates
in the soil

ammonia
in the soil



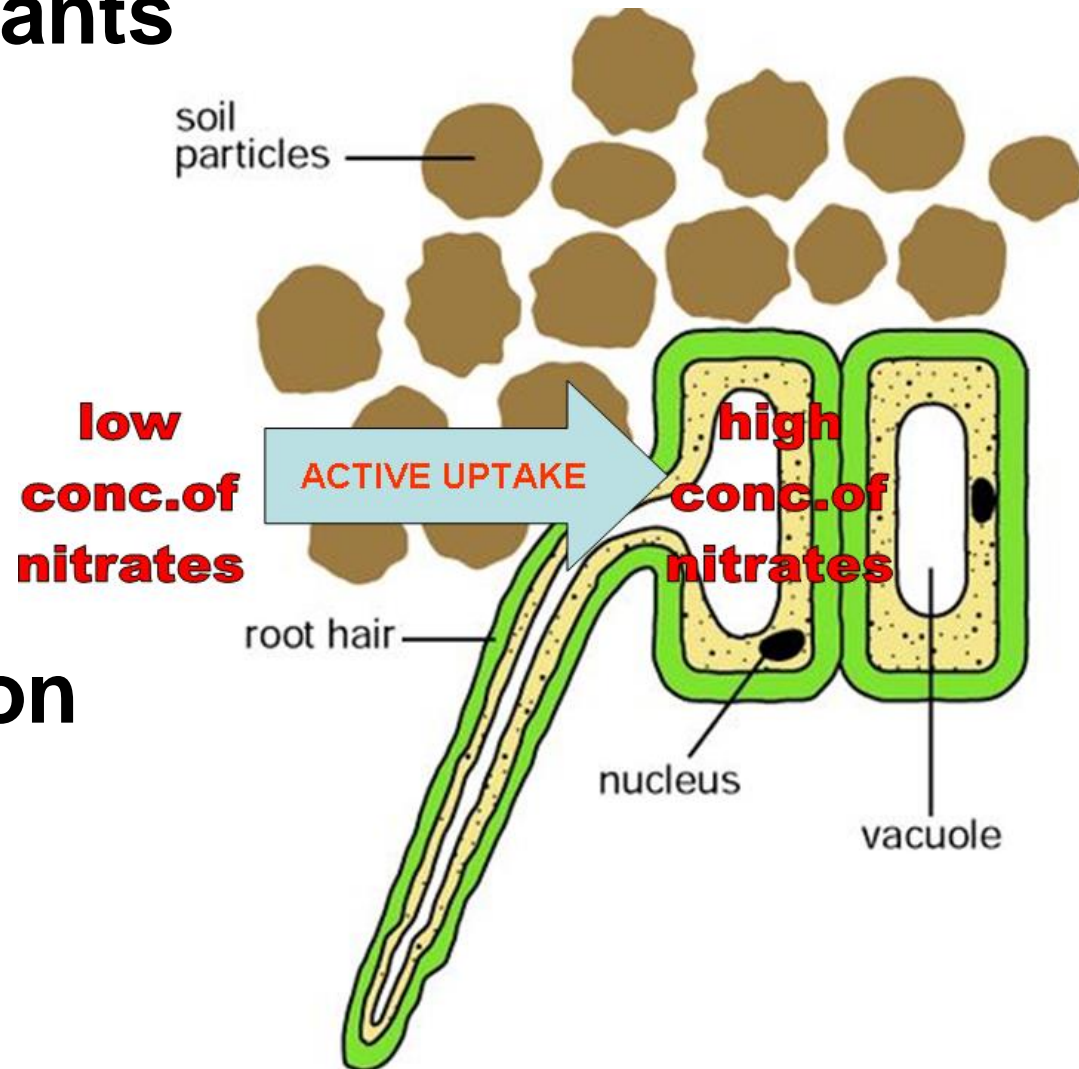
nitrogen fixing bacteria

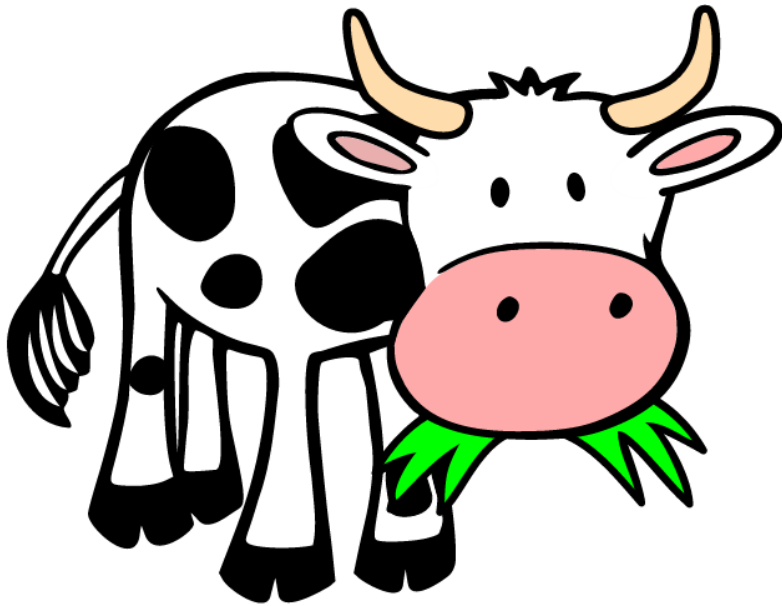
- live in the soil
- and in the root nodules of leguminous plants
- convert nitrogen gas in air into nitrates



active uptake

- root hair cells of plants take up nitrates
- from an area of low concentration in the soil
- to an area of higher concentration in cells
- using energy from respiration





feeding

- animals eat plants
- they convert nitrogen containing amino acids into proteins for growth

decomposers

bacteria & fungi

- feed on dead organisms
- & waste material

- convert nitrogen containing compounds
e.g. proteins & amino acids
into ammonia



nitrifying bacteria

- live in the soil
- convert ammonia into nitrates



© Copyright 1995, Suichi Suwa

harvesting

- removes plants from the area
- nitrogen compounds not returned to the soil



fertiliser



- artificial fertiliser made in factories
- contains ammonia and nitrates
- added to the soil to replace nitrogen compounds removed in harvesting



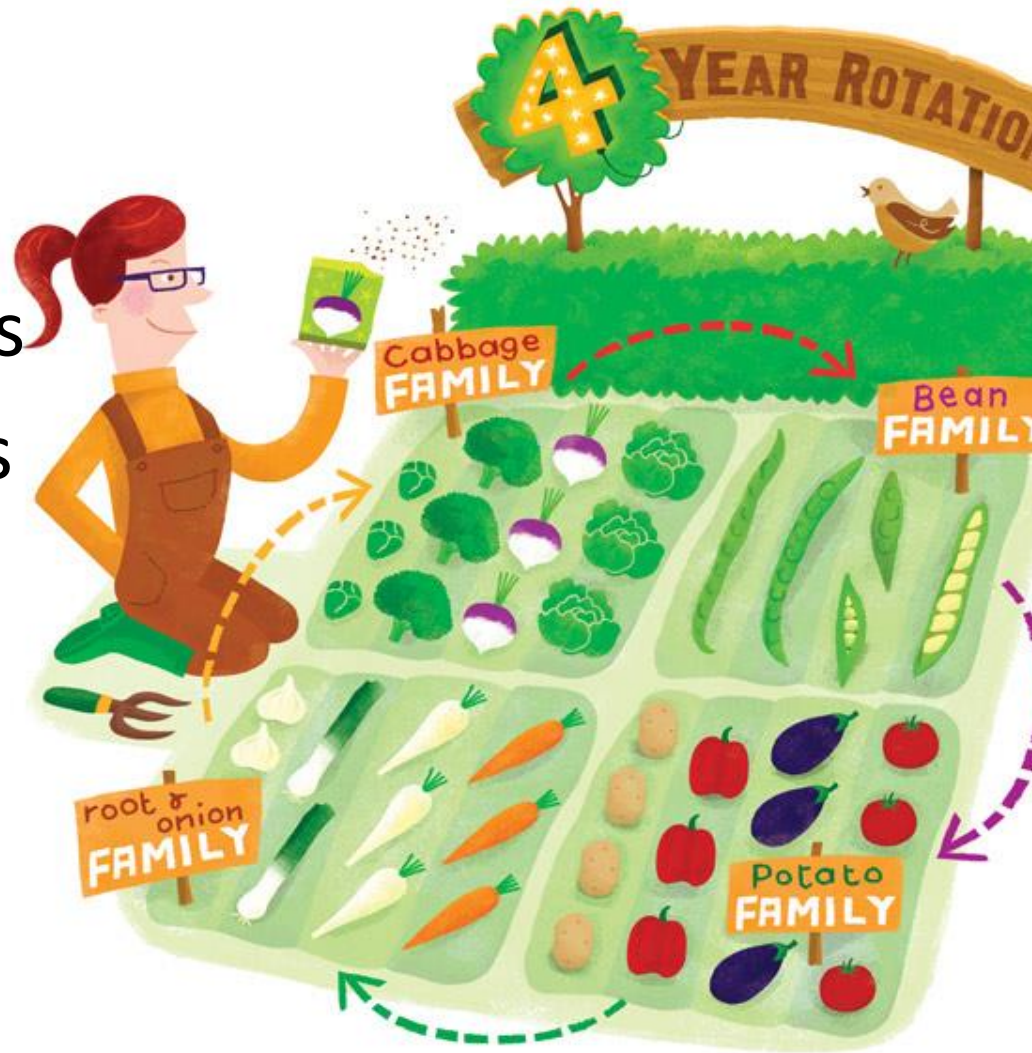
denitrifying bacteria

- **live in waterlogged soil (flooding)**
- **in anaerobic conditions (compacted by tractors)**
- **convert useful nitrates into atmospheric nitrogen gas**

how do farmers aid the N cycle?

crop rotation

farmers rotate their crops, planting legumes such as peas and beans in an area one year and root vegetables, potatoes or cabbages in the same area the next year.



What is the advantage of this?

Advantages:

- Potatoes/cabbages etc remove nitrates from soil to make amino acids & proteins for growth.
- We harvest them and remove N compounds
- Recycling reduced, nitrate levels reduce
- Peas/beans etc are legumes, have N fixing bacteria in root nodules
- Convert N gas in air in soil to nitrates
- Harvest beans etc but roots & many nitrates dug back into soil
- Increase nitrate levels for future crops

Ploughing

Farmers put air into the soil when they plough their fields. This provides oxygen for aerobic decomposers and nitrifying bacteria and speeds up decay and nitrate formation.

It also provides oxygen to root hair cells to speed up respiration and active uptake of nitrates.

Name **TWO** other ways in which ploughing helps crop growth.



**drainage
space for roots to
grow through**

Artificial fertilisers
often contain
compounds of
ammonia.



Why is this useful?

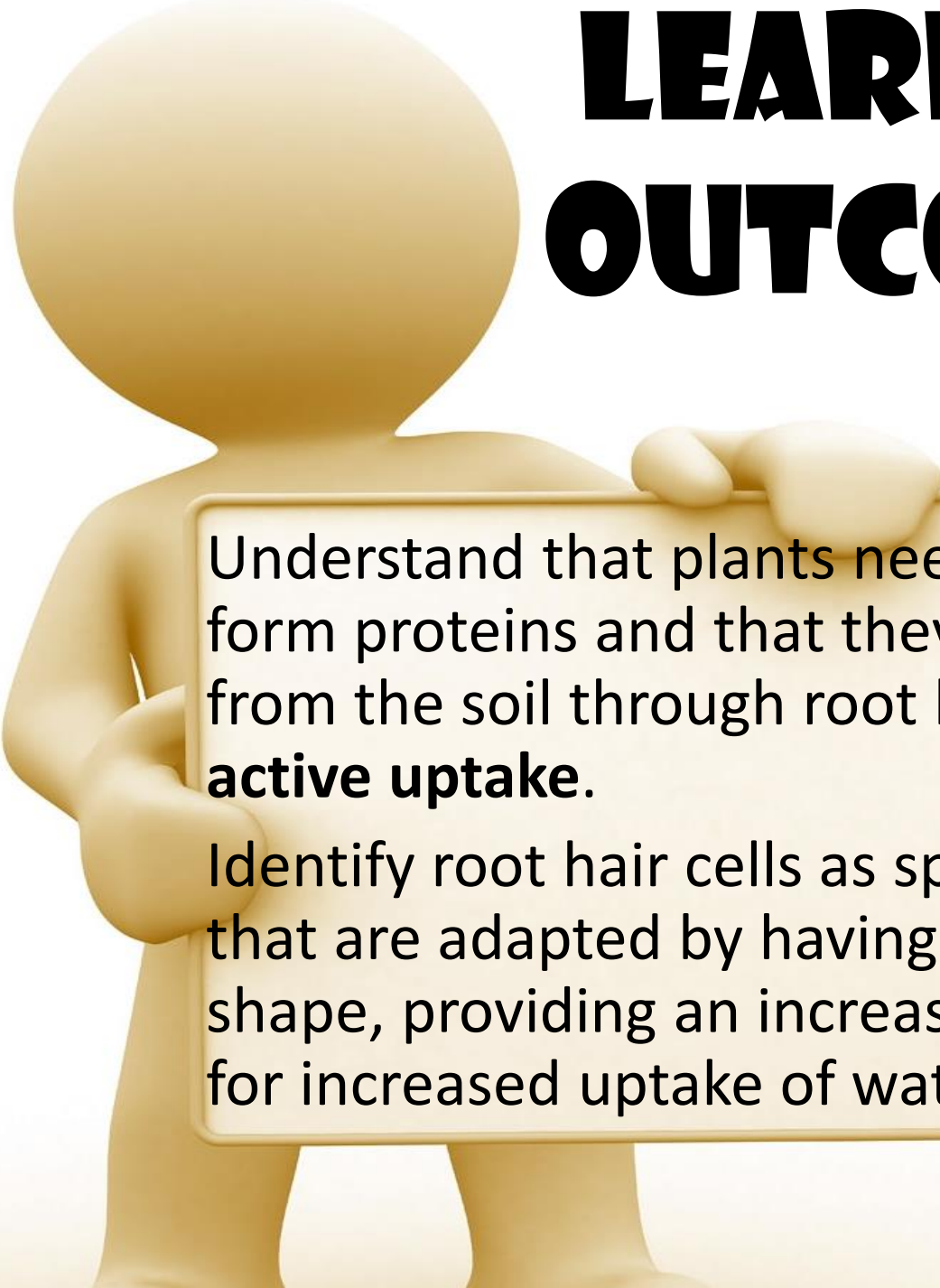
**Ammonia → nitrates by
nitrifying bacteria**

**Taken up by plants by active
transport**

**Use to make aas & proteins for
growth**



LEARNING OUTCOMES

A 3D rendered orange character with a large head and small body, holding a rectangular sign with rounded corners. The character is positioned on the left side of the frame, with its right hand resting on top of the sign and its left hand holding the bottom edge. The sign contains two paragraphs of text.

Understand that plants need nitrates to form proteins and that they obtain these from the soil through root hair cells by **active uptake**.

Identify root hair cells as specialised cells that are adapted by having an extended shape, providing an increased surface area for increased uptake of water and minerals;

**HIGHER
TIER**

LEARNING OUTCOMES

Understand active uptake is a process that requires energy to transport the minerals against a concentration gradient.

ROOT HAIR CELLS AND ACTIVE UPTAKE

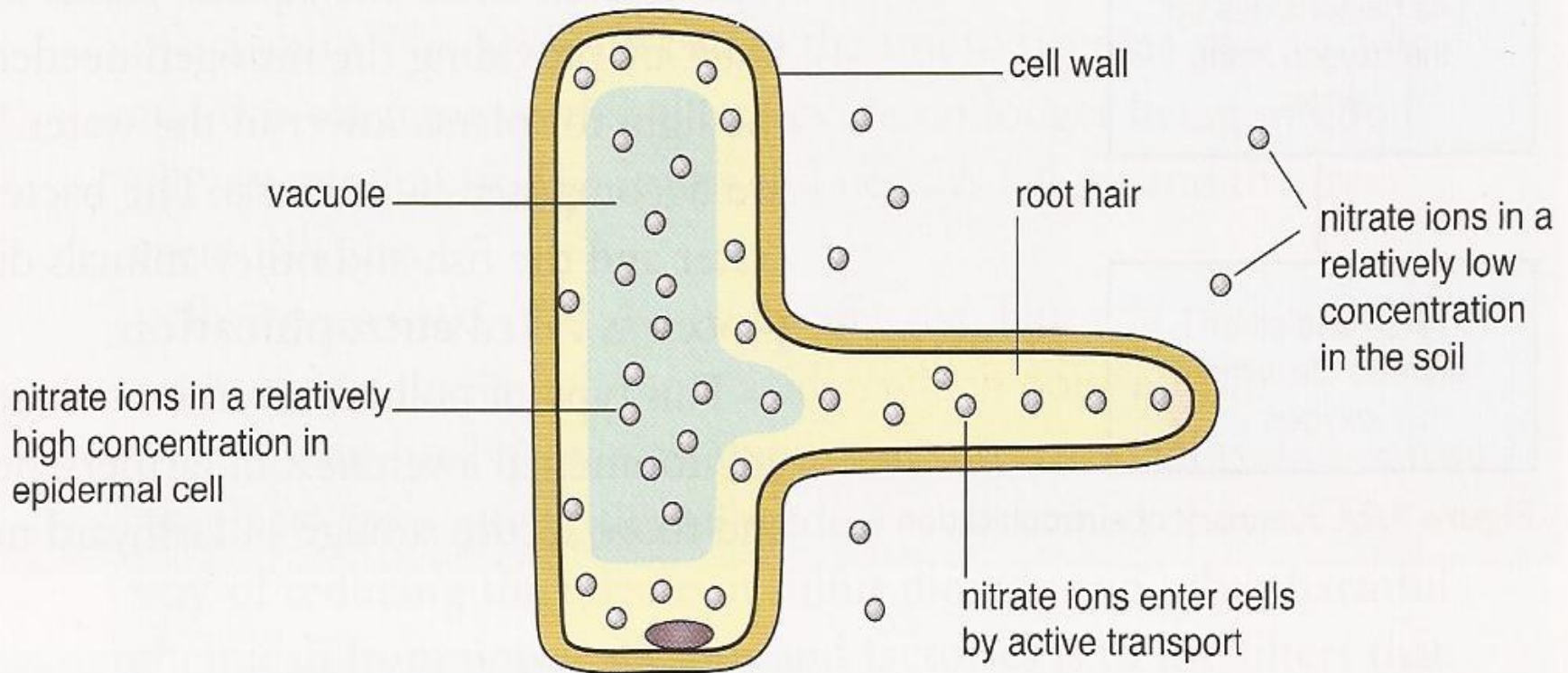


Figure 7.20 Active uptake of nitrates in an epidermal cell

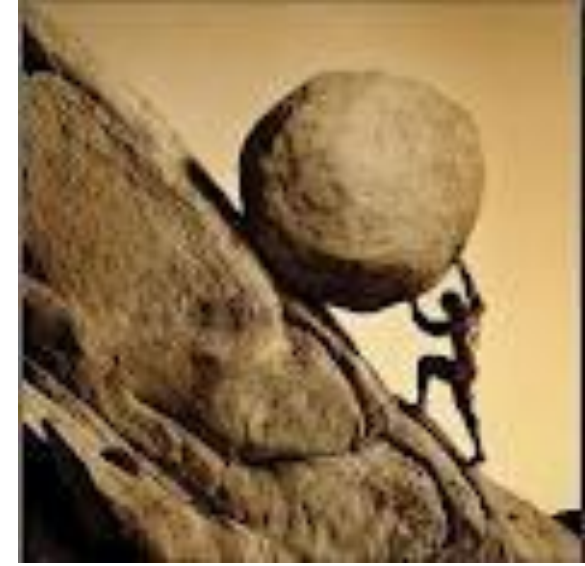
TIM & MOBY

Plants need **nitrates** to form **proteins** and they obtain these from the soil through root hair cells by **active uptake**.

The diagram of a root hair cell shows the adaptations of the cell:

- **An extended shape** (a 'cytoplasmic extension')
- Providing an **increase in cell surface area** for *increased uptake of water and minerals*.

Active uptake is a process that requires **energy** to transport minerals **against** a concentration gradient.

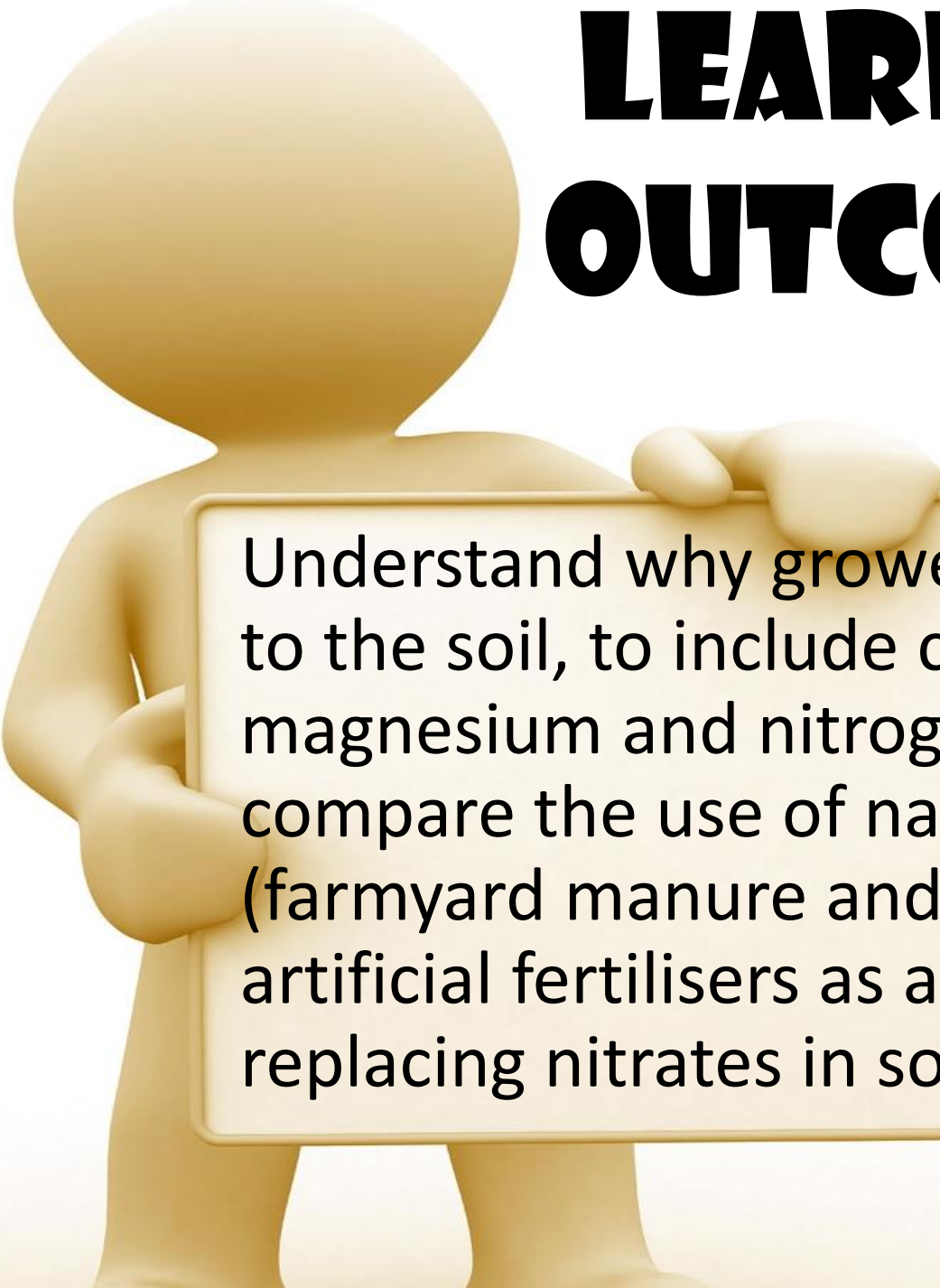


This is because there are more nitrate ions inside the cell compared with outside in the soil. **This process requires oxygen for aerobic respiration to produce the energy needed** to transport the nitrates against the concentration gradient.

Review:

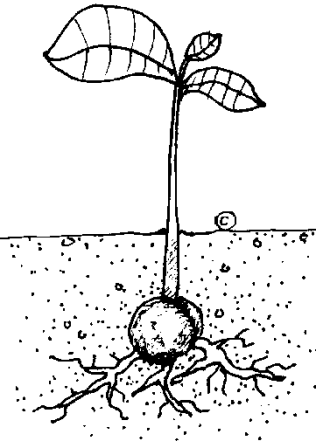
what is meant by 'concentration gradient'?

LEARNING OUTCOMES

A 3D rendered orange character with a large head and small body, holding a rectangular sign with a yellow border. The character is positioned on the left side of the frame, with its right hand resting on top of the sign and its left hand holding the bottom edge. The sign contains text about learning outcomes.

Understand why growers add minerals to the soil, to include calcium, magnesium and nitrogen, and compare the use of natural fertilisers (farmyard manure and compost) and artificial fertilisers as a means of replacing nitrates in soil

Minerals



To stay healthy plants need specific mineral ions which they absorb from the soil by active transport.

- **Nitrates:** needed for protein production
- **Magnesium:** needed to make chlorophyll
- **Calcium:** needed to make cellulose in cell walls

Active transport needs energy from respiration.

Plants growing in soil which has low oxygen levels, e.g. waterlogged or compacted soils, are unable to take up sufficient minerals for healthy growth



CONTROL

NO CALCIUM

NO MAGNESIUM

NO NITROGEN

FERTILISERS

When farmers harvest crops, or animals are taken to the abattoir, the nutrients they took from the soil are not replaced. The crops do not decay and decompose back into the soil to recycle the nutrients. For this reason, soil needs to be fertilised on a regular basis.

Both natural fertilisers and artificial fertilisers may be used to replace minerals lost from the soil.

	Natural fertilisers	Artificial fertilisers
Examples	Recycled waste e.g. manure, compost, slurry	Made artificially from fossil fuels e.g. NPK, expensive to buy.
Speed of action	Slow to break down and release nutrients, but improves soil structure	Very soluble, but excess leach into waterways
Application	Difficult to apply evenly & need large quantities; heavy machinery causes compact soils	Easy to spread evenly
Mineral content	Can't control mineral content	Known mineral content

Highlight advantages in green
& disadvantages in red

**HIGHER
TIER**

LEARNING OUTCOMES

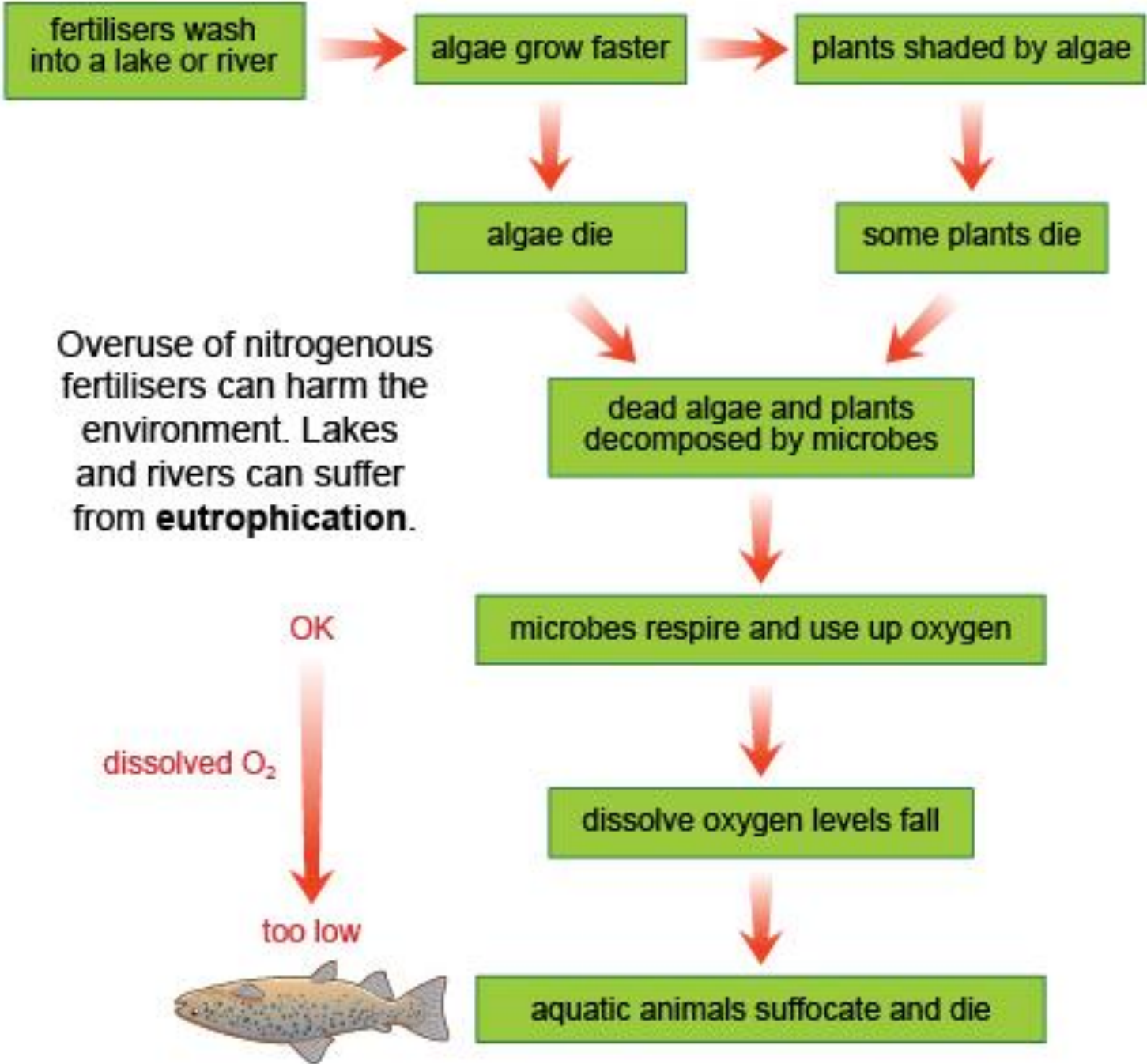
Explain how sewage disposal and fertiliser run-off can cause eutrophication in terms of: [1] nitrates stimulating growth of aquatic plants and algae; [2] the death of aquatic plants and algae due to subsequent nitrate depletion and shading; [3] the role of aerobic microorganisms in the decomposition of plants and algae; [4] the consequences of oxygen depletion on other aquatic vertebrates and invertebrates.

EUTROPHICATION

The problem with using fertilisers is that not all the nutrients sprayed onto fields get used by plants. Fertiliser is washed off the land by rainwater into rivers and lakes. This is called **run-off**.

video

- The increase in nitrates in the water cause an **increase in the growth** of **algae**;
- The algae form a **bloom over the water surface**.
- This **shades** and prevents sunlight reaching other water **plants**, which then **die**, as they cannot photosynthesise.
- As the nitrate concentration decreases **algae die**.
- The dead organisms are **broken down by bacteria**, and as they **respire they use up oxygen** in the water
- Most other **aquatic vertebrates and invertebrates die** due to **oxygen depletion**.



Overuse of nitrogenous fertilisers can harm the environment. Lakes and rivers can suffer from **eutrophication**.

SEWAGE

16 MARCH 2013

- More than 150 eels were killed when pollution escaped into a Co Down river from a sewage pumping station, Bangor Magistrates Court has heard.

08 MARCH 2011

- Northern Ireland Water has been fined £1,000 for allowing untreated sewage to spill into a Co Down river.

SEWAGE

A photograph showing a large number of dead fish floating on the surface of a body of water. The fish are mostly silver and yellowish, and they are scattered across the frame. The water is dark and murky, and there are some green plants visible in the background. The overall scene is somber and illustrates the impact of sewage on aquatic life.

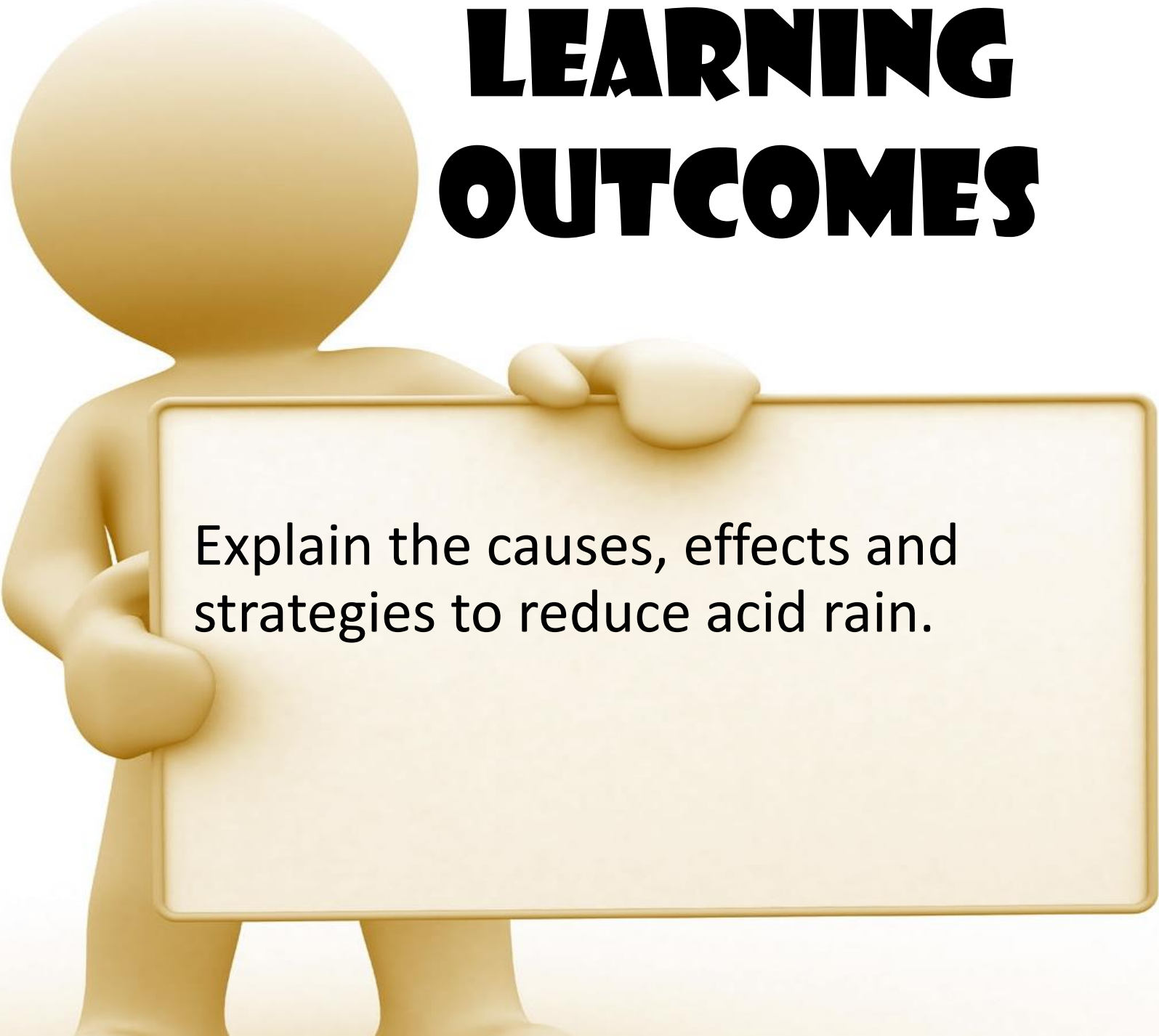
- Sewage spills often occur into rivers and lakes
- Bacteria rapidly digest the organic material in the sewage
- There is a dramatic increase in the population of these bacteria
- The bacteria use up oxygen from the water for respiration
- Oxygen levels decrease
- Other organisms die due to oxygen depletion



http://www.bbc.co.uk/schools/gcsebitesize/science/add_gateway_pre_2011/greenworld/

Select The carbon and nitrogen cycles

LEARNING OUTCOMES

A 3D rendered orange character with a large head and small body, holding a rectangular sign. The character is positioned on the left side of the frame, with its right hand resting on top of the sign and its left hand holding the bottom edge. The sign is white with a thin orange border and contains the text 'Explain the causes, effects and strategies to reduce acid rain.'

Explain the causes, effects and strategies to reduce acid rain.

ACID RAIN



Use the textbook p66 – 67 to create an annotated diagram, poster or graphic organiser to explain:



- 1. causes of acid rain**
- 2. effects of acid rain**
- 3. strategies to reduce acid rain**

Acid rain

Waterways (and land) can also be polluted by acid rain. Fossil fuels produce sulfur dioxide (and other gases including nitrogen oxides) and when the sulfur dioxide dissolves in water, acids such as sulfuric acid are produced, which can fall as acid rain. Much of the sulfur dioxide produced in Britain is produced by the burning of fossil fuels in power stations and other large-scale industrial burning.

One of the main problems with acid rain is that it often falls in other countries well away from those causing most of the pollution. This is because the prevailing winds carry the clouds that produce the acid rain for hundreds of miles before the rain actually falls.

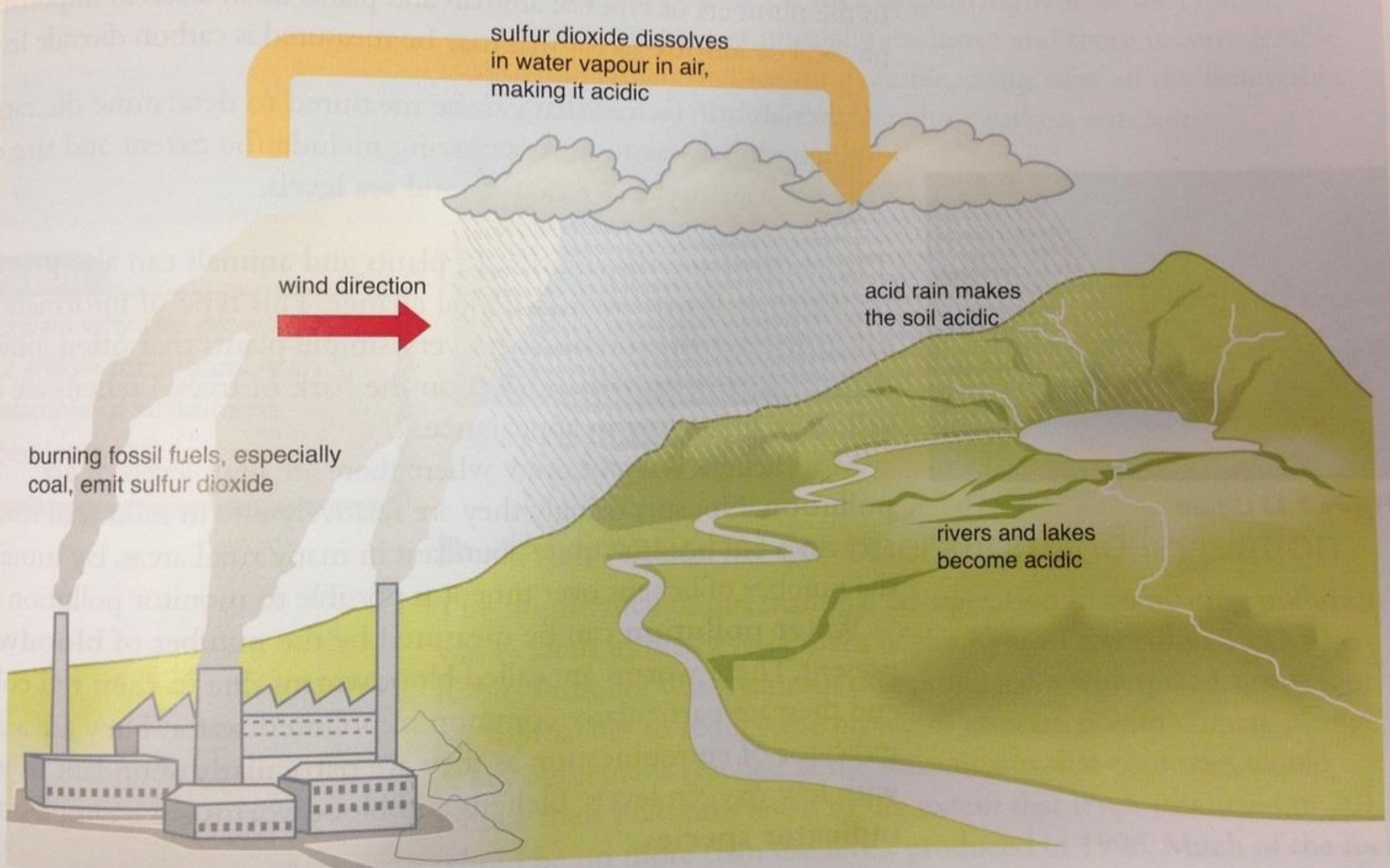


Figure 7.22 How acid rain is produced

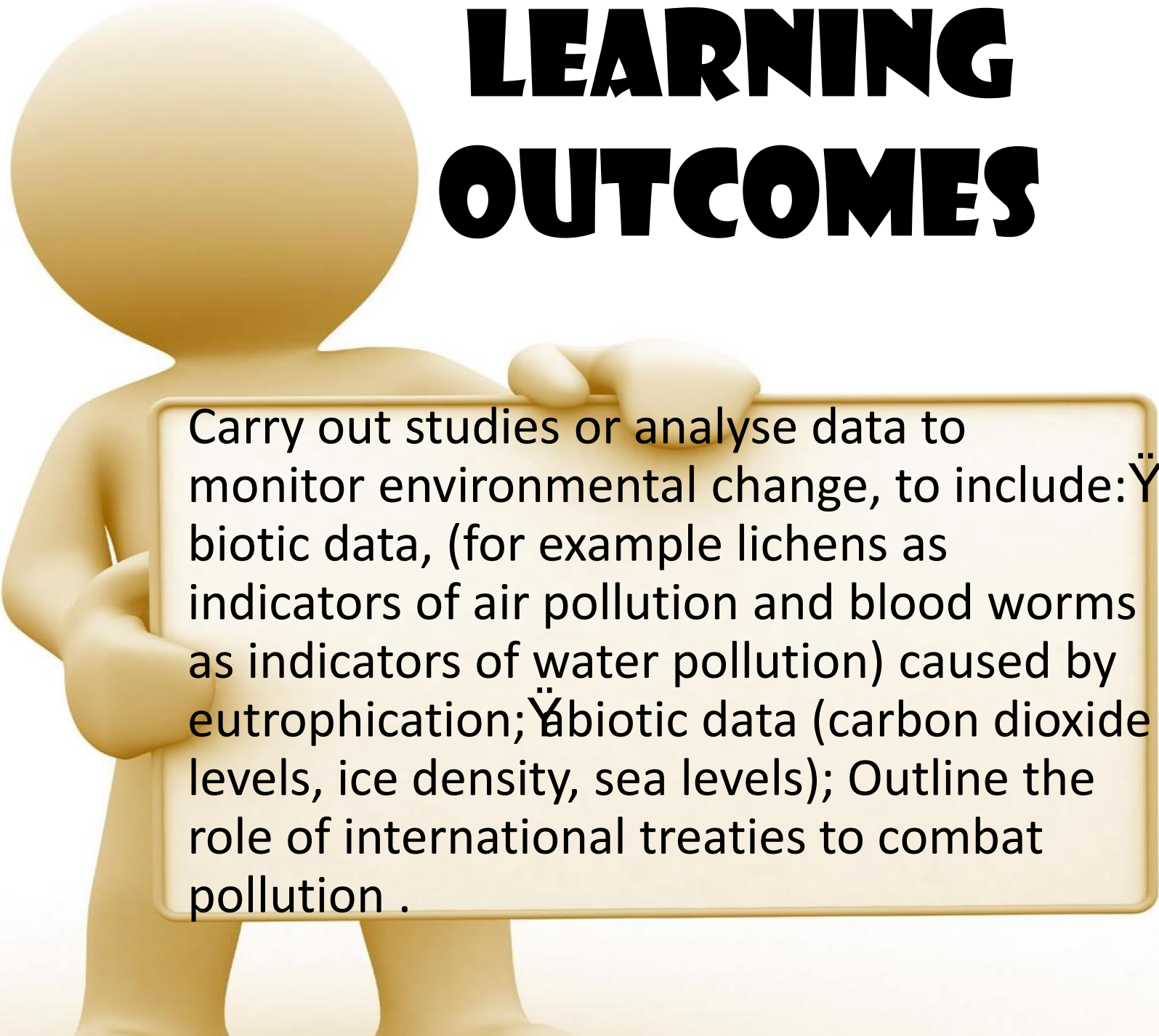
But what is the effect of the acid rain on the area on which it falls? Over much of Europe, trees have been destroyed by the effects of acid rain. The acid rain causes the soil to become more acidic and this often means that the trees are no longer living in good growth conditions. The leaves and needles fall off and the trees eventually die.

Rivers and lakes are also badly affected. The acid rain causes the water to become much more acidic, which poisons fish.

Acid rain has become an important international issue because its effects cross international borders as described above. One way of reducing the release of sulfur dioxide and other harmful chemicals from power stations and factories is to use filters that trap these harmful gases. There is also a greater awareness that other sources of generating electricity, such as wind, water, solar and even nuclear power, may be better long-term solutions than fossil fuels.

It has been estimated that Britain has been able to reduce its sulfur dioxide emissions by about 80% over the last 25 years. This has resulted in the recolonisation by native species of many lakes that were seriously damaged by acid rain.

LEARNING OUTCOMES

A 3D rendered orange character is holding a sign. The sign contains the following text:

Carry out studies or analyse data to monitor environmental change, to include: biotic data, (for example lichens as indicators of air pollution and blood worms as indicators of water pollution) caused by eutrophication; abiotic data (carbon dioxide levels, ice density, sea levels); Outline the role of international treaties to combat pollution .

How the local environment has been impacted by government

1. Changes in agriculture (including EU Nitrates Directive- an international agreement)
2. Methods of monitoring change in the environment
3. The role of the Government in conserving the environment
4. Reduction of carbon emissions and increased use of renewable energy.
5. International co-operation and legislation.

SMR 5. Protection of Water Against Nitrate Pollution

On land located within a Nitrate Vulnerable Zone you must follow the Nitrate Action Programme measures which include not spreading N fertiliser (chemical or organic manures) during the closed period, not exceeding the crop requirement for N, not exceeding the field and whole farm limits. You must also observe the spreading controls, storage and record keeping requirements of the Action Programme. A new Action Programme will be applied to all of Northern Ireland in 2006.



MACHINERY TO DIRECT SLURRY DIRECTLY TO THE SOIL AND REDUCE RUN OFF

MONITORING CHANGE INDICATOR SPECIES

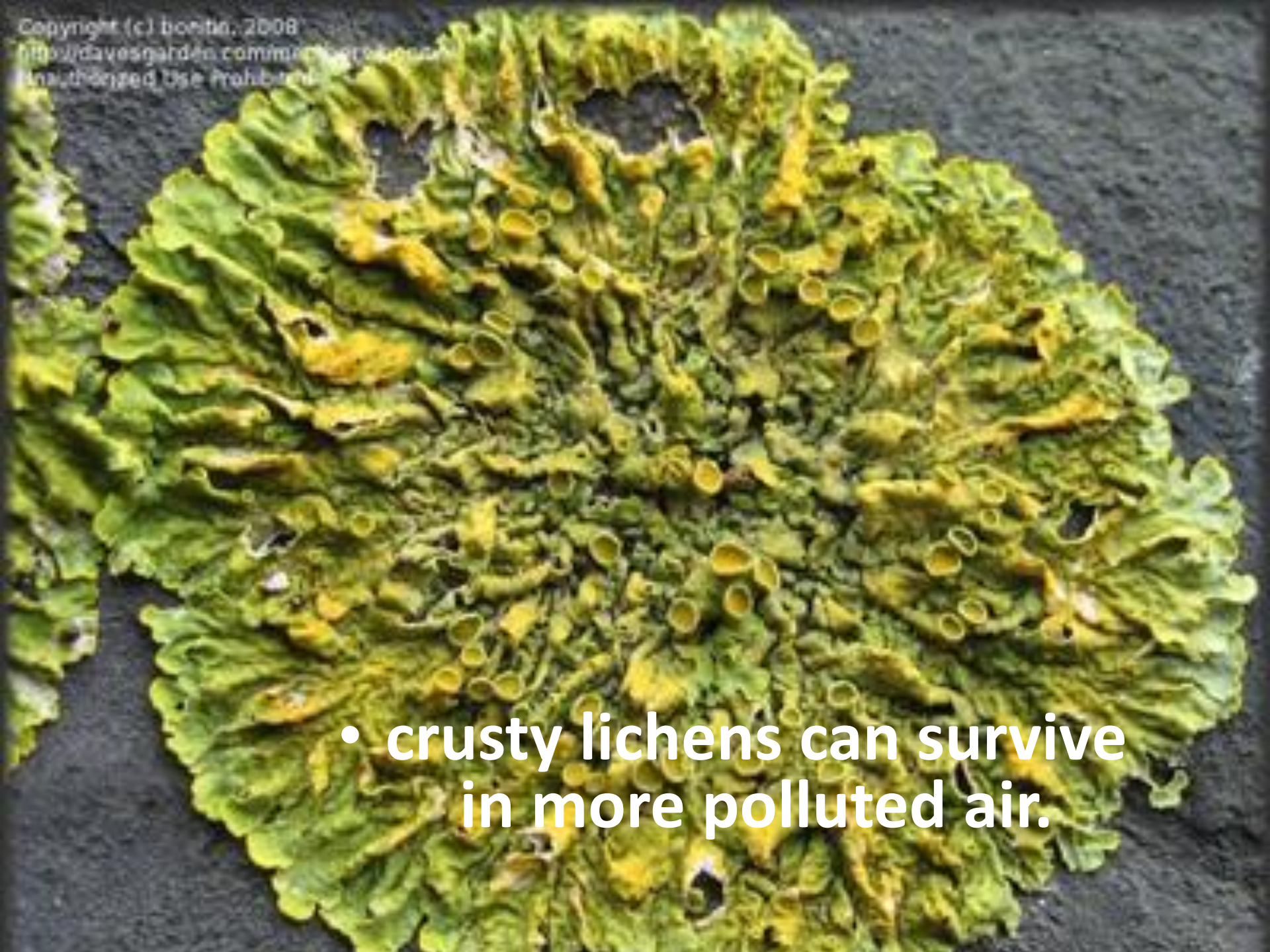
LICHENS are made up of an algae and a fungus growing together. They grow in exposed places such as rocks or tree bark. They need to be very good at absorbing water and nutrients to grow there. Rainwater contains just enough nutrients to keep them alive. Air pollutants dissolved in rainwater, especially sulfur dioxide, can damage lichens, and prevent them from growing. This makes lichens natural indicators of **air pollution**.



- **bushy lichens need really clean air**

- leafy lichens can survive a small amount of air pollution





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- crusty lichens can survive in more polluted air.

In places where no lichens are growing, it is often a sign that the air is heavily polluted with sulfur dioxide.

LICHEN



Water pollution

Oil spills cause a lot of harm to the environment, both at sea and on land. Water pollution is caused by the discharge of harmful substances into rivers, lakes and seas, including sewage and farm waste.

Many aquatic invertebrate animals cannot survive in polluted water, so their presence or absence indicates the extent to which a body of water is polluted.

**level of
water
pollution**

**indicator
species**

Clean

mayfly larva



Low

freshwater shrimp



High

water louse



very high

blood worm are able
to tolerate very low
oxygen levels



ND BOROUGH COUNCIL



NATIVE WILDFLOWERS ON ROAD VERGES

NATIONAL TRUST
PROTECTING RED
SQUIRREL HABITAT



KEEP NI BEAUTIFUL

TREE PLANTING



CONSERVATION VOLUNTEERS



COASTAL LITTER SURVEYS & CLEAN UPS

MISSION

TO REDUCE EMISSIONS OF CO₂, Methane (CH₄), Nitrous oxide (N₂O) and Hydrofluorocarbons (HFCs)

Each signatory country was set a percentage target reduction based on their emissions

HOW?

Reduce the use of fossil fuels and increase renewable technologies

Countries that exceed their targets able to sell carbon credits to the World Bank

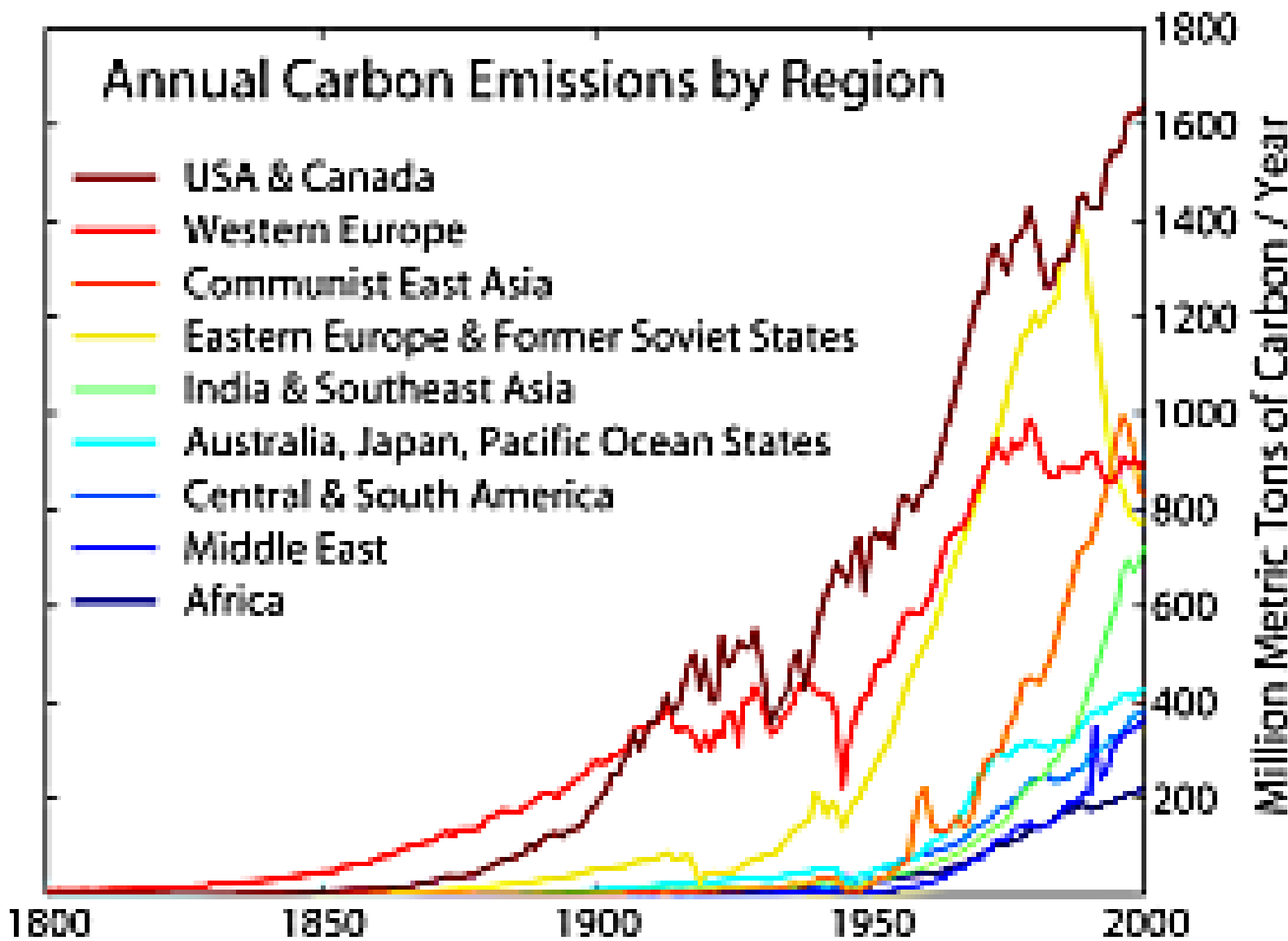
Countries unable to meet their targets purchase carbon credits

PROBLEMS

It is costly to fall behind targets set, however many nations believe that this is simply a method of redistributing wealth to developing countries

Annual Carbon Emissions by Region

- USA & Canada
- Western Europe
- Communist East Asia
- Eastern Europe & Former Soviet States
- India & Southeast Asia
- Australia, Japan, Pacific Ocean States
- Central & South America
- Middle East
- Africa



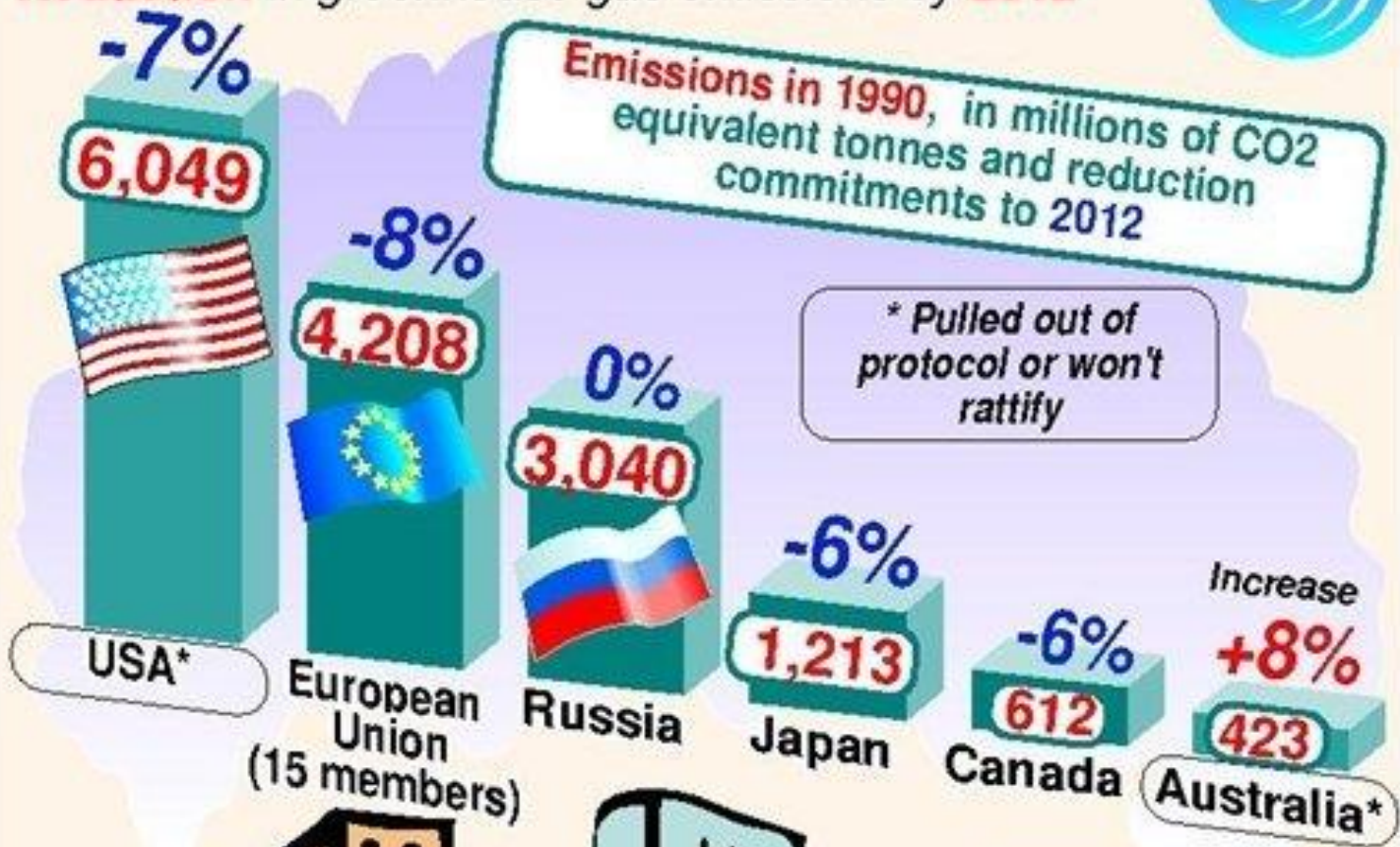
Greenhouse gases: the Kyoto protocol



Reduction in greenhouse gas emissions by 2012

Emissions in 1990, in millions of CO2 equivalent tonnes and reduction commitments to 2012

* Pulled out of protocol or won't ratify





<http://lgfl.skool.co.uk/keystage4.aspx?id=315>

Select Ecology to review this section