

# Biology Paper 2 Revision – Unit 7 Ecology

- Adaptations, interdependence and competition
- Organisation of an ecosystem
- Biodiversity and the effect of human interaction on ecosystems
- Trophic levels in an ecosystem (biology only)
- Food production (biology only)



# LearnIT! KnowIT!

Adaptations, interdependence  
and competition

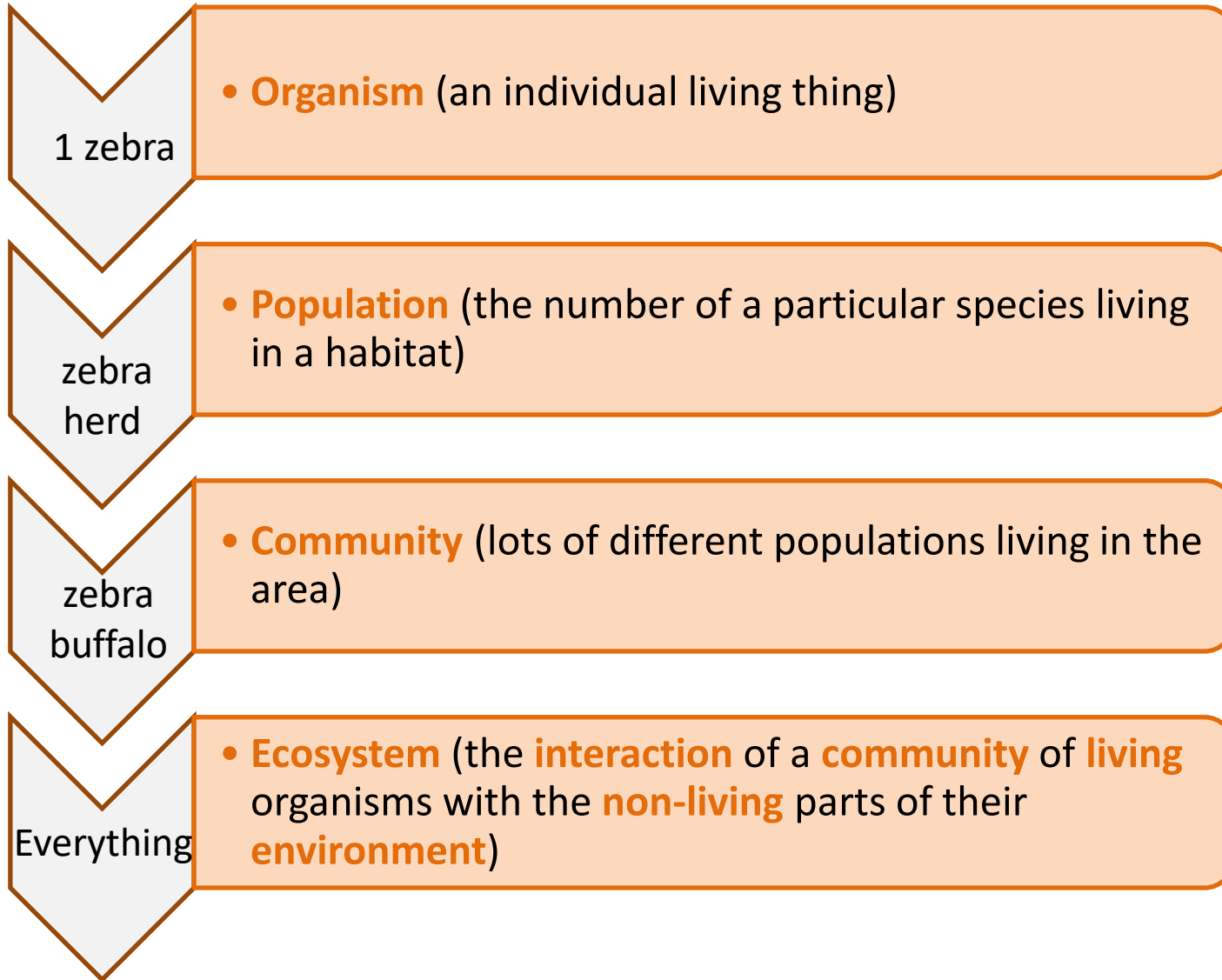
Part 1

- Communities
- Abiotic factors
- Biotic Factors
- Adaptations



# Adaptations, interdependence and competition part 1 - Communities

The different **levels of organisation** in an ecosystem are:





# Adaptations, interdependence and competition part 1

## - Communities

To **survive** and **reproduce**, organisms require a **supply of materials** from their **surroundings** and from **other living organisms** there.

**Plants** in a community or habitat compete with each other for:

- Light
- Space
- Water and mineral ions from the soil



**Animals** in a community often compete with each other for:

- Food
- Mates
- Territory



# Adaptations, interdependence and competition part 1

## - Communities

Within a community each species **depends** on other species for their **survival**. This is called **interdependence**. If one species is removed it can affect the whole community.



Many flowering plants rely on insects like bees or butterflies for pollination.

Pandas rely on bamboo for food.



Animals or birds may carry plant seeds away from the parent plant to reduce competition.



Clown fish are protected from predators by the stinging tentacles of the anemone.

# Adaptations, interdependence and competition part 1

## - Communities

A **stable community** is one where **all** the **species** and **environmental factors** are in **balance** so that the **population** sizes remain fairly **constant**.

**Competition** is important in a community. It helps **maintain** the **balance**. When the weather is mild and **food is plentiful** in UK woodlands, rabbits **reproduce** and more **offspring survive** than is usual. This affects the amount of grass and vegetation being eaten by the increasing rabbit population leaving **less** for **other species**.

The fox population increases as there are plenty of rabbits for food and so more fox offspring survive. A greater number of foxes eat more rabbits and **reduce** their **population** back to normal. The fox population then slowly decreases as some foxes **starve** to death as they **compete** for food. The **balance returns** in the community.

# Adaptations, interdependence and competition part 1

## – Abiotic factors

‘**Bio**’ means **life** in Greek.

- ❑ Biology is the study of living organisms
- ❑ A biography is an account of someone’s life

The prefix ‘**a**’ in front of a science word often means ‘not’ or ‘non’.

An **abiotic factor** is a **non-living factor**. Abiotic factors which may affect a community are:

- Light Intensity
- Temperature
- Moisture levels
- Soil pH and mineral content
- Wind intensity and direction
- Carbon dioxide levels for plants
- Oxygen levels for aquatic animals (living in water)





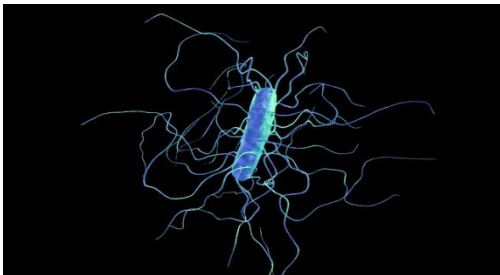
# Adaptations, interdependence and competition part 1

## – Biotic factors

**Biotic** factors means **living** factors.



**New predators** which organisms might not be able to defend against.



**New pathogens** being introduced and organisms having no resistance.

**Biotic factors  
which can affect  
a community  
are:**

Low **food availability** means organisms find it harder to survive and breed.



**One species outcompeting another** so the numbers are no longer sufficient to breed. In most of the UK, grey squirrels have outcompeted red squirrels.



# Adaptations, interdependence and competition part 1

## -Adaptations

Organisms have **features** (adaptations) which enable them to **survive** the conditions in which they normally live.

**Adaptations** can be:

- **behavioural** (actions an organisms takes)
- **structural** (how an organism is built)
- **functional** (how the organism works).



Migration or hibernation are examples of behavioural adaptation. They **increase** the **chances** of **survival** when food availability decreases in a habitat. [Video Bowerbird behaviour](#)

A duck with webbed feet, or trees having thick bark to resist fire, or cacti having needle like leaves to reduce water loss, are examples of **structural adaptations**.

**Functional adaptations** are not always easy to see. An example is a desert lizard producing very concentrated urine to conserve water.

# Adaptations, interdependence and competition part 1

## -Adaptations

Some organisms live in environments which are very extreme, such as at **high temperature**, **pressure** or **salt** concentration.

These organisms are called **extremophiles**.

-phile means 'a strong liking for'.

Acidophile - describes an organism that lives in acidic conditions.

Hydrophilic means water loving.



The vivid colours in this hot spring in Yellowstone National Park are the results of micro organisms living in this **extreme** environment.

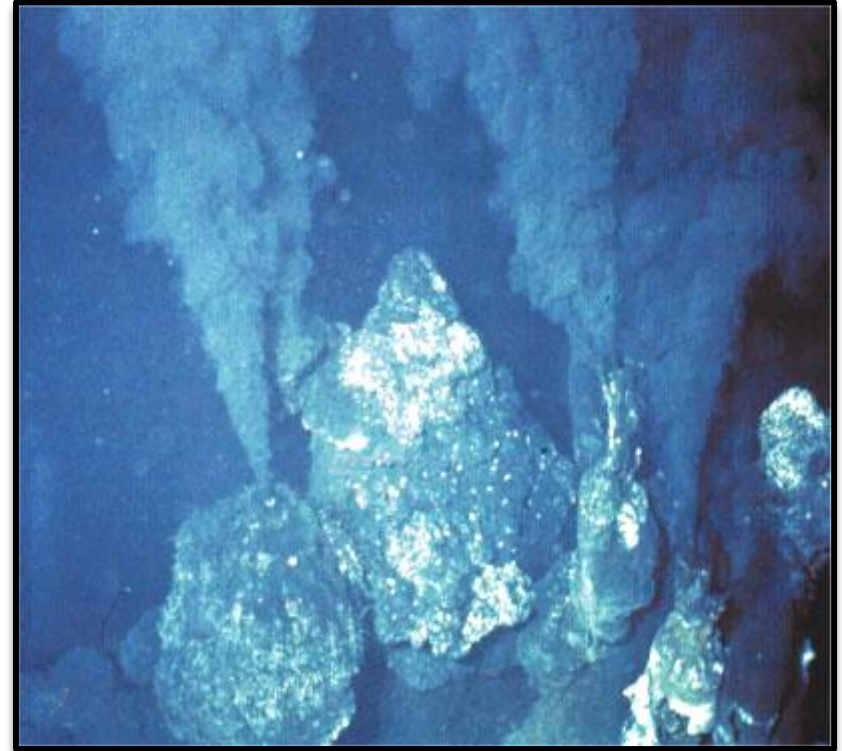
# Adaptations, interdependence and competition part 1

## -Adaptations

A particular species of **bacteria** has been found living 2500m below the surface of the sea in **hydrothermal ocean vents**.

Temperatures are over  $100^{\circ}\text{C}$ , it is very acidic and pressures are very high. These conditions are very extreme.

These bacteria are **extremophiles**. In order to survive, the **enzymes** found in these bacteria are specially **adapted** so they do not denature at high temperature.





# QuestionIT!

Adaptations,  
interdependence and  
competition

## Part 1

- Communities
- Abiotic factors
- Biotic Factors
- Adaptations



# Adaptations, interdependence and competition

## part 1 – QuestionIT

1. What is the definition of an ecosystem?
2. What do plants compete with other plants for?
3. What do animal compete with each other for?
4. List two ways a plant may depend on another species for its survival.
5. What is interdependence?
6. What is meant by a stable community?
7. What is the definition of an abiotic factor?
8. List **three** abiotic factors which can affect an aquatic organism.
9. List **three** abiotic factors which can affect a plant.

# Adaptations, interdependence and competition

## part 1 – QuestionIT

10. What is the definition of a biotic factor?
11. List **four** biotic factors which can affect a community.
12. There are three types of adaptation that an organism may show to aid its survival. What are the three types?
13. What is an extremophile?
14. Give three examples of what might make an environment be described as extreme.
15. Name a particular extremophile you have studied.



# AnswerIT!

Adaptations,  
interdependence and  
competition

## Part 1

- Communities
- Abiotic factors
- Biotic Factors
- Adaptations



# Adaptations, interdependence and competition

## part 1 – AnswerIT

1. What is the definition of an ecosystem?

*The interaction of a community of living organisms with the non-living parts of their environment.*

2. What do plants compete with other plants for?

*Light*

*Space*

*Water and mineral ions from the soil*

3. What do animal compete with each other for?

*Food*

*Mates*

*Territory*

4. List two ways a plant may depend on another species for its survival.

*Pollination*      *Seed dispersal*

# Adaptations, interdependence and competition part 1 – AnswerIT

5. What is interdependence?

*If one species is removed it can affect the whole community.*

6. What is meant by a stable community?

*One where all the species and environmental factors are in balance so that population sizes remain fairly constant.*

7. What is the definition of an abiotic factor?

*A non living factor*

8. List three abiotic factors which may affect an aquatic organism.

*Oxygen levels*

*Temperature*

*Carbon dioxide levels*

*Light intensity*



# Adaptations, interdependence and competition part 1 – AnswerIT

9. List three abiotic factors which can affect a plant.

*Light intensity*

*Temperature*

*Carbon dioxide levels*

*Oxygen levels*

10. What is the definition of a biotic factor?

*A living factor which may affect a community*

11. List four biotic factors which can affect a community.

*Food availability*

*A new predator*

*A new pathogen*

*One species outcompeting another so that numbers are no longer sufficient to breed*

# Adaptations, interdependence and competition

## part 1 – AnswerIT

12. There are three types of adaptation that an organism may show to aid its survival.  
what are the three types?

*Behavioural*

*Structural*

*Functional*

13. What is an extremophile?

*An organism which lives in an extreme environment*

14. Give three examples of what might make an environment be described as extreme.

*High temperature*

*Pressure*

*Salt concentration*

15. Name a particular extremophile you have studied.

*Bacteria living in deep sea vents*

# LearnIT! KnowIT!

## Organisation of an ecosystem Part 2



- Levels of organisation
- How materials are cycled
- Decomposition (biology only)
- Impact of environmental change (biology only (HT only))

# Organisation of an ecosystem part 2 – Levels of organisation

**Food chains** are used to represent the **feeding relationships** within a **community**. **All** food chains **begin** with a **producer** which **synthesises** molecules. Molecules are made when atoms are joined by chemical bonds. This is usually a **green plant** or **alga** which makes **glucose** molecules by **photosynthesis**.

Photosynthetic organisms are the producers of **biomass** for life on Earth.

**Biomass** is the mass of **living material** in an organism.



**Producers** are eaten by **primary consumers** which in turn may be eaten by **secondary consumers** which may be eaten by **tertiary consumers**.

# Organisation of an ecosystem part 2 – Levels of organisation



producer (grass)



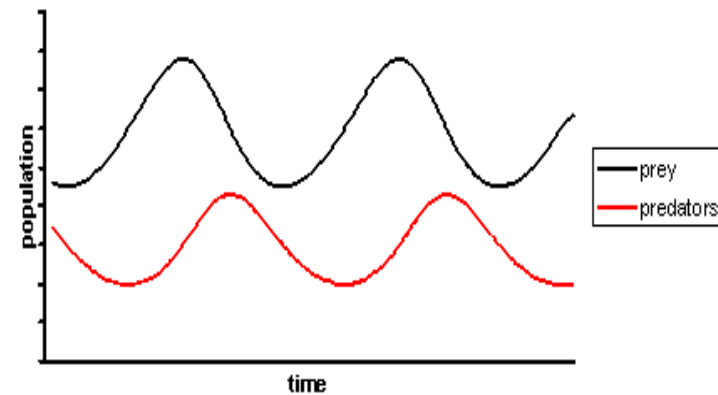
primary consumer  
(rabbit)



secondary consumer  
(fox)

**Consumers** that **kill and eat** other animals are known as **predators** and those that are **eaten** are **prey**.

In a **stable community** the **numbers** of predators and prey **rise** and **fall** in **cycles**. The increases and decreases in predator population usually lag slightly behind that of the prey cycle.





## Organisation of an ecosystem part 2 – Levels of organisation

It is important for **ecologists** to be able to determine the **distribution** and **abundance** (how many) of a **species** in an **ecosystem**. If one species is in decline, it can affect the whole ecosystem.

**Sampling** techniques are used to estimate the size of a population.

**Quadrats** are often used to do this and they can be used in a random way or by placing them along a line through an area called a **transect**.



Quadrats are frames usually with an area of  $0.25\text{m}^2$ . They are placed on the ground and the organisms (usually plants) inside the frame are counted.

Quadrats are used to calculate population density, population frequency or percentage cover in an area. [video](#)

You need to be able to understand and calculate the mean, mode and median.

[Link to required practical](#)

# Organisation of an ecosystem part 2 – How materials are cycled.

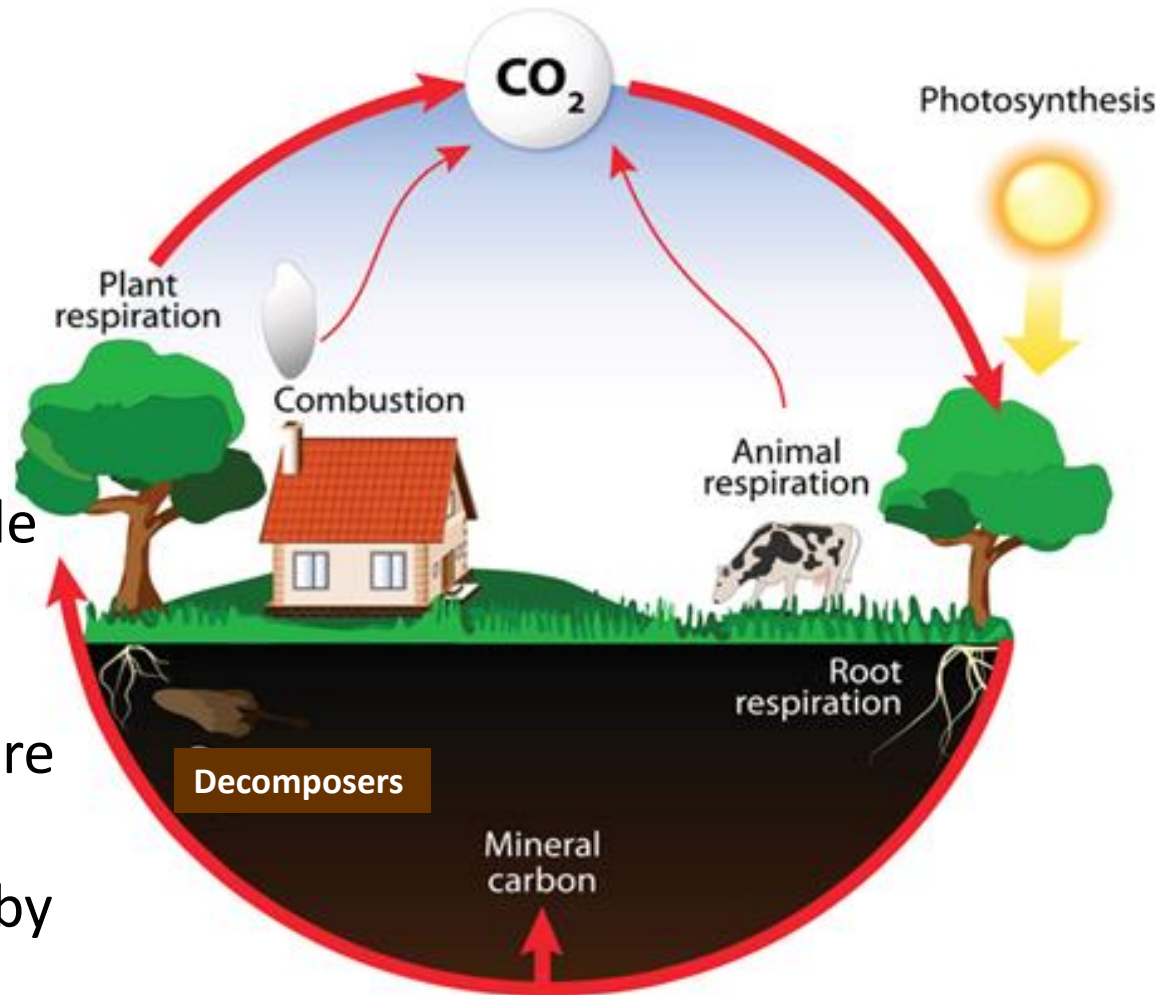
All materials in the living world are **recycled** to provide the building blocks for **future** organisms.

## The carbon cycle

**returns** carbon from organisms to the **atmosphere** as **carbon dioxide**.

Plants use carbon dioxide in **photosynthesis**.

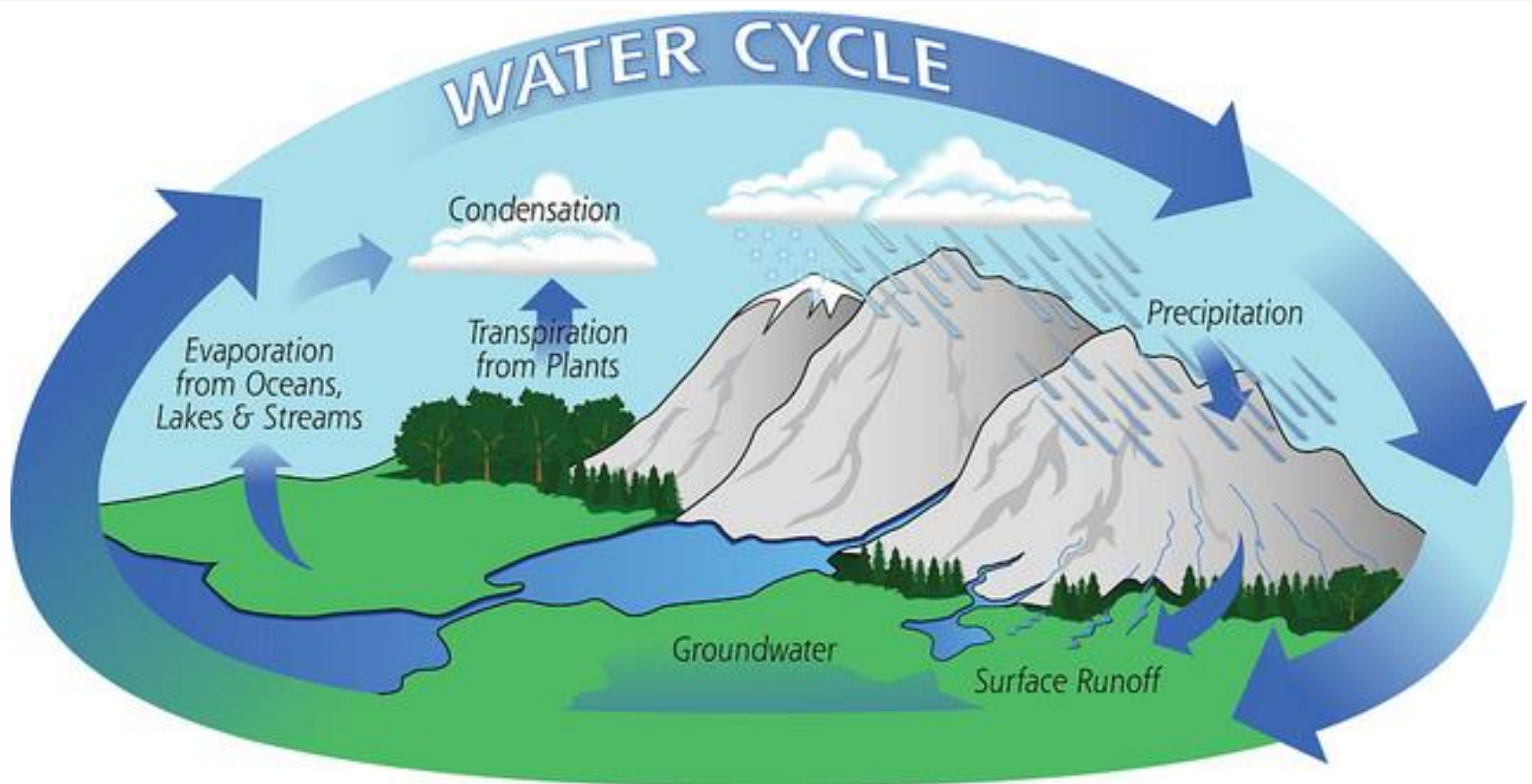
**Microorganisms** return carbon to the atmosphere as carbon dioxide and **mineral ions** to the soil by **decomposition**.



## Organisation of an ecosystem part 2 – How materials are cycled

The **water cycle** provides **fresh** water for plants and animals on **land** before **draining** into the **seas**.

Water is continuously **evaporated** and **precipitated**.





## Organisation of an ecosystem part 2 – Decomposition (biology only)

Gardeners and farmers try to provide optimum (the best) conditions for **rapid decay** of **waste biological material**. Biological materials have once been living or part of a living organism.

**Compost** is produced and this is used as a **natural fertiliser** for growing garden plants or crops.

The **key factors** required for optimising **decay** are the presence of:

- ✓ Water
- ✓ Oxygen
- ✓ Warmth
- ✓ Microorganisms called **decomposers**. These are bacteria or fungi.



# Organisation of an ecosystem part 2 – Decomposition (biology only)

Required Practical 10: Investigate the effect of temperature on the rate of decay of fresh milk by measuring pH change.

## Background information

There are **bacteria** present in pasteurised milk.

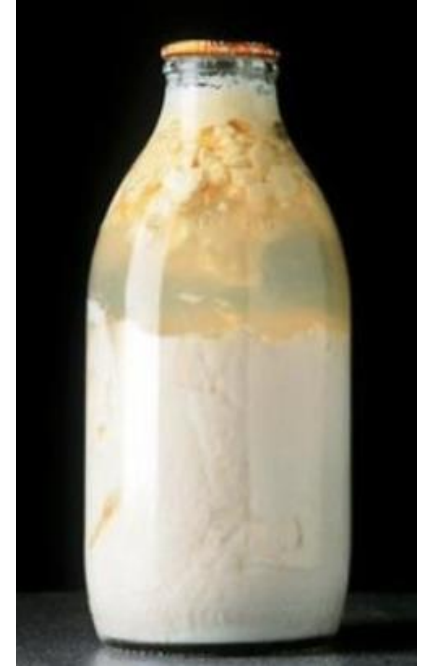
Pasteurised milk in the **fridge** remains useable for 3-5 days. Bacteria **reproduce slowly** at low temperatures.

If the milk is left out in the kitchen, the milk **warms** up and the **rate** of **bacterial reproduction** increases.

The bacteria digest the **lactose** in milk and release acid waste products (**lactic acid**) which makes the **milk decay** and turn sour.

In this experiment the process of decay would take too long, so we add lipase enzyme to **model** what would normally happen. Lipase enzyme catalyses the break down of fat in milk to fatty acids and glycerol. The increase in acid causes **cresol red** indicator to change

from **purple to yellow**.



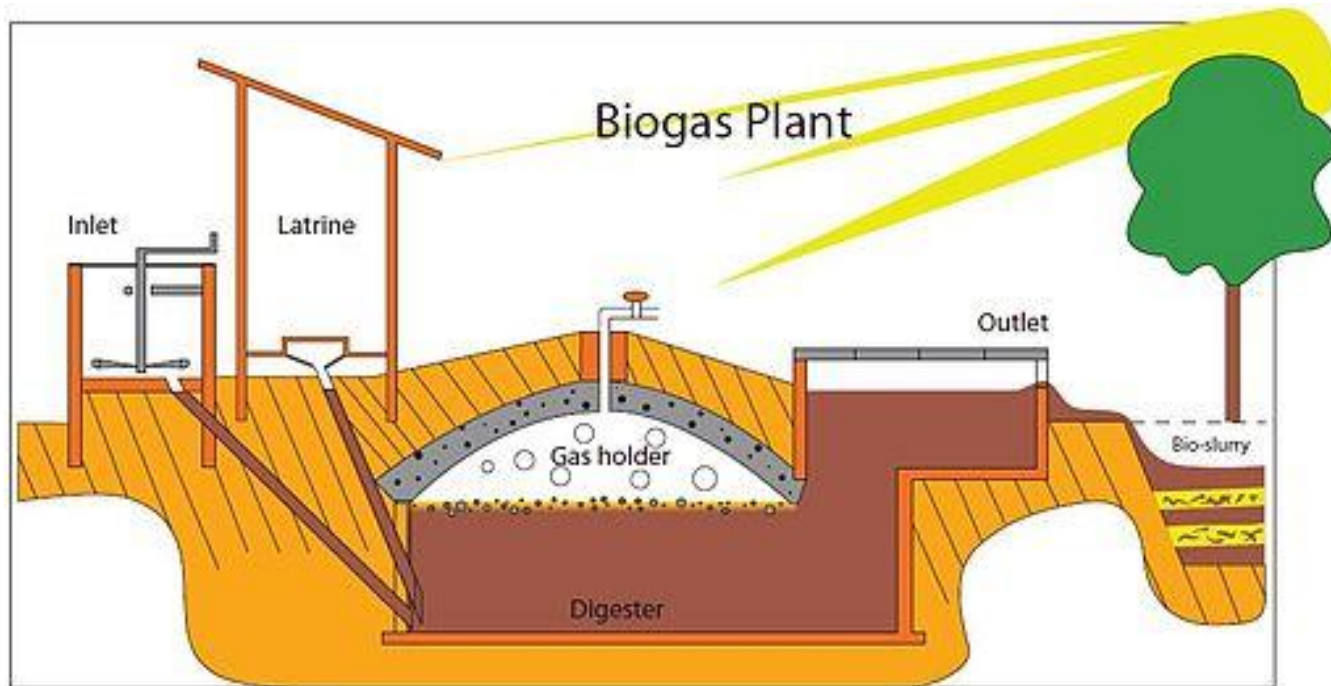
[Link to required practical](#)



## Organisation of an ecosystem part 2 – Decomposition (biology only)

If **insufficient oxygen** is present then **anaerobic decay** will occur. Anaerobic decay produces **methane gas**.

**Biogas generators** can be used to anaerobically digest waste biological material and produce **methane**. The methane gas can then be used as a **fuel**.



# Organisation of an ecosystem part 2 – Impact of environmental change (biology HT only)

The **distribution** of **species** in an ecosystem can be affected by **environmental changes**.

Such environmental changes may include:

- Temperature
- Water availability
- Composition of atmospheric gases

Changes may be:

- **seasonal** e.g. migration of wildebeest
- **geographic** e.g. coastal soil is more salty
- or caused by **human interaction** e.g. introduction of a new predator to an area or buildings.



# QuestionIT!

## Organisation of an ecosystem

### Part 2

- Levels of organisation
- How materials are cycled
- Decomposition (biology only)
- Impact of environmental change (biology HT only )



## Organisation of an ecosystem part 2 – QuestionIT

1. What is biomass?
2. What does a food chain show?
3. What do all food chains begin with?
4. Name two different types of organism which would be found at the start of a food chain.
5. What is meant by the terms mode and median?
6. What might eat a secondary consumer?
7. Define the term predator.
8. Define the term prey.
9. What piece of equipment is usually used to sample abundance of an organism in an area?

## Organisation of an ecosystem part 2 – QuestionIT

10. Why is it essential that materials are recycled in the living world?
11. What is precipitation in the water cycle?
12. List **three** main processes in the carbon cycle.

### **Biology Only**

13. Name **three** factors which must be present for rapid decay of waste biological material to occur.
14. What do gardeners call the end product after waste biological material has decayed?
15. What is this end product then used for?
16. What causes anaerobic decay to occur?



## Organisation of an ecosystem part 2 – QuestionIT (biology only)

17. Name a useful end product of anaerobic decay.
18. What is this product used for?
19. What is the name of the equipment used to process and collect this end product?

### **Biology Higher Tier only**

20. List **three** environmental changes which may alter the distribution of a species in an ecosystem.
21. Name **three** reasons why these environmental changes may occur.

# AnswerIT!

## Organisation of an ecosystem

### Part 2

- Levels of organisation
- How materials are cycled
- Decomposition (biology only)
- Impact of environmental change (biology HT only )



## Organisation of an ecosystem part 2 – AnswerIT

1. What is biomass? *Amount of living material in an organism*
2. What does a food chain show? *Feeding relationships within a community*
3. What do all food chains begin with? *A producer*
4. Name two different types of organism which would be found at the start of a food chain. *Green plant*

*Alga*

5. What is meant by the terms mode and median?

*Mode = number which occurs most often in a set of data.*

*Median = middle value in a set of data*

## Organisation of an ecosystem part 2 – AnswerIT

6. What might eat a secondary consumer? *A tertiary consumer*
7. Define the term predator. *An animal which kills and eats another animal.*
8. Define the term prey. *An animal which is hunted and killed for food by a predator*
9. What piece of equipment is usually used to sample abundance of an organism in an area? *Quadrat*
10. Why is it essential that materials are recycled in the living world? *To provide the building blocks for future organisms.*

## Organisation of an ecosystem part 2 –AnswerIT

11. What is precipitation in the water cycle? *Rain*

12. List three main processes in the carbon cycle.

*Photosynthesis*

*Respiration*

*Combustion*

*Decay*

### Biology Only

13. Name three factors which must be present for rapid decay of waste

biological material to occur. *Warmth*

*Oxygen*

*Water*

*Microorganisms (Decomposers)*



## Organisation of an ecosystem part 2 –AnswerIT

14. What do gardeners call the end product after waste biological material has decayed? ***Compost***

15. What is this end product then used for? ***As a natural fertiliser for garden plants or crops***

16. What causes anaerobic decay to occur? ***Insufficient oxygen***

17. Name a useful end product of anaerobic decay. ***Methane***

18. What is this product used for? ***As a fuel***

19. What is the name of the equipment used to process and collect this end product? ***A biogas generator***

# Organisation of an ecosystem part 2 – AnswerIT

(biology HT only)

## Biology Higher Tier only

20. List three environmental changes which may alter the distribution of a species in an ecosystem.

*Temperature*

*Availability of water*

*Composition of atmospheric gases*

21. Name three reasons why these environmental changes may occur.

*Seasonal*

*Geographic*

*Human interaction*

# LearnIT!

# KnowIT!

Biodiversity and the effect of human interaction on ecosystems.

## Part 3

- Biodiversity
- Waste Management
- Land Use
- Deforestation
- Global Warming
- Maintaining biodiversity



# Biodiversity and the effect of human interaction on ecosystems part 3 –biodiversity

Biodiversity is the variety of all the different species of organisms on Earth, or within an ecosystem.

A high **biodiversity** ensures the **stability** of **ecosystems** by **reducing** the **dependence** of one species on another for **food**, **shelter** and the maintenance of the **physical environment**.

The physical environment includes abiotic factors such as the availability of water, soil quality and climate.



Coral reefs have a high diversity. The animals shown have a wide variety of food available, lots of space and plenty of places to shelter from predators and when there is poor weather.

# Biodiversity and the effect of human interaction on ecosystems part 3 –biodiversity

The **future** of the **human** species **rely** on us maintaining a good level of **diversity**. Many **human activities** have **reduced** the **biodiversity** in particular places. It is only very **recently** that measures have been taken to try and **stop** this reduction.

The following activities are having a **negative effect** on **biodiversity**:

- How we **manage waste**
- How we **use land**
- **Deforestation**
- **Global warming**

Pollution kills plants and animals which can reduce diversity.

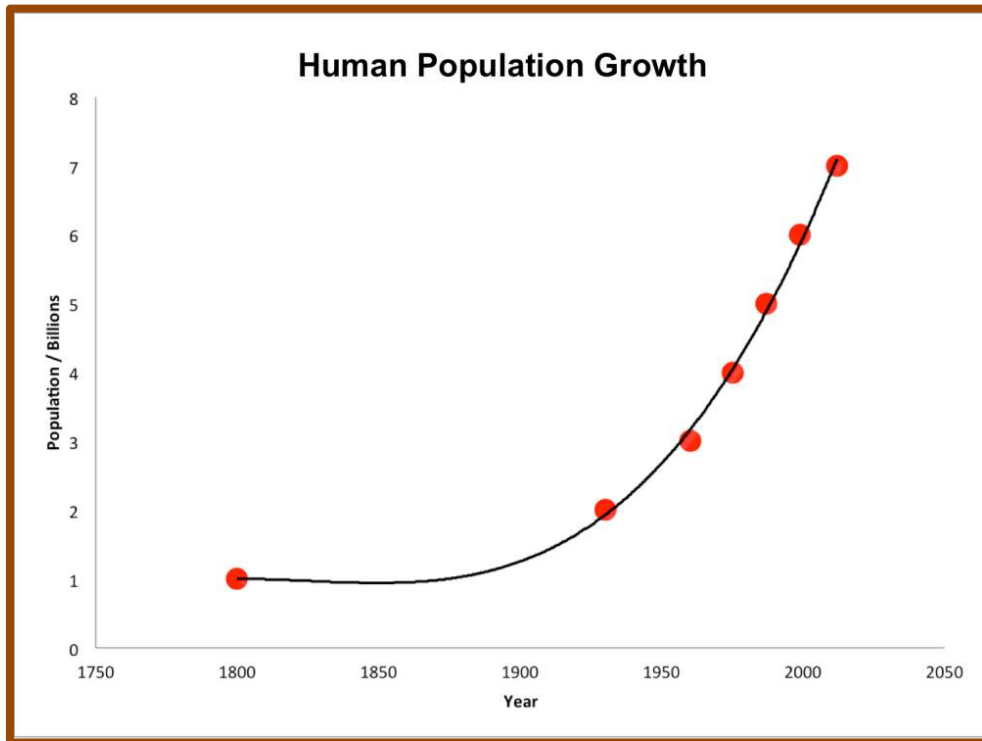


A turtle caught in a ghost net.



## Biodiversity and the effect of human interaction on ecosystems part 3 –biodiversity

The **human population** has been **growing** rapidly along with the **standards of living**.



**More resources** are used to produce materials for humans and so **more waste** is also produced.

The amount of **pollution** caused also increases unless the waste and chemical materials are properly handled.

**Land pollution** from **human waste** and **toxic chemicals** is a concern.

## Biodiversity and the effect of human interaction on ecosystems part 3 – Waste management

**Water pollution** can occur as a result of human activities.

**Sewage** or **toxic chemicals** may enter lakes, rivers or the sea.

The use of **artificial fertiliser** to improve plant growth in farming may enter waterways via **run off** from the fields.

This can lead to **eutrophication**.

**Algae** in the water **grow rapidly** due to the fertiliser. The algae **reduce** the amount of **light** available for plants and so they die.

The decay process uses up **oxygen** and so other living organisms such as **fish die** as well.

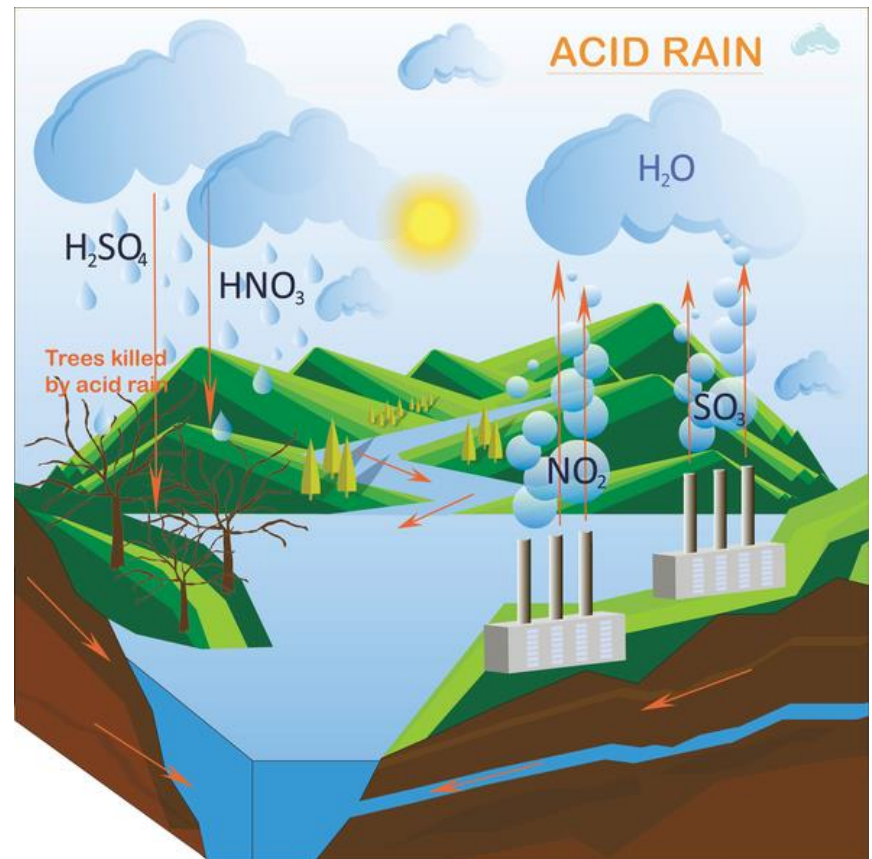


# Biodiversity and the effect of human interaction on ecosystems

## part 3 – Waste management

Air pollution can occur as a result of human activities. Without careful management, air pollution can cause serious harm to humans and other living organisms.

Burning **fossil fuel** produces **smoke** and **acidic gases**. As the population has grown and standards of living increased more fossil fuels are being used in industry, transport and in homes. Fossil fuels contain **impurities** such as **sulfur**, which reacts with oxygen to form **sulfur dioxide**. High concentrations can cause **breathing difficulties**.





# Biodiversity and the effect of human interaction on ecosystems

## part 3 –Land Use



**Quarrying**

Humans **reduce** the amount of **land available** for other animals and plants by actions such as:



**Building**



**Crop growing**



**Farming**



**Waste dumping**

# Biodiversity and the effect of human interaction on ecosystems

## part 3 –Land Use



Peat is made in **waterlogged** bogs over thousands of years. The moss and plants that grow there ‘lock in carbon dioxide’ and as they die, the **anaerobic** conditions **prevent decay**.

**Peat bogs** are being **destroyed** in order to sell peat as garden **compost**. This special **habitat** is being **reduced in size** and the **variety** of different plants, animals and microorganisms which live there is also **declining**.

**Biodiversity** is being **reduced** by the economic demand for cheap compost to **grow food** or as a fuel. **Decay** of peat as it mixes with soil or the **burning** of peat releases **carbon dioxide** into the atmosphere.





# Biodiversity and the effect of human interaction on ecosystems

## part 3 –Deforestation

In some wooded areas, the land is more in demand than timber. The forest is cut down and the wood burned to get rid of it. No new trees are planted. The **removal** of the **forest habitat** is called **deforestation**. Deforestation reduces **biodiversity** in the area and it can **impact** on a **species** directly if the species is unable to move to a new area.



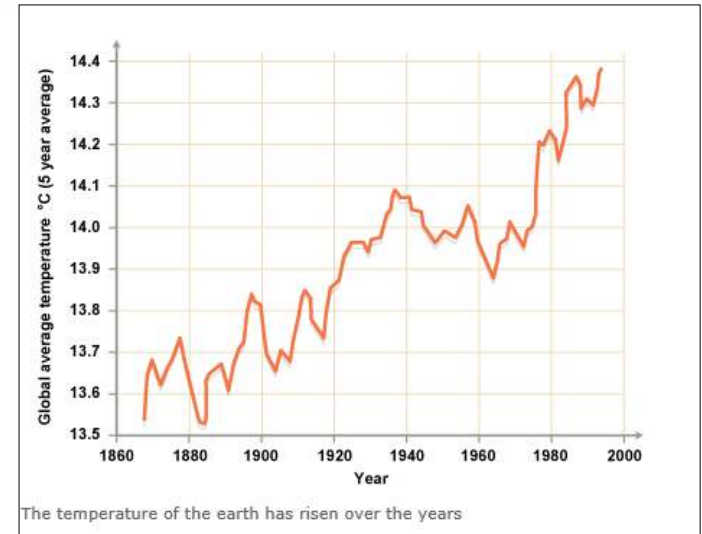
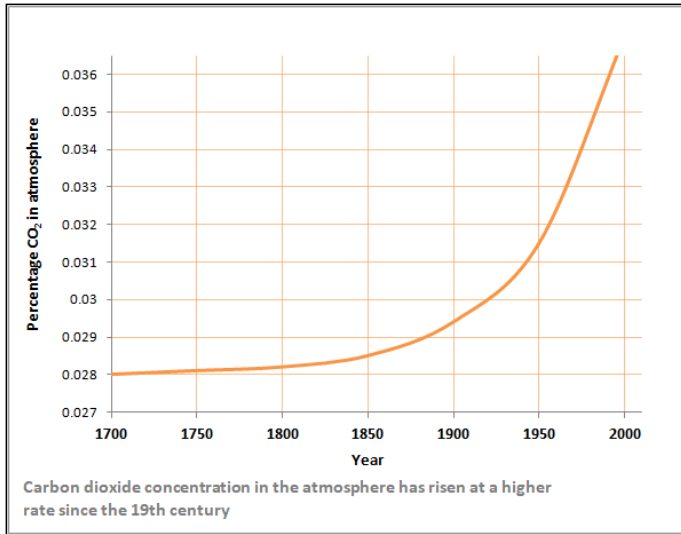
**Large scale** deforestation has happened in **tropical** areas to :

- Provide **land** for farming **cattle** which can provide food
- Provide **land** for **rice fields** to provide food
- Provide **land** to grow **crops** for producing **biofuel** (fuel produced by living organisms) such as **bio ethanol**, **wood** and **biogas**.

# Biodiversity and the effect of human interaction on ecosystems

## part 3 –Global warming

The levels of **carbon dioxide** and **methane** in the **atmosphere** are **increasing**. These two gases **contribute** to **global warming**.



Global warming has **biological consequences** such as:

- **Changes in weather** which include flooding and drought
- **Melting of ice caps** and increase in sea levels
- **Habitat loss** which can lead to species becoming **extinct** or critically endangered.

Scientists and concerned citizens have put in place programmes to **reduce the negative effects of humans** on biodiversity and ecosystems. These include:

**Reintroduction of field margins** (the land between the crop and the field boundary) and **hedgerows** in agricultural areas where farmers grow one type of crop. This encourages diversity of wildlife as there is a variety of food.



**Protection and regeneration of rare habitats.** These are often designated as SSSI and managed by conservation organisations.

SSSI = site of special scientific interest.



**Breeding programmes** for endangered species to guard against extinction and be able to increase numbers in the wild.



[endangered list](#)



**Recycling resources** instead of dumping waste in landfill.

**Reduction of deforestation and carbon dioxide emissions** by some governments across the world. Almost 200 governments have signed the Kyoto protocol.

# QuestionIT!

Biodiversity and the effect of human interaction on ecosystems.

## Part 3

- Biodiversity
- Waste Management
- Land Use
- Deforestation
- Global Warming
- Maintaining biodiversity



# Biodiversity and the effect of human interaction on ecosystems part 3 – QuestionIT

1. Define the term biodiversity?
2. What **two** factors have increased the use of resources by humans?
3. List **three** categories of pollution caused by human activity.
4. What can cause pollution in each of these three categories?
5. Name **four** processes which humans carry out that reduces the land available to other animals , plants and microorganisms.
6. Give **three** reasons why humans should not destroy peat bogs to make compost.
7. What is a biofuel?
8. Why do humans undertake large scale deforestation in tropical areas?



# Biodiversity and the effect of human interaction on ecosystems part 3 – QuestionIT

9. Name two gases which are increasing in the atmosphere and contribute to global warming.
10. List **three** biological consequences of global warming.
11. Consider the negative aspects of how humans interact with ecosystems. What could be done positively to counteract this effect?

Negative effects of human interaction on an ecosystem	Positive effects of human interaction on an ecosystem
Global warming and deforestation	
Animals and plants becoming in danger of extinction due to reduction in habitat	
Large 40 acre fields growing one crop	
Dumping waste in landfill sites	

# AnswerIT!

Biodiversity and the effect of human interaction on ecosystems.

## Part 3

- Biodiversity
- Waste Management
- Land Use
- Deforestation
- Global Warming
- Maintaining biodiversity



# Biodiversity and the effect of human interaction on ecosystems part 3 – AnswerIT

1. Define the term biodiversity? *The variety of all the different species or organisms on Earth or within an ecosystem.*
2. What two factors have increased the use of resources by humans? *Rapid growth in population and rise in standards of living*
3. List three categories of pollution caused by human activity.  
*Air*  
*Water*  
*Land*
4. What can cause pollution in each of these three categories?  
*Air: smoke and acidic gases*  
*Water: sewage, fertiliser or toxic chemicals*  
*Land: from landfill and from toxic chemicals*

# Biodiversity and the effect of human interaction on ecosystems part 3 – AnswerIT

5. Name four processes which humans carry out that reduces the land available to other animals , plants and microorganisms.

*Building*

*Quarrying*

*Dumping waste*

*Farming*

6. Give three reasons why humans should not destroy peat bogs to make compost.

*Decay of peat releases carbon dioxide into the atmosphere.*

*Reduces the area of the natural habitat for organisms that live there.*

*Reduces the diversity of the area as it reduces the number of animals, plants and microorganisms living there.*

7. What is a biofuel? *A fuel made by living organisms.*

# Biodiversity and the effect of human interaction on ecosystems part 3 – AnswerIT

8. Why do humans undertake large scale deforestation in tropical areas?

*To provide land for cattle farming*

*To provide land for rice fields*

*To grow crops for biofuels*

9. Name two gases which are increasing in the atmosphere and are contributing to global warming. *Carbon dioxide and methane*

10. List three biological consequences of global warming.

*Ice caps melting and causing rise in sea levels*

*Change in climate – droughts and flooding*

*Loss of habitat and species needing to migrate*



# Biodiversity and the effect of human interaction on ecosystems part 3 – AnswerIT

11. Consider the negative aspects of how humans interact with ecosystems. What could be done positively to counteract this effect?

Negative effects of human interaction on an ecosystem	Positive effects of human interaction on an ecosystem
Global warming and deforestation	<i>Agreement by governments to reduce carbon dioxide emissions and deforestation</i>
Animals and plants becoming in danger of extinction due to reduction in habitat	<i>Introducing breeding programmes and protection of habitats by conservation trusts</i>
Large 40 acre fields growing one crop	<i>Reintroduce smaller fields and replant hedgerows and leave edges of field to grow wild.</i>
Dumping waste in landfill sites	<i>Recycle resources more effectively</i>



# Trophic levels in an ecosystem part 4 – Trophic levels (biology only)

**Trophic levels** are defined as the **feeding levels** within an ecosystem. Trophic levels can be represented by numbers.



**Apex predators** are carnivores with no predator.

Carne = meat  
Herb = plant  
Omni = plant & meat  
vore = eater

Level 4: **Carnivores** that eat other carnivores are called **tertiary consumers**.

Level 3: **Carnivores** that eat herbivores are called **secondary consumers**.

Level 2: **Herbivores** eat plants/alga and are called **primary consumers**.

Level 1: **Plants and alga** make their own food and are called **producers**.

## Trophic levels in an ecosystem part 4 – Trophic levels (biology only)

**Decomposers** play an important part in the **carbon cycle**. They break down **dead plant** and **animal** matter by **secreting enzymes** into the **environment**.

Small **soluble** food **molecules** then **diffuse** into the microorganism. A variety of **nutrients** will also be released into the soil and these can be **absorbed** by **plants**.

Decomposers are usually bacteria or fungi.

Remember the key factors for creating optimum conditions for decay are:

- Presence of oxygen
- Water
- Warmth
- Presence of microorganisms



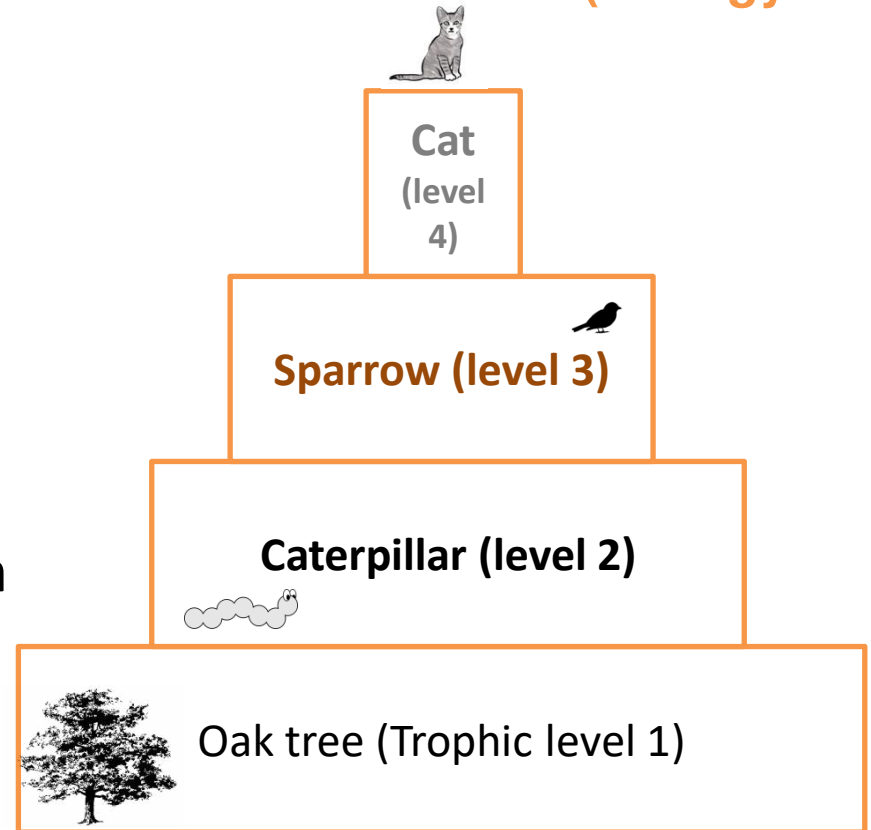
# Trophic levels in an ecosystem part 4 – Pyramids of biomass (biology only)

**Biomass** is defined as the amount of **living material** at each **trophic** (feeding) level.

**Pyramids of biomass** can be constructed to represent the relative amount of biomass in each level of a food chain.

**Trophic level 1** (plant or alga) is always at the **bottom** of the pyramid.

**Oak tree → caterpillars → sparrows → cat**



The diagram is a **pyramid** shape because the amount of **biomass** and energy available at each trophic level **decreases**.



## Trophic levels in an ecosystem part 4 – Transfer of biomass (biology only)

**Producers** are mostly **plants** and **algae**. They transfer about **1%** of the **incident energy** from light for **photosynthesis**.



Incident light is the light which shines on the producer.

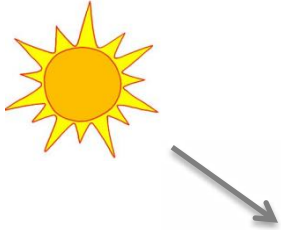
Only **10%** of the **biomass** from **each trophic level** is **transferred** to the level above it.

**Losses of biomass** are due to:

- Not all **ingested material** (food taken in) is **absorbed** into the body. Some is **egested** as **faeces**.
- Not all the **absorbed** material is used to make **new biomass**. Some is lost as **waste** such as carbon dioxide and water in **respiration** and water and urea in **urine**.
- Large amounts of **glucose** are used up in **respiration** and provide energy for movement, growth and keeping a constant body temperature.

# Trophic levels in an ecosystem part 4 – Transfer of biomass (biology only)

## Calculating efficiency of biomass transfer



**Biomass available** at  
each trophic level

6000g

500g

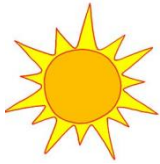
170g

The rabbit population has 6000g of biomass from the grass available.  
The fox population has 500g of biomass available from the rabbits.  
170g is the amount of biomass that has been used by the fox.

The following equation can be used to find out the **efficiency** of biomass transfer between two trophic levels as a percentage:

**Efficiency of biomass transfer** =  $\frac{\text{biomass transferred to the next level}}{\text{biomass available at the previous level}} \times 100$

## Trophic levels in an ecosystem part 4 – Transfer of biomass (biology only)



Biomass available at  
each trophic level

6000g

500g

170g

Calculate the efficiency of biomass transfer between the grass and the rabbit .

Efficiency of biomass transfer =  $\frac{\text{biomass transferred to the next level} \times 100}{\text{biomass available at the previous level}}$

$$\text{Efficiency of biomass transfer} = \frac{500}{6000} \times 100 = 8.3\%$$

# QuestionIT!

Trophic levels in an ecosystem  
(biology only)

## Part 4

- Trophic levels
- Pyramids of biomass
- Transfer of biomass



## Trophic levels in an ecosystem part 4– QuestionIT

1. Define the term trophic level.
2. What is a carnivore?
3. What is a herbivore?
4. What type of consumer is a carnivore which eats another carnivore?
5. What do we call a carnivore that has no predators?
6. What is a decomposer?
7. How do decomposers gain their food from dead plant or animal matter?
8. What does the pyramid of biomass represent?



## Trophic levels in an ecosystem part 4– QuestionIT

9. How much energy as a percentage is transferred by producers from incident light for photosynthesis ?
10. Approximately how much biomass, as a percentage, is transferred from a trophic level to the one above it?
11. List **two** ways in which biomass can be lost at each stage of a food chain.
12. What is the equation which should be used to calculate the efficiency of biomass transfer between trophic levels as a percentage?

# AnswerIT!

Trophic levels in an ecosystem (biology only)

## Part 4

- Trophic levels
- Pyramids of biomass
- Transfer of biomass



## Trophic levels in an ecosystem part 4– AnswerIT

1. Define the term trophic level. *Feeding level within an ecosystem*
2. What is a carnivore? *Meat eating animal*
3. What is a herbivore? *Plant eating animal*
4. What type of consumer is a carnivore which eats another carnivore?  
*Tertiary consumer*
5. What do we call a carnivore that has no predators? *Apex predator*
6. What is a decomposer? *Microorganisms that break down dead plant and/or animal matter*
7. How do decomposers gain their food from dead plant or animal matter? *By secreting enzymes into the environment. Small soluble food molecules diffuse into the microorganism.*
8. What does the pyramid of biomass represent? *The relative amounts of biomass at each level of a food chain.*

## Trophic levels in an ecosystem part 4– AnswerIT

9. How much energy as a percentage is transferred by producers from incident light for photosynthesis ? *Approximately 1%*
10. How much biomass as a percentage is transferred approximately from a trophic level to the one above it? *10%*
11. List 2 ways in which biomass can be lost at each stage of a food chain.  
*Not all ingested food is absorbed- some is lost as faeces.*  
*Not all absorbed food is converted into biomass – some used for keeping constant body temperature or movement.*
12. What is the equation which should be used to calculate the efficiency of biomass transfer between trophic levels as a percentage?  
*Efficiency of biomass transfer =  $\frac{\text{biomass transferred to the next level} \times 100}{\text{biomass available at the previous level}}$*





## Food production part 5 – Factors affecting food security (biology only)

**Food security is defined as having enough food to feed a population.**

### Biological factors which threaten food security :

Increasing **birth rate** in some areas mean it is challenging to feed everyone.

Changing **diets** in **developed countries** means **scarce food resources** are **shipped** around the world. Quinoa was a staple diet in Bolivia but the majority is now shipped to the US and Europe.

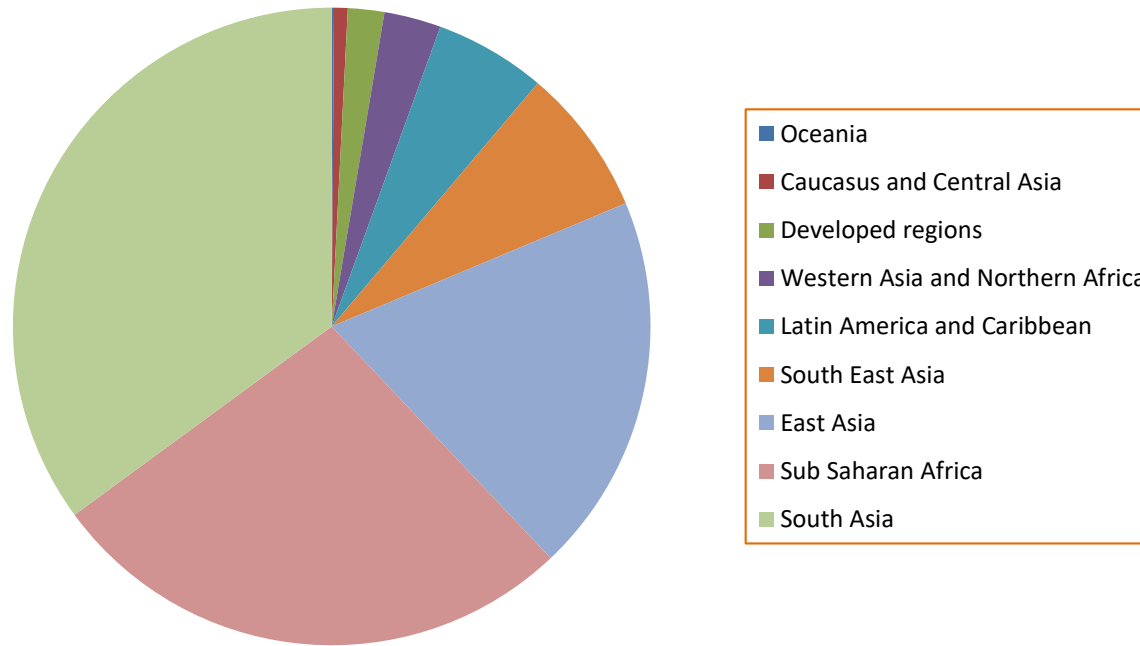
**New pests** and **pathogens** that affect farming e.g. Bird flu

**Environmental changes** due to **global warming** affect food production e.g. famine if rains fail as crops do not grow.

The **cost** of **agricultural inputs** such as irrigation systems, fertilisers and quality seed are **high** and so threaten food security.

**Conflicts** (fighting) that have arisen in parts of the world which affect the **availability** of **food** or **water**.

## Food production part 5 – Factors affecting food security (biology only)



An estimated **868 million people** between 2010 and 2012 were classed by the Food and Agricultural Organisation of the United Nations (FAO) as being undernourished. They would be described as being **food insecure**. This means there was limited or uncertain availability of nutritionally adequate and safe foods **OR** there was limited or uncertain ability to acquire food in a socially acceptable way.

## Food production part 5 – Factors affecting food security (biology only)

The jackfruit is native to Southern India. It is said to taste a bit like pulled pork and smells like fruit gums.



The jackfruit is being suggested as a possible solution to food insecurity. A jackfruit can grow up to 35kg.

### **Why is the jackfruit a potential solution?**

- ✓ The tree requires relatively little care once it is established.
- ✓ It is a perennial so does not require regular replanting.
- ✓ It requires very little irrigation or use of pesticide unlike rice.
- ✓ The fruit is high in protein, potassium and vitamin B.
- ✓ It is versatile and can be dried, boiled, roasted or ground to make flour.

## Food production part 5 – Farming techniques (biology only)

**Sustainable methods** must be found to feed all the people on Earth. The **efficiency of food production** can be improved by **restricting wasted energy transfer** from food animals to the environment. This means more energy will be available to humans from their food.

These pigs are kept in a **temperature controlled building**. This means that less heat will be transferred to the environment from the pigs. The pigs will expend less energy in maintaining a constant body temperature and so more energy will be available to the humans in their food.



These pigs cannot **move** much and so **less energy** is transferred to the **muscles** for movement. They are fed **high protein** food to increase **growth**.

## Food production part 5 – Sustainable fisheries (biology only)

Fishing has been a way of life for humans throughout history. However the **fish stocks** in the oceans are **declining**.

It is important to maintain fish stocks at a **sustainable level** where **breeding** occurs. If this does not occur, certain **species** may **disappear** altogether in some areas.

In some areas, **fishing quotas** are in place for the amount and type of fish which can be caught. However once a fish has been caught it is usually dead and so quotas do not always work.



**Controls** over the **size of holes** in fishing nets are important. Larger holes mean that young fish can swim out of the net and **live longer** to **breed** and increase in **size**.



Modern **biotechnology** techniques enable large quantities of **microorganisms** to be **cultured** for **food**.

The fungus *Fusarium* is useful for producing **mycoprotein**. Mycoprotein is a protein-rich food suitable for **vegetarians**. The sausages in the photograph are made from mycoprotein.



The fungus is **grown** on **glucose** syrup in **aerobic** conditions and the **biomass** is then **harvested** and **purified**.

## Food production part 5 – Role of biotechnology (biology only)

**Genetically modified crops** (GM) could be used to provide **more food** or food with an improved **nutritional value**.

Scientists have added a **gene** to wild strains of **rice** which make it produce **beta carotene**. The rice looks a golden colour due to the beta carotene. It is called **Golden Rice**.

Beta carotene is an important component in the manufacture of **vitamin A** (needed for **good vision**) in the human body. Almost 500 000 children become blind every year as a result of a lack of vitamin A in their diet. Golden Rice was designed to try and reduce this number by increasing the amount of beta carotene in the diet.

Some people have **concerns** about **GM crops** because they think that GM food has **not** been **tested** thoroughly enough to be sure there are no drawbacks to health. There is also concern that GM crops may **contaminate** wild crops.

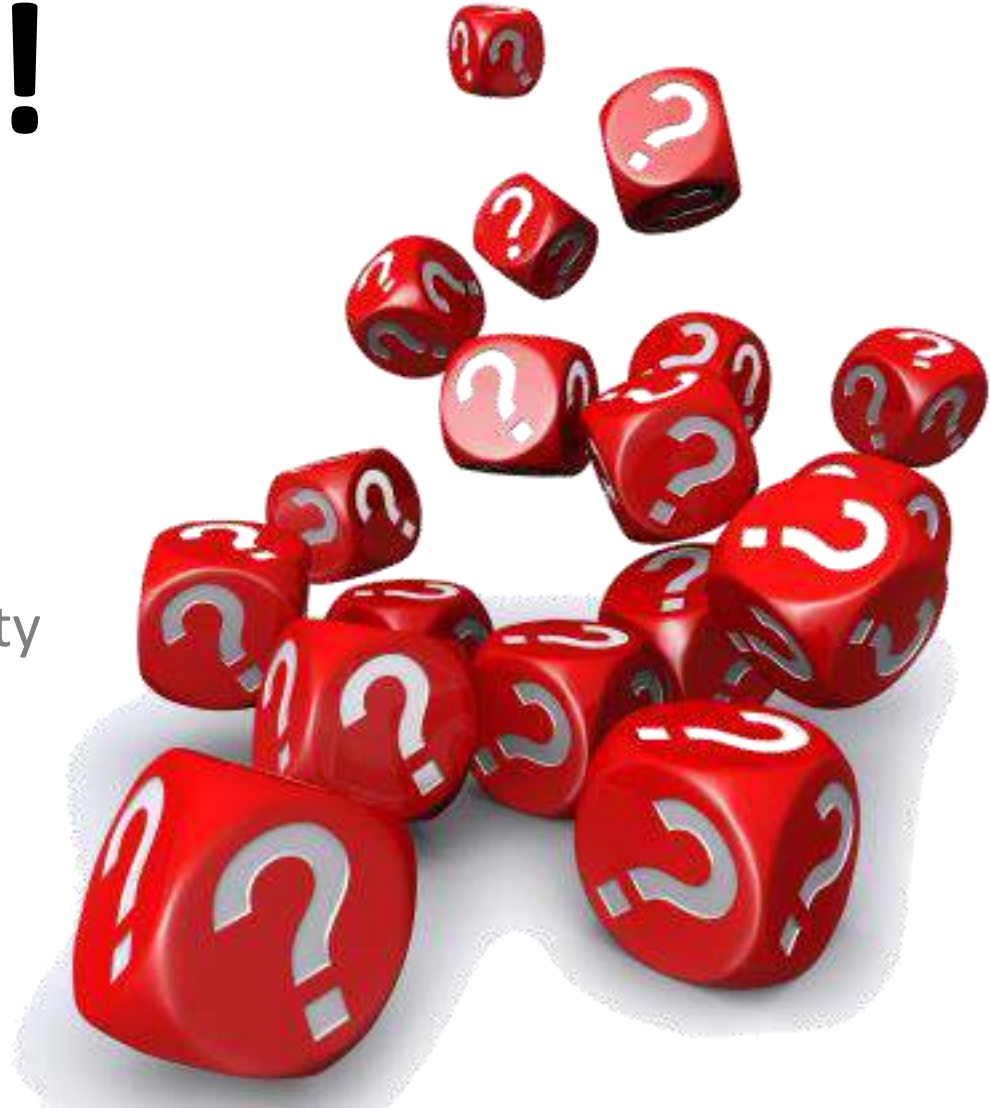
Revise how genetically modified bacteria produce human insulin to treat diabetic people.

# QuestionIT!

## Food production (biology only)

### Part 5

- Factors affecting food security
- Farming techniques
- Sustainable fisheries
- Role of biotechnology



## Food production part 5– QuestionIT

1. What is meant by the term food security?
2. List **four** biological factors which threaten food security.
3. Give **two** ways in which energy transfer to the environment can be restricted in food animals.
4. Some farmers feed their animals high protein food. Why?
5. List **two** things which can be done to conserve fish stocks in the ocean at a sustainable level.
6. What type of food does the fungus *Fusarium* produce?
7. How is *Fusarium* grown?
8. What is golden rice?
9. What type of organism produces genetically engineered human insulin?

# AnswerIT!

## Food production (biology only)

### Part 5

- Factors affecting food security
- Farming techniques
- Sustainable fisheries
- Role of biotechnology





## Food production part 5– AnswerIT

1. What is meant by the term food security?

*Having enough food to feed a population.*

2. List **four** biological factors which threaten food security.

*Increasing birth rate*

*Changing diets in developed countries leading to food being shipped around the world*

*New pests and pathogens affecting farming*

*Environmental changes*

*Costs of agricultural inputs*

*Conflicts which have reduced access to food and water*

3. Give **two** ways in which energy transfer to the environment can be restricted in food animals. *Restrict movement*

*Control the temperature of the surroundings*

## Food production part 5– AnswerIT

4. Some farmers feed their animals high protein food. Why?

***Increase growth***

5. List **two** things which can be done to conserve fish stocks in the ocean at a sustainable level. ***Control size of holes in net***

***Introduce fishing quotas***

6. What type of food does the fungus *Fusarium* produce? ***Mycoprotein***

7. How is *Fusarium* grown? ***On glucose syrup in aerobic conditions***

8. What is golden rice? ***Genetically modified rice which has high levels of beta carotene present.***

9. What type of organism produces genetically engineered human insulin?

***Bacteria***