Unit 3 Revision

BRIGHT MINDS
MENTORING

1. Photosynthesis - Pathway

The basic photosynthesis equation :

$$\text{Carbon Dioxide + Water} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \text{Oxygen + Glucose}$$

Two stage Photosynthesis process.

1. Light Reactions

- Light energy is absorbed by chlorophyll in the chloroplast and converted into chemical energy which is used to make ATP.
- Water is split to produce hydrogen and oxygen
- Oxygen is a by-product which diffuses from the cell.

2. Carbon Fixation

- Uses hydrogen and ATP from light reactions to fix carbon dioxide to produce **glucose**
- Series of **enzyme controlled** reactions (temperature dependent)

- **Fates of Glucose**

The chemical energy stored in glucose can be converted into:

1. **S**tarch for **S**torage
2. **C**ellulose for **C**ell walls (structural)
3. Energy for respiration

Energy Transfer - 3 marks

1. **Light energy** is absorbed by chlorophyll.

2. This is converted into **chemical energy** in the form of **ATP.**

3. This is used to make **chemical energy** called **glucose.**

1. Photosynthesis - Pathway

Light Reactions



Light energy

Absorbed by chlorophyll in the chloroplast

Chemical energy

Diffuses from cell as a by-product

Water

ATP

Oxygen + Hydrogen

Carbon Fixation

(light reactions)

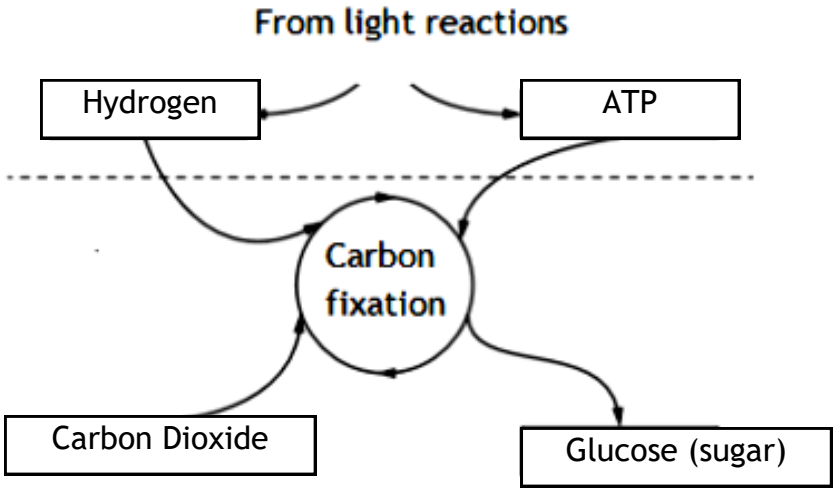
ATP

Carbon Dioxide + Hydrogen → **Glucose**

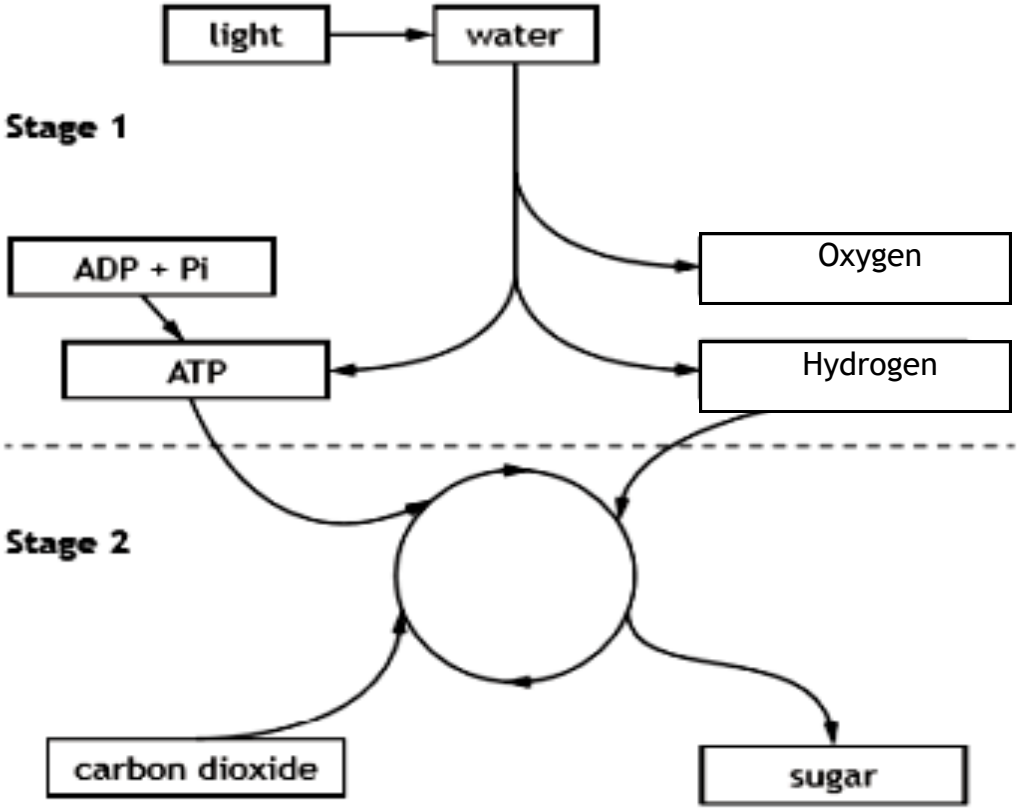
(atmosphere) (light reactions) (Sugar)

1. Photosynthesis - Pathway

Example Exam Diagram 1.



Example Exam Diagram 2.



1. Photosynthesis - Limiting Factors

Limiting Factors

Limit the rate of photosynthesis that occurs within a plant.

There are **three** limiting factors (TLC)

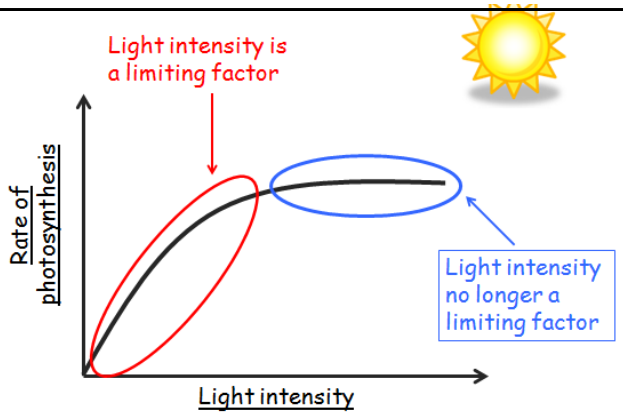
1. Temperature
2. Light Intensity
3. CO_2 Concentration

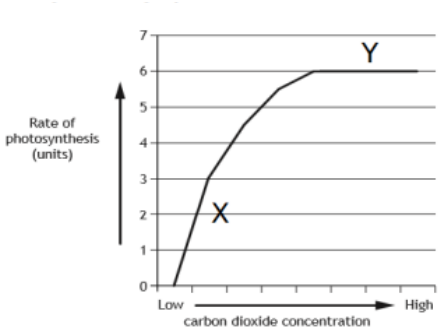
Shown by graph increasing in response to increase in the factor

Limiting Factor Graphs

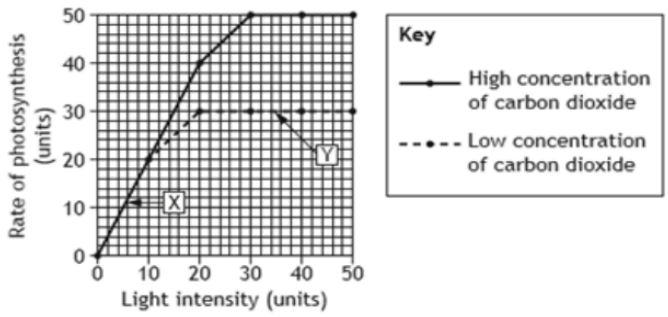
Hint: If the line is still increasing look down at the X Axis

If the line stays the same it will be one of the other limiting factors





X - Carbon Dioxide Concentration
Y - Temperature or Light Intensity



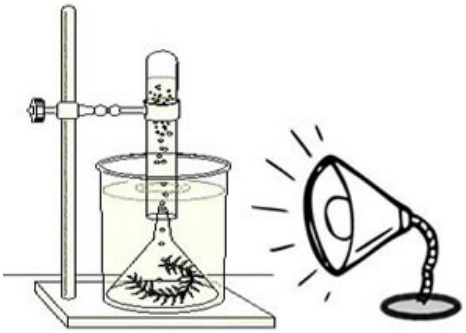
X - Light Intensity
Y - Carbon Dioxide Concentration

1. Photosynthesis - Measuring rate of photosynthesis

Measuring the Rate of Photosynthesis

Photosynthesis can be measured in the following ways:

1. Number of **oxygen** bubbles produced per minute.

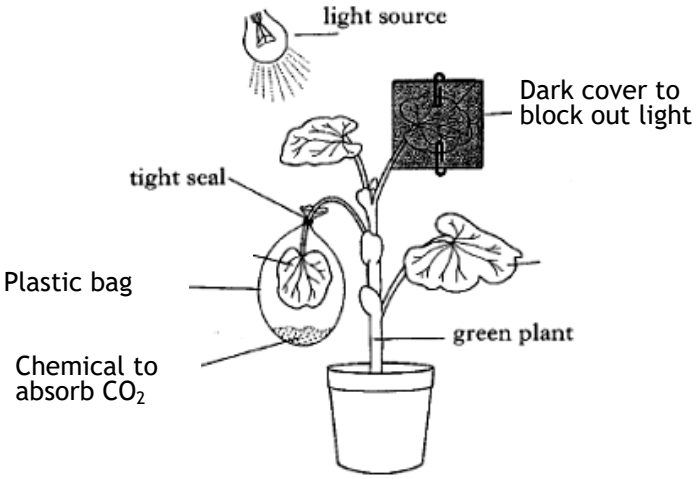


2. Volume of **carbon dioxide** taken in by the plant.

3. Measuring the increase in dry mass of the plant.

   (measures the mass of starch produced)

Limiting Factor Investigations - (investigates if photosynthesis has taken place)



Black paper - removes light.

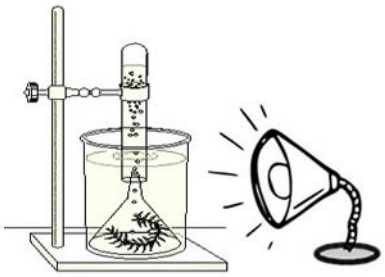
Plastic bag with chemical - removes CO_2

1. Photosynthesis - Investigation Question/Answer

Experiment Question

An experiment was set up to investigate the effect of light intensity on rate of photosynthesis in the water plant, Cabomba.

The number of oxygen bubbles produced in one minute was used to measure the rate of photosynthesis.



Distance of lamp from beaker (cm)	Number of O_2 bubbles produced per minute.
10	40
20	30
30	25
40	15
50	5

Potential Investigation Question and Answers

Question	Answer
Name the independent variable.	Light intensity
Name the dependent variable.	Rate of photosynthesis
Give an example of a variable you need to keep the same.	Volume of water, mass of Cabomba, temperature, carbon dioxide concentration
Describe a suitable control for this experiment.	Exact same set up but no light
Explain the purpose of a control?	To prove that light intensity is affecting the rate of photosynthesis
Describe how you would make the experiment more reliable?	Repeat at each light intensity
Describe how you would ensure validity in the experiment.	Keep everything the same apart from light intensity
Describe two ways in which the apparatus would be adapted to demonstrate the effect of temperature rather than light intensity.	1. Keep light intensity the same 2. Use a wide range of temperatures.
What conclusion can be drawn from the results?	As light intensity increases, rate of photosynthesis increases.

2. Energy in Ecosystems - Food Chains

Terms

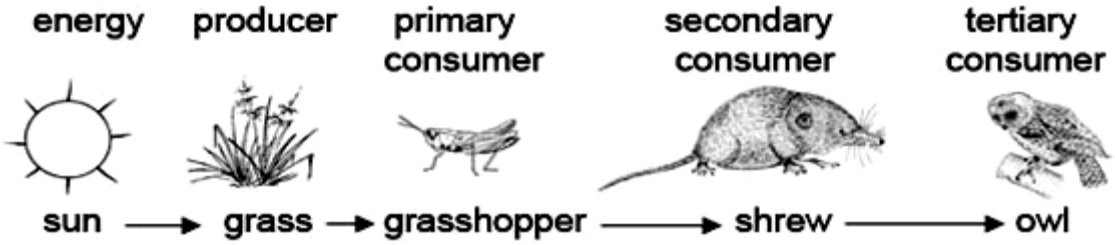
Producer – makes their own food (by photosynthesis).

Consumer – needs to eat other organism to obtain food.

Food Chains

All food chains start with a producer (green plant).

The arrows show the **direction of energy flow**.



Food Chain Terms

Primary consumer	first consumer.
Secondary consumer	second consumer.
Tertiary consumer	third consumer.



Predators	animals who hunt other animals for food.
Prey	animals who are hunted by other animals.
	(note prey cannot be PLANTS)

Carnivores	eat animals only
Herbivores	eat plants only
Omnivores	eat animals & plants



2. Energy in Ecosystems - Energy Transfer

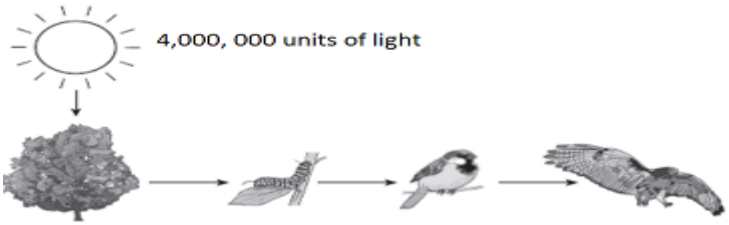
All energy comes from the **sun**.
Plants absorb a **small percent** of this energy and use this to make food (photosynthesis).

Likely Percentage Calculation 1

4% of the light energy reaching the sun is converted into new plant material.

How much energy did the Oak tree Receive?

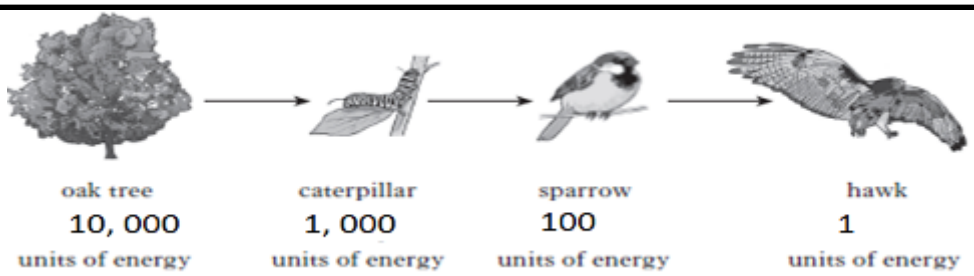
(4%) = 4/100 x 4,000,000 = <u>160,000 units of energy</u>



Likely Calculation 2

Working out the units of energy passed on to each organism in a food chain.

Only **10% of energy** is passed on at each stage of a food chain for **growth.**



<u>90% </u>of energy is lost from the food chain via:

1. Heat
2. Movement
3. Undigested material (faeces)

2. Energy in Ecosystems - Pyramids

Two types of Pyramids *** learn definitions ***

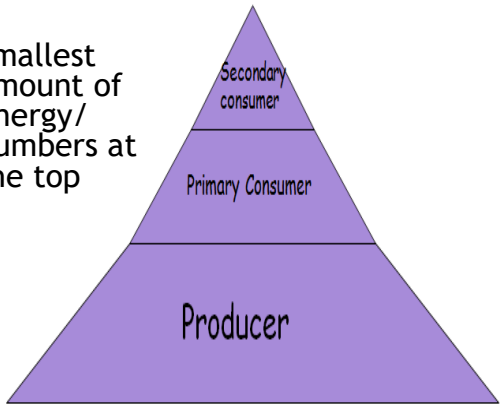
1. Pyramids of Numbers

   The **number of organisms** at **each stage of a food chain.**

2. Pyramids of Energy

   The **energy** received by organisms at **each stage of a food chain.**

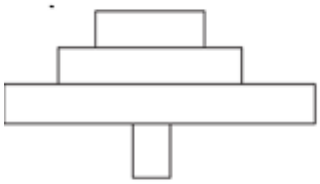
Smallest amount of energy/ numbers at the top



Largest amount of energy/ numbers at the bottom

Problem with pyramids of numbers

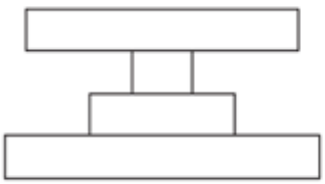
Pyramid of numbers does not resemble a true pyramid shape when a tree is a consumer (smaller at bottom) OR insect at the top!



Too small at bottom if tree is the producer



Oak tree → greenfly → was → blue tit



Too large at top if insect is the top consumer

Grass → zebra → lion → flea



******Pyramid of energy always looks like a pyramid shape ******

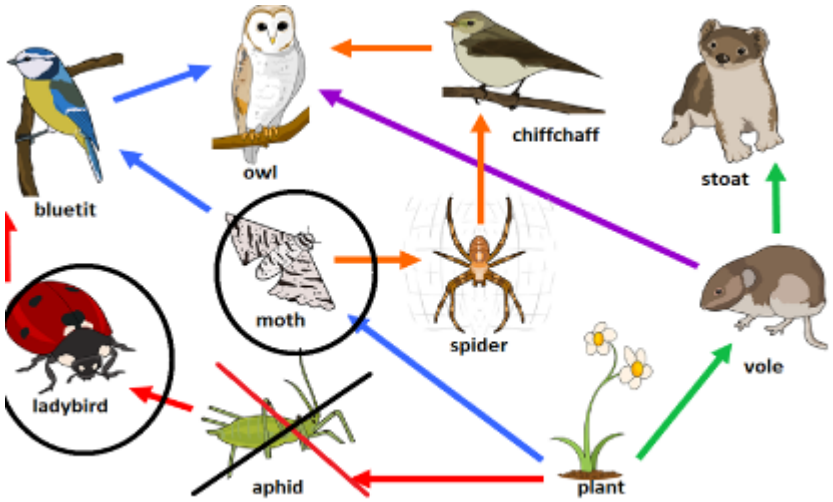
Energy is always lost as you move up the food chain.

2. Energy in Ecosystems - Food Webs

All organisms are **connected in a food web**. Removing one organism from the food web destroys the delicate balance.

When an organism is removed it will **ALWAYS affect** other organisms in a good or bad way, dependent on the circumstances.

Common Exam Question



What would happen to the moths and ladybirds if the aphids were removed?

A) Moths—increase

Why—Less aphids mean more plants for moth to eat.

B) Ladybirds—decrease

Why—Less aphids to eat. OR

More moths mean more blue tits which mean less ladybirds.

3. Competition and Niche

Competition

When resources are in SHORT supply

Resources required

Animals	**Plants**
Food	Water
Shelter	Nutrients
Mates	Space
Territory	Light

Interspecific Competition

DIFFERENT SPECIES

Between **different** species

who want one/few similar **resources**.

e.g. lion and hyena

Intraspecific Competition (fiercer)

SAME SPECIES

Within the **same species** who want ALL of the **same resources**.

e.g. Two lions

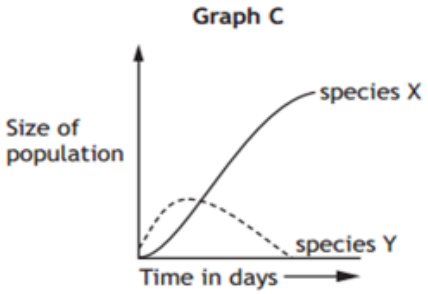
Competition Graphs

Results in the survival of the fittest

(Natural Selection)

1 species increases

1 species decreases



Niche

The role an organism plays in its community.

1. Resources it requires in ecosystem (light/nutrient availability0.
2. Interaction with other organisms (competition/predation)
3. Conditions it can tolerate (temperature)

4. Ecosystem and Biodiversity terms

Biodiversity

Variety and relative abundance (amount) of living organisms.

Importance of Biodiversity

Variety of Organisms needed for a stable planet as all food webs are linked together.



If one type of organism dies out, others will be affected.

Ecosystem Terms

Term	Definition	Example
Habitat	Where an organism lives.	Pride Rock/Caves
Population	One type of species.	Lions
Community	All the different species living together .	Lions, hyenas, monkeys
Ecosystem	Made up of living (community) and non living (habitat) parts.	Desert



5. Sampling Biotic and Abiotic Factors

Factors affecting the distribution of organisms which can cause an increase or a decrease in biodiversity.

Biotic Factors (LIVING)

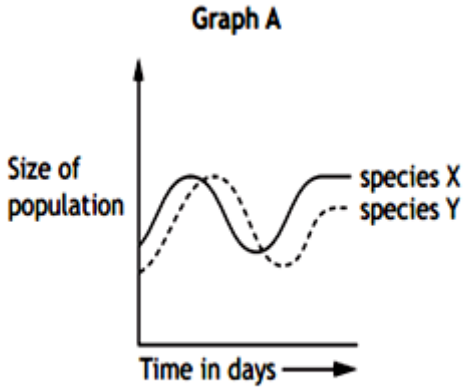


Abiotic Factors (NON LIVING)



Biotic Factors	**Abiotic Factors**
Grazing	Temperature
Predation	Light Intensity
Disease	pH
Competition	Moisture
Food availability	

<u>Predation and Prey Graphs (Biotic Factor)</u>



<u>Explaining the Graph</u>
Prey are high when predators are low
Why—less predators to eat prey

Prey are low when predators are high
Why—prey eaten by predators

5. Sampling Biotic and Abiotic Factors

Sampling techniques can be used to sample both biotic and abiotic factors.

Biotic Sampling Techniques	Abiotic Sampling Techniques
Pitfall Traps	pH meter
Quadrats	Moisture meter
	Light meter
	Thermometer

Biotic Sampling Techniques

Pitfall Trap - Samples number of small invertebrates living on the ground, such as beetles, spiders and slugs.

Using a Pitfall Trap

1. Dig hole not above ground to ensure insects fall in.

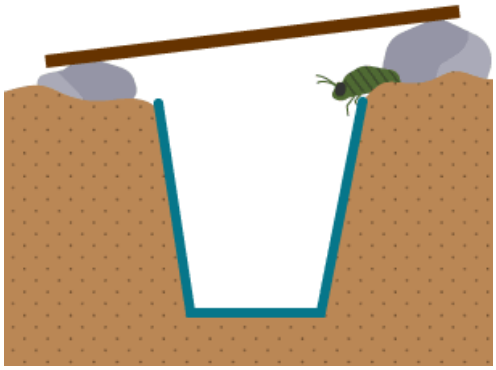
2. Cover in leaves to ensure nothing eats insects.

Errors when setting up a Pitfall Trap

1. Trap too high above soil

2. Trap not camouflaged

3. Trap left too long (all insects die or are eaten)



Quadrat Samples number of plants and slow moving animals e.g. slugs and snails.

Using a Quadrat

1. Throw quadrat at **random** to make sure sample is representative.

2. Count the number of squares that have chosen plant present.



Errors when using a Quadrat

1. Only throwing quadrat once - not reliable.

2. Counting the number of plants rather than the number of squares.

5. Sampling Biotic and Abiotic Factors

Abiotic Sampling Techniques

pH and Moisture meters - used to measure pH or moisture



Using the meter

Place **probe** into soil and take reading

Errors

Forgetting to wipe the probe between readings

Light meter - used to measure light intensity



Using the meter

Meter held at **maximum** light intensity

Errors

Measurer creating a shadow over the meter.

Thermometer - used to measure temperature



Using the meter

Hold thermometer at the top and read temperature

Errors

Avoid holding the bulb at the bottom or wipe between readings

Line Transect

Uses a quadrat to measure the abundance of a plant at regular intervals.

Shows the effect of an abiotic factor on the distribution of a plant.

E.g. The effect of light intensity on daisy population.



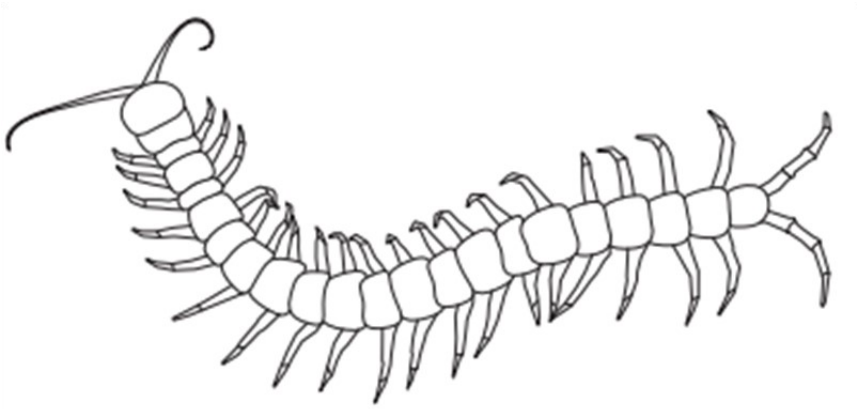
6. Paired Statement Keys

Paired statement keys are used to identify organisms.

Example Question 1.
This question requires you to **use a** paired statement key to identify the name of the organism.

At each stage you are given a choice. Make the appropriate choice and go to where you are asked to go. This will allow you to identify the organism.

What is the name of this invertebrate?



A Dromopoda
B Arachnida
C Chilopoda
D Diplopoda

The following paired statement key can be used to identify invertebrate groups.

1. Six legs..... *Hexapoda*
   More than six legs..... go to 2
2. 8 legs..... go to 3
   More than 8 legs..... go to 4
3. Curved sting..... *Dromopoda*
   No curved sting..... *Arachnida*
4. 1 pair of legs per body segment..... *Chilopoda*
   2 pairs of legs per body segment..... *Diplopoda*

6. Paired Statement Keys

Paired statement keys are used to identify organisms.

Example Question 2.
This question requires you to **construct** a paired statement key to identify an organism.

TIP
Use the first statement and categorise all the animals that fit into that statement.

E.g. only categories the animals with legs then go back and categorise the animals with no legs.

Complete the following key using information from the diagrams.

1 Legs ..... Go to 2

No legs .....

TIP
Cross out an organism once you have identified it. This makes the key less confusing.



Butterfly species	*Wing shading*	*Wing tip*	*Wing spots*
Large White	pale	black	yes
~~Orange Tip~~	~~pale~~	~~orange~~	~~no~~
Peacock	dark	blue	yes
Red Admiral	dark	white	yes
Wood White	pale	black	no

TIP
Information in the paired statement key needs to be the opposite of one another.

4 Shell .....

No Shell .....

Black breast stripe absent

Black breast stripe **Present**

Tail length **Shorter than body**

Tail length longer than body

6. Paired Statement Keys

Ex-

The diagrams below show the invertebrates collected by the pupils.
They are not drawn to scale.



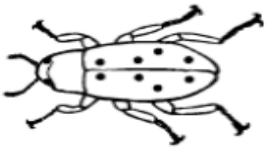
Earthworm



Snail



Spider



Beetle



Woodlouse

Complete the following key using information from the diagrams.

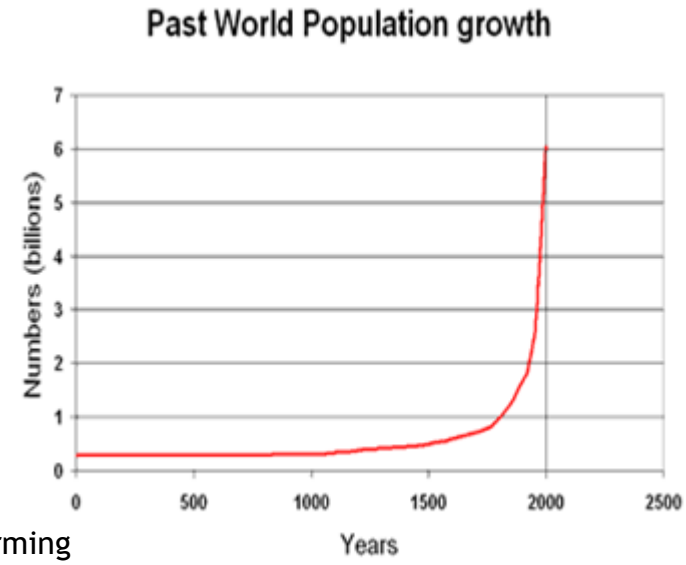
1	Legs	Go to 2	
	No legs	**Go to 4**	1
2	12 legs or more	*Woodlouse*	
	Fewer than 12 legs	Go to 3	
3	Spots on body	*Beetle*	
	No spots on body	**Spider**	1
4	Shell	*Snail*	
	No Shell	**Earthworm**	1

ample Question.

7. Food Production

World Food Problem

Population rising sharply, hence not enough food.



Need to **increase food yield.**

<u>Three solutions</u>

1. Intensive farming
2. Biological Control
3. Genetic Modification of crops

1. Intensive Farming

Two **chemicals** are used in intensive farming

Intensive farming methods	Description	Problem	Alternative
Fertiliser	Add nitrates into soil which increase the growth of crop plants.	Algae bloom	GM crops
Pesticide	Kill insects which eat crops.	Pesticide builds up in the food chain and is toxic to the top predator	GM Crops Biological control

<u>Fertilisers - Potential Exam Question</u>

Nitrates dissolve into soil water and are absorbed by plants. The <u>nitrates</u> are used to make <u>amino acids</u> which then create <u>plant protein.</u>

<u>Animals</u> consume other animals or plants to <u>gain amino acids for protein synthesis</u>.



7. Food Production - Intensive Farming Problems

Problem with fertilisers ***learn this process***

Fertiliser washes into water

↓

Increased algae bloom due to extra nitrates

↓

This **decreases** light levels killing aquatic plants/algae.

↓

Increase in bacteria as they feed on dead algae/plants

↓

Decreases oxygen levels

↓

Decreases biodiversity (aquatic animals die)

Problems with Pesticides (DDT is an example)

Toxic chemicals can accumulate in the bodies of organisms over time. (bioaccumulate)

They move up in the food chain and reach toxic levels, killing the top predator.



7. Food Production - Alternatives to Intensive Farming

Biological Control (Alternative to Pesticide)

Natural method of pest control.

1. Introducing disease
2. Introducing predator



Virus Myxoma & Rabbits

Virus introduced to limit rabbit population.

Ladybirds & greenfly

Ladybirds (predator) of greenfly, reduce their numbers.

GM Crops (Alternative to Fertilisers and Pesticides)

When a foreign gene in inserted into a plant to produce a desirable characteristic.
Desirable characteristics of GM crops:

1. Plants that are now Drought resistant

2. Plants that are now Disease resistant



Some GM Rice plants take up nitrates more efficiently - Alternative to fertilisers

GM plants with added Bt toxin to kill off pests - Alternative to pesticides

7. Food Production - Indicator Species

Indicator species definition

By its presence or absence determines the level of pollution.

Two Examples

1. Lichen (air pollution)



Lichen only grow where air is clean

(lacks sulphur dioxide)

2. Stone fly nymph (water pollution)



Nymphs only live where water is oxygenated

8. Mutations and Speciation

Mutations

Random change to genetic material



1. Mutations are spontaneous

2. Only source of NEW alleles

Environmental factors

Increase the frequency of a mutation occurring.

1. Radiation (UV, X-Ray)
2. Chemical agents (mustard gas)





Types of Mutations

1.	Disadvantageous	cause genetic disease
2.	Advantageous	help to increase variety & biodiversity (cause natural selection & formation of new species)
3.	Neither	no effect on survival

Remember

1. Change to DNA base sequence
2. Changes the Amino Acid sequence at the ribosome
3. **Changing the protein shape & protein is non functional**

e.g. enzyme, hormone, antibody etc

8. Mutations and Speciation - Adaptations

Variations in alleles (mutation) cause species to evolve over time in response to changing conditions.

This is due to species being selected that have a selective advantage for survival (natural selection)

Natural selection results in species becoming better ADAPTED to their environment.

<u>Natural Selection</u> (aka Survival of the fittest)

When selection pressures ensure only organisms with a selective advantage survive and reproduce to pass on successful alleles

Process

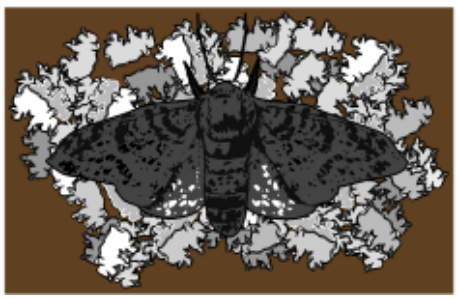
1. **Variation** occurs naturally due to different alleles (mutations)
2. Fierce **competition** for resources (inter/ intra).
3. Increased selection pressure for those with a **selective advantage.**
4. Those individuals with a selective advantage **reproduce and pass on the successful alleles.**
5.. Weaker individuals die out
6. Successful alleles increased in frequency in population.

The Peppered Moth - *Biston betularia* (Light Form)



The Peppered Moth - *Biston betularia* (Dark Form)

N.B. The Dark Form is often referred to as the 'melanic form'.



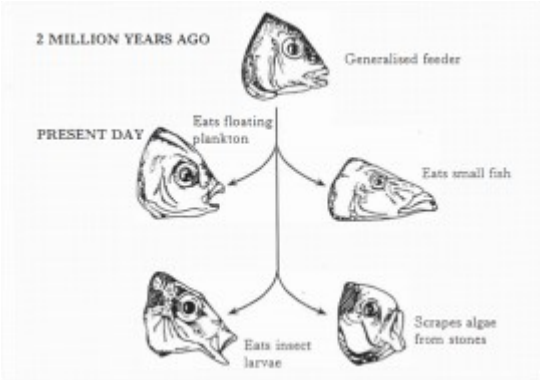
Example of Natural Selection	Alleles	Selective Advantage
Peppered Moth	Dark & Peppered moth	Black moth—camouflaged against polluted lichen.
Antibiotic Resistance	Sensitive & Resistant bacteria	Only resistant bacteria can survive antibiotics leading to multi-resistant bacteria.
Human Skin Colour	Light & Darker Skin	Darker skin advantage where weather is warmer as melanin protects against the sun.

8. Mutations and Speciation - Speciation

Species

Can **interbreed** to produce **fertile offspring**.

Speciation: formation of a new species

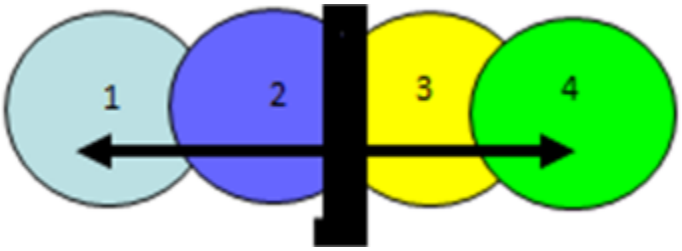


I'M a New Species!

1. Isolating Mechanisms
2. Mutations
3. Natural Selection
4. Speciation

Isolating Mechanisms (barrier)

Importance: Prevents gene flow/interbreeding between sub populations.



2 species form due to isolation

Type of Isolating mechanisms:

1. Behavioural
1. Geographical - mountain or river
2. Ecological

Exam Tip

Write Geographical NOT river in exam!

8. Mutations and Speciation - Speciation

2. Mutations

Mutations are RANDOM— different mutations will occur at either side of the barrier due to different selection pressures.

3. Natural Selection

Increased **selection pressure** for those with a **selective advantage**.

These individuals **survive and reproduce** & **pass on successful alleles**.

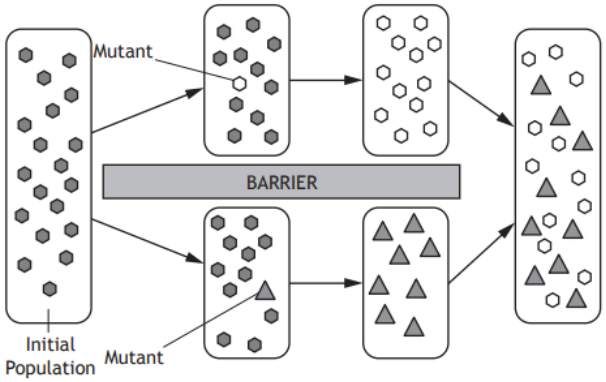
Weaker individuals die out.

4. Speciation

The two groups/subpopulations cannot interbreed to produce fertile offspring.

Example Exam Question

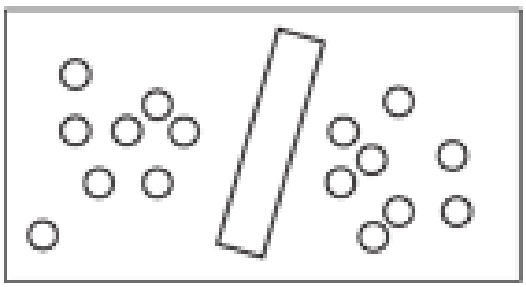
Using information from the diagram describe how new species are formed.



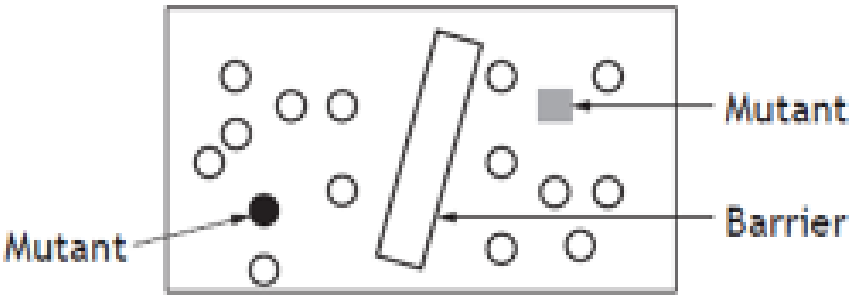
1. Initial population id split by a barrier
2. Different mutations occur in each subpopulation
3. Natural selection occurs where the individual with a selective advantage will survive and reproduce, passing on alleles to offspring.
4. Subpopulations / groups are no longer able to interbreed to produce fertile offspring.

8. Mutations and Speciation - Speciation

Diagram

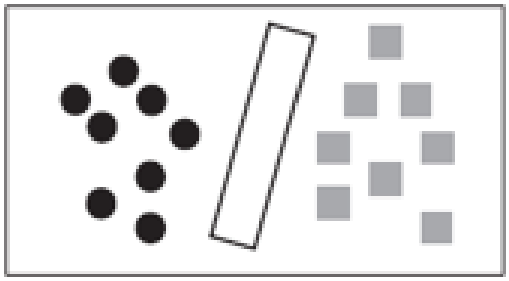


Isolating Mechanism
1 species split into 2 sub –populations by isolating mechanism (no gene flow)



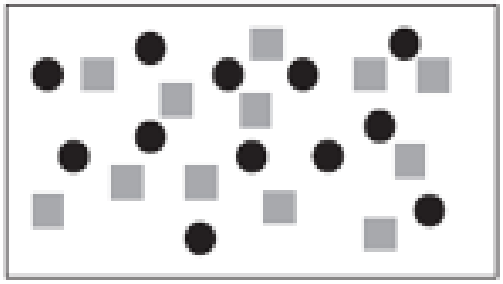
Mutations
Different mutations occur either side.

Some mutations are advantageous



Natural Selection
Increased selection pressure for those with a selective advantage for SURVIVAL

Successful individuals reproduce & pass on their alleles.



Speciation
Two species formed.

They cannot interbreed to produce fertile offspring.