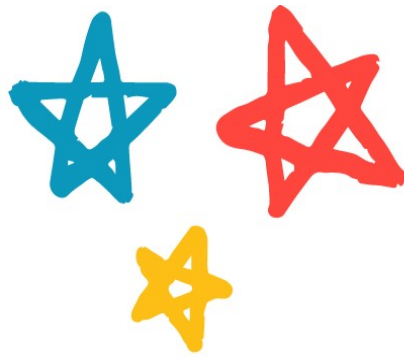
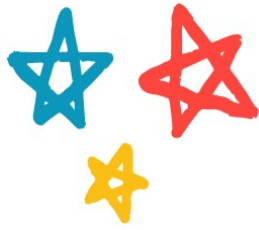
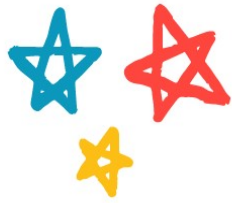
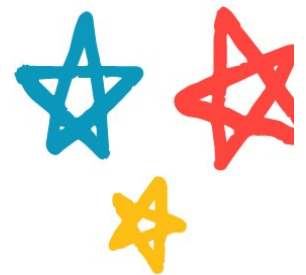
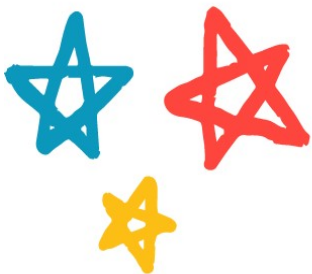
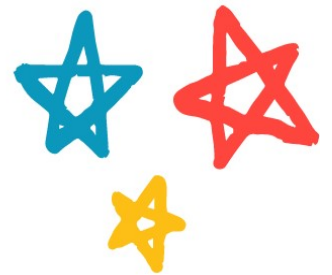
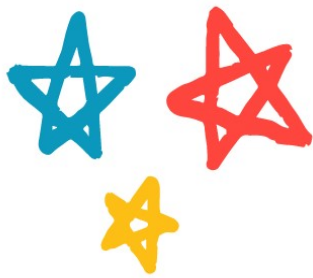
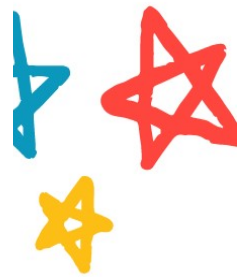




Unit 3



Revision Notes



Contents

1. Measuring Biodiversity
2. Threats to Biodiversity
3. Symbiosis
4. Altruism/Kin Selection & Social Insects
5. Social Hierarchy
6. Primate Behaviour
7. Photosynthesis
8. Food Security and Crop Protection
9. Animal Welfare
10. Plant and Animal Breeding
11. Genetic Technology and Field Trials

1. Measuring Biodiversity

3 measurable components to biodiversity (GES)

Biodiversity Component	Definition	How it effects Biodiversity
1.Genetic diversity	Number and frequency of all the alleles within a population	1. Inbreeding depression lowers reproductive rates/success 2. Less adaptable to changing environment
2.Ecosystem diversity	Number of distinct ecosystems within a defined area.	
3. Species diversity	1. Species Richness Number of different species in an ecosystem 2.Relative abundance Number of each species in the ecosystem	A community with a dominant species has a lower species diversity than one with the same species richness but no particularly dominant species

4

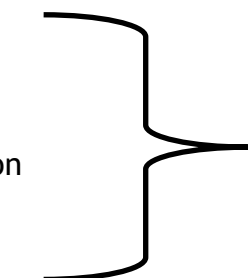
threats to Biodiversity

1. Over Exploitation

2. Bottleneck effect

3. Habitat fragmentation

4. Invasive Species



Lowers genetic diversity



Lowers genetic & species diversity

2. Threats to Biodiversity

Over Exploitation

Populations can be reduced to a low level through over exploitation activities such as

Over Fishing



Over Hunting



This low-ers genetic diversity:

1. lowers reproductive success/rates due to inbreeding depression
2. Populations less adaptable to changing environment

Recovery

Some species may **recover** if strategies are put in place to stop the over exploitation.

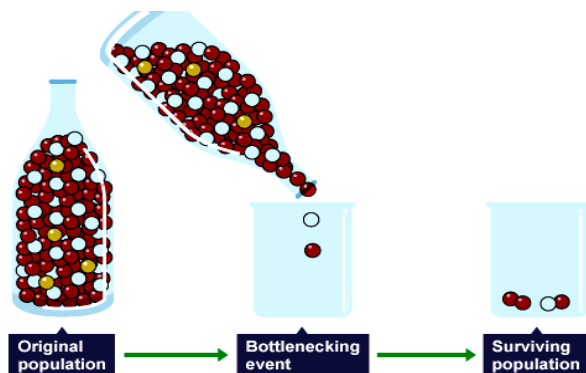
Other species have a naturally **low genetic diversity** in their population and yet remain viable.

Bottle neck effect

When a large population becomes much smaller due to a catastrophic events (e.g. flood or forest fire)

_This lowers genetic diversity:

1. lowers reproductive success/rates due to inbreeding depression
2. Populations less adaptable to changing environment

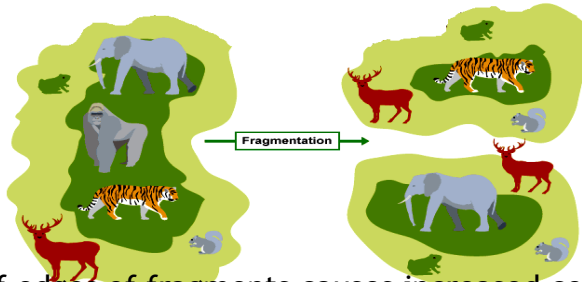


2. Threats to Biodiversity

Habitat Fragmentation

The clearing of habitats by humans for roads/ housing etc.

This causes the habitats to split; becoming smaller & more isolated.



Degradation of edges of fragments causes increased competition between species.

This leads to a decrease in species & genetic biodiversity .

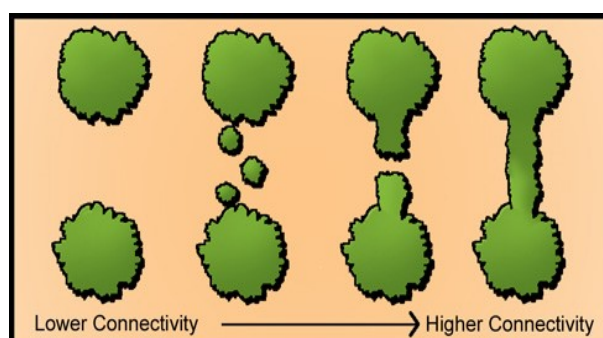
1. lowers reproductive success/rates due to inbreeding depression
2. Populations less adaptable to changing environment

Habitat Corridors

Link fragments together enabling movement of animals between fragments.

Advantages

1. Increased access to food/ mates.
2. Allows re-colonisation of small fragments after local extinctions.



2. Invasive Species

Invasive Species

Stage	Description
Introduced Species	Humans have <u>moved</u> species intentionally/accidentally to a <u>new</u> geographic location.
Naturalised Species	When introduced species become <u>established</u> in their <u>new</u> location.
Invasive Species	When the naturalised species <u>spread rapidly</u> and <u>eliminate</u> native species.

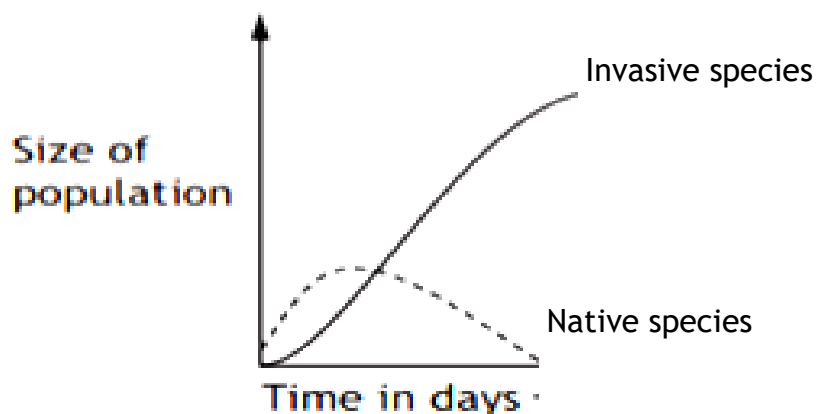
Their new location is free from

- (a) Natural Predators
- (b) Natural Parasites
- (c) Natural Pathogens
- (d) Competition

The native species eliminated by invasive species

- (a) Prey on native species.
- (b) Outcompete native species for resources.
- (c) Hybridise with native species.

Why are native species eliminated by



3. Symbiosis

Symbiosis

Symbiosis is a **co-evolved intimate** relationship between members of **two species**.

Two forms of symbiosis

1. Parasitism (+/-)
2. Mutualism (+/+)

Parasitism (+/-)

A parasite benefits in terms of **energy or nutrients**, while its host is harmed by the loss of these resources.

Para-
sites

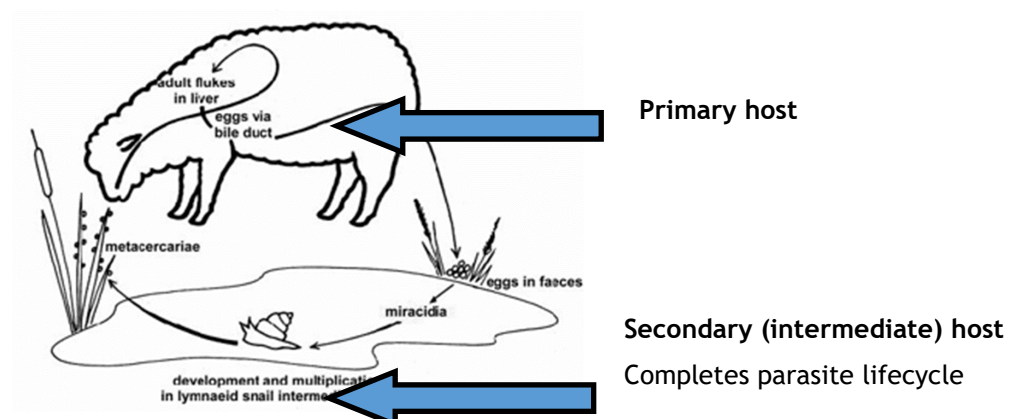
often have **limited metabolism** and **cannot survive** out of contact with the host.

Parasite Transmission

Parasites can be transmitted using three methods;

1. **Direct contact** e.g. Ticks/head lice pass from contact between hosts e.g. cuddling.
2. **Vectors** e.g. Mosquitos actively transmit parasites from host to host.
3. **Resistant Stages** parasites survive digestive tract of host and egg pass out in host faeces ready to move into a second host.

Parasite Lifecycle



3. Symbiosis

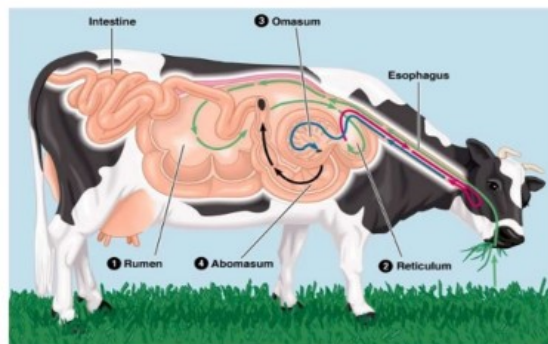
Mutualism

Both species benefit from the interdependent relationship.

Example 1: Cattle & Bacteria

Cattle - Benefit as bacteria digest cellulose to provide an energy source for the cattle.

Cellulose-digesting Bacteria - provided with a warm, moist habitat in the cattle's gut.



Example 2: Coral & Algae

Algae - Benefit as they are provided with a safe habitat.

Coral - Supplied with glucose/nutrients from the algae.



4. Altruistic behaviour

Altruism

Harms the donor but benefits the recipient in unrelated individuals.

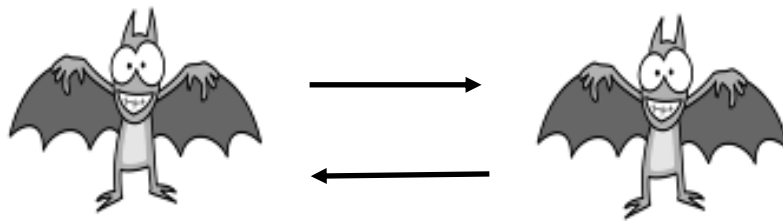
Reciprocal Altruism

Occurs in social animals.

Where the roles of donor and recipient later reverse.

Bat Example

Vampire bats who have hunted successfully may share food with those who have not with the hope that they would return the favour in the future.



Prisoner's Dilemma

The prisoner's dilemma is an example of reciprocal altruism where one stays silent (donor) and gets a longer prison sentence and the other goes free (recipient).

THE PRISONER'S DILEMMA

	B stays silent (cooperates)	B betrays A (defects)
A stays silent (cooperates)	Both serve 1 year	A serves 3 years, B goes free
A betrays B (defects)	A goes free, B serves 3 years	Both serve 2 years

4. Kin Selection and social animals

Kin Selection - Altruistic behavior between a donor and recipient if they are related.

Advantage

Donor benefits due to increased chance of survival of shared genes in the recipients offspring.

Types of Altruistic social insects

1. Bees
2. Wasps
3. Termites
4. Ants

Structure of Bee Colony

Organism	Sex	Role
Single Queen Bee	Female	Reproduction
Several Drones	Male	Reproduction
Workers	Female	1. Defend the hive 2. Collect pollen 3. Carry out waggle dance to show direction of food. 4. Raise relatives (sisters) as altruistic Worker bees are sterile but benefit Indirectly (kin selection). This increase the <u>survival</u> of <u>shared</u> genes in recipient's offspring ***

5. Social Hierarchy

Many animals live in social groups and have adapted their behaviour to group living.

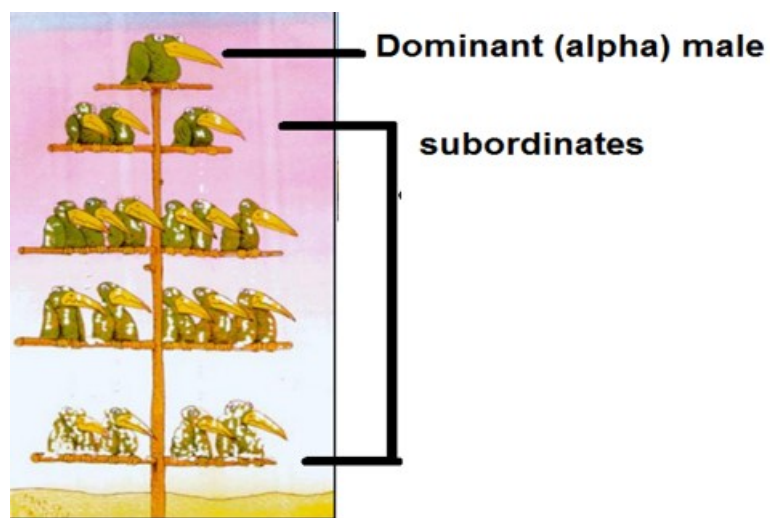
3 types of Social behaviours

1. Social Hierarchy
2. Cooperative Hunting
3. Social defence

Social Hierarchy

This is a rank/pecking order within a group of animals to reduce conflict consisting of

1. Dominant individuals carry out ritualistic displays.
2. Subordinate individuals carry out appeasement behaviour.



Advantages of Social Hierarchies

1. Increase dominant male's favorable genes being passed on to offspring.
2. Guarantees strong leadership.

6. Primates

Parental Care

Primates have a long period of parental care to enable primates to learn complex social behaviours.

Complex Social behaviours

4 types of complex social behaviours support the social hierarchy & **reduce conflict**.

Complex Social Behaviour	Ritualistic Display (dominant)	Appeasement behavior (subordinate)
1.Body posture	Beating chest Hunched Swaggering	Lie flat Lie on back Expose neck and belly
2. Facial Expressions	Growling Snarling Showing teeth	Hide teeth Whimper
3.Sexual presentations	Show genitals	Hide genitals
4.Grooming	Groomed by lower ranks	Groom higher ranks
<u>Alliances</u> Low rank females increase their social status by forming alliances with higher ranking females . This allows them better access to food/ mates		

E.g. lower rank female grooms offspring of higher rank to increase low rank's social status

6. Cooperative Hunting and Defence

Co-operative Hunting

When a group of animals hunt together to kill a prey.

Benefits subordinate animals as well as dominant ones.

Advantages of Co-operative Hunting

1. Catch larger prey
2. Increases the chance of hunting success
3. Less energy used per individual
4. Gain more food than by foraging alone

Social Defence Strategies

1. Adopt specialised formations when under attack (birds/fish)
2.
 Advantage
 1. Young protected
 2. Confuses predator making it harder to pick off a single prey in large group.
2. Some individuals watch for predators whilst others can forage for food.

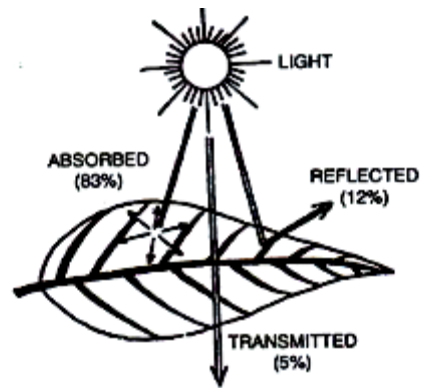
Advantage

This increases the chance of survival by avoiding predation but also
Spending a longer period eating/foraging.

7. Photosynthesis

3 fates of light energy

1. Transmitted
2. Absorbed
3. Reflected



Photosynthetic Pigments

Each pigment absorbs a different range of lengths of light.

wave-

Photosynthetic Pigment	Wavelength of light absorbed
Chlorophyll a	Red and Blue
Chlorophyll b	All other wavelengths of light.
Carotenoids	

Function of car-

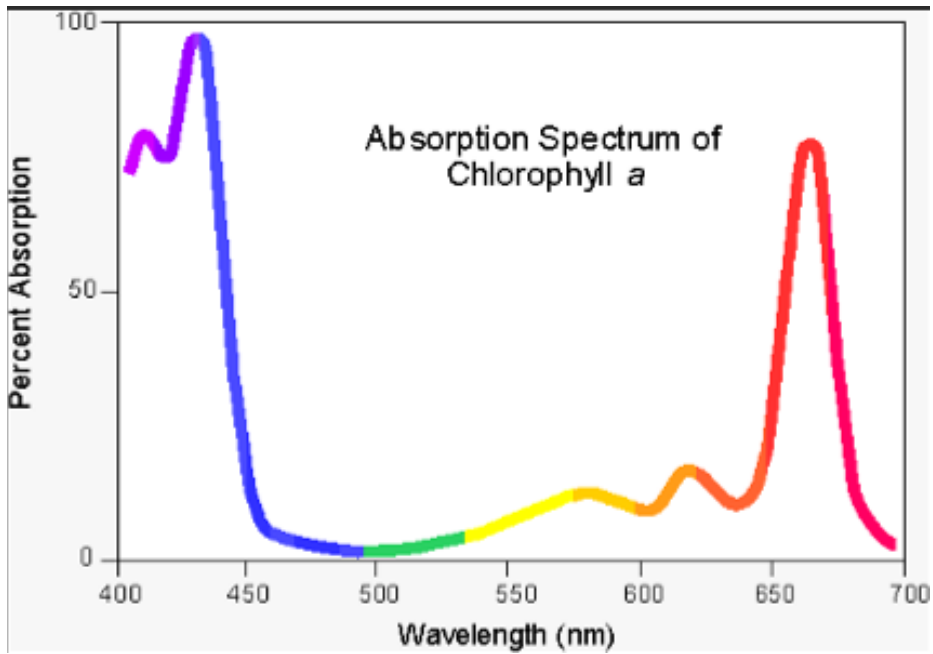
tenoids

To extend the range of wavelengths absorbed and pass the energy to chlorophyll for photosynthesis.

7. Photosynthesis

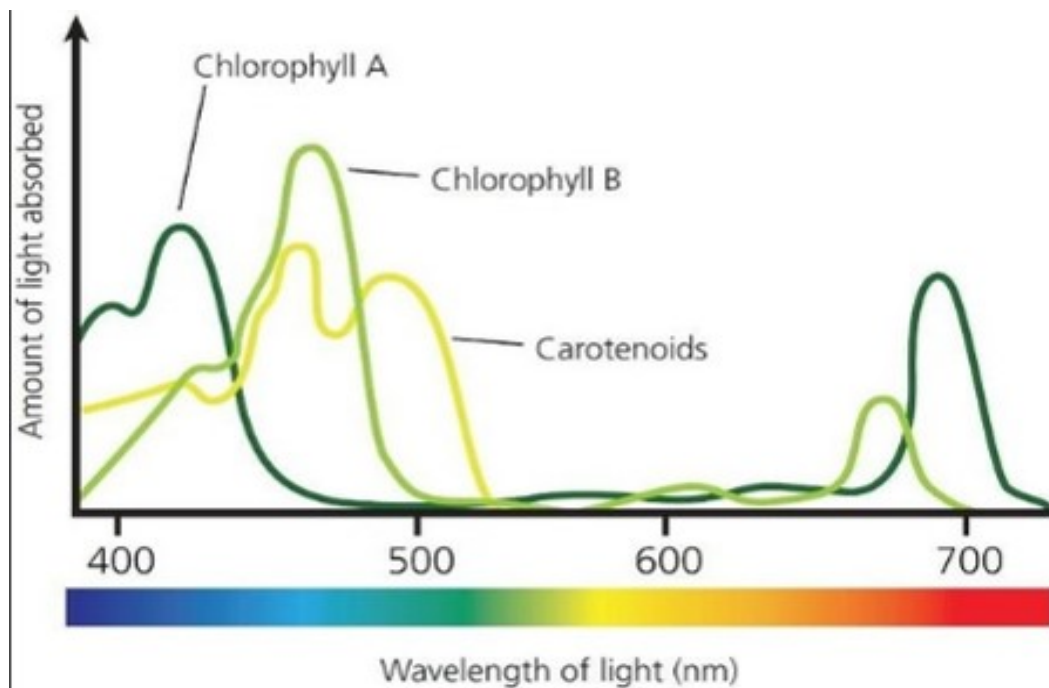
Absorption Spectrum

Chlorophyll a (red and blue light absorbed)



Chlorophyll B and Carot-

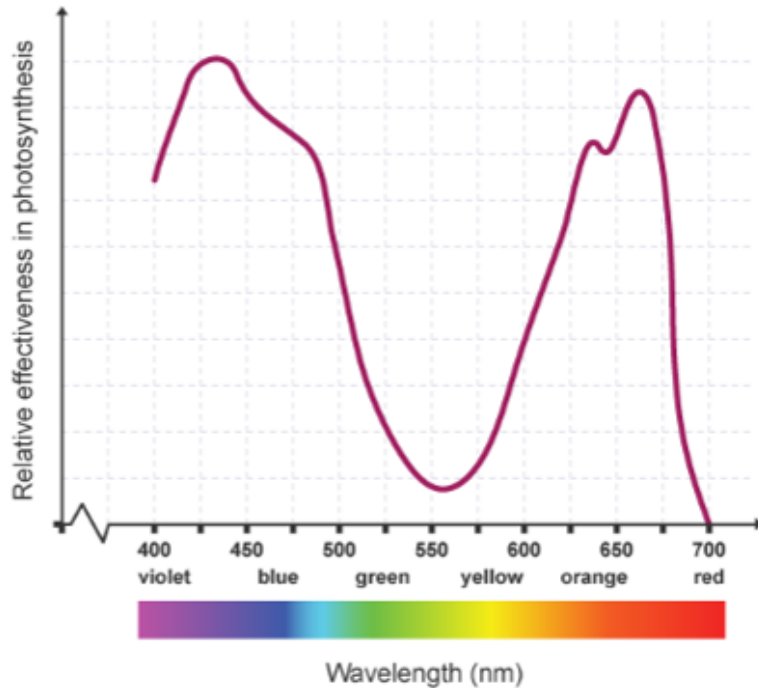
enoids



7. Photosynthesis

Action Spectrum

Plant photosynthesis' at colours other than red and blue due to role of carotenoids broadening wavelengths of light absorbed for photosynthesis.



Sun vs

Shade plants

Sun plants

High percentage of chlorophyll a and absorb mainly red and blue light.

Shade plants

Grow below sun plant and are blocked from red and blue light by sun plant absorbing these colours of light.

Shade plants absorb green light that is transmitted through sun plant and due to higher percentage of carotenoids

7. Photosynthesis

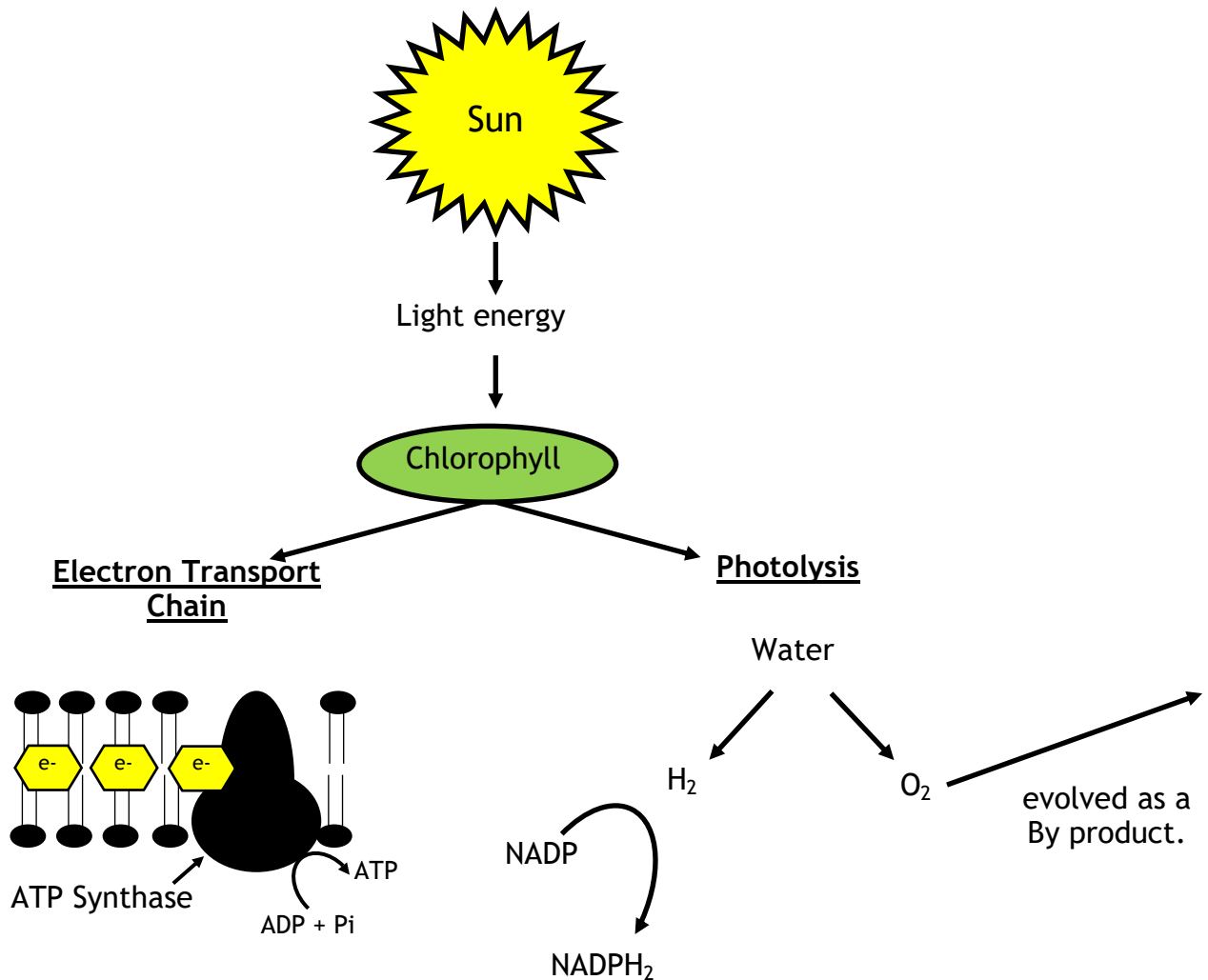
Photosynthesis occurs in two stages:

1. Light dependent stage
2. Carbon fixation stage (Calvin cycle)

Light Dependent Stage

Light absorbed by photosynthesis causes two reactions to occur in the light dependent stage:

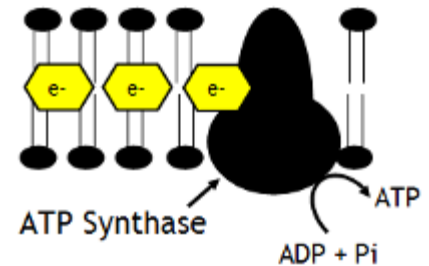
1. Generate ATP through the Election Transport Chain
2. Split water during Photolysis



7. Photosynthesis

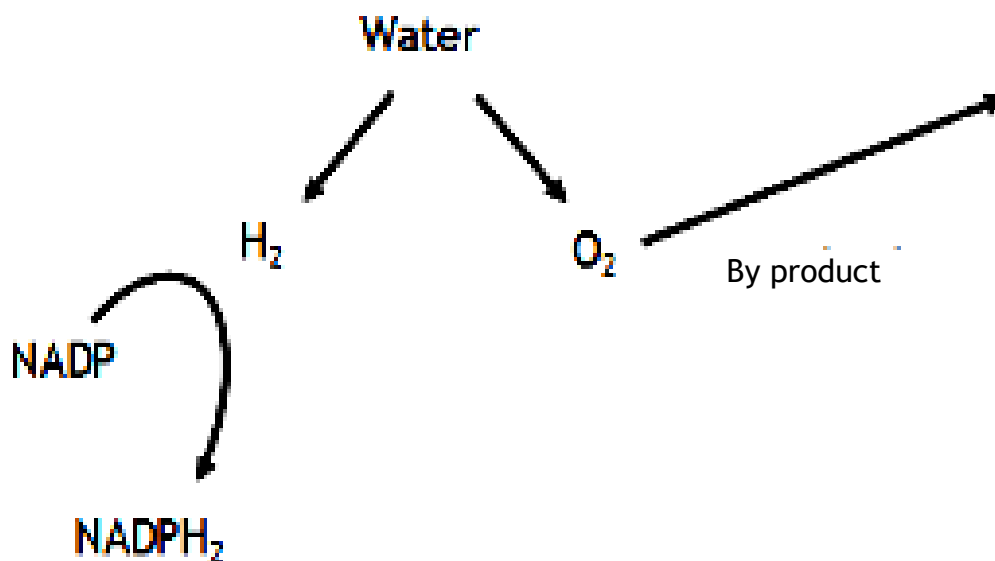
Electron Transport Chain

1. Absorbed light energy excites electrons in the pigment molecule.
2. The electrons are transferred through the electron transport chain.
3. They release energy to generate ATP by ATP synthase.



Photolysis

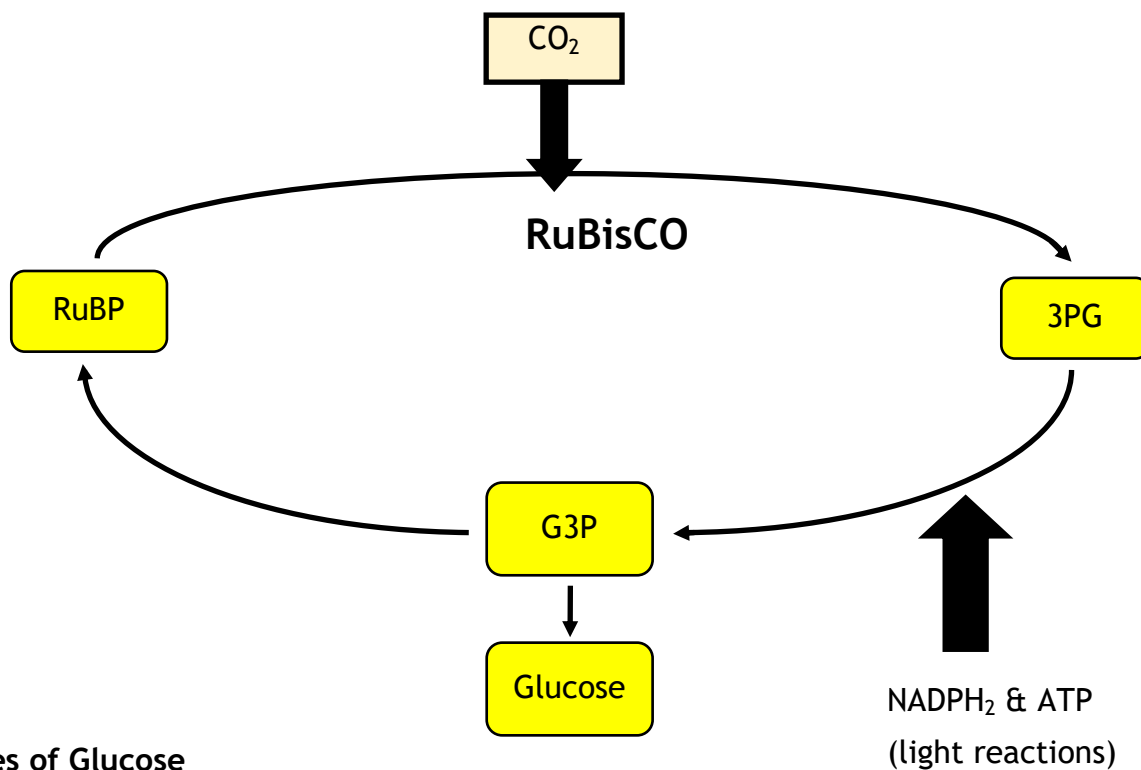
1. Light energy is used to split water.
2. Oxygen is released as a by-product.
3. Hydrogen ions are transferred to the coenzyme NADP to form NADPH.



7. Photosynthesis

Carbon Fixation

1. The enzyme RuBisCO fixes CO_2 by attaching it to RuBP (ribulose biphosphate).
2. This produces 3PG (3-phosphoglycerate).
3. 3PG is phosphorylated by ATP and combined with H_2 from NADPH_2 to form G3P.
4. G3P either regenerates RuBP or synthesises glucose.



Fates of Glucose

Glucose can be

1. Used as a respiratory substrate glucose
2. Joined together to form the storage carbohydrate Starch
3. Joined together as structural carbohydrate cellulose for cell walls
4. Passed on to biosynthetic pathways to make DNA, protein or fat.

8. Food Security

Human Population

Increase in human population has led to concerns for food security and food production.

Food Security

The ability of human populations to access food of sufficient quality and quantity.

Food Production

Whilst food production must increase to cope with issues of food insecurity it must also be

1. Sustainable
2. Not degrade the natural resources

Crop versus livestock production

More energy produced per unit area

Less energy produced per unit area



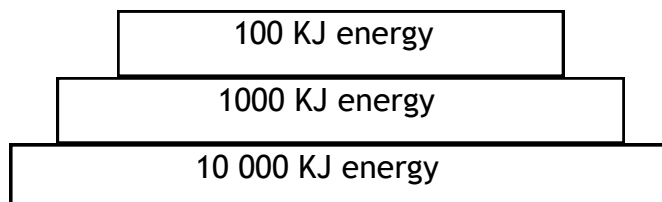
Live-
ble for crops.

stock production should only



occur in habitats unsuita-

For example sheep on a steep hill.



Loss of energy between trophic levels means livestock production is less economical.



8. Food Security

Types of Farming

Feature	Intensive Farming	Free Range farming (organic)
Land Required	<u>Less</u> land required	<u>More</u> land required
Labour intensive	<u>Less</u> labour intense	<u>More</u> labour intense
Price of product	<u>Lower</u> price	<u>Higher</u> price
Cost effectiveness of process	More cost effective	<u>Less</u> cost effective
Net profit	<u>Higher</u> profit	<u>Lower</u> profit
Ethical practice	<u>Less</u> ethical	<u>More</u> ethical
Animal welfare/ quality of life of animals	<u>Low</u> quality of life/welfare	<u>Better</u> quality of life/ welfare

8. Animal Welfare

4 behavioural indicators that can show poor animal welfare during intensive farming.

Indicator	Example
Stereotype behaviour	Repeated pointless behaviour
Misdirected behaviour	Inappropriate behaviour
Altered levels of activity	Apathy—low levels Hysteria—High levels
Failure in sexual/parental behaviour	Failure to reproduce Rejecting young

8. Factors affecting Agriculture Production

Examples of plant crops

1. Cereals
2. Potatoes
3. Legumes
4. Roots



Factors affecting Agriculture production

There are 2 main factors which can affect agriculture production

1. Plant growth
2. Factors affecting photosynthesis

As the area to grow crops is limited, it is important to maximise plants growth which will increase food production.

4 main factors

1. Breeding of higher yielding cultivars (plant varieties)

2. Use of fertilisers

3. Protecting crops from pests, disease and competition.

- Chemical control methods
- Biological control methods
- Cultural methods
- Integrated Pest management

4. GM crops

All food production is ultimately dependent on photosynthesis

1. Temperature

Enzymes needed at each stage of Carbon fixation

2. Carbon dioxide concentration
- more RuBP converted to 3PG

3. Light intensity

Needed to produce H and ATP for 3PG to go to G3P

8. Crop Protection

Three factors that reduce crop productivity.

1. **Weeds** compete with crop plants
2. **Pests** damage crop plants
3. **Diseases** damage crop plants

Weeds

1. **Annual weeds**
Weeds complete their life cycle in one year
2. **Perennial weeds**
Weeds persist form year to year.

Annual Vs Perennial Weeds

Property	Annual Weeds	Perennial Weeds
Rapid Growth	✓	
High seed output	✓	
Short life cycle	✓	
Long-term seed viability	✓	
Storage organs		✓
Vegetative propagation		✓

8. Crop protection

Pests

There are 3 main types of pests

1. Insects
2. Nematodes (worms)
3. Molluscs (snails/slugs)

Disease

Plant disease are caused by parasitic microbes such as

1. Fungus
2. Bacteria
3. Virus

They are often transmitted by pests which act as vectors transmitting the parasite from primary to secondary host.



mitting the

Cultural Control methods

There are 3 main methods of controlling pests and disease.

1. Cultural - Traditional simplistic methods such as
 - a) Weeding
 - b) Ploughing
 - c) Crop rotation

Chemical control

2. Chemical Control methods

Use of pesticides (5 types) to kill pests, weeds or prevent disease,

Type of Pesticide	Function
Herbicide	Kills weeds
Fungicide	Controls fungal disease. <u>Application of fungicide</u> Based on fungal forecast to prevent spread of fungal disease. It is more effective to try to prevent spread than treat fungal diseased crops.
Insecticide	Kills insects pests.
Molluscicides	Kills mollusc pests.
Nematicides	Kills nematode pests.

Herbicides

Types of Herbicides

1. Selective Herbicide
2. Systemic herbicide

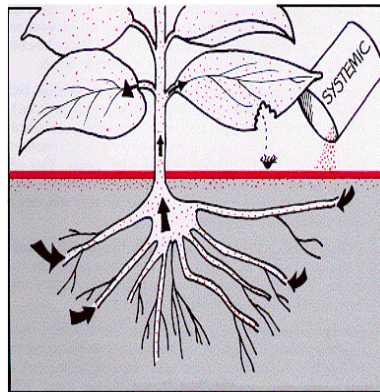
Selective Herbicide

Greater effect on certain plant species (kills weeds NOT crops).

Only kill broad leaves weeds.

Systemic herbicides

Spreads through vascular system of weed and prevents weed re-growth.

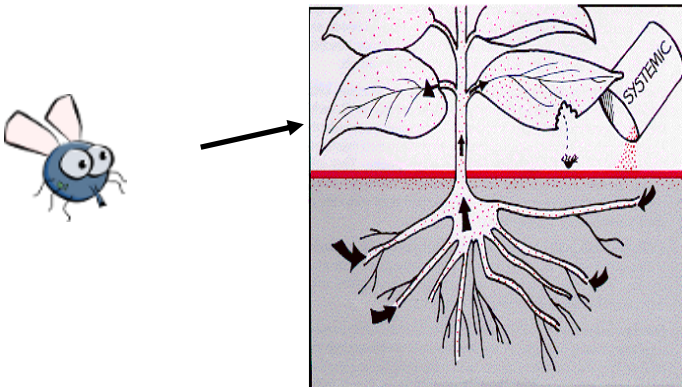


Vascular system of plants
(xylem)

Systemic Insecticides/ nematocide (pesticide)

mollus-

Spreads through vascular system of crop & **kills pests** feeding on crop plant.



Herbicides

4 problems with pesticide use

1. Toxic to non target species.
2. Persists in the environment
3. Production of resistant populations of pest
4. Bioaccumulation or Bio magnification in food chains.

Bioaccumulation

Build up of chemical in a single organism

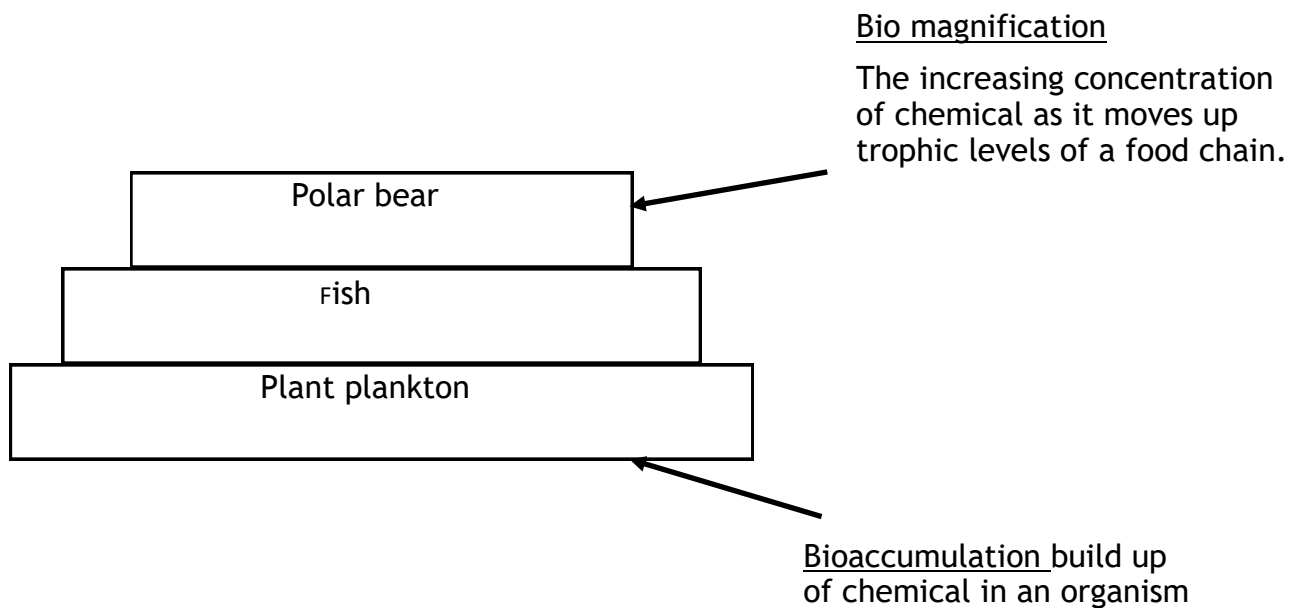
E.g. DDT/DDD concentration in one fish

Biomagnification

Increasing concentration of toxic chemical as it moves up trophic levels of a food chain.

Lethal to top predator

E.g. DDD/DDT in top predator (polar bear in example below)



Biological Control

3. Biological Control methods

The control agent is a NATURAL ...

1. Predator
2. Pathogen
3. Parasite

Advantage

No need for pesticides

Disadvantage

May become an invasive species itself.

Integrated Pest Management (IPM)

This involves a combination of all 3 control methods.

1. Cultural + Chemical
2. Cultural + Biological
3. Chemical + Biological
4. Cultural + Chemical + Biological

GM Crops

Offer an alternative solution to issues with chemical control via

1. Crops that better absorb fertilisers from soil so less fertiliser is needed
2. Bt toxin gene inserted so plant is toxic and less pesticides are needed
3. Drought resistance crops
4. Pesticide (glyphosphate) resistance gene inserted into crop plants

10. Animal and Plant Breeding

Plant and animal breeding

Produce offspring with improved characteristics to help support sustainable food production

Improved Characteristics

1. Higher food yields
2. Higher nutritional value
3. Pest and disease resistance
4. Ability to thrive in particular environmental conditions.

Inbreeding

Selected related plants/ animals are bred for several generations until the population breeds true to the desired type.

This results in the elimination of unwanted heterozygous alleles.

Disadvantage

Lowers genetic diversity in populations and susceptible to inbreeding depression.

Inbreeding depression

An increase in individuals who have homozygous, recessive & deleterious alleles.

1. Lower reproductive rates/success
2. Less adaptable to changing environments

10. Animal and Plant Breeding

Crossbreeding

Breeding different breeds/cultivars with desirable features may produce new F1 crossbreed populations with improved characteristics of both parents.

New alleles introduced through creation of F1 hybrid that has improved characteristics.

F1 Hybrids

1. Increased Vigour
2. Increased yield/growth

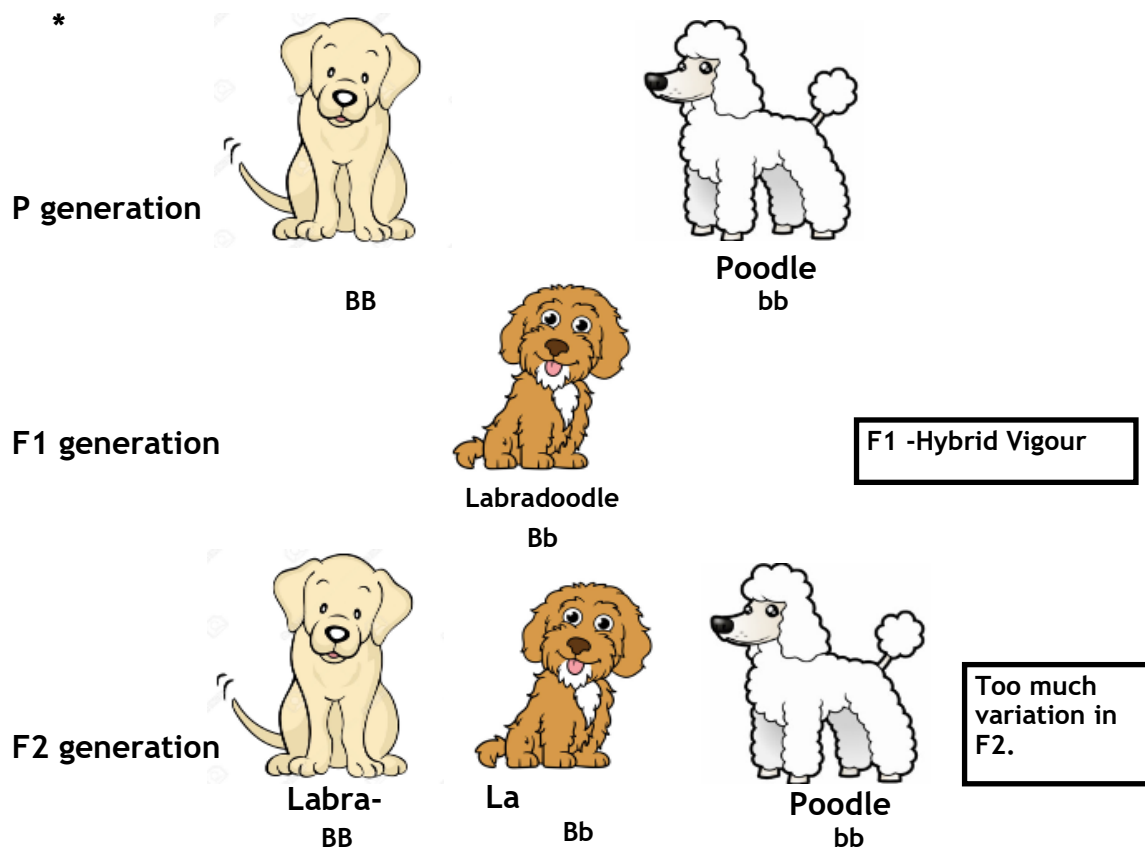
Producing F1 hybrids

The two parent breeds are maintained to produce more F1 hybrids.

F1 hybrids are not bred together as **F2** is too genetically variable.

Crossbreeding in Plants

F1 hybrids produced by crossing of two different inbred lines, create a uniform heterozygous crop.



11. Genetic Technology

1. Genomic sequencing

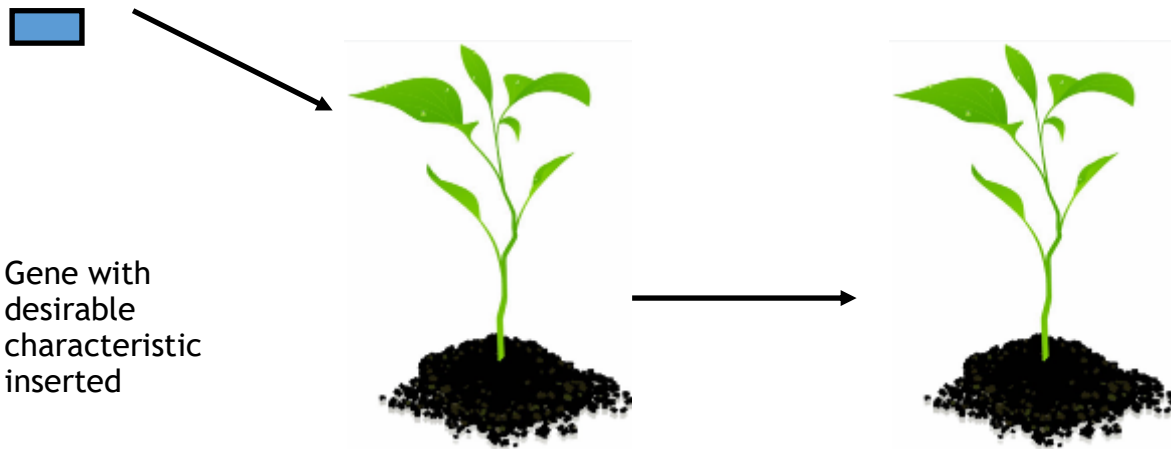
Organisms with desirable genes can be identified for inbreeding/outbreeding

2. Breeding programmes.

Inbreeding or outbreeding programmes.

Recombinant DNA Technology in Breeding Programmes

A gene for a desirable characteristics can be inserted into the genome of a crop plants, creating GM plants with improved characteristics that can be used in breeding programmes.



Examples

- | | | | | | |
|----|-----------------------------------|---|---------------------------------------|--|-------------|
| 1. | Bt toxin gene into sistence. | Gene inserted into genome of crop plants. | plants for pest sistence gene erance. | GM plant created with improved characteristic. | re-inserted |
| 2. | Glyphosate re- for herbicide tol- | | | | |

11. Field Trials

Plant field trials are carried out in a range of environments.

Field Trial Independent Variables

1. Different cultivars
2. Different Treatments (fertilisers/pesticides)
3. GM crops vs Non GM crops

Design	Reason
Selection of Treatment	Ensure valid comparisons
Number of Replicates	To take account of variability
Randomisation of Treatments	Eliminates bias