Sexual and asexual reproduction:

Sexual reproduction:

- Involves the fusion of male and female gametes (fertilisation)
- There is mixing of genetic information (offspring receives genetic information from mom and dad) → 23 chromosomes from mom and 23 from dad
- Every gamete is different so there is variation
- Uses meiosis

Asexual reproduction:

- Involves only one parent so it does not involve gametes
- No mixing of genetic information
- All genetically identical (clones)
- Undergoes mitosis

Meiosis and fertilisation:

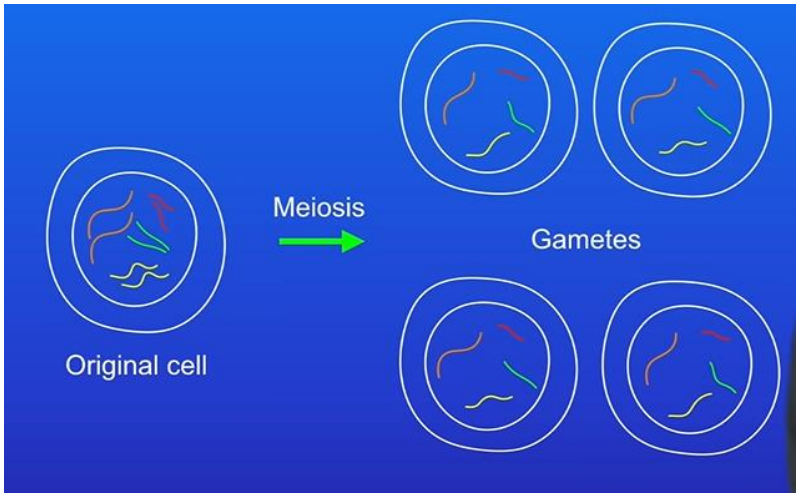
Meiosis only takes place in the reproductive organs

Steps of meiosis:

1. All of the chromosomes are copied
2. The cell divides into two

3. Both of the cells divide one more time forming gametes

- It produces 4 gametes from one original cell
- The gametes are all genetically different
- Each gamete has different alleles



After fertilisation:

1. New cell divides by mitosis producing an embryo
2. As the embryo develops, the cells differentiate forming different cell types (blood, muscle, nerve, skin cells)

Advantages and disadvantages of sexual and asexual reproduction:

Advantages of sexual reproduction:

- Increases chance of survival by natural selection through variation which is good if conditions change

- Carry out selective breeding to get the best type of species

Disadvantages of sexual reproduction

- Takes time to find mate
- Takes energy to find mate

Advantages of asexual reproduction:

- Only one parent is needed which makes it more faster

Disadvantages of asexual reproduction:

- Very risky because all offspring are genetically identical and they could all die

Malaria:

- Parasite uses sexual reproduction inside the mosquito
- Parasite uses asexual reproduction inside the human body

Fungi:

- They produce spores and do asexual reproduction
- They can also do sexual reproduction

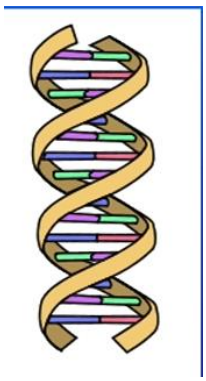
Strawberry plant:

- They can produce asexually by sending runners and when it touches the soil it can develop into a new plant

Daffodils:

- They can reproduce asexually by bulb division
- The parent plant has an underground bulb which produces buds and then form into offspring

DNA and the genome:



DNA contains two strands

The strands are polymers

The two strands wrap around to form a double helix

Gene = A small section of DNA on a chromosome

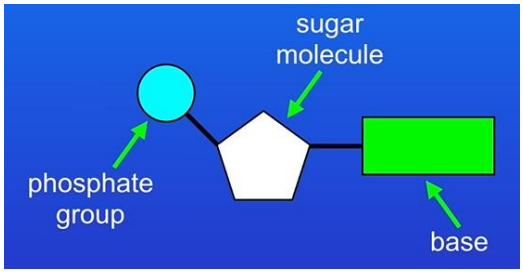
Each gene encodes for a specific sequence of amino acids to make a specific protein

Genome = The entire genetic material of a organism

Benefits of studying the genome:

- Help us search for genes that are linked to disease for example genes that increase the risk of developing cancer
- Understand and treat inherited disorders (cystic fibrosis)
- Use it to trace human migration patterns which can help find ancestry

DNA structure:



This is a polymer called a nucleotide

Three main parts:

- Phosphate group attached to a sugar molecule
- The sugar is attached to a base

In DNA, the phosphate group and the sugar molecule never change

Four different bases:

- A
- G
- C
- T

DNA contains four different types of nucleotides

DNA strands are complimentary = Same bases always pair on the opposite strands

C – G

A – T

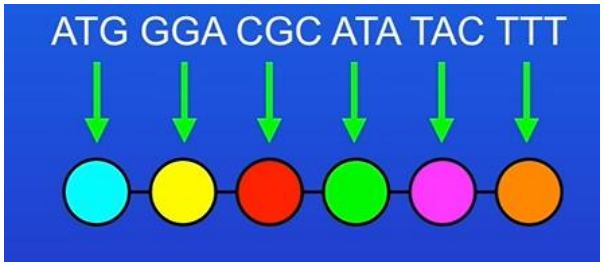
Protein synthesis:

The specific order of the amino acids determines the shape of the protein

The shape of the protein determines its function

The order of amino acids is determined by the sequence of bases in the gene for that protein

Each triplet encodes for a specific amino acid in the protein

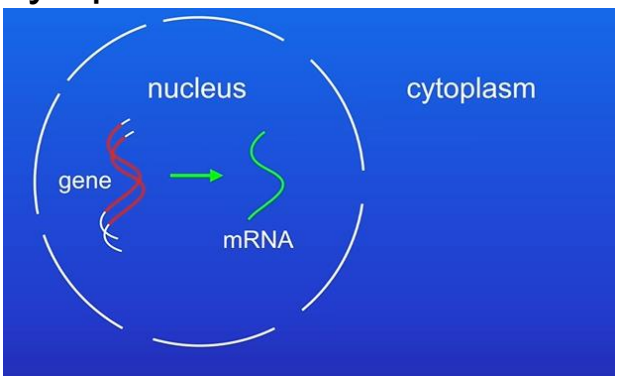


The cell reads the DNA sequence as triplets of bases

Each triplet encodes for a specific amino acid in the protein

Protein synthesis:

1. This is called transcription. The base sequence of the gene is copied into a complimentary template molecule. This template is known as the messenger RNA/mRNA. This happens in the nucleus. mRNA passes out of the nucleus into the cytoplasm.



2. This stage is called translation. mRNA molecule attaches to a ribosome. Amino acids are brought to the ribosome on carrier molecules. These carrier molecules are called transfer RNA/tRNA. The ribosome reads the triplets on the mRNA and uses this to join the correct amino acids in the correct order.
3. The protein folds into its shape and enables it to carry out its function

Mutations:

Mutation = A change in the base sequence

Mutation in coding parts of DNA will change amino acid sequence which will change protein

Non coding part of DNA is the region which switches genes on and off (tells them when to produce protein)

Mutation in non-coding part of DNA means that the protein may be produced at the wrong time

Allele:

Allele = Version of gene

Genotype = Tells us alleles present

Phenotype = Tells us characteristics caused by person allele

Dominant allele is always expressed

Recessive allele is only expressed when there is no dominant allele

Cystic fibrosis:

Cystic fibrosis is a disorder of cell membranes

C – Normal cell membrane

c – Defective cell membrane

Cystic fibrosis is recessive

Carrier = Heterozygous

Polydactyly:

This is when you have extra fingers or toes

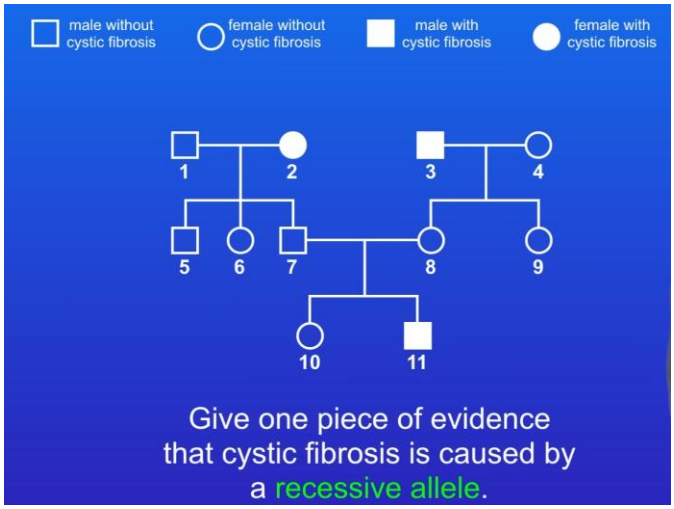
Polydactyly is dominant so you cannot be a carrier

Embryo screening – Embryos are tested for inherited disorders and those without will be inserted into the mother

Issues of embryo screening:

- Expensive
- Some embryos are destroyed
- People can alter the embryo to have desirable traits

Family trees:



Person 11 has cystic fibrosis

However, person 11's parents don't have cystic fibrosis which must mean they are a carrier

Cystic fibrosis allele must be recessive

If it was dominant then at least one of the parents would have it

Inheritance of sex:

Males have the sex chromosome XY

Females have the sex chromosome XX

Variation:

Variation = All differences in the characteristics of individuals in a population

Three main causes of variation:

- Alleles which individuals have inherited (genetic)
- Environment
- Combination of alleles and environment

Mutations may lead to new phenotype → Beneficial if environment changes

Evolution by natural selection:

Evolution by natural selection = Life developed from simple life forms

Natural selection:

1. Mutation in base sequence changing amino acid sequence
2. Animal becomes better adapted and survives and animals that are not adapted die
3. Grows
4. Reproduce and passes on advantageous allele
5. Increased proportion of advantageous allele in population

Evolution = Change in the inherited characteristics of a population over time through a process of natural selection

Selective breeding:

Examples of selective breeding

- Dogs → Gentle nature
- Food crops → Disease resistance
- Cows → More meat/milk
- Plants → Large flowers

Selective breeding

1. Take a mixed population of cows and select the largest male and female
2. Breed these two cows together

- Sexual reproduction produces variation in offspring → Offspring will be mixture of larger and smaller animals

3. Select the largest male and female offspring and breed them together
4. Repeat step 3 over many generations until all offspring are large

Problems:

- Breeding together closely related animals/plants could cause inbreeding → Breeds can be prone to disease or inherited defects

Genetic engineering

Genes from humans are cut out and transferred to cells in a different organism (genome of organism is modified)

To have high yield crops or make them disease resistant or insect attacks or produce bigger and better fruits, you can genetically modify them

Gene therapy = Use genetic engineering to treat inherited diseases

How genetic engineering is performed

1. Identify gene that we want to transfer
2. Use enzymes to isolate gene
3. Transfer gene to plasmid or virus (vectors because they can transfers DNA one to another)
4. Desired gene is transferred into cells of target organism (transfer in early stage of embryo → make sure all cells receive gene)

<u>Cloning plants</u>

Advantage – Know all characteristics of the clone

Two ways of cloning plants

- Take cuttings of plant → Add hormone rooting powder to the end of the cutting (rooting powder

contains plant hormones and encourages plant to develop roots) → Produce genetically identical clone

- Tissue culture: Take plant → Divide into hundreds of small pieces (each piece contains small number of cells) → Small groups of cells incubated with plant hormones (hormones stimulate plants to grow and develop fully); conditions must be sterile (don't want to introduce microorganisms)

Cloning animals

1. Start with sperm and egg cell from animal with characteristics that we want
2. Fertilisation produces fertilised egg
3. Allow fertilised egg to develop into an early stage embryo (cells must not have begun to specialise
4. Use a glass rod to split the embryo into two
5. Transplant the two embryos into the host mothers
6. Animals that are born will be genetically identical (clones)

Problem:

- Starting with sperm and egg means that we are not certain that offspring will have characteristics we want: Use adult cell cloning

Adult cell cloning:

1. Remove cell from animal we want to clone
2. Remove nucleus from cell
3. Take unfertilised egg cell from female
4. Remove nucleus from unfertilised egg cell and throw it away
5. Insert nucleus from original adult body cell into empty egg cell
6. Give egg cell electric shock which causes it to divide to form an embryo
7. When embryo has developed into ball of cells, insert it into womb of adult female

Darwin and natural selection

Theory of evolution

- We can see wide range within species of genetic variation for any characteristic
- Individuals with characteristics most suited to environment can easily survive → Can survive and breed → Pass onto next generation

Why theory of evolution was accepted gradually:

- People believed God created animals
- Scientists felt Darwin didn't have enough evidence
- People didn't understand how characteristics are inherited

Lamark's theory

- As characteristic become more used, they become developed
- This strengthened characteristic is passed onto offspring

Problem

- Changes that occur in an organism's life cannot be passed onto offspring

Speciation

Speciation = How new species form

Closely related species are often separated by geographical barriers

How speciation happens

- Needs a geographical barrier to separate the population into two
- This will prevent interbreeding between the two populations

Mendel and genetics

Mendel said that characteristics are determined by inherited units and that these units do not change (units=gene)

Also said that some characteristics could be masked and then reappear in later generations (recessive alleles)

Evidence for evolution (fossils)

Fossils = Remains of organisms from millions of years ago which are found in rocks

How fossils form:

- When parts of organisms haven't decayed which can happen when the conditions needed for decay are absent
- If parts of the organism are slowly replaced by minerals during the decay process
- Preserved traces of organisms

Many animals were soft bodied organisms and the fossils of them were destroyed by changes in rock in the Earth's crust

There were very few fossils of early life, scientists cannot be certain how life on earth began

Extinct = No remaining species individuals of species still alive

How species become extinct:

- Catastrophic event
- Environmental changes
- Disease or new predator
- A new, more successful species evolves and competes with it (for food/water)

Evidence of evolution (bacteria)

Certain strains of bacteria are no longer killed by antibiotics and evolved and now are antibiotic resistant

How antibiotic resistance happens

1. All other bacteria are killed by antibiotic
2. Antibacterial strain survives and reproduces without any competition from other bacteria
3. Overtime population of bacteria strain rises
4. Resistant strain now spreads because people are not immune to it and there is no effective treatment
5. Antibiotic resistant bacterium is resistant to antibiotics

How to reduce development of resistant

- Doctors should not prescribe antibiotics inappropriately (don’t use antibiotics for viruses)
- Patients should complete their course of antibiotics
- Restrict antibiotic use in farming

Developing new antibiotics

- Expensive
- Time consuming
- Not able to keep up

Classification

Two kingdoms

- Animals
- Plants

Kingdom

Phylum

Class

Order

Family

Genus

Species

King Philip Came Over For Good Soup

Organisms name (binomial name) = Genus + Specie

Scientists use three domain system present day

Three domain system includes

- Archae (bacteria found in extreme conditions)
- True bacteria
- Eukaryota

Scientists use classification data to make evolutionary tree

For extinct organisms, scientists use fossils but fossil records are incomplete which is a problem