



Biology Knowledge Organiser

Inheritance

Key terms

Meiosis	Cell division in reproductive organs resulting in gametes.
Gametes	Sex cells. In animals: sperm and egg in animals, pollen and egg in flowering plants.
Clone	Genetically identical organisms.
Variation	Differences between organisms.
DNA	A polymer made up of two strands forming a double helix. The long strands are made up of repeating nucleotides.
Chromosome	A long strand of DNA wrapped around proteins contains many different genes. Humans have 23 pairs of chromosomes.
Gene	A small section of DNA on a chromosome. Each gene codes for a protein.
Genome	All the genetic material (DNA) in an organism
Phenotype	The physical characteristic/trait that an organism has.
Genotype	The two alleles an organism has for a particular characteristic
Allele	A version of a gene (we all have a gene for eye colour, but some of us have the allele for blue eyes, others the allele for brown)
Dominant	If an allele is dominant, it is always expressed in the phenotype.
Recessive	If an allele is recessive, it is only expressed in the phenotype if there is no dominant allele.
Homozygous	When the alleles in the genotype are the same
Heterozygous	When the alleles in the genotype are different.
Polydactyly	An inherited condition characterised by having extra fingers or toes. It is controlled by a dominant allele.
Cystic fibrosis	An inherited condition characterised by the production of thick sticky mucus in the lungs and digestive system. It is controlled by a recessive allele.

Reproduction

sexual	Asexual
Fusion of male and female gametes	One parent and no fusion- more time and energy efficient
Mixing of genetic information leading to variation- increases survival chances	Genetically identical offspring- clones
Meiosis	Mitosis

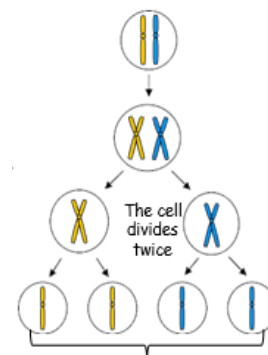
Using both:

Malaria parasites reproduce sexually in the mosquito but asexually when in a human host. Fungi reproduce by spores but can also reproduce sexually when conditions are not good enough. Plants reproduce sexually forming seeds but they also reproduce asexually by runners

Meiosis

Reproductive cells divide by meiosis to form gametes such as sperm and eggs.

The cell divides twice and forms four gametes that are all genetically different





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	Mitosis	Meiosis
In which type of cell does it occur?	Body cells (somatic cells)	Cells in the testes or ovaries (germline cells)
How many daughter cells are produced?	2	4
Type of reproduction it is important for?	Asexual	Sexual
How many chromosomes do the daughter cells contain (in humans)?	46 (two sets)	23 (one set)

DNA and the human genome

The genetic material in the nucleus of a cell is composed of a chemical called DNA. DNA is a polymer made up of two strands forming a double helix. The DNA is contained in structures called chromosomes. A gene is a small section of DNA on a chromosome. Each gene codes for a particular sequence of amino acids, to make a specific protein.

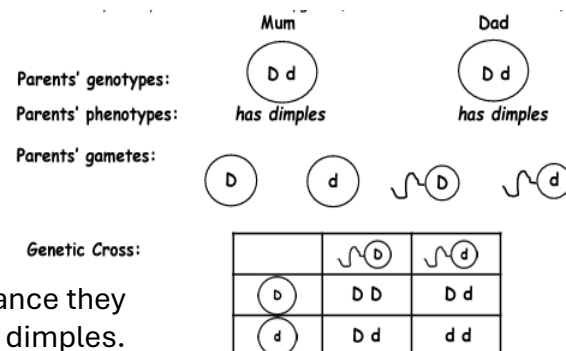
The genome is the entire genetic material of an organism. The human genome has been sequenced and will be vital for finding genes linked to diseases, understanding inherited disorders and treating them, and tracing migrating patterns

Inheritance in action

Some characteristics are controlled by a single gene, such as: fur colour in mice; and red-green colour blindness in humans. Each gene may have different forms called alleles. The alleles present, or genotype, operate at a molecular level to develop characteristics that can be expressed as a phenotype.

If we know the genotype (the alleles) of parents, we can work out what possible genotypes their children could have and the probability in each case. We do this by doing a 'genetic cross'. Genetic crosses are achieved by using a Punnett square to work out all possible combinations of sperm and egg during fertilisation.

The allele for having dimples is dominant (represented by D) and the allele for not having dimples is recessive (represented by d).



There is a $\frac{1}{4}$ or 25% chance they will have a baby without dimples.



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Inherited disorders

Cystic fibrosis

an inherited disorder of cell membranes that mainly affects the lungs and digestive system. They can become clogged with lots of thick, sticky mucus as too much is produced. Over many years, the lungs become increasingly damaged and may eventually stop working properly. It is caused by a faulty recessive allele on chromosome 7. To be born with cystic fibrosis, a child has to inherit two copies of this faulty gene - one from each of their parents. Their parents will not usually have the condition themselves, because they will only carry one faulty gene and one that works normally.

		Mother	
		C	c
Father	C	CC (25%)	Cc (25%)
	c	Cc (25%)	cc (25%)

Gene frequencies:
CC (normal) = 25%
Cc (carrier) = 50%
cc (with cystic fibrosis) = 25%

Polydactyly

Polydactyly is an inherited condition in which a person has extra fingers or toes. It is caused by a dominant allele of a gene. This means it can be passed on by just one allele from one parent if they have the disorder.

Someone who is homozygous (PP) or heterozygous (Pp) for the dominant allele will develop polydactyly.

Screening for genetic disorders

Screening embryos:

- Embryonic screening can take place in order to test for alleles. This process can take place in many ways:
- Amniocentesis – A sample of amniotic fluid from the area surrounding the foetus can be tested.
- Chorionic Villous Sampling – A sample from the placenta is taken and checked.
- In order to screen, DNA must be taken from the embryo and is tested.
- When testing during IVF, the whole cell is removed from the embryo before implantation occurs.
- If the screening shows the embryo is affected parents have a choice- to carry on the pregnancy or terminate it.

Concerns about embryo screening:

- Ethics in Normal Pregnancy – Parent will be in the knowledge of a portion of the health of the child and may get the option of terminating the pregnancy. Some therefore, believe that this testing is unethical, as it could ruin the opportunity for an embryo to live a life. Others may not terminate the pregnancy, but use the result to prepare for pregnancy and the life of the child.
- Ethics in IVF – During IVF, if an embryo is found to have a genetic disorder, it is not implanted. There are questions regarding the ethics of this, as the embryo is then destroyed.
- Cost – One thing to remember is that all of this testing is very expensive, however the cost of the healthcare for the child who suffers from a disorder may be much greater.
- False results – If the results are a false positive or a false negative, they could lead to great trauma to a family.