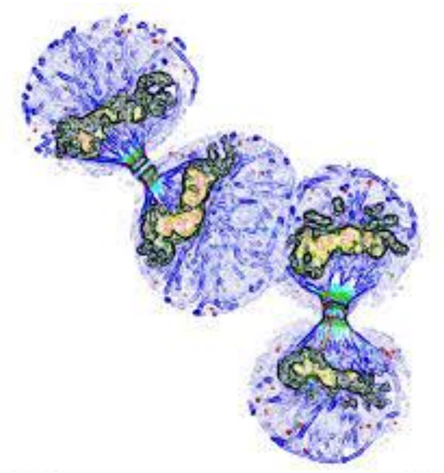
Sexual & Asexual Reproduction



Name	______________________
Class	______________________
Teacher	______________________

L1 Sexual and Asexual reproduction

Sexual reproduction involves the joining of two sex cells, or gametes during fertilisation. Organisms produced by sexual reproduction have two parents and are genetically similar to both but not identical to either.

Advantages	Disadvantages
it produces variation in the offspring the species can adapt to new environments due to variation, which gives them a survival advantage a disease is less likely to affect all the individuals in a population humans can speed up natural selection through **selective breeding**, which can be used, for example, to increase food production.	time and energy are needed to find a mate it is not possible for an isolated individual

Asexual reproduction only involves one parent so there is no joining of sex cells during fertilisation. Organisms produced by asexual reproduction are genetically identical to each other and their parent. They are clones.

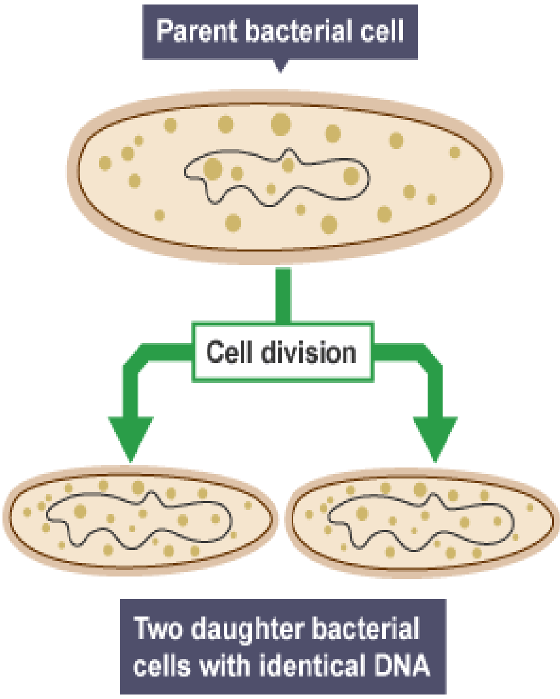
Advantages	Disadvantages
the population can increase rapidly when the conditions are favourable only one parent is needed it is more time and energy efficient as you don't need a mate it is faster than sexual reproduction.	it does not lead to variation in a population the species may only be suited to one habitat disease may affect all the individuals in a population

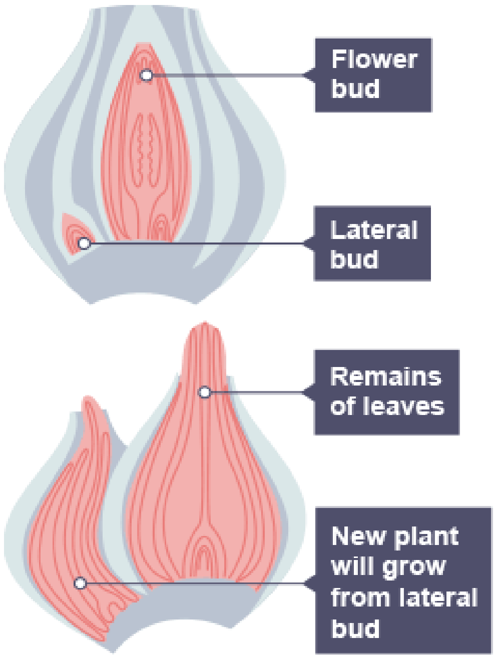
Organisms reproduce to pass on their genes and create new members of their species. If the organisms of a species all fail to reproduce then the species may become extinct.

<u>Plants</u>

In flowering plants, male and female reproductive structures can be found in the same individual plant. The organ of sexual reproduction is the flower. Male gametes are found in pollen grains and produced in the anthers of the flower. Female gametes are found in ovules and produced in the ovary of the flower.

Asexual reproduction does not involve sex cells or fertilisation. Only one parent is required, unlike sexual reproduction which needs two parents. Since there is only one parent, there is no fusion of gametes and no mixing of genetic information. As a result, the offspring are genetically identical to the parent and to each other. They are clones.





Asexual reproduction in plants can take a number of forms. Many plants develop underground food storage organs that later develop into the following year's plants. Potatoes and daffodils are both examples of plants which do this.

A daffodil bulb at the beginning and end of the growing season, with a lateral bud where the new plant will grow.

Strawberry runners branching off plant

Some plants such as the spider plant, Chlorophytum, produce side branches with plantlets on them. Other plants like strawberries, produce runners with plantlets on them.

Asexual reproduction in animals does occur in sea anemones and starfish, but it is much less common than sexual reproduction.

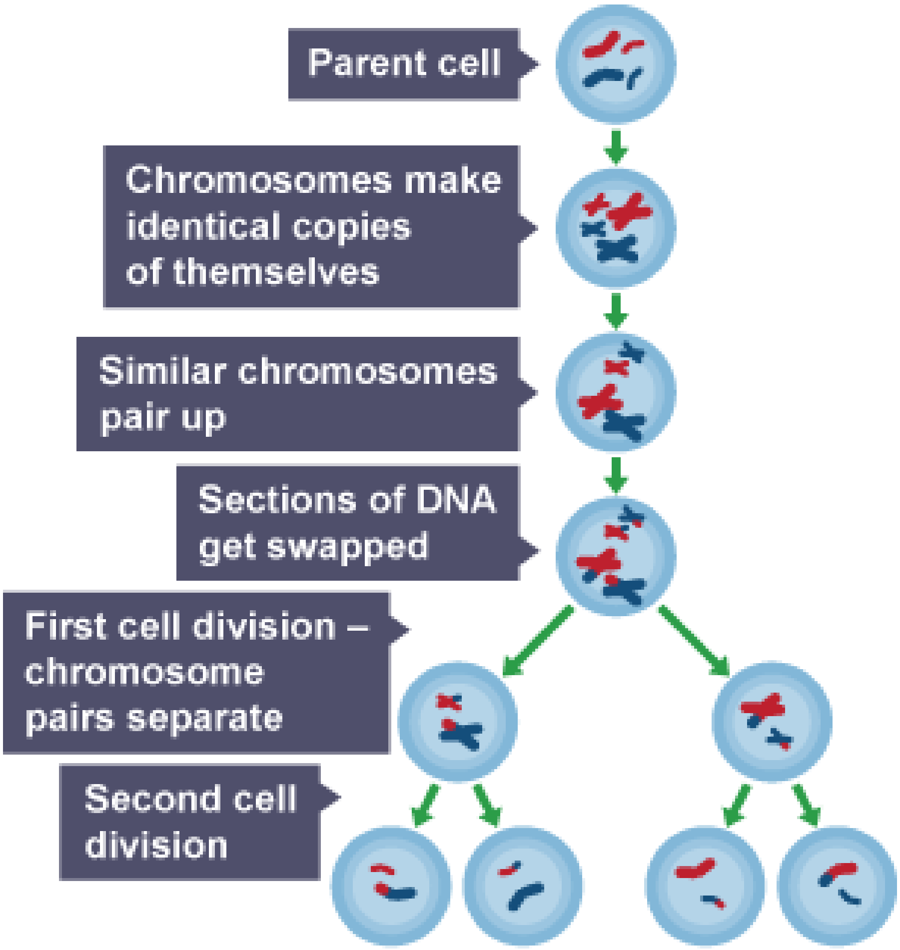
Independent Practice

1. Sexual reproduction involves the joining of two cells. Which cells are these in humans?
2. How many parents are required for sexual reproduction?
3. Are offspring identical to their parents in sexual reproduction?
4. What is interesting about the offspring produced in sexual reproduction which acts as a survival advantage?
5. Give two disadvantages of sexual reproduction
6. What is another word given to describe the offspring of asexual reproduction?
7. What are gametes?
8. Name the gametes in animals.
9. Name the gametes in plants.
10. Complete the sentence: "Sexual reproduction leads to …… in the offspring."
11. State two differences between asexual and sexual reproduction
12. **Extended writing: explain the different forms of asexual reproduction in plants**

L2 Meiosis

Cells in reproductive organs divide by meiosis to form gametes (sex cells). The number of chromosomes must be halved when the gametes are formed. Otherwise, there would be double the number of chromosomes after they join at fertilisation in the zygote (fertilized egg). This halving occurs during meiosis, and so it is described as a reduction division in which the chromosome number is halved from diploid to haploid, resulting in genetically different cells.

It starts with chromosomes doubling themselves as in mitosis and lining up in the centre of the cell. After this has happened the cells divide twice so that only one copy of each chromosome passes to each gamete. We describe gametes as being haploid – having half the normal number of chromosomes. Due to this double division, meiosis produces four haploid cells.



Each chromosome is duplicated (makes identical copies of itself), forming X-shaped chromosomes

First division: the chromosome pairs line up along the centre of the cell and are then pulled apart so that each new cell only has one copy of each chromosome

Second division: the chromosomes line up along the centre of the cell and the arms of the chromosomes are pulled apart. A total of four haploid daughter cells will be produced. Meiosis makes gametes eg. sperm cells and egg cells in animals, pollen grains and ovum cells in plants and increases genetic variation of offspring.

Meiosis produces variation by forming new combinations of maternal and paternal chromosomes every time a gamete is made, meaning that when gametes fuse randomly at fertilisation, each offspring will be different from any others

Gametes join at fertilisation to restore the normal number of chromosomes

When the male and female gametes fuse, they become a zygote (fertilised egg cell). This contains the full number of chromosomes, half of which came from the male gamete and half from the female gamete

The zygote divides by mitosis to form two new cells, which then continue to divide and after a few days form an embryo

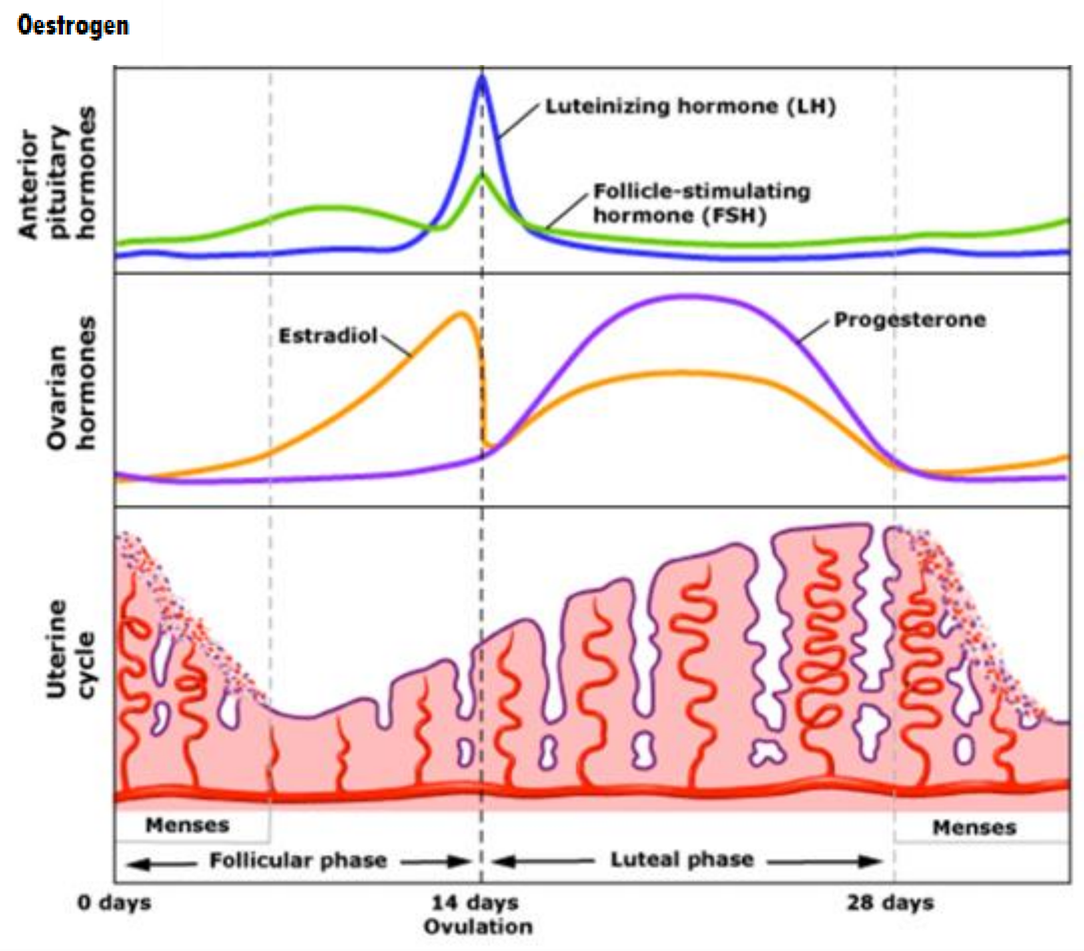
Cell division continues and eventually many of the new cells produced become specialised (the cells differentiate) to perform functions and form all the body tissues of the offspring. The process of cells becoming specialised is known as cell differentiation

<u>Independent Practice</u>

1. Name the organ that produces egg cells.
2. Name the organ that produces sperm cells.
3. How many divisions does a cell undergo in meiosis?
4. Name the process by which a sperm and an egg cell fuse together.
5. How many chromosomes are there in a human gamete?
6. Define 'gametes'.
7. Name the gametes in animals.
8. Describe the cells produced by meiosis.
9. Describe the cells produced by mitosis.
10. State the three key steps in meiosis.
11. **Extended writing: write out the steps of mitosis alongside a flowchart diagram.**

L3 Hormones in human reproduction

The female reproductive hormones are synchronised to ensure the menstrual cycle follows a regular pattern. This is summarised in the diagram below

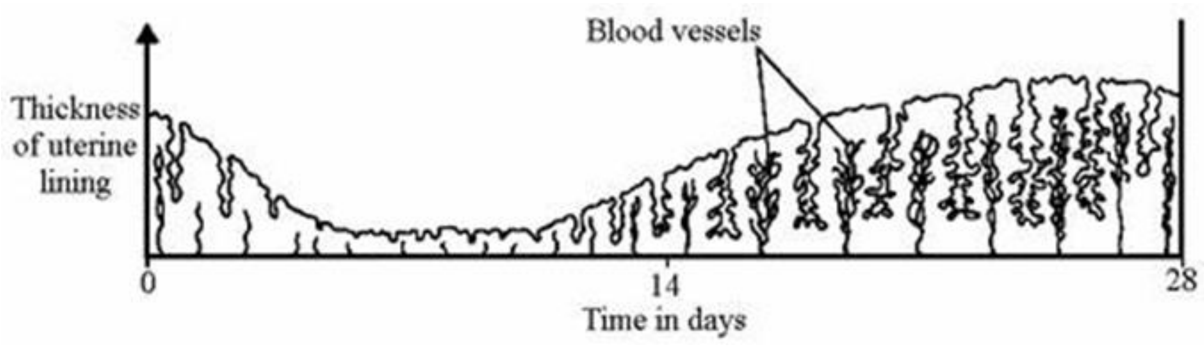


The cycle starts with menstruation. The lining is shed because oestrogen and progesterone levels are low. At the same time FSH begins to rise slightly, triggering a new egg cell to begin maturing. FSH stimulates Oestrogen production so oestrogen levels begin to rise and the lining of the uterus begins to re-grow.
A day or two before ovulation the levels of oestrogen, LH and FSH all reach their maximum. Once the egg is released they all begin to drop. Progesterone and oestrogen rise to maintain the lining of the uterus. If the egg is fertilised it will embed in the lining and progesterone and oestrogen will remain high. Oestrogen inhibits FSH, and progesterone inhibits the release of LH. This prevents a second egg being released during the 9 months of a gestation. If the egg is not fertilised, then progesterone drops and menstruation happens. The cycle repeats.

<u>Independent practice</u>

1. How many hormones are involved in the control of the menstrual cycle.

2. State what hormone oestrogen inhibits.
3. State what hormone LH is stimulated by.
4. Describe the hormonal interaction between progesterone and LH .
5. What happens when FSH and LH rise suddenly
6. Why does progesterone increase after ovulation?
7. **Extended writing (paragraph needed)** Describe the sequence of hormonal interactions in the menstrual cycle. [6]
8. What happens if the egg is fertilised, and why?
9. What happens if the egg is not fertilised.
10. Name the hormone that causes the release of the egg.
11. True or false: The ovaries releases oestrogen and FSH
12. Name the hormones involved in the menstrual cycle released by the pituitary gland.
13. A woman wants to have a baby. She has been told that her body is not making and releasing eggs. What hormones is she lacking?
14. **Extended writing (Paragraph needed)** Describe how changes in the lining shown in the diagram adapt it for its function if an egg is fertilised.



L4 Contraception

Contraception is an essential topic to understand, especially as you study biology. It's all about preventing pregnancy by controlling the process of fertilization. In this summary, we'll break down two main types of contraception: hormonal and non-hormonal methods.

Hormonal Contraception:

Hormonal contraceptives inhibit FSH production by releasing oestrogen and/or progesterone. This stops eggs maturing. The potential disadvantages include side effects such as headaches, nausea, sore breasts and vaginal yeast infections (thrush). The hormones can also cause spotting between periods or lead to mood swings, and may reduce women's sexual desire. There is also a small risk of blood clots forming (thrombosis).

- Birth Control Pills: These are tiny pills taken daily to prevent pregnancy. They contain hormones that stop the release of eggs, thicken cervical mucus to block sperm, and make the womb lining less suitable for an embryo to implant.
- The Contraceptive Patch: This is a small, sticky patch worn on the skin. It releases hormones that work in a similar way to birth control pills but is changed once a week.
- The Contraceptive Injection: It's a shot that is given every 8 to 12 weeks. This shot contains hormones to prevent pregnancy.
- Implants: These are small rods placed under the skin of the arm. They release hormones gradually and can work for up to three years.
- Intrauterine Device (IUD): A T-shaped device is inserted into the womb by a healthcare provider. There are hormonal and non-hormonal IUDs available.

Non-Hormonal Contraception:

Non-hormonal methods provide either a physical barrier or preventing embryo implantation.

- *Barrier methods:* Mainly the condom or the diaphragm. Both of these provide a physical barrier that prevents sperm entering the uterus. The condom has an added advantage of preventing the spread of STI's.
- *Copper Intrauterine devices (IUD):* Often called 'the coil' they are tiny plastic or metal devices that are inserted into the uterus. They aim to mimic an implanted embryo, stimulating progesterone and oestrogen and prevent a mature egg begin released.
- *Spermacidal gels:* These kill sperm on contact. Often added to barrier methods to improve their effectiveness.
- *Abstinence:* Various apps are now available to monitor the menstrual cycle. By doing this they can predict when you will have a low chance of conceiving if you have sex. This is the least effective method as sperm can survive inside the oviduct for a number of days.

- *Surgical sterilisation:* This is when a person is preventing from releasing sperm or eggs due to a small surgical procedure. In males it is a vasectomy, and in women it is a tubal ligation In both cases these are permanent procedures and come with some short term discomfort while you recover from the operation. They do not prevent the spread of STI's.

Independent practice

1. What is the common purpose of all forms of contraception?
2. What are the two main categories of contraception?
3. Which forms of contraception also prevent STI's?
4. Which forms of contraception are permanent?
5. Which hormones are found in hormonal contraception?
6. **Extended writing (paragraph needed)** Explain why a person may choose to not use hormonal contraception, and instead would use condoms.
7. Why would it still be recommended that a homosexual male wear a condom?
8. Brad says "I can't catch an STI because my girlfriend is on the pill" Is he right or wrong? Give a reason.
9. Duncan says "I don't like the feeling of a condom, but my girlfriend has bad side effects on the pill. I'm not sure what to do?" What advice would you give Duncan? Make sure you include reasons for any advice you give.
10. Susie says "I take my birth control pill every day that I had sex.". What is likely to happen?
11. **Extended writing (paragraph needed)** Evaluate the use of the contraceptive methods below.

Method	Effectiveness (%)	Other information
Contraceptive pill	99.8	Must be taken every day, free from GPs, side effects include headaches and increased blood pressure.
Condom	99.0	May tear, offer protection from STIs, inexpensive to buy.
Spermicide gel	75.0	Allergic reactions to gel can occur, easy to administer, inexpensive to buy.

12. A GP can refuse to carry out Tubal Ligation. Suggest why they are less likely to refer patients under the age of 30.
13. What are the key factors individuals should consider when choosing the most suitable contraceptive method for their specific needs and lifestyle?
14. What are the potential social, economic, and health implications of limited access to contraception, especially in underserved communities?

L5 IVF

It is a cruel twist of irony that while some people spend a lot of time ensuring they cannot fall pregnant during sex; others spend years desperately trying to have child and not succeeding.

Fortunately, scientific developments over the last 50 years have been able to help couples in this situation.

Fertility drugs: These are mixtures of FSH and LH taken over a series of days. The aim is to help the egg cells to mature and be released. The woman can then fall pregnant in a traditional fashion.

IVF: In-Vitro Fertilisation is a sophisticated process that can help a couple conceive.

1. The woman is given a large dose of FSH and LH so she matures and releases many eggs
2. The eggs are collected and fertilised by the sperm from the father. This is done in laboratory conditions. The words 'in vitro' mean 'outside of the body'
3. The embryos develop in the lab
4. When the embryos are developed into a ball of cells, 1 or 2 embryos are implanted into the mother to be carried to term like a normal pregnancy.

About 60,000 of the 755,000 babies born last year were conceived via IVF. It is a vital service for some couples but it is not without its risks:

- It is physically and emotionally stressful on the woman
- Its success rates are also not very high (under 30%)
- There is a high chance of multiple births, which can put extra pressure on the mother and babies as they develop in the uterus. This increases the chance of complications during pregnancy.

IVF is also expensive; luckily it is available on the NHS in the UK for free. However not everyone is eligible for IVF on the NHS, the decision is made by The National Institute for Health and Care Excellence (NICE) fertility guidelines make recommendations about who should have access to IVF treatment on the NHS in England and Wales. These guidelines recommend that IVF should be offered to women under the age of 43 who have been trying to get pregnant through regular unprotected sex for 2 years.

In 2019, the percentage of IVF treatments that resulted in a live birth was:

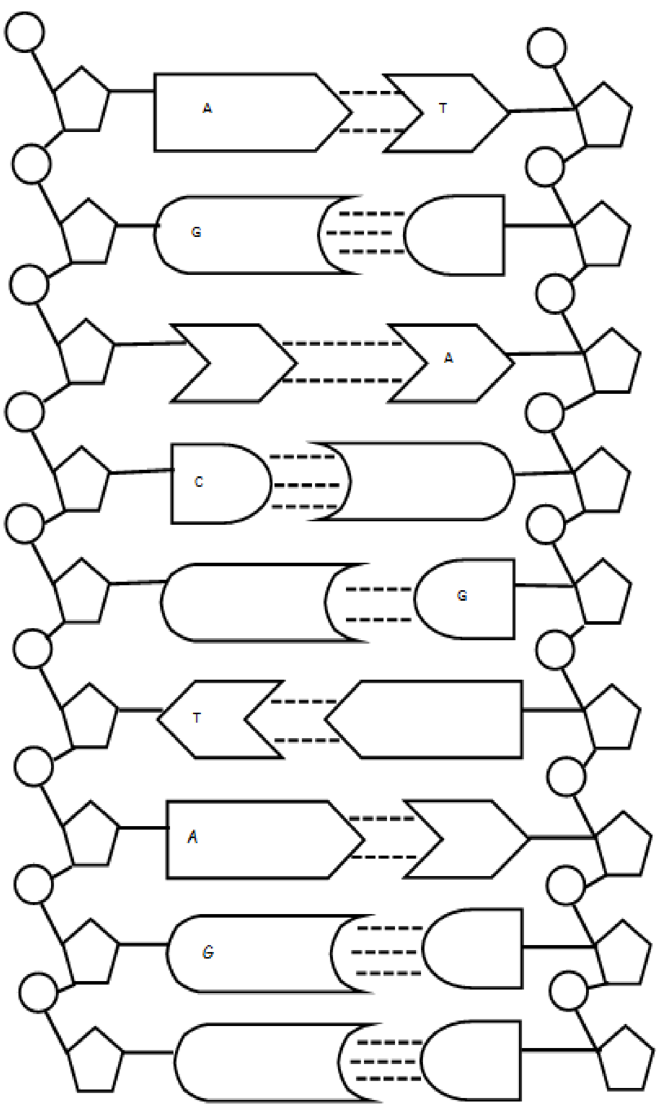
32% for women under 35
25% for women aged 35 to 37
19% for women aged 38 to 39
11% for women aged 40 to 42
5% for women aged 43 to 44
4% for women aged over 44

Independent practice

1. Can you explain the concept of fertility drugs and what they aim to achieve?
2. What is the function of FSH?

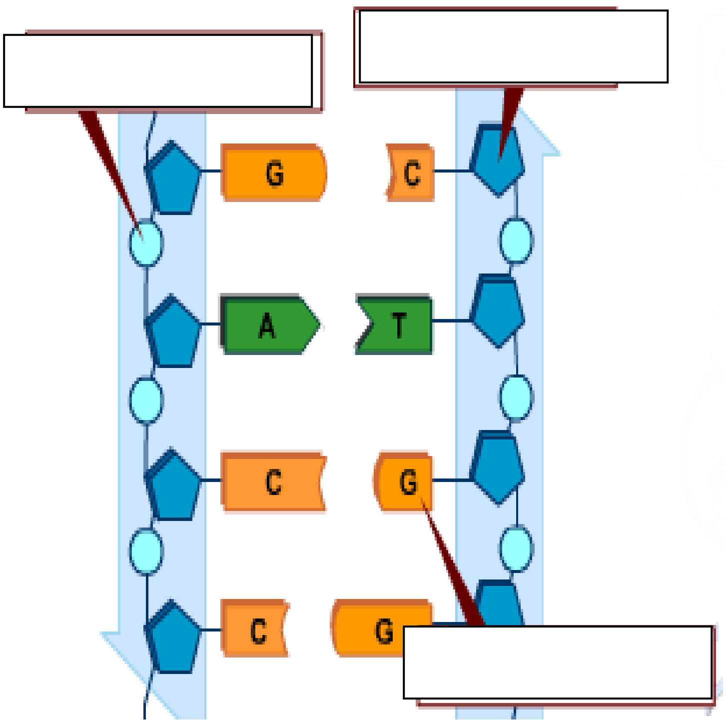
3. What is the function of LH?
4. How are FSH and LH used in fertility treatments?
5. Why are some couples unable to conceive children naturally?
6. What does IVF stand for, and how does it differ from traditional conception?
7. **Extended writing (paragraph needed)** Describe the steps involved in the IVF process.
8. What is the significance of the term "in vitro" in IVF?
9. What are the risks associated with IVF treatments?
10. What is the success rate of IVF treatments in general?
11. How do the success rates of IVF vary with a woman's age?
12. How does the chance of multiple births in IVF affect mothers and babies?
13. Explain why despite the low success rates of embryo implantation why only 1 or 2 embryos are used in IVF.
14. **Extended writing (paragraph needed)** What are some ethical considerations related to assisted reproductive technologies like IVF?

L6 DNA Structure



Circle me- True or false

1. DNA has 3 strands T/F
2. The base A joins with T on a DNA strand T/F
3. G pairs with T T/F
4. DNA is found in the nucleus of a few cells. T/F
5. DNA is the instructions for life T/F
6. The base C joins with A on a DNA strand T/F

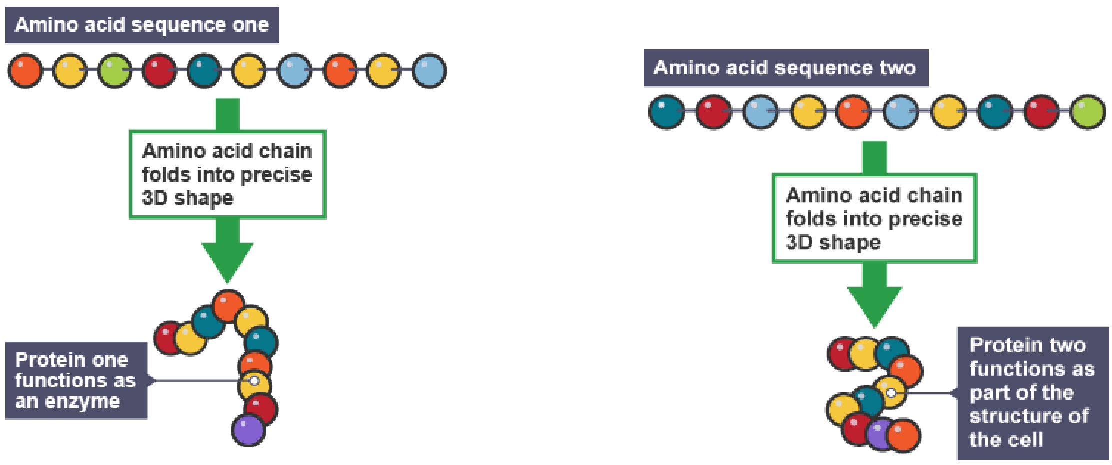


DNA is needed to make ____________. DNA is found inside every living cell (typically inside the nucleus.) DNA is shaped like a spiralled stair case. This shape is referred to as a ________ __________. A molecule of DNA has a sugar _________ backbone on the outside for strength and support. ______ are found on the inside. There are only 4 different bases A (adenine), T (thymine) G (guanine) and _____ (________). Bases on either side of the DNA double helix pair up. They are called base ________. A always pairs with ___ and G always pairs with _____. These bases are held together by __________ bonds. There are _____ hydrogen bonds between cytosine and _________ between adenine and _________.

Word bank: C, double helix, proteins, T, thymine. hydrogen, phosphate, bases, pairs, G, three, guanine, two, cytosine

L6 DNA Structure (HT)

The DNA that code for the *protein* remain in the *nucleus*, but a copy, called mRNA, moves from the nucleus to the *ribosomes* where proteins are *synthesised*. The protein produced depends on the template used, and if this sequence changes a different protein will be made. Proteins are made from amino acids.
Carrier molecules bring specific *amino acids* to add to the growing protein in the correct order. There are only about 20 different naturally-occurring amino acids.
Each protein *molecule* has hundreds, or even thousands, of amino acids joined together in a unique sequence. It is then folded into the correct unique shape. This is very important, as it allows the protein to do its job. Some proteins are enzymes, others are hormones and others form structures within the body, such as collagen. Each of these proteins needs a different shape.

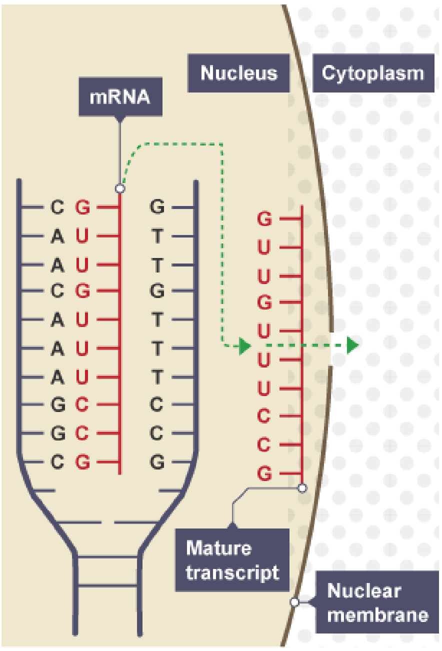


A straight amino acid sequence folds into a precise 3D shape, the protein functions as an enzyme.,
End of image gallery
Cells express their genes by converting the genetic message into protein. This process of protein synthesis occurs in two stages - transcription and translation.

Transcription
When a gene is to be expressed, the base sequence of DNA is copied or transcribed into mRNA (messenger RNA). This process takes place in the nucleus and occurs in a series of stages.

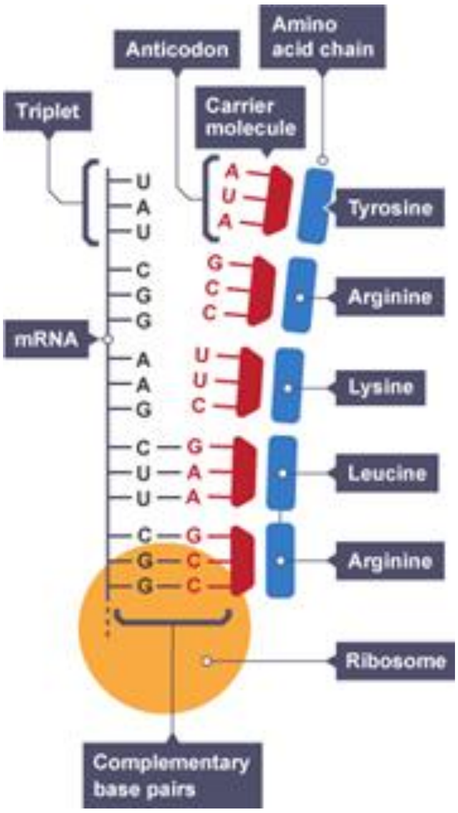
1. The two strands of the DNA helix are unzipped by breaking of the weak Hydrogen bonds between base pairs. This unwinding of the helix is caused by an enzyme (helicase enzyme).
2. The enzyme RNA polymerase attaches to the DNA in a non-coding region just before the gene.

3. RNA polymerase moves along the DNA strand. Free RNA nucleotides form hydrogen bonds with the exposed DNA strand nucleotides by complementary base pairing to form a strand of mRNA:
   - Note - RNA nucleotides contain the same bases as DNA, except that T is replaced by U. U base pairs with A.
   - Because the opposite base bonds with the exposed DNA bases, the strand of mRNA is an opposite copy of the DNA strand (except that U replaces T). We call this a complementary copy.
4. The newly formed strand of mRNA is now ready to leave the nucleus and travel to the ribosome.



Translation

1. The mRNA strand travels through the cytoplasm and attaches to the ribosome. The strand passes though the ribosome.
2. For every three mRNA bases the ribosome lines up one complementary molecule of tRNA. We call every three bases a **codon**.
3. tRNA molecules transport specific amino acids to the ribosome which they leave behind shortly after lining up opposite the DNA. Because there are three mRNA bases for each tRNA molecule, we call this the **triplet code**.
4. Used tRNA molecules exit the ribosome and collect another specific amino acid.
5. A chain of several hundred amino acids in the correct order according to the original DNA is then made. This is called a **polypeptide**.

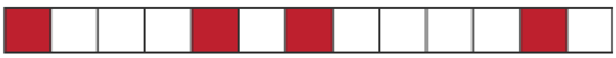


After translation, the polypeptide is finally folded into the correct shape and becomes a protein. Peptide bonds form between the adjacent amino acids to finalise the structure.
The structure of *DNA* is important in making specific *proteins* needed in biological processes.

Not all parts of the DNA code for proteins. In fact, it is believed that a human is made from only about 20,000 *genes*. This means that there are large parts of our DNA which don't make proteins. We call these non-coding regions.

However, there are sections of non-coding DNA which can switch genes on and off. Not all the genes you need to survive are needed throughout your life. Some regions of these non-coding DNA are not as good as binding to RNA polymerase. This means the enzyme is less likely to bind and so less protein is produced. If less protein is produce this can affect the *phenotype* of the organism.

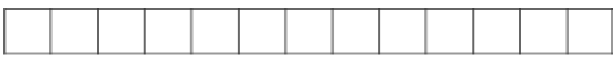
The diagram below shows DNA with certain genes switched on and others switched off:



Red boxes - genes switched on

White boxes - genes switched off

This diagram shows all of the genes are switched off:



In different cells around the body, certain genes will be switched on and others will be switched off. This will vary depending on which cells you examine.

Individuals in a population are usually similar to each other, but not identical. Some of the *variation* within a *species* is *genetic*, some is as a result of the environment they live in, and some is a combination of both.

Children generally look a little like their mother and their father, but are not identical to either. They inherit their features from each parent's DNA.

Every sperm and egg cell contains half of the genetic information needed for an individual. Each sex cell is known as *haploid*, which has half the normal number of *chromosomes*. When the chromosomes fuse during *fertilisation*, a new cell is formed, which is known as a *zygote*. It has all the genetic information needed for an individual, which is known as *diploid* and has the full number of chromosomes.

Examples of genetic variation in humans include blood group, skin colour and natural eye colour.

Whether you have lobed or lobeless ears is due to genetic causes.

Sex is also an inherited variation - whether you are male or female is a result of genes you inherited from your parent.

Environmental causes of variation

Some examples of variation are not caused by the inheritance of genetics. Whether or not you have a scar or tattoo was not determined when the sperm fertilised the egg to begin your life. This variation is often caused by the environment we live in and so is called *environmental variation*.

Genetic and environmental causes of variation

Many kinds of variation are influenced by both environmental and genetic factors, because although our genes decide what characteristics we inherit, our environment affects how these inherited characteristics develop. For example:

a person might inherit a tendency to be tall, but a poor diet during childhood will cause poor growth

plants may have the potential for strong growth, but if they do not receive sufficient mineral resources from the soil, they may hardly grow at all

Identical twins are a good example of the interaction between inheritance and environment, because such twins are genetically the same. Any differences you may see between them – for example in personality, tastes and particular aptitudes – are due to differences in their experience or environment.

Independent practice (HT) only

1. Describe protein synthesis
2. Explain simply how the structure of DNA affects the protein made
3. Describe how genetic variants may influence phenotype: a) in coding DNA by altering the activity of a protein: and b) in non-coding DNA by altering how genes are expressed.
4. Which bases are complimentary?
5. Explain how a change in DNA structure may result in a change in the protein synthesised by a gene.
6. What do carrier proteins do?
7. What does the 3D shape of the protein allow it to do?
8. What is a genetic mutation?
9. What can mutations cause?
10. What are non-coding parts of DNA and what do they do?