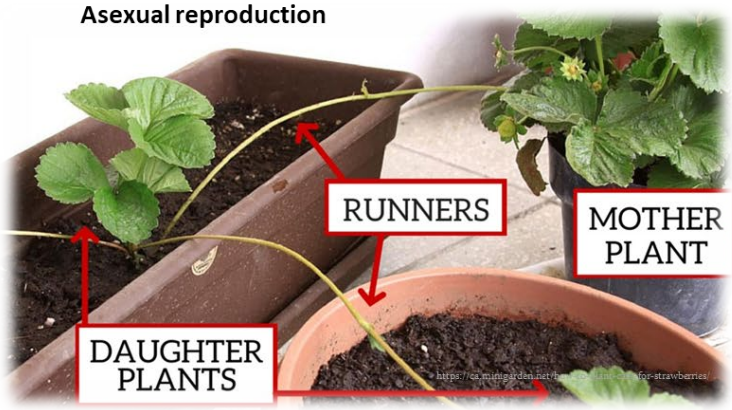
Importance of Reproduction

All organisms need to **reproduce**; to create offspring that carry their genetic information, as part of the life processes that defines them as living.

Some organisms reproduce **sexually**, and together with a mate of the same species produce offspring that have a combination of both parent's genetic material. The offspring from sexual reproduction will show variation in their traits.

Other organisms can reproduce **asexually**, with no mate required and all of their offspring will have identical genetic material to their parents with no variation seen. Some species can reproduce using both methods.

Asexual reproduction



Sexual reproduction

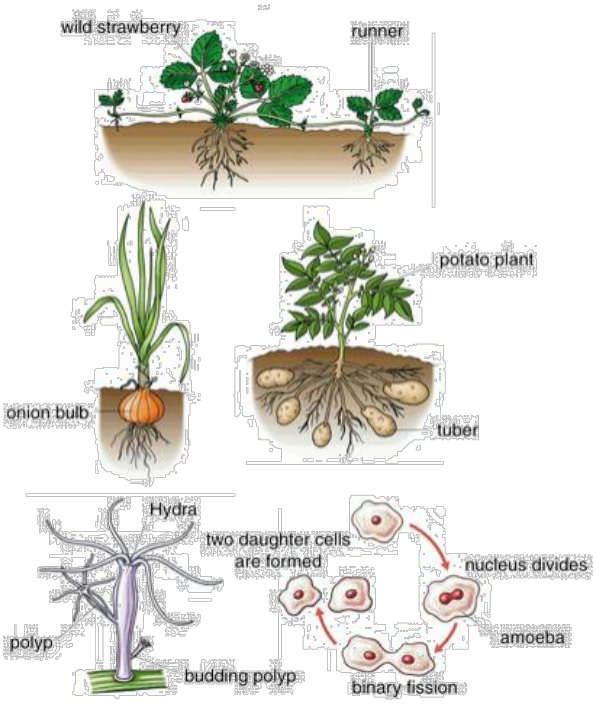
Sexual Reproduction

Organisms of a species that reproduce sexually are not identical therefore, they exhibit **variation**. Variation or differences in traits are caused by genetic factors (what genes you are born with) and environmental factors, but only genetic variation can be passed onto the next generation by sexual reproduction.

Genetic material (DNA) carried in the egg & sperm (gametes) provide the **inherited instructions** for making offspring. The inheritance of this mixture of genetic material leads to variation in the offspring.

Advantages	Disadvantages
Variation in offspring means that some will be better suited to changing conditions, and so will survive better.	Need two parents that are able to reproduce
Mates can be selected to pass on desirable traits to the offspring.	If conditions are stable, it could introduce variation, which may be counterproductive.
Humans can selectively breed traits in other species for their advantage. For example different rose types.	Involves energy in producing reproductive structures or phenotypes to attract mates
	If pollination is unsuccessful, then no seeds are produced – i.e. a waste of energy and time, as no genetic material will be passed on to future generations
	Time consuming compared to asexual reproduction (takes time to produce reproductive structures, attract pollinators etc.)

Asexual reproduction produces identical offspring



Some organisms, more commonly bacteria and plants but also some animals, reproduce asexually. This type of reproduction does not involve the manufacture of sex cells (gametes) from two parents. Every new organism produced by asexual reproduction is genetically identical to the parent – a **clone**. The advantages are that there is no need to search for a mate. Asexual reproduction can therefore lead to a rapid population build-up. The disadvantage of asexual reproduction arises from the fact that only identical individuals (clones) are produced – there is **no variation** and an asexual population cannot adapt to a changing environment and is at risk of extinction.

Summary of Advantages and disadvantages of **Asexual Reproduction**

Advantages	Disadvantages
Fast – do not have to spend time producing flowers or attracting mates	
No need to spend energy producing flowers or finding a mate	
No need to rely on pollinators/males	
Guaranteed success of producing offspring	
Can make numerous copies of plants through cuttings	Population overruns a food source quickly
All desirable traits are passed down	If parents have an undesirable trait then all offspring inherit it
All offspring are genetically identical and best suited to an environment if conditions remain stable	All offspring are identical so this creates vulnerability if the environment changes or pests/ diseases occur

Asexual Reproduction vs Sexual reproduction

Asexual reproduction occurs when only a single individual passes on all its genes to the offspring. The offspring are genetically identical to the parent. **Sexual reproduction** occurs when two parents create offspring and pass only half their genes to the offspring. The offspring half a different/unique set of genes. **Asexual** reproduction is **fast compared** to **sexual** reproduction.

Advantages for asexual reproduction are that only one parent is needed, and identical offspring are adapted to same environment as parent. An **advantage of Sexual Reproduction** is that variation can increase survival chances of a species if the environment changes.

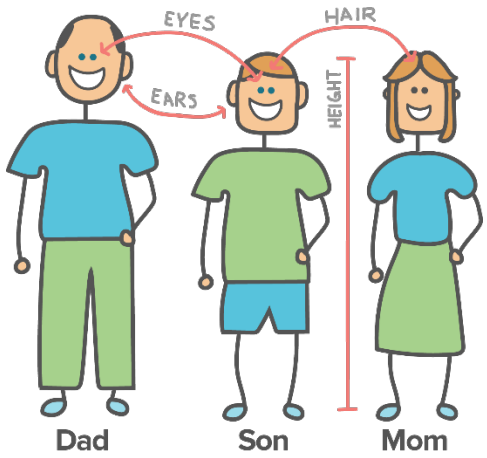
Summary of **Asexual Reproduction vs Sexual reproduction**

Asexual reproduction	Sexual reproduction
Single individual is the only parent	Two parents create offspring
The single parent passes on all its genes to the offspring	Each parent passes on only half of its genes to the offspring
The offspring are genetically identical	Each individual offspring has a unique combination of genes
Variation is only created by rare mutation	Variation is created in each individual

Variation

As a species, humans all have the same set of genes. However, each individual, except identical twins, has a different combination of alleles inherited from both parents and this creates **variation**. Variation of traits causes each individual to look different from another and in many cases behave differently from each other as well.

An individual within an ethnic group tends to have more similar traits in common to others within the same group.

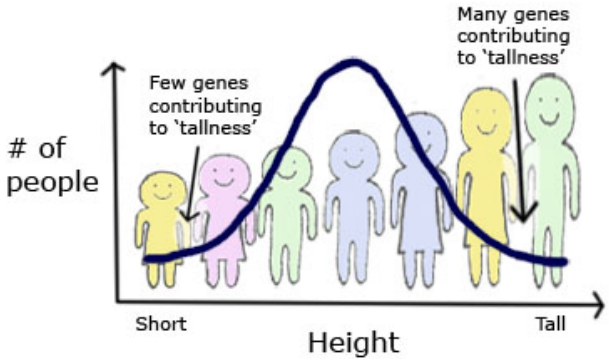


Continuous and discontinuous variation

Variation of a trait in an individual can be **continuous** such as tallness where height can be either very tall or very short as well as any height in between. Offspring will most often show height half way between the two parents as alleles inherited from both parents have a combined effect.

Variation of a trait can also be **discontinuous** such as the ability to roll your tongue. You can either roll it or you cannot, but you can't "half roll" it. Offspring will inherit their trait from one parent or the other but not both.

Continuous Variation



A group of genes creates traits that cause continuous variation. When random groups of people are measured for a particular trait the extremes tend to be expressed the least and the mid-point tends to be expressed the most. This creates a **bell-shaped curve** when graphed.

In the example beside, many more people tend to be of average height compared to being very short or very tall.

Discontinuous Variation

Discontinuous Variation produces an "either/or" trait (physical characteristic).

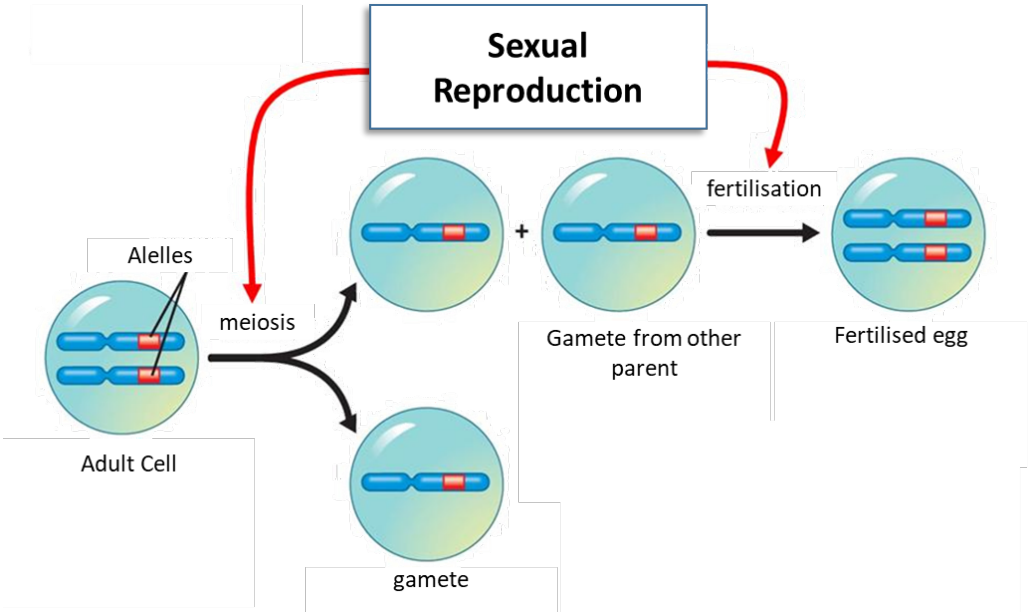
Every person inherits one allele (a version of a gene producing the trait) from each parent. This gives the person **two alleles** for each trait (their genotype)

If a person has one or two dominant alleles, then they will also have the dominant phenotype (trait). A person can only have the recessive phenotype (trait) if they have two recessive alleles.

Examples of inherited Traits for Discontinuous Variation

Dominant phenotype (trait)	Recessive phenotype (trait)
Cleft Chin 	No Cleft 
Widow's Peak 	No Widow's Peak 
Dimples 	No Dimples 
Brown/Black Hair 	Blonde Hair 
Freckles 	No Freckles 
Brown Eyes 	Gray/Blue Eyes 
Free Earlobe 	Attached Earlobe 

The process of sexual reproduction in humans



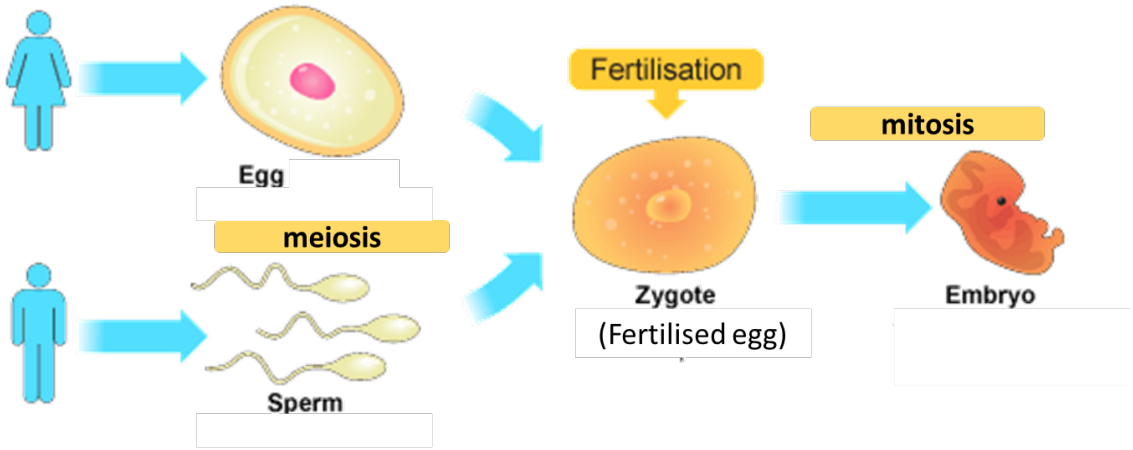
Variation is due to genes being passed on from parents to offspring during sexual reproduction. **Gametes** are produced by the parents – sperm in the males and eggs in the female. Genetic material (DNA) carried in the egg & sperm (gametes) provide the **inherited instructions** for making offspring. The inheritance of this mixture of genetic material leads to **variation** in the offspring

Sexual reproduction involves a mobile male gamete (sperm) fusing with a stationary female gamete (egg)

Both males and females only donate half of their chromosomes (one from each **homologous** pair) to form gametes through **meiosis**. (Gametes = egg or sperm). When the chromosomes from the egg and sperm rejoin to form a **zygote** (fertilised egg) with the total number of chromosomes **fertilisation** has occurred.

Once fertilisation has produced a zygote then **mitosis** occurs throughout the remainder of the babies/person's lifetime for growth and cell repair.

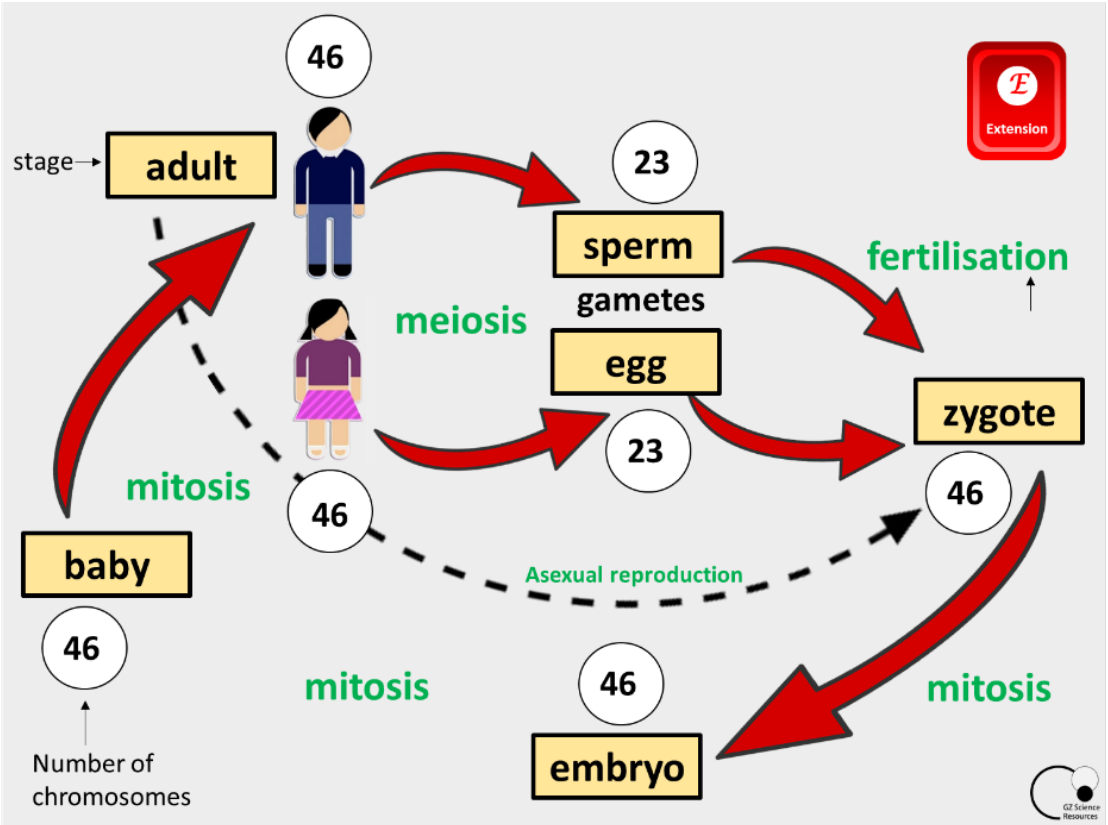
Gametes contain half the normal number of chromosomes and fertilisation restores the normal number



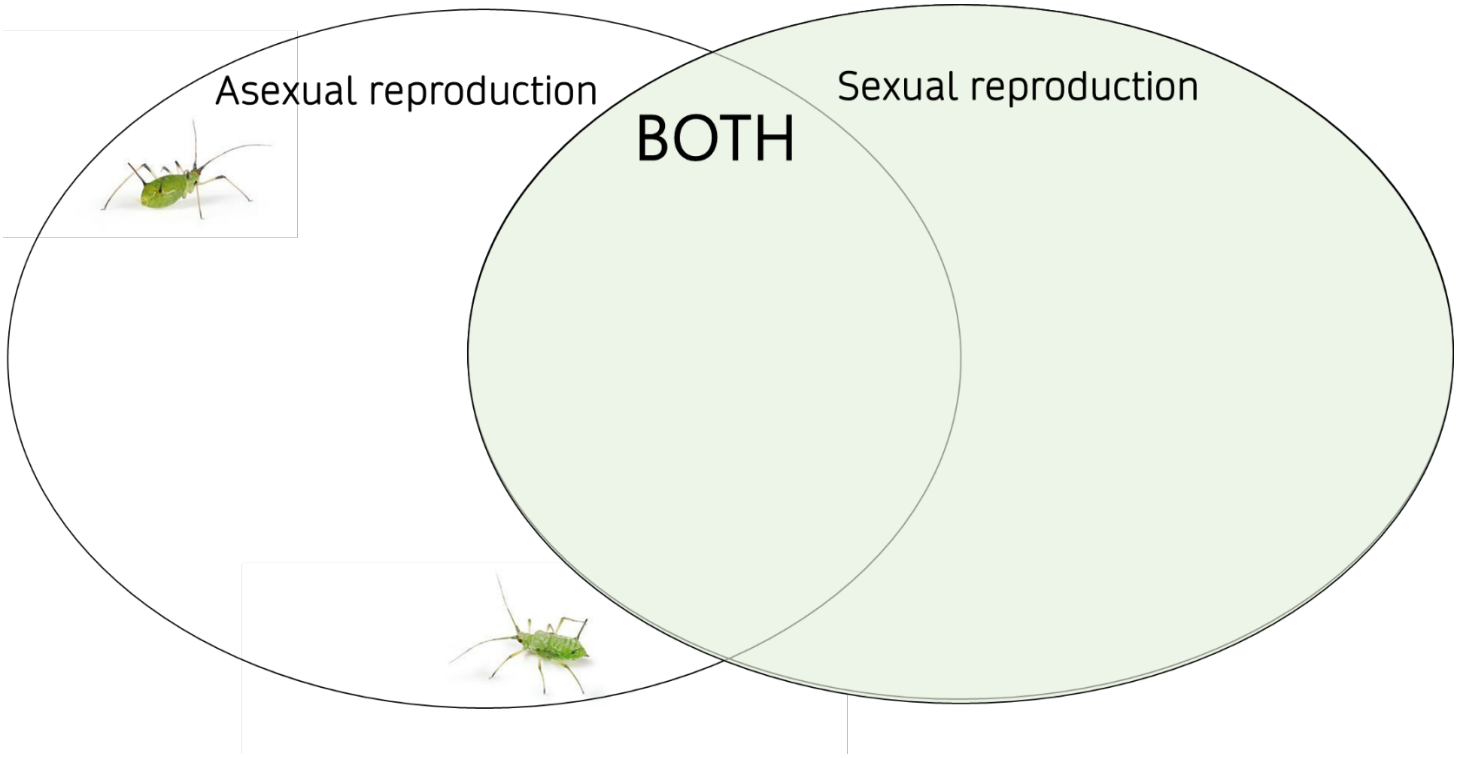
Genes are passed on from parents when the DNA in each parent's **gametes** combine to form an embryo during **fertilisation**, which then develops into a baby.

Variation occurs when each parent's gametes are created – sperm in males and eggs in females – through a process of **Meiosis**. Meiosis randomly sort's one chromosome from each pair of chromosomes (there are 23 pairs or 46 individual chromosomes) contained in a cell and produces a gamete cell, which will contain 23 single chromosomes.

When the gametes combine during fertilisation, the 23 single chromosomes from each gamete re-join to form 46 or 23 pairs once more in the embryo cell.



1. Write down features about both types of reproduction that are the same AND different from each other.

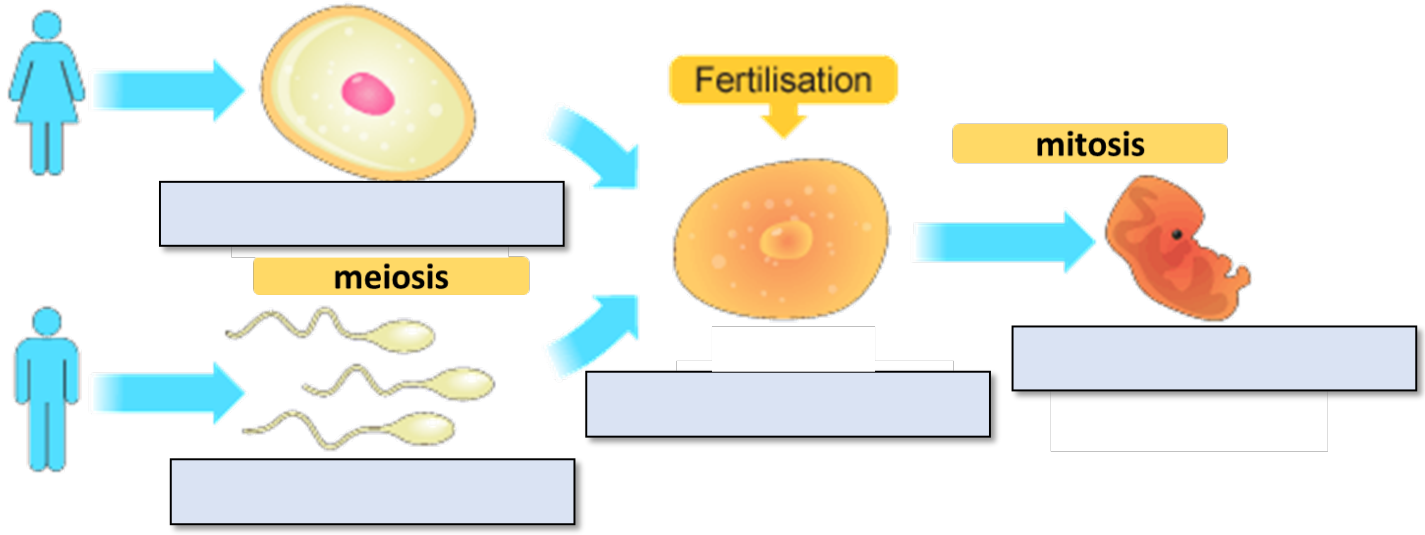


2a. Identify the following examples of human traits as either discontinuous or continuous variation

2b. Research and add some more examples of each in the chart below

Discontinuous Variation	Continuous Variation

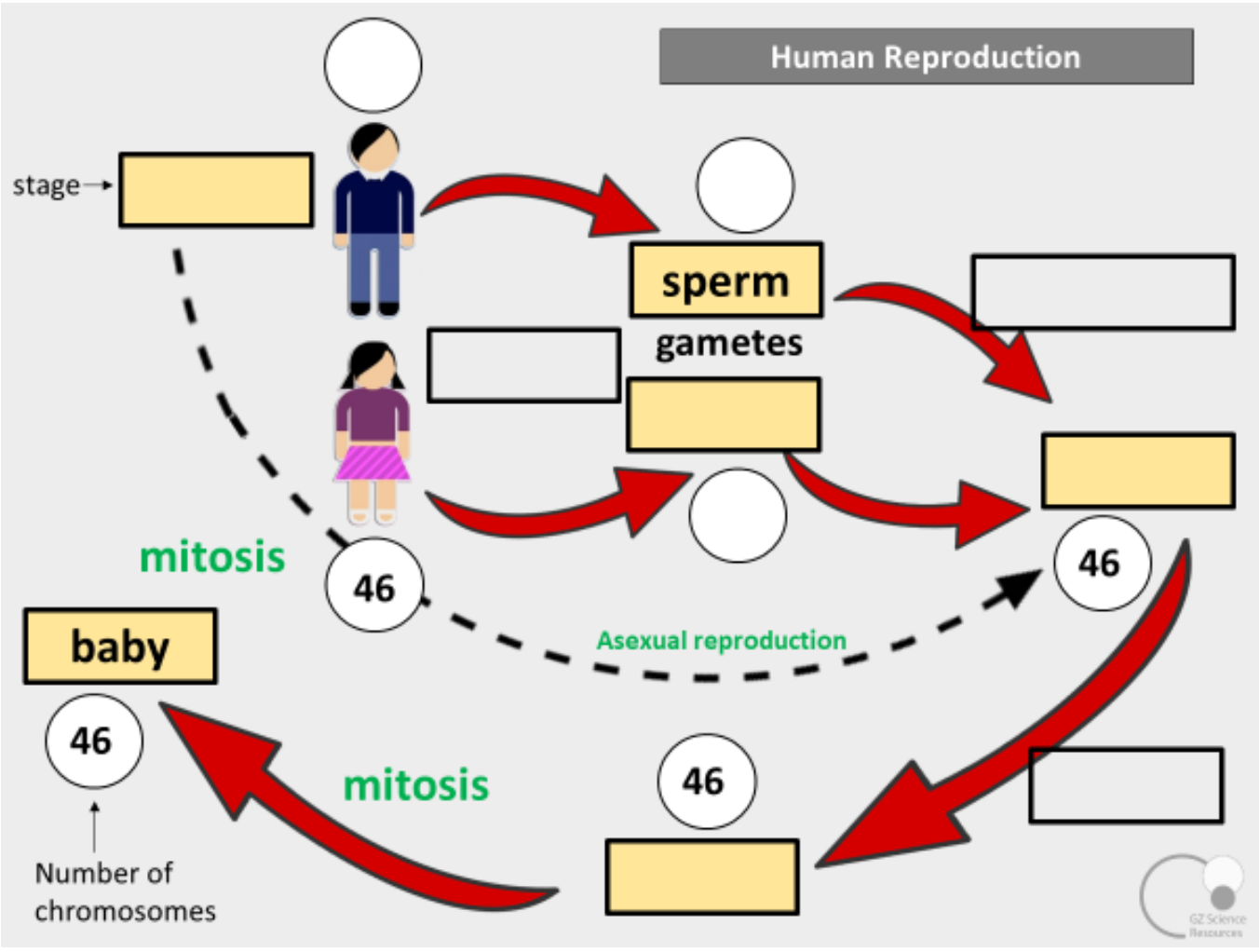
3. Complete labelled diagram



4. In humans, Identify the number of chromosomes in the following:

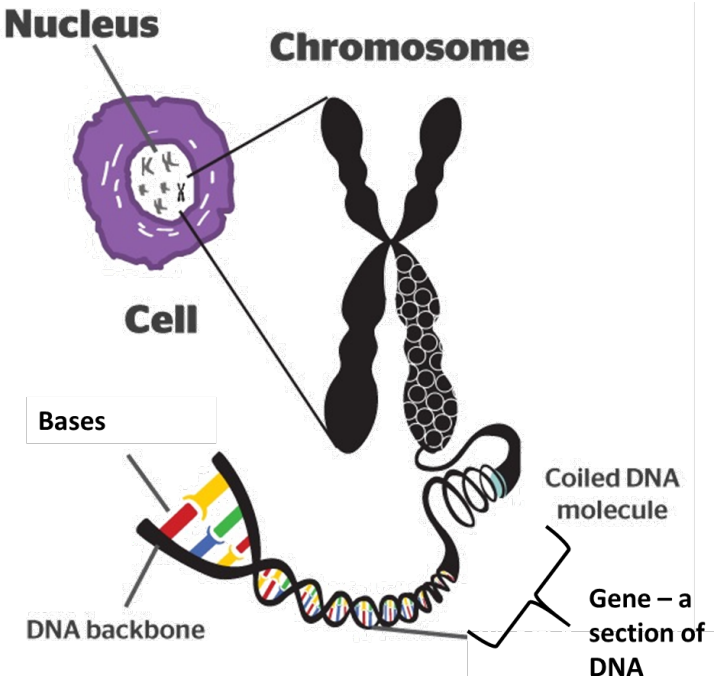
skin cells	sperm	embryo	eggs	zygote

5. Complete the labels on the diagram below for processes, chromosome numbers and stages.



Genes are the sources of inherited information

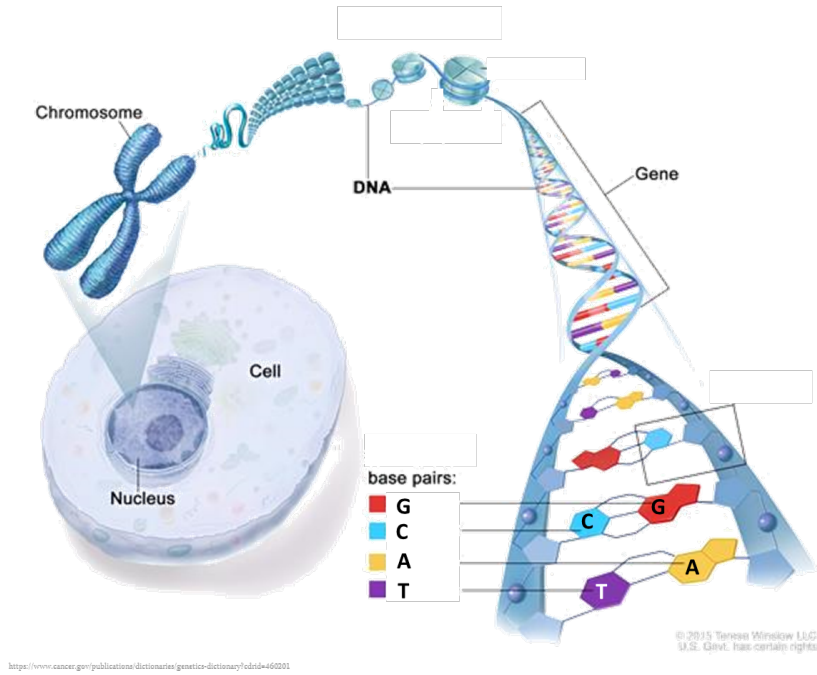
All living things are made of cells. The **nucleus** of a cell contains **chromosomes**, which carry instructions for the physical characteristics of an organism. The chromosomes are made of long strands of **DNA.** The instructions are called the **genetic code**. A segment of the DNA that codes for a specific trait is called a **gene**.



DNA forms a Double Helix shape

DNA is arranged in a **double helix** shape. The up rights of the "ladder" consist of alternating sugar and phosphate molecules bonded together. Making up the "rungs" are **two base molecules** bonded to each other.

A nucleotide is one unit of DNA. DNA (deoxyribonucleic acid) is made from smaller repeating units called nucleotides, which consist of a sugar, a triphosphate and a base.



There are 4 bases

A, T, C, G

Complementary base-pairing rule

G bonds with C

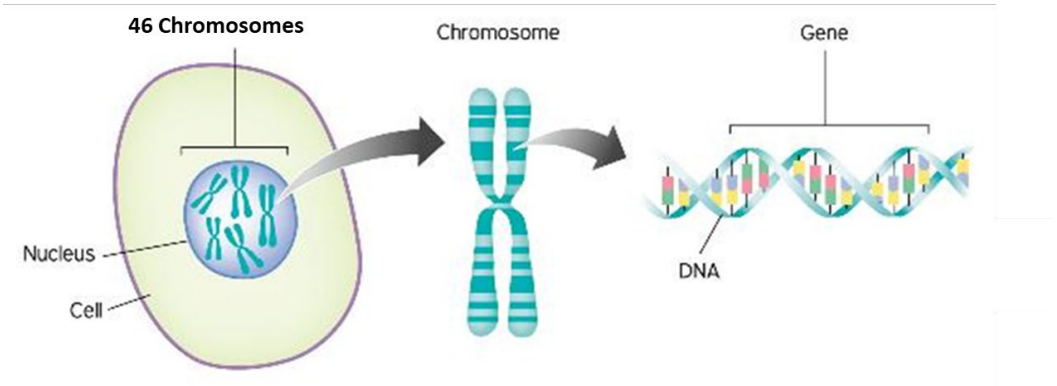
A bonds with T

The order of these bases is the **code** for a **characteristic**.

The sequence of bases coding for a specific protein, leading onto a trait, is called a gene.

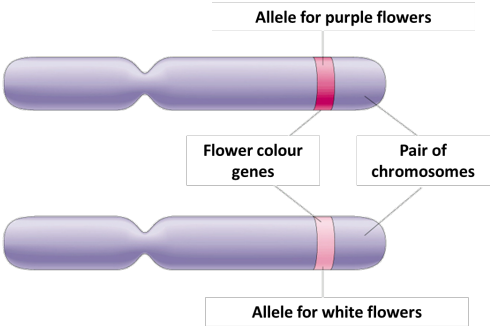
DNA is organised into chromosomes and genes

The human cell has **46 chromosomes** arranged into 23 pairs of chromosomes. Each chromosome in a pair has the same genes, (called **homologous** pairs) although there may be variation between the genes of each pair, as one comes from the father and one comes from the mother. Each gene is represented by two **alleles**, which are different varieties. The alleles can be the same or different, but the body only uses one.



Alleles are different forms of the same gene

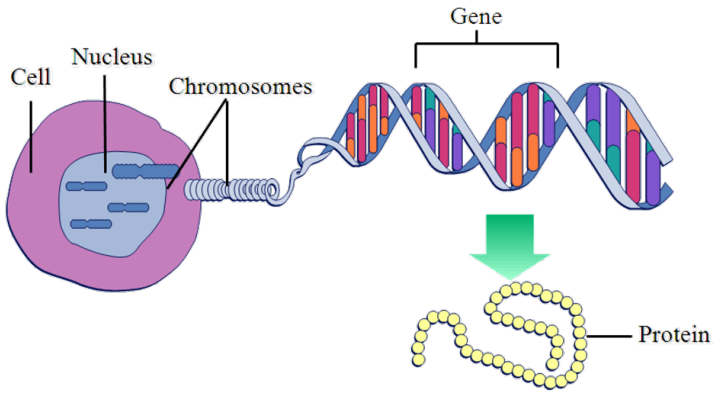
Chromosomes occur in **pairs**. These pairs of chromosomes have the same genes in them at the same place. The versions of genes are called **alleles** and they may be different from each other.



Summary: Cell, nucleus, chromosome, DNA, gene and protein

Chromosomes are found in the **nucleus** of each **cell** and are made up of **DNA**. DNA is a large molecule that is coiled into a double helix (twisted ladder structure). Along this molecule are **bases**. These bases pair up; A always pairs with T, and G with C.

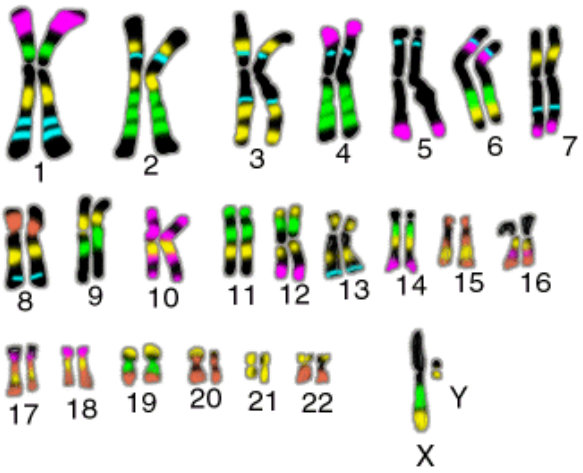
A sequence of bases, which codes for a particular **trait/characteristic** (e.g., eye colour) is called a **gene**. The different versions of each gene are called **alleles**, and these show the different **variations** of each characteristic, e.g. brown / blue eyes. Because chromosomes come in pairs for each trait, there will be two possible alleles. These different versions of genes (alleles) occur because the DNA base sequence is different.



Extension

Genes code for **proteins** - the **genetic code/ base order** determines which particular **protein** is made and therefore which **characteristic** is coded for.

Chromosomes come in pairs



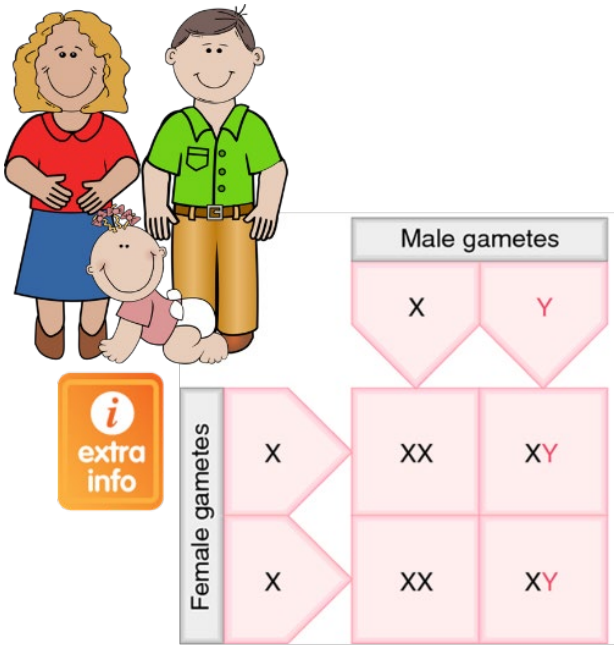
Chromosomes come in pairs. One pair is the sex chromosomes – XX in females and XY in males. A complete set of chromosomes of an organism placed into pairs of matching chromosomes is called a **karyotype**. The human karyotype consists of **23 pairs** of chromosomes.

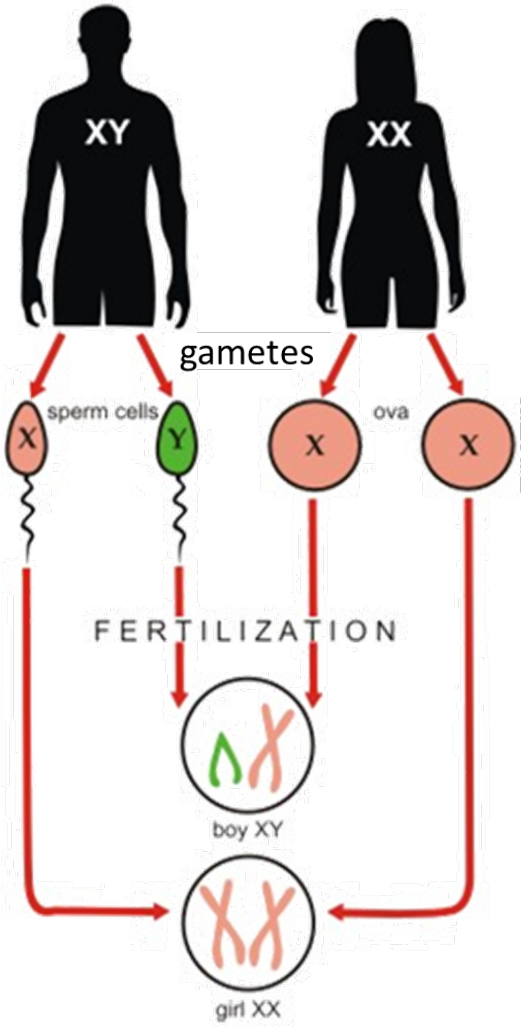
Sex determination

A pair of chromosomes are called the **sex chromosomes**. The female always has a homologous pair of two x chromosomes. The female can only donate a x chromosome. The male has a x and y chromosome. He can donate either an x or y chromosome to form a gamete. **The male determines the sex of any children.**

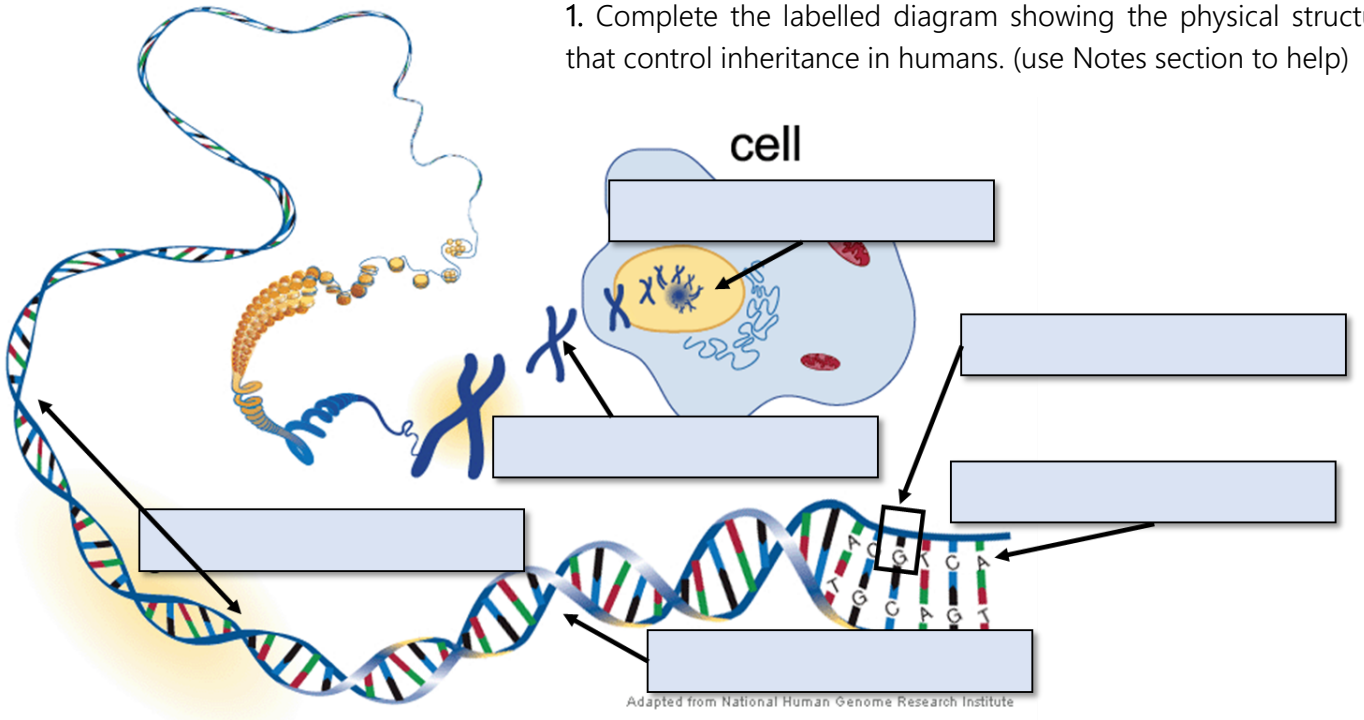
A Punnett square can be used to demonstrate that in any fertilisation there will be a 50% chance of either a boy or a girl.

If there are a small number of offspring, then there is less chance that the actual ratio of male to female offspring will be the same as the predicted ratio. Each new fertilisation is independent of any previous fertilisation episodes.

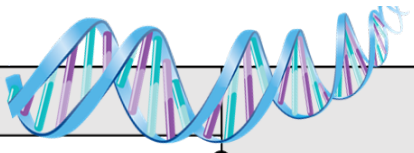




1. Complete the labelled diagram showing the physical structures that control inheritance in humans. (use Notes section to help)

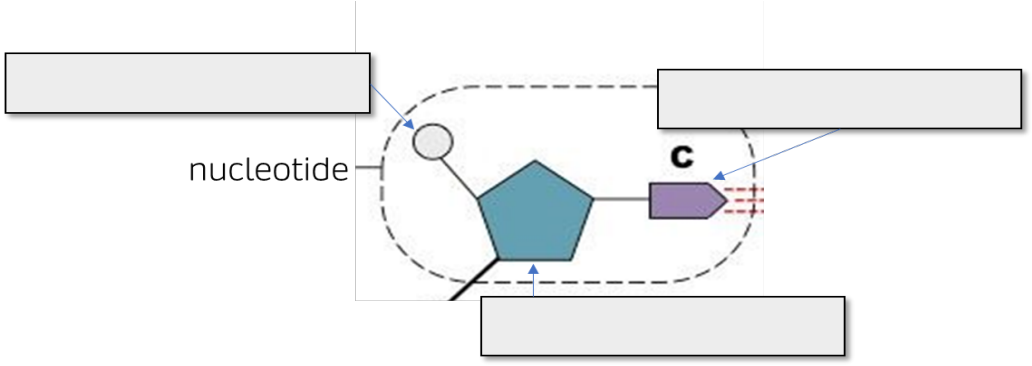


2. Place the names of the physical structures from above in **order of size** from smallest to largest, then **draw a line** to match definitions

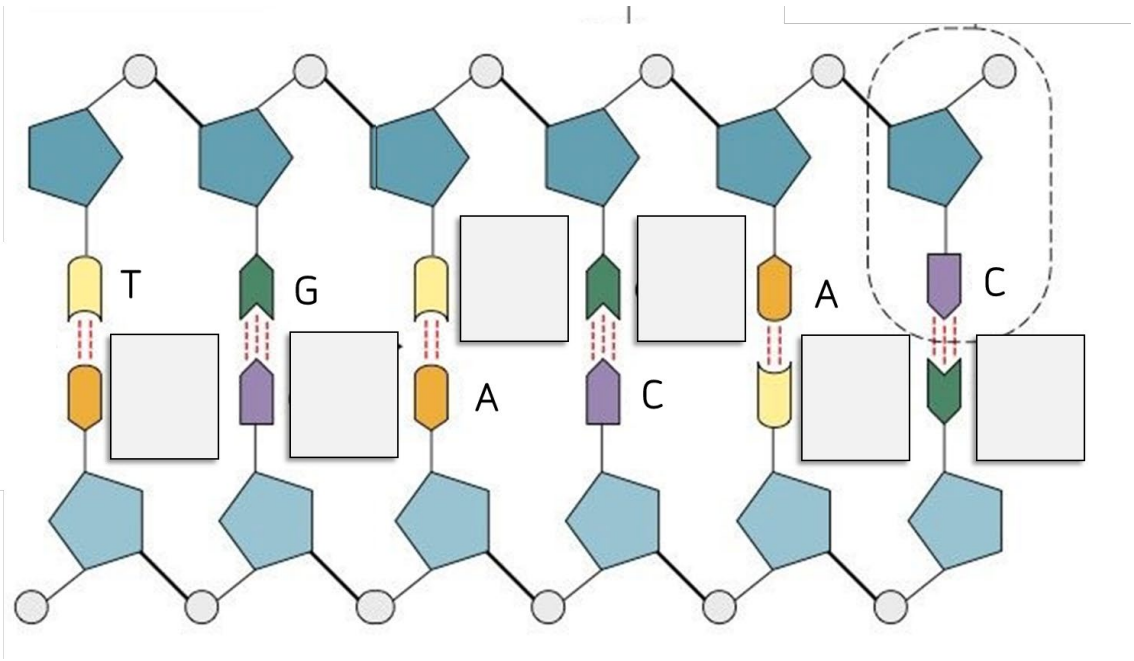


Term	Definition
smallest	Organelles inside a cell and containing all the genetic material
	A segment of the DNA that codes for a specific trait
	Structures, of which there are 46 in each human body cell
	Small repeating units, which consist of a sugar, a triphosphate and a base.
	these come in four different types, pairing together
	Arranged in a **double helix** shape.

3. Label the nucleotide unit with the names of the three components



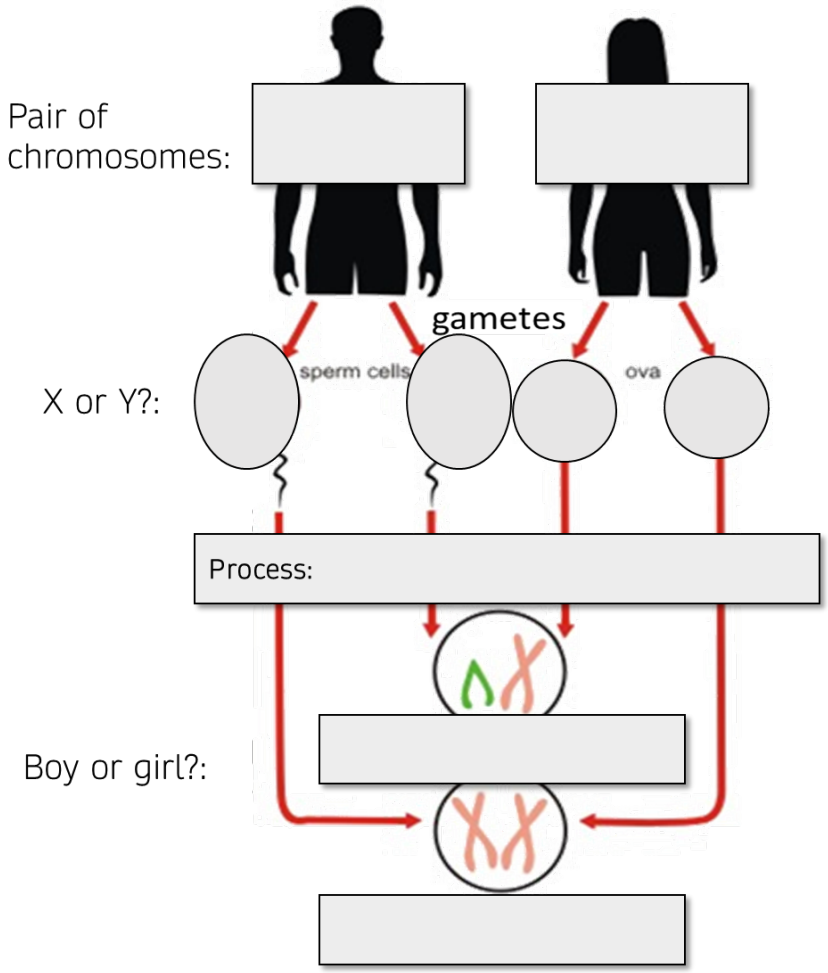
4. Complete the base sequence in this DNA strand



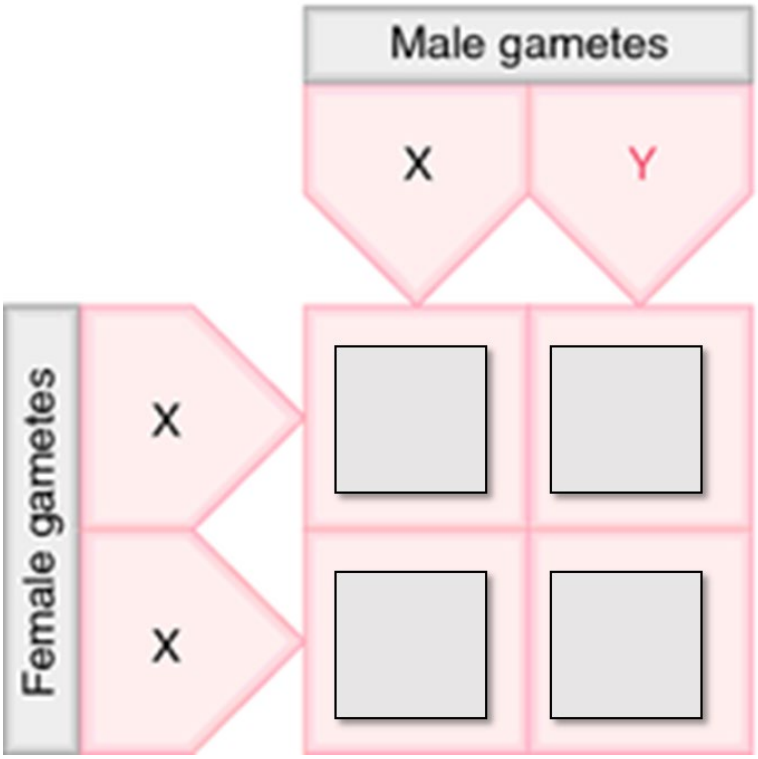
5. Use the writing grid to help develop a discussion level answer in your own words for the link between DNA, genes, chromosomes, and alleles. (see notes above for help)

1. explain link between chromosomes and DNA	
2. describe the physical structure of DNA	
3. **Explain the pairing rule of DNA**	
4. link the **base sequence to trait and gene (use example)**	
5. Give the definition for an allele (use example)	
6. link pair of chromosomes to pair of alleles	
7. link alleles to base sequence	

6. Complete the labelled diagram showing sex determination in humans.



7. Complete the Punnett square to show what chances there are of having a boys or girl



What are the chances of having a girl?

_____ %

What are the chances of having a boy?

_____ %

What are the chances of a family having a boy, after having three girls – and explain why.

_____

_____

_____

_____

_____