Name:

Junior Science

Reproduction

Downloadable Resource

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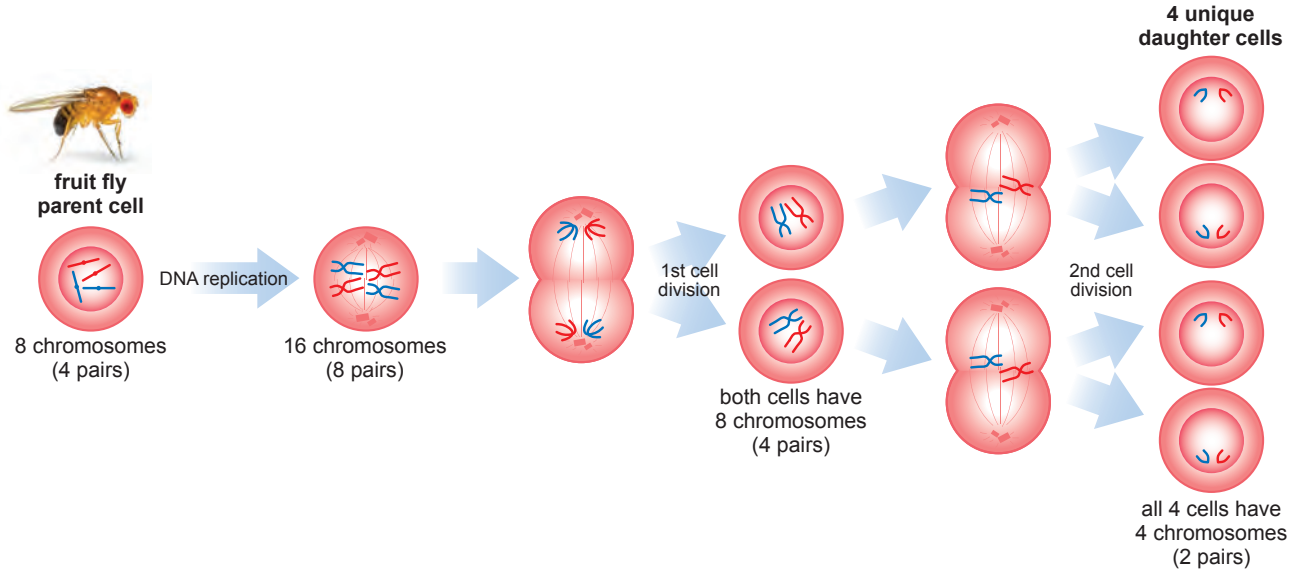
Meiosis and Mitosis

When a baby is made, it has the correct amount of **genetic information** and is unique in its appearance and features. It also develops from just one cell (the **zygote**). This is just plainly amazing! How can something so complex and complicated as a human be produced from one single tiny cell? Well, the answer is actually two different processes: **mitosis** and **meiosis**.

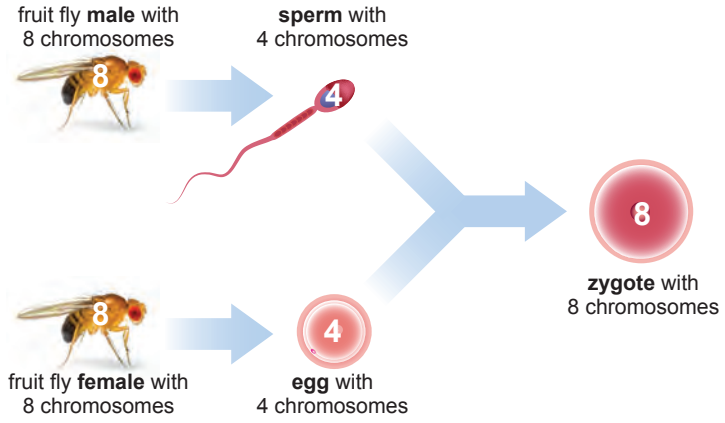
Meiosis occurs in the **reproductive** (**sex**) **organs**, the ovaries, testicles and anthers. It is a type of **cell division** which means that cells divide or split to produce more cells. In order to reproduce sexually, the **gametes** (sex cells) have to combine during the process of **fertilisation** to make the **zygote** (the first cell of the living thing). So here's the amazing and tricky bit...

Let's take the tiny, insignificant fruit fly for example. Fruit flies have 8 chromosomes in their normal body cells (**somatic cells**). This number of chromosomes makes them a normal functioning fruit fly. If we combined two normal fruit fly cells together we would expect to make a cell that contained 16 chromosomes – not right! This would result in an undeveloped **foetus** and death. To stop this and in order to get the right number of chromosomes in the offspring meiosis has to occur.

Meiosis



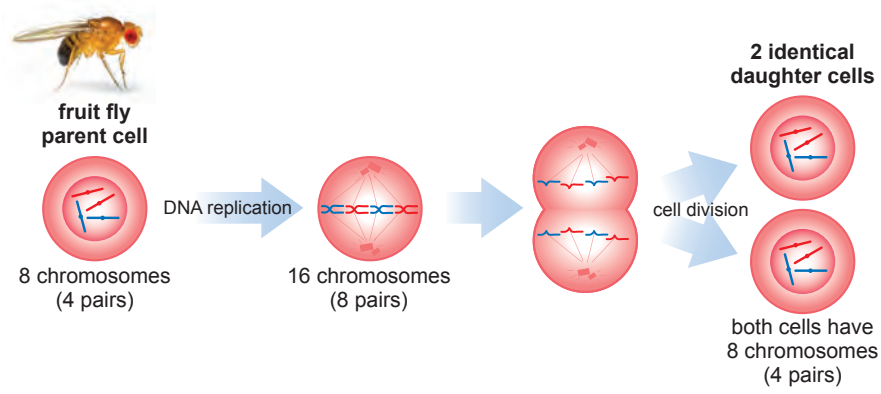
Meiosis



Each of the four cells made has half the chromosomes (4) of the original cell, these new 'daughter cells' become **gametes**. In this case it is a male fruit fly so they become sperm. The same process occurs in the female fruit fly except she makes eggs instead. So now when we fuse two of the cells made from meiosis, we get the right number of chromosomes (8) in the zygote.

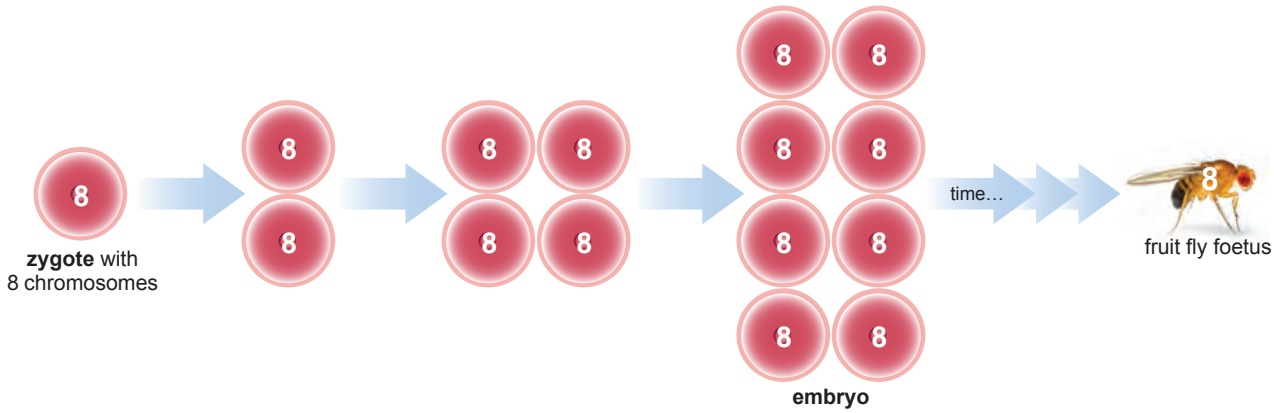
We now have one cell. This has to become an entire fruit fly which is made up of thousands of individual cells - this happens through the wonder of **mitosis**. Mitosis is also **cell division** but it produces cells that are identical to the parent cell. This means it is used in the growth and repair of damaged cells. Mitosis ensures that each cell made performs the right functions as they are identical to the original cell. Let's look at the fruit fly again ...

Mitosis



Two identical cells are made that function in the same way as the parent cell. Once a **zygote** is made, **mitosis** occurs to produce more and more cells, forming the **embryo** and then the **foetus**. Once born, the baby continues to carry out **mitosis** at a fast rate and grow bigger and bigger.

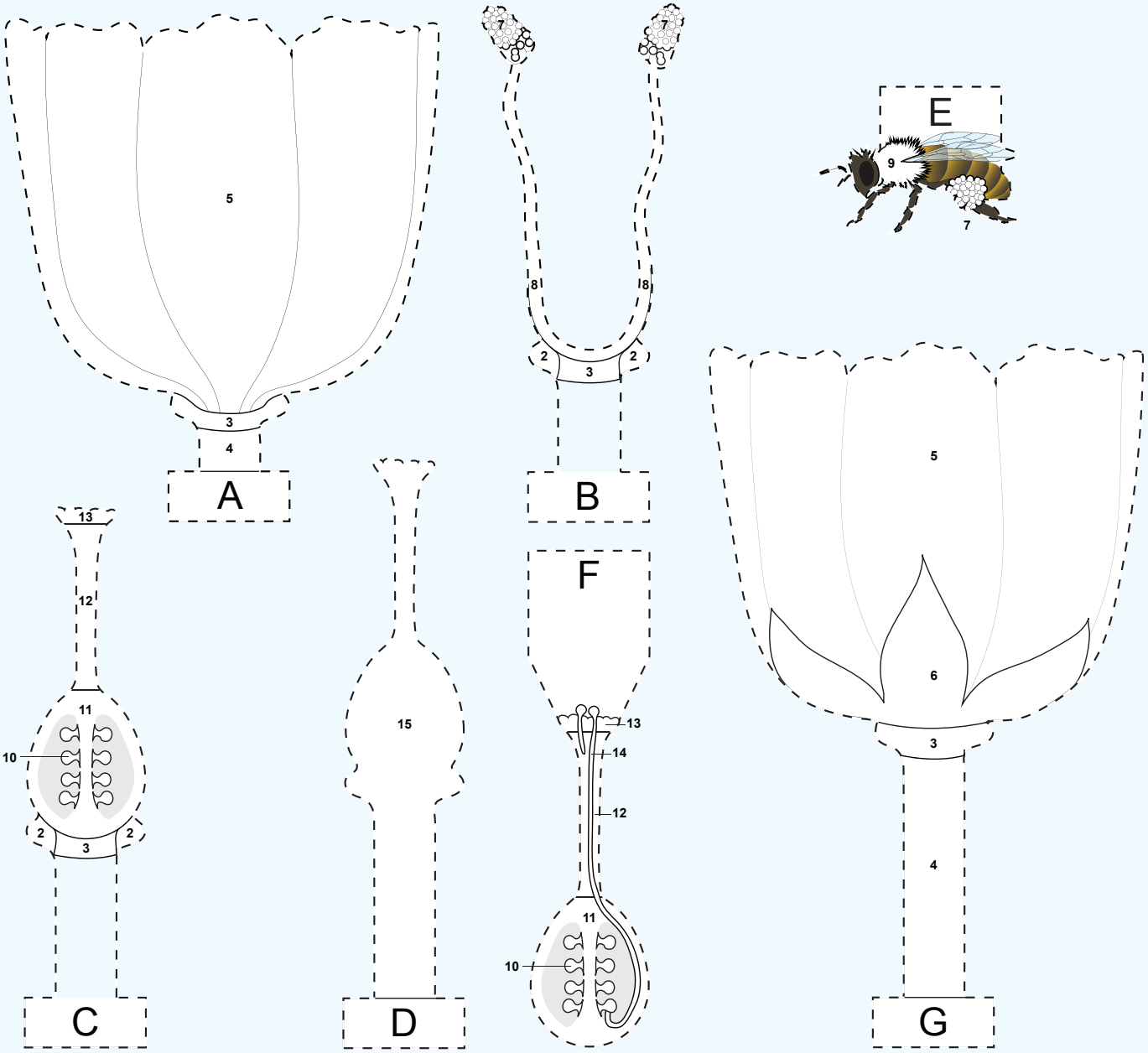
Mitosis



In order for sexual reproduction to occur, both mitosis and meiosis have to occur – meiosis to make the sex cells that produces the zygote and mitosis to produce the embryo, foetus and baby. If we were to reproduce asexually then only mitosis occurs because no gametes are involved.

Pollination and Fertilisation

1. Firstly, we will start by colouring the parts in your workbook. Colour the fruit (1) red, the nectary (2) orange and the receptacle (3) green.
2. Find any other parts which also have a nectary (2) and colour them in orange and any receptacles (3) green.
3. On part A, colour the stem (4) green and the petals (5) pink.
4. On part G also colour the stem (4) green and the petals (5) pink. Also colour the sepal (6) green.
5. On part B, colour the pollen (7) yellow and the anthers (8) orange.
6. On part E, colour the pollen (7) attached to the bee's pollen basket yellow and the bee's thorax (9) brown or black.
7. On part C, colour each of the 8 ovules (10) yellow and the ovary (11) surrounding them red. Colour the style (12) blue and the stigma (13) green.
8. Use all the same colours from step 7 on part F. Then colour the pollen and pollen tubes (14) yellow.
9. On part D, colour all of the carpel (15) purple.
10. Carefully cut out all parts A-G following the dashed lines, making sure not to cut off the tabs.
11. Starting with part A, glue or use adhesive tape to attach the tab over the corresponding A box in your workbook. Then repeat with parts B, then C, D, E, F and finally G in alphabetic sequence.
12. Complete the Colour Key in your workbook for easy reference.



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The Orchid and the Bee


corpse flower

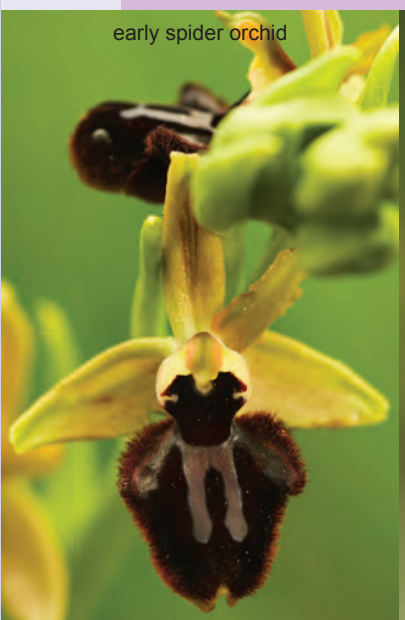
Plants are sneaky tricksters. They use a variety of techniques to **entice** insects and some small animals to pollinate them. Some like honeysuckle use the reward of sweet, tasty nectar; others like jasmine use a strong smelling perfume and most such as roses use bright coloured petals that stand out amongst the green surrounding environment. These three techniques are very general, as they don't tend to target a specific species – they just hope to attract any insect. Others are a bit more specific such as flowers like the corpse flower that produces a smell like dead and **decaying** meat to attract flies and other **carrion**-eating beetles. Some flowers even trap their pollinators in order to ensure they are completely covered in pollen as they struggle to escape. It makes sense to be more specific in the species that they target as it means less competition between plants for pollinators and it guarantees that pollen is transferred to the same species of plant.

A subfamily of plants that goes even further than pretty petals and nice smells are orchidoid orchids. They are probably the most **deceptive exploiters** of them all. Some of these orchids are specially adapted into tricking various insects by mimicking the female insect.

One particular orchid, Ophrys bombyliflora (or commonly known as the bumblebee orchid) is specially adapted into tricking solitary bees (which are not actually bumblebees at all like the name suggests). The flowers of the orchids are mostly dark brown-black with hairy bits, making them look like a female solitary bee. They also release chemical signals called **pheromones** that are very similar to those released by the female solitary bee. The bees use this to attract a male for mating. The orchids actually releases a stronger pheromone than the female bees, which makes them more attractive than the bee itself. When a male solitary bee sees the flower and senses the pheromones, it flies to the flower and starts to mate with it. As he struggles and shifts about, the flower drops **pollinia** (a mass of pollen grains in a sticky blob made by the anther) that stick to his head or rear end depending on the way he mates. Once he realises that the flower isn't a female bee at all, he flies away, carrying the pollen with him. He is then attracted to another flower and again tries to mate with it. This time as he jiggles, he rubs off the pollen onto the stigma of the flower and so pollinates it. Yet again, he realises that he has been **duped** and flies off in search of a female solitary bee.

Other examples include hammer orchids, which attract specific species of thynnid wasps and bee orchids (such as the yellow bee orchid, fly orchid, cyprus bee orchid, early spider orchid) which attract specific species of bees and other insects.

This subfamily of orchids has evolved to attract a specific pollinator and expends much energy to ensure pollination. The benefit of this is that its pollen is guaranteed to be collected and deposited on the same species of flower resulting in **fertilisation** and the continuation of their species. The relationship between these two organisms is **commensalistic** because the flower benefits by being pollinated and while it is an inconvenience to the bee, it neither benefits nor is harmed. Plants are sneaky, conniving and don't think twice about getting animals to do their dirty work; you might even think that they are very, very smart.


early spider orchid


bee orchid


fly orchid


bumblebee orchid

In the Womb

A baby grows, is protected, provided with nutrients and has its wastes removed in the safety of the womb, or uterus. The uterus is an area within the lower part of a women's abdomen inside the protective bones of the pelvis.

In a non-pregnant woman, the pear-shaped womb is 7.5 cm long and 4.5 cm wide and has an average mass of 60 g. Then as the baby develops and grows, it enlarges to be as big as a watermelon or around 30 cm long and can have an increase in mass up to 900 g.

The uterus has a thick, highly vascular (lots of blood vessels) wall or lining that provides the initial energy for the embryo. The uterine wall is where the embryo burrows into and attaches before the placenta and umbilical cord are formed. The placenta connects the foetus (a developing baby after 8 weeks of pregnancy) to the uterine wall. It starts to form as soon as the embryo implants into the uterine wall and at around 12 weeks of pregnancy, it is complete. The uterus is a vital organ that provides the foetus with oxygen, food and water provided by the mother and takes away wastes like carbon dioxide.

The foetus is surrounded by a clear, transparent liquid called amniotic fluid. This solution acts as a cushion if the mother is bumped or jolted, allowing the baby to move around. The baby also swallows the amniotic fluid which helps to create the digestive system and first urine and faeces.

The tube that connects the baby to the placenta is the umbilical cord. It forms from the embryo at around five weeks of development. When the baby is born, the umbilical cord is 50 cm long. It contains two main blood vessels (an artery and a vein) that connects the foetus with the mother and allows for the transfer of vital nutrients and removal of dangerous wastes.

At the opening of the uterus is the cervix. The cervix is a narrow muscular canal that is around 8 mm in width (this has to increase to around 100 mm in order to give birth). During pregnancy, it is sealed with a mucus plug to prevent exit and entry from the uterus. The cervix also provides a place for the foetus's head to rest during the early stages of the birthing process.

The vagina is a muscular tube that joins the uterus to the outside world, where it opens up to the vulva. The vagina's main function in reproduction is to allow the male's penis to deposit sperm and as an exit point for the baby.

The Bits and Bobs

The reproductive systems of animals are hugely varied in their structures and functions. For this article, we will focus on the reproductive systems of male and female humans.

The **male reproductive system** has some easily recognisable and commonly referred to parts as well as quite a few hidden and often unheard of bits, all of which are equally as important. The overall functions of the male reproductive system are to produce and transport sperm into the female system and to produce hormones in order to maintain the system.

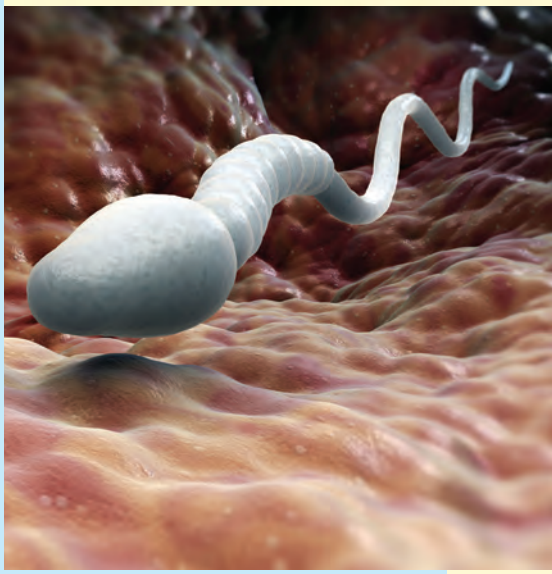
The penis is the external male sex organ, which consists of a shaft through which a tube called the urethra runs. This tube allows urine to leave the body and to transport semen to the female's vagina during sexual intercourse. The penis contains spongy tissue that can fill with blood to become erect (hard) which allows the penis to be inserted into the vagina easily.

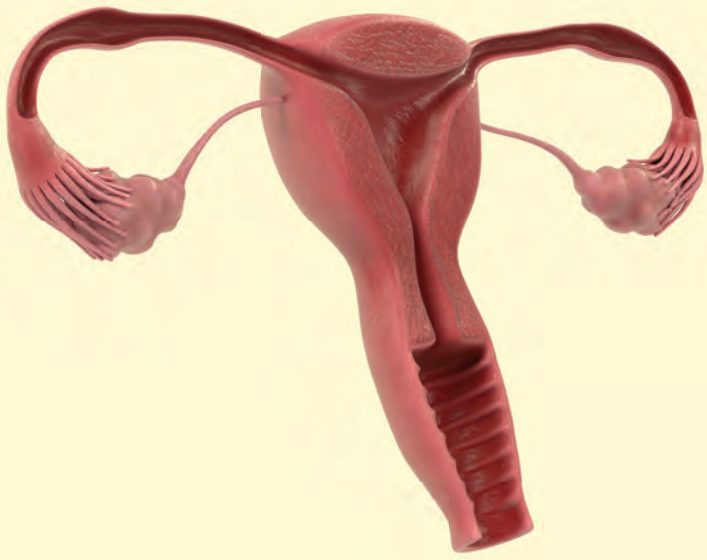
The other external male organs are the testicles which are suspended outside of the body in order to keep the temperature cool for sperm production. The testicles are covered and protected by a pouch of skin called the scrotum.

The sperm (male gamete) is made in the testicles and stored in the epididymis. This is a tightly coiled tube that covers the rear of each testicle. The epididymis holds the sperm until it has matured and gained the ability to swim. The sperm travel up another tube called the sperm duct, to the prostate gland, located below the bladder where they are mixed with seminal fluid to produce semen.

The seminal fluid is made in the seminal vesicle which is located behind the prostate gland. It is a white solution that contains the energy and other chemicals needed by the sperm to function and travel the epic journey to the fallopian tubes and fertilise the egg.

Two other organs that can be seen in most reproductive system diagrams are the bladder and the anus. The bladder is joined to the urethra above the prostate gland. The bladder is a hollow sac that stores urine. The anus can also be seen, this connects the large intestine with the outside world and allows faeces to be removed.





The **female reproductive system** has the main functions of producing eggs needed for reproduction and providing a site for fertilisation and implantation of the embryo so that it can grow and develop safely. As well as this, it also produces hormones to maintain the reproductive cycle (menstruation cycle). It is very different to the male system starting with the fact that most of the parts are internal.

The external parts and opening are collectively referred to as the vulva. The vulva itself is composed of several different parts such as the labia and clitoris. The vulva opens up into a muscular tube called the vagina, which is where the penis is inserted and ejaculates into during sexual intercourse.

The vulva then leads onto the cervix which is a narrow (8 mm diameter) tube that allows sperm to enter the uterus from the vagina. The cervix also produces a large amount of mucus to make it easier for the sperm to move.

Once through the cervix, you reach the uterus or womb. It is a fleshy, blood-rich hollow organ that periodically has a thick lining. If the female doesn't become pregnant, this lining breaks down and exits via the vagina as the period or menstruation. Many animals such as horses and cows reabsorb the lining so don't experience periods.

The uterus is the area that the foetus develops in. The thick blood-filled lining is where the embryo first implants and receives its nourishment from.

At either side of the top of the uterus are the fallopian tubes or oviducts. These are tubes that join the uterus to the ovaries. Ova (eggs) travel from the ovaries at the end of the fallopian tubes to the uterus and sperm (if present) will fertilise the ovum inside these tubes. Each fallopian tube has a separate ovary at its end. These resemble a pouch of marbles and have the function of making eggs (ova). Within the ovaries are follicles of varying sizes that contain the developing eggs. When an egg matures, the follicle bursts and releases the ovum into the oviduct where it becomes available for fertilisation. Usually, only one egg is released each month and the ovaries take turns at doing this.

The female also has an anus for the expulsion of faeces and a bladder for the storage of urine. The bladder sits in front of the uterus and has a tube called the urethra which takes the urine out to the vulva.

Mating Rituals and Weird Mating Habits

Animals can be truly bizarre! Forget about going to the movies, buying flowers or updating their social media status! They go to extreme lengths and perform a range of weird behaviours to find a mate. I recommend you don't try any of the following methods to try and find a boyfriend or girlfriend.

Example One: Praying Mantis

Most species of praying mantis are predators that feed on flies, beetles, crickets and even small scorpions, lizards, frogs, birds, snakes and fish. They lie in wait until the prey comes close enough then they launch and grab them with their spiked front legs.

Praying mantises will perform mating dances to attract and confirm a mate. Once mating has been agreed upon, the male will climb on the back of the female and begin to mate with her. Sometimes during mating, the female will bite the head off the male which causes him to jerk around wildly and results in the sperm being ejaculated. Other females will wait until the male has finished then as he dismounts she will eat him. This is known as sexual cannibalism, and while it is common in 90% of species, it only occurs in around 20% of matings.

The female then lays her eggs in a special foam produced in her abdomen that hardens like a shell around the eggs protecting them.

Example Two: Porcupines

Porcupines are spine-covered rodents that are found in Europe, Asia, Africa and Northern America. The female porcupine is only interested in mating for around 12 hours out of an entire year. She has complete control over mating and the male has to perform some weird rituals in order to woo her. If she doesn't want to mate or finds the male unappealing then she uses her spiky quill covered tail to swipe at his soft unprotected reproductive organs and stomach.

The ritual starts by the male rubbing his nose against the females' nose. If she finds him attractive then she will allow him to continue to try and win her over but if not, she will walk off to find a more attractive mate. The successful male then stands on his hind legs and sprays a massive stream of urine all over the female porcupine's body, covering her from head to toe. It isn't normal urination though – it is a super high powered jet, much like a fire hose. The female will then sniff and taste the urine and if she is impressed by the pheromones that she senses then she will allow him to mate with her. She will show the male her non-quilled belly and allow him to mate with her repeatedly. If he tires too soon, she will leave him and find another male to mate with.

The female porcupine is pregnant for around 210 days, then she gives birth to baby porcupines which luckily for her, have soft spikes.

Example Three: Banana Slugs

Banana slugs are often yellow and sometimes have brown spots like an overripe banana. They are the second largest land slug and grow up to 30 cm and weighing in at 115 g. They are found in North American forests and bush land where they feed on decaying material such as leaves, animal poop and mushrooms.

Banana slugs, like many slugs and snails, are hermaphrodites. In fact, they are simultaneous hermaphrodites which means that have both male and female sex organs at the same time. In order to find a mate, they produce a thick mucus that contains pheromones that attract another slug.

Each banana slug has a vagina and a penis that is almost the same length as they are. Their penis comes out of a pore in their head. When they find some slime pheromones that tickle their fancy, they nip and bite their mate, then extend their penis and insert it into their mate's vagina. After a long time, they ejaculate and transfer their sperm. Each slug does this at the same time so both slugs become fertilised.

Where it gets weird is what happens next! More often than not, the slugs then chew off each other's penis so that they become lodged inside their mate. Unfortunately for the slugs, the penis doesn't grow back. It was originally thought that they did this because they had got stuck but new research and theories show that it could be to prevent the mate mating with another slug and having too much competition between the sperm.

Example Four: Camels

The Arabian camel has only one hump and is found throughout the hot, dry deserts of the world such as Africa, Middle East and Australia. They are large animals and can grow around 2 m tall. The hump on their back is a store of fat that allows them to walk for days on end in the inhospitable desert without stopping to eat.

Male Arabian camels go to quite extreme lengths to find and attract a mate and get her to have sex with him. Firstly, they urinate on their own tails to emit their pheromones and rub their necks on any surrounding objects they can find. They do this because they have glands called 'poll glands' that make a brown, smelly, gooey substance that also contains sex pheromones.

The most disgusting part of their ritual is that they fill part of their mouth with air so it forms a large (30 cm) pink sac that hangs out the side of their mouth. This is called a dulaa. They then drool, producing massive amounts of foamy saliva and make gurgling noises in the saliva pooling in their mouths. This is what female camels find attractive and a male with a large mouth sac can attract large groups of females (up to 20) with whom he mates and produces offspring.

Males will fight each other for the females and become quite aggressive where they bite and pinch their opponent's dulaa. If it becomes damaged, it may become stuck, hanging outside the mouth.

Example Five: Honey Bees

Male honey bees (drones) have one function in life, which is to mate. They don't work, help raise the young or defend the nest. While this might seem like a nice life, they are only needed for mating and really aren't much more than a sperm donor. In fact, if a male bee fails to mate, he will be driven from the nest as the honey is too important to waste on him.

When they mate, honey bees do it in the air while flying. The queen bee flies out of the nest and proceeds to circle around trying to find a mate. The drones will compete with each other and form a swarming mass around the queen, all trying to be the chosen one.

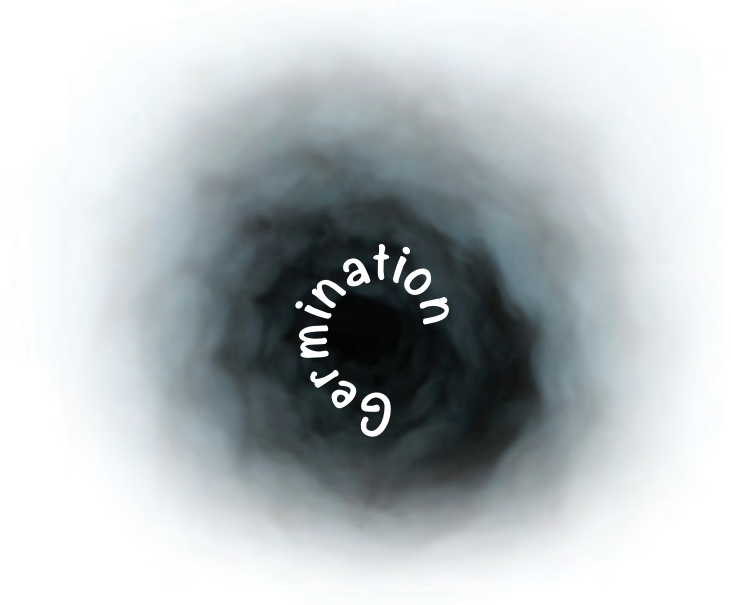
When a drone is successful, he holds onto the queen and extends his penis into her reproductive tract. His ejaculation is immediate and occurs with so much power that his testicles basically explode and the tip of his penis is ripped off and remains inside the queen. The drone then drops to the ground dead. This is referred to as 'sexual suicide'.

These are just a handful of the weird and wonderful ways animals mate. There are many, many, more examples that could have been used such as the bower birds, hippopotamuses, flatworms, frigate birds, male hooded seals and the bedbugs … and the list could go on. The animal kingdom is full of unique (sometimes terrifying and disgusting) mating rituals.

Word Games

1. Terminology Tornado

Using the following science term, see how many words of 3 or more letters you can make in 10 minutes.



Points
3-4 letters = 1 point
5+ letters = 2 points

Scores
0-5 points = awful
6-10 = average
10+ = amazing

2. Six Word Scramble

Use the clues to work out what the 6 key science words are and then spell the word in the grid by colouring in the squares that make up the word. Use different colours for each answer.

RM	KY	NG	ST
TER	UM	RS	WA
COL	RI	OF	OU
FSP	SPE	IC	OV

Clues

a. The correct scientific name for babies. (9) _____
b. The stigma is this in an insect pollinated flower. (6) _____
c. The male human gamete. (5) _____
d. A single female gamete. (4) _____
e. One of the things seeds need to germinate. (5) _____
f. Insect pollinated flowers have petals of bright... (7) _____

3. Block Buster

Cross out each of the terms that fit with one of the clues. You will be left with one word that doesn't fit; this is your answer.

germination	voice deepens	vulva	anther	ovary	stigma
penis	seed dispersal	bract	pubic hair	nectary	sexual maturity
fallopian tube	facial hair	style	muscles grow	life cycle	mating
uterus	fertilisation	epididymis	pollination	scrotum	hips widen

Clues

a. Parts of an animal's reproductive system.
b. Parts of a flower.
c. Changes that occur during puberty.
d. Stages of plant or animal reproductive cycles.

Answer

4. Lingo Lattice

All of the answers to the questions are in the lattice below, either as a word or picture. Once you have found each one, there will be one left over, this is the final answer.

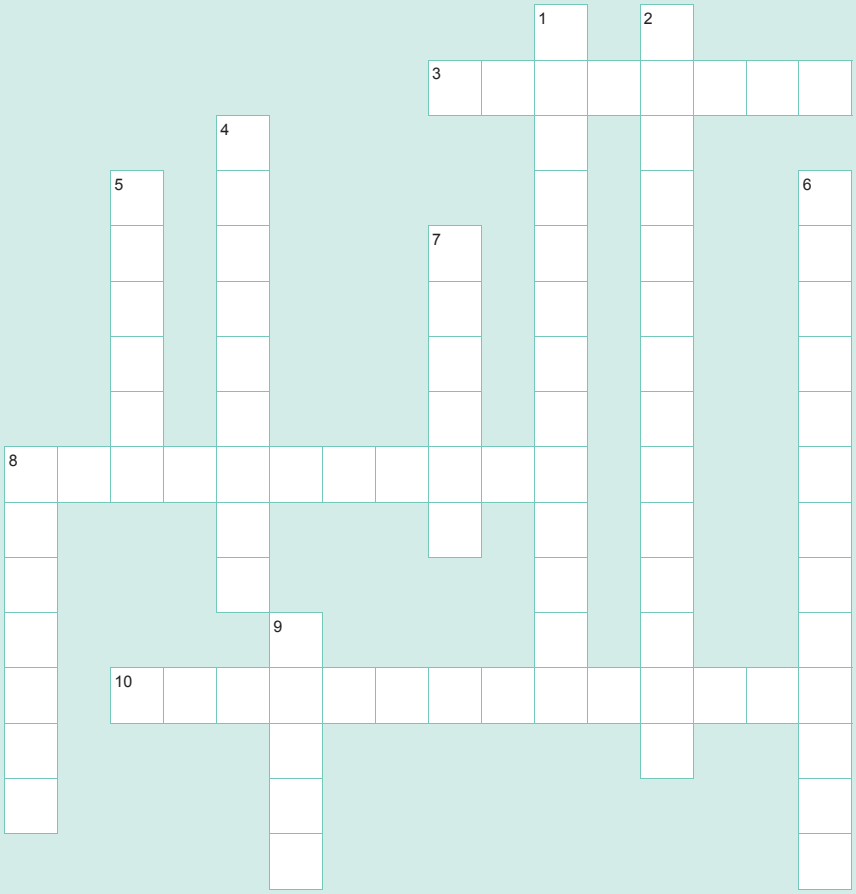
Questions

1. An example of asexual reproduction.
2. Seminal fluid + sperm.
3. Process where pollen is transferred from anther to stigma.
4. The male gamete of most plants.
5. Another name for the uterus.
6. An example of a monocotyledon.
7. The male reproductive parts of a flower.
8. The male gamete of most animals.
9. Reproduction that involves two different gametes joining and makes variation in the offspring.
10. An example of how plants spread their seeds via animals (internal).
11. One way that flowers attract insects in order to be pollinated.

Final Answer

pollen	mitosis	
	stamen	womb
sexual	pollination	
	semen	perfume

5. Crossword



Across

3. This describes the stigma of a wind pollinated flower.
8. The process when a seed starts to grow.
10. Makes semen.

Down

1. Where the sperm meets the egg and fertilises it.
2. The process by which a plant makes food in its true leaves.
4. A method of seed dispersal that relies upon tension in a drying pod.
5. A substance produced in flowers to attract insects.
6. A seed with only one food storage part.
7. Narrow muscular tube that has to enlarge to 10 cm during birth.
8. Sperm, pollen or ovum.
9. The part of a seed where it was attached to the ovary.