REPRODUCTIVE SYSTEM

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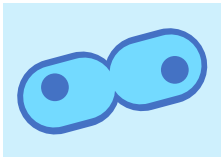
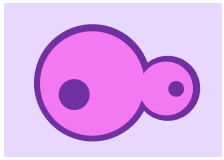
ASEXUAL REPRODUCTION

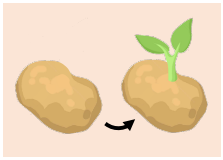
Asexual reproduction involves a single parental organism producing **genetically identical offspring** (clones), resulting in the offspring inheriting adaptations that are suited to the existing environment. Examples of mechanisms for asexual reproduction include binary fission (bacteria), budding (yeast), fragmentation (starfish), vegetative propagation (plants) and sporogenesis (certain types of fungi). Multicellular organisms also regrow tissues via regeneration – while this does not produce new life, it is still asexual reproduction.



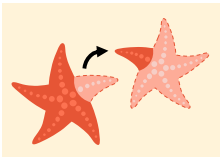
BINARY FISSION



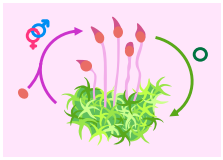
BUDDING



PROPAGATION



FRAGMENTATION

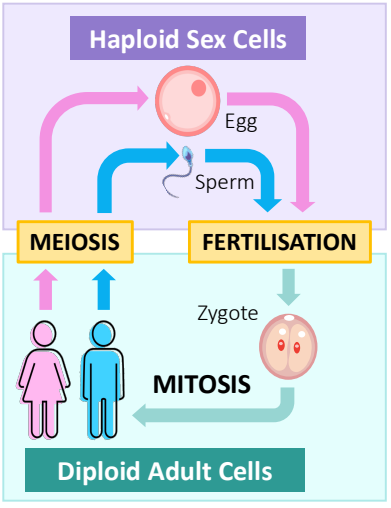


SPOROGENESIS

REGENERATION

SEXUAL REPRODUCTION

Sexual reproduction involves two parents producing offspring with **new gene combinations**, resulting in the offspring having the genetic variation required for adaptation to a changed environment. The life cycle of a sexually reproducing organism requires the formation of haploid sex cells (gametes) and their subsequent fusion to form a new organism. The sex cells are produced via the process of meiosis, which functions to separate the parental combination of alleles to create cells with half the number of chromosomes. The subsequent fusion of haploid gametes (fertilisation) results in the formation of a totally new and genetically distinct diploid cell (called a **zygote**). The zygote is now able to undergo multiple mitotic divisions to form a multicellular organism that is different to the parents.

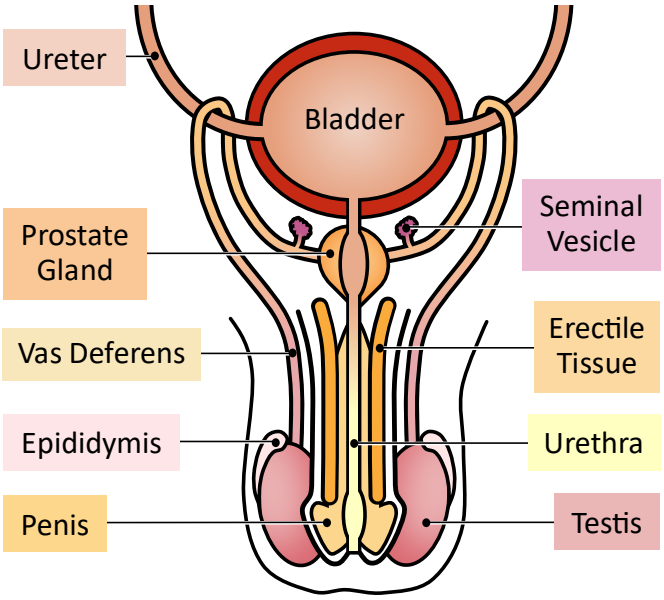


GAMETES

Gametes are haploid sex cells required for sexual reproduction. The male gamete is **sperm**, which travels to the female gamete – so it is smaller, with less food reserves. The female gamete is an egg cell (or **ovum**), which is larger as it provides all the organelles and cellular material for the resulting zygote. Because of these functional differences, the process of gamete formation differs between the sexes. Egg production is a finite process (ends at menopause) and each germ cell only gives rise to one egg (polar bodies also form).

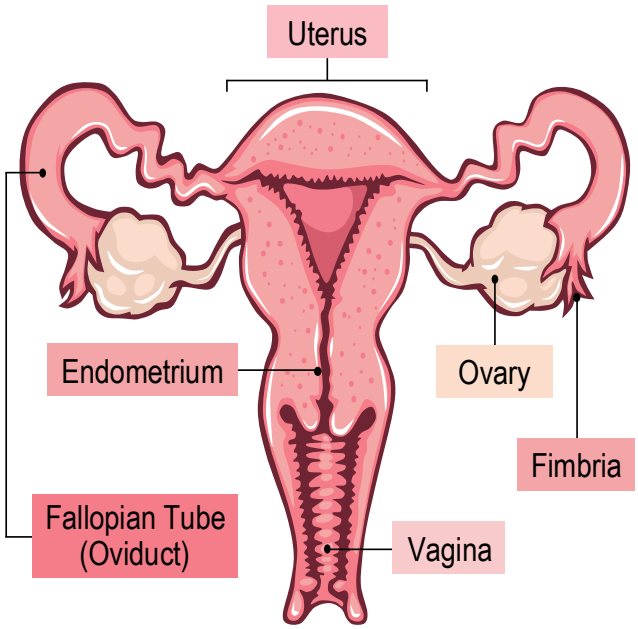
MALE REPRODUCTIVE SYSTEM

The male reproductive system includes all organs involved in the production and transport of sperm. sperm production occurs in the **testes**. The sperm then matures in the **epididymis**, where it develops the ability to be motile. The **vas deferens** is a long tube that conducts the sperm from the testes to the prostate gland during ejaculation. The fluid in which sperm is transported (semen) consists of fructose and prostaglandins, which are released by the **seminal vesicle**. The **prostate gland** secretes an alkaline fluid to neutralise vaginal acids, and semen is then conducted along another hollow tube (called the **urethra**) to exit from the body via an erect penis.



FEMALE REPRODUCTIVE SYSTEM

The female reproductive system includes all organs involved in the production and transport of egg cells. Each egg cell develops within a follicle found on the **ovaries**. When an egg cell is released from a follicle (via ovulation), it is swept into the oviducts by a fringe of tissue called **fimbriae**. The egg cell will travel along the **oviduct** (fallopian tube) towards the **uterus**. The uterus is lined by a mucous membrane that is called the **endometrium** – this is where the egg will implant if it was fertilised by sperm within the oviduct. But if fertilisation did not occur, the egg cell will instead exit the body via the **vagina** – along with the endometrium (which forms menstrual blood). An egg is released each month via a menstrual cycle until no more eggs remain.



MENSTRUAL CYCLE

The menstrual cycle describes recurring changes that occur within the female reproductive system to make pregnancy possible. It collectively involves two main stages – called the ovarian cycle and the uterine cycle.

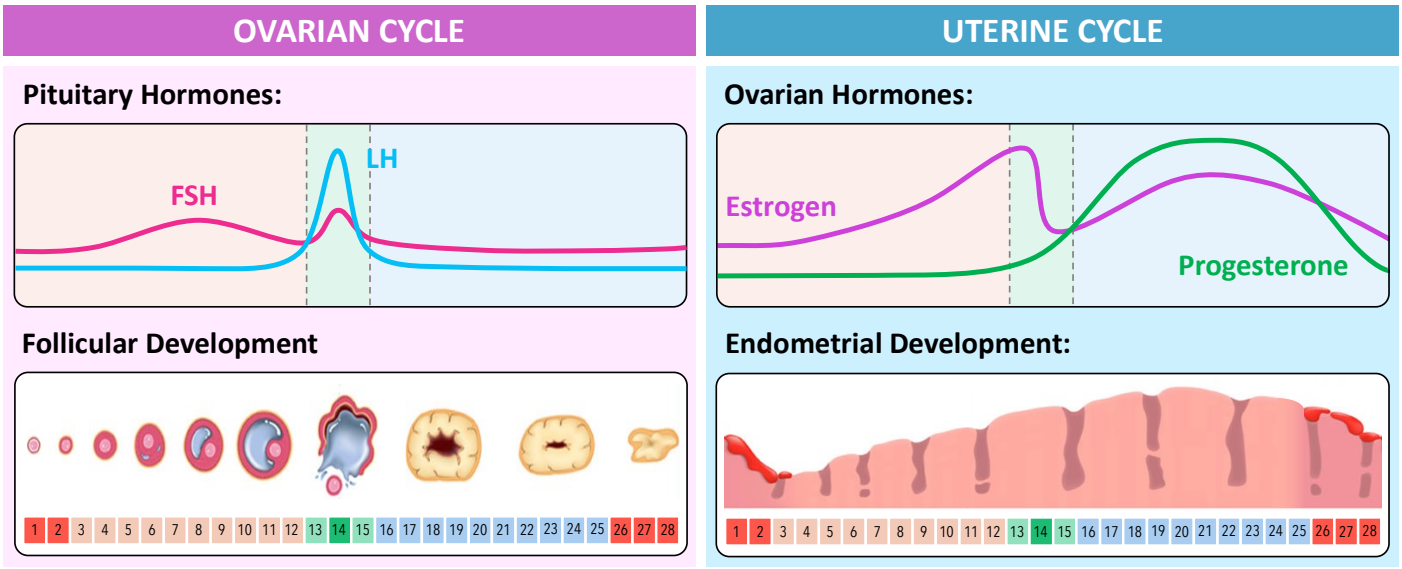
Ovarian Cycle:

The ovarian cycle covers the development of follicles within the ovaries and the subsequent release of egg cells. At the beginning of the cycle, follicle stimulating hormone (FSH) is secreted from the anterior pituitary and stimulates the growth of ovarian follicles. A dominant follicle produces estrogen (oestradiol), which inhibits FSH secretion via negative feedback to prevent other follicles growing. Midway through the cycle (~ day 12), estrogen levels reach a critical threshold, which stimulates the release of pituitary hormones via positive feedback. This results in a large surge of luteinizing hormone (LH) and a lesser surge of FSH. The LH causes the dominant follicle to rupture and release an egg cell (ovulation). The ruptured follicle develops into a corpus luteum that secretes progesterone and estrogen. These hormones inhibit FSH and LH release, preventing other follicles from developing while the corpus luteum is active. When the corpus luteum is finally degraded, the subsequent rise in FSH levels will constitute the start of a new ovarian cycle.

Uterine Cycle:

The uterine cycle covers the development of the endometrial lining within the uterus and its shedding (via menstruation). At the beginning of the cycle, the FSH released from the pituitary gland stimulates the production of estrogen by the ovarian follicles. This estrogen acts on the uterus to stimulate the thickening of the endometrial layer. When the follicle ruptures (during ovulation), the corpus luteum that develops will produce both progesterone and estrogen. These hormones act to further support the thickening and maintenance of the endometrial lining while the egg cell is in transit. If the egg is fertilised by a sperm, it will implant in the endometrial lining and start producing hormones that maintain the corpus luteum. But if fertilisation does not occur, the corpus luteum will degrade and stop releasing estrogen and progesterone. This means the endometrium cannot be maintained and is sloughed away (this is the menstrual blood).

STAGES OF THE MENSTRUAL CYCLE



FERTILISATION

Fertilisation describes the fusion of a sperm and egg cell to create a zygote. When the membranes of the egg and sperm fuse, the sperm nucleus will enter the egg but the mitochondria (in the midpiece) and the tail are destroyed. The nuclear membranes of both the egg and sperm dissolve, allowing the two sets of condensed chromosomes to undergo a joint mitosis. From this diploid cell, a new organism will develop.

IN VITRO FERTILISATION

Fertilisation can occur externally for individuals struggling to conceive offspring. Drugs are used to halt the regular secretion of FSH and LH – this arrests the normal menstrual cycle. Then artificial doses of hormones are administered to promote superovulation. Multiple eggs are extracted and incubated in the presence of a sperm sample from a male donor. The eggs are examined for successful fertilisation and then implanted into a suitable surrogate. Typically, multiple embryos are transferred to improve the chances of successful implantation. Following this procedure, a pregnancy test is taken to determine if the surrogate is pregnant.