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TYPES OF GAMETES STRUCTURE AND FUNCTION OF SPERM

In many species, there are two types of gametes whose form and function are distinct from one another. In humans and other mammals, for instance, the ovum is much larger than the sperm. The sperm also has a distinctive tadpole-like appearance with special adaptations for its primary function of traveling through the female reproductive tract and fertilizing the egg. In a similar manner, the ovum has a number of structural adaptations that aid the process of accurate fertilization and subsequent implantation. Species that have obvious differences in the appearance of gametes are said to display *anisogamy*.

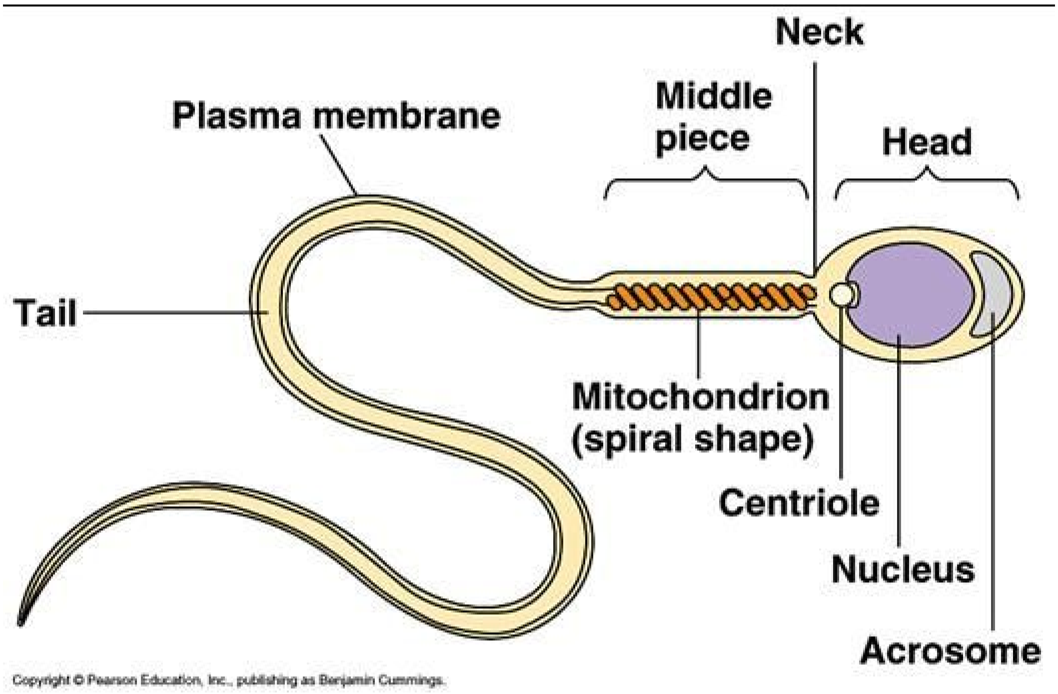
In addition, most species are also heterogametic – containing a different set of chromosomes in each type of gamete. In mammals, the female gamete contains a single X chromosome in addition to 22 somatic chromosomes. On the other hand, the male gamete, the sperm, could carry either an X or a Y chromosome as the 23rd chromosome. Depending on the chromosome present in the sperm, the resultant diploid zygote could either be a female (XX) or a male (XY). In birds, this form of heterogamy is reversed. Females produce gametes that could contain either the W or the Z chromosome and males produce a single type of gamete.

Examples of Gametes

The two most common gametes are sperm and ova. These two haploid cells can undergo internal or external fertilization and can differ from each other in size, form, and function. Some species produce both sperm and ova within the same organism. They are called hermaphrodites. However, the majority of sexually reproducing organisms have distinct sexes with each producing a single type of gamete.

Structure and Function of Sperm

Human sperms are highly specialized cells that have undergone an extensive period of differentiation.



As shown in the image, sperms contain four morphological regions – the head, neck, midpiece, and tail. These generic terms are in fact referring to different subcellular organelles that have been adapted to aid the sperm in its function.

The 'head', for instance, contains the genetic material. The DNA in a mature sperm is highly compacted, has nearly non-existent transcriptional activity and all the chromosomes are tightly condensed. They even have special proteins called protamines to pack the DNA more tightly than histones. The head is also surrounded by a cap-like structure containing hydrolytic enzymes called the acrosome. Acrosomal enzymes act on the outer membranes of the egg, allowing the DNA in the sperm access to the plasma membrane of the ovum.

The neck of the sperm is made of a pair of centrioles. The proximal centriole enters the oocyte during fertilization and even duplicates within the zygote. The distal centriole gives rise to filamentous structures that form the lashing tail of the sperm.

The tail is made of flagella that allow this cell to travel along the female reproductive tract – from the cervix, through the uterus towards the fallopian tubes where fertilization can occur. This motility is even necessary for species that undergo external fertilization. Sperm flagella contain a central cytoskeletal axonemal filament that is surrounded by 2 fibrous sheaths. The axoneme has a pair of extended microtubules that mediate movement through motor proteins called dynein.

The energy for flagellar movement is provided by spirally arranged mitochondria in the tubular midpiece. Some energy is also derived from glycolysis that occurs in the fibrous sheaths of the flagellum. The carbohydrate needed for glycolysis, aerobic respiration and oxidative phosphorylation is transported into sperm either from the semen or the mucus membranes of the female genital tract.

The sperm does not have many organelles that are commonly seen in most cells. For example, sperm do not have an endoplasmic reticulum or ribosomes since most protein and lipid synthesis is completed during spermatogenesis. Even after an extensive period of differentiation, however, sperm need to undergo another process called capacitation after ejaculation, before they become fully functional. This usually involves changes to the membrane, activation (and deactivation) of some enzymes and protein modifications.