

ONPRC Module 2: Male Reproductive System And Production of Sperm & Testosterone

Guiding Question:

How does the male reproductive system work?

Module Question	Laboratory Questions
What are the important parts of the male reproductive system, and how are sperm and testosterone produced?	<ul style="list-style-type: none"> • How does a scientist obtain testes for a study? • How do researchers look at testis morphology? • How does male reproductive anatomy differ between mammalian species (mice, humans, monkeys, sheep, horses, cats, dogs)? • What can male reproductive anatomy tell us about pregnancy in the different species?

Learning Outcomes:

Identify male reproductive anatomical structures of different species (mice, humans, monkeys, sheep, horses, cats, dogs).

Explain how sperm are produced and the changes made in the sperm as they mature.

Explain what capacitation is and why it is important for the formation of a zygote.

Define the source and function of hormones involved in the male reproductive system.



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Male Reproductive Vocabulary

Penis - the male organ of copulation and, in mammals, of urinary excretion

Testis - the male gonad or reproductive gland; either of two oval glands located in the scrotum that produce spermatozoa and testosterone

Scrotum – the pouch of skin that contains the testes

Seminiferous Tubules – one of two or three twisted, curved tubules in each lobule of the testis in which spermatozoa develop

Epididymis – coiled tubule next to the testes where sperm mature and may be stored for a short time

Vas Deferens – the duct that transports the mature sperm from the epididymis to the penis; also called Ductus Deferens

Urethra - part of both the urinary and reproductive system that passes urine and mature sperm outside of the body

Prostate Gland - a donut shaped gland that adds fluid to the semen

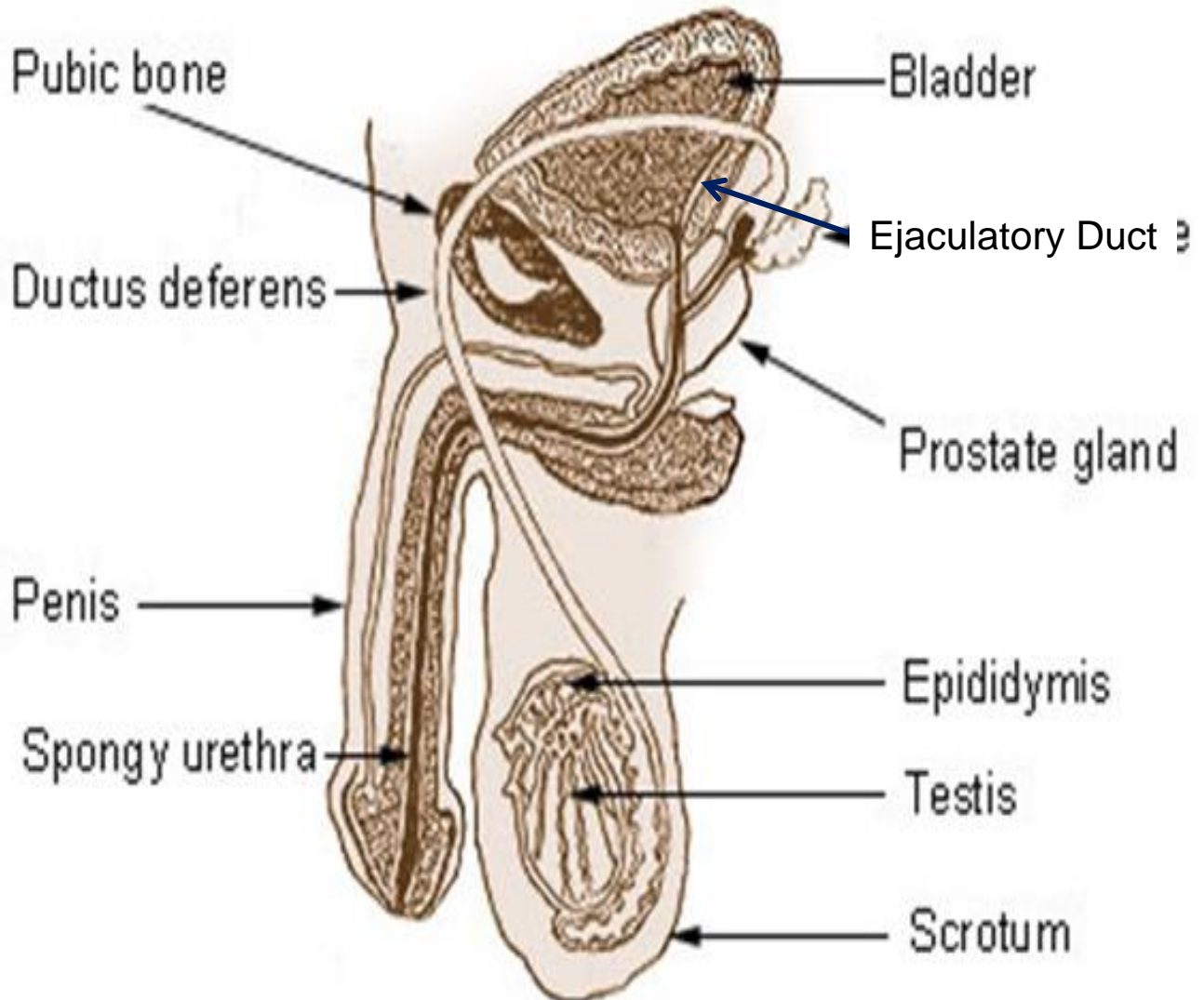
Seminal Vesicle – ducts that are about 5 cm long that add nutrients and fluid to semen

Ejaculatory Duct – canal that passes from the seminal vesicle and vas deferens, conveying semen to the urethra



What are the structures of the male reproductive system?

Male Reproductive System



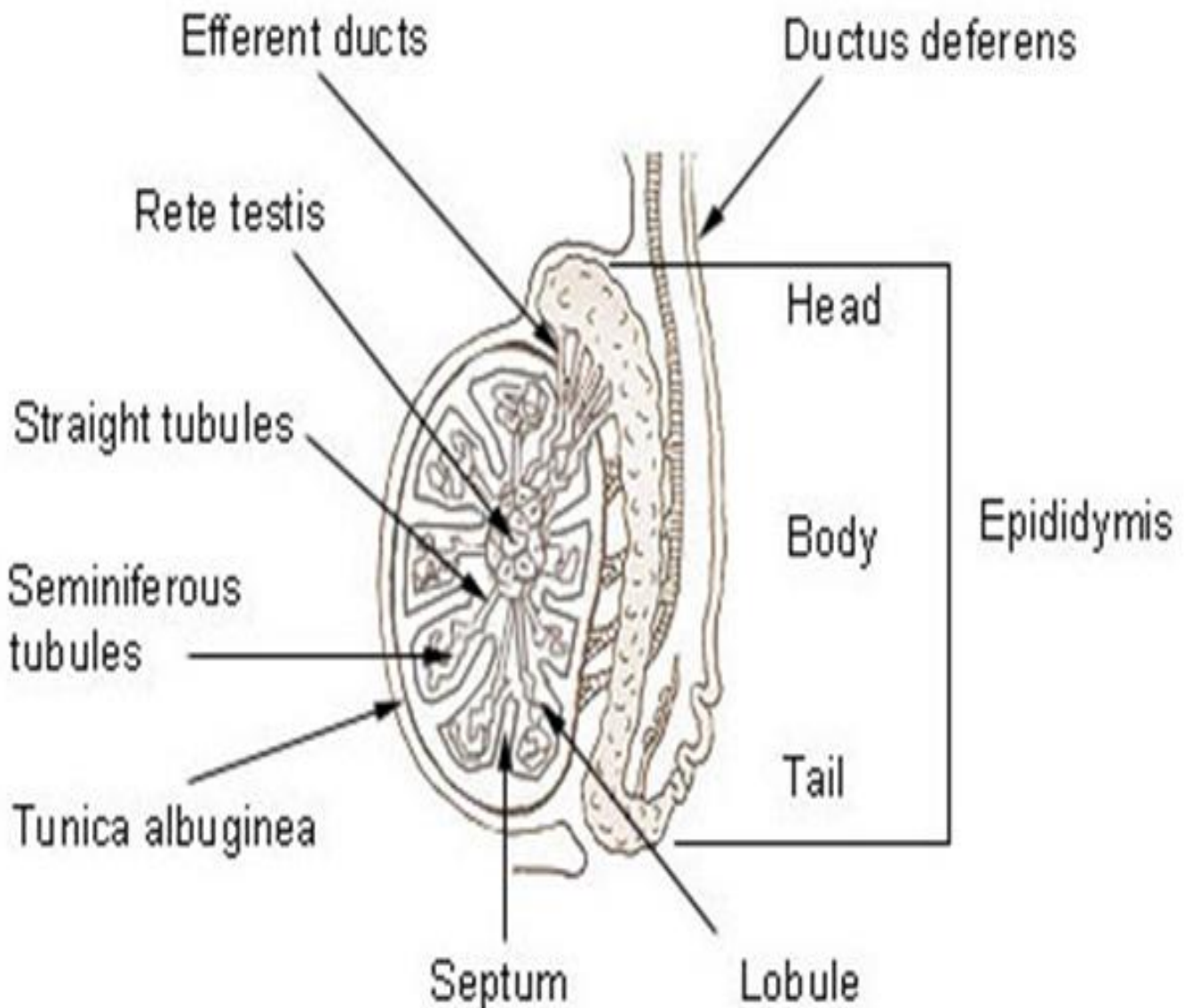
Questions to Think About:

How is the male reproductive tract adapted to produce millions of sperm a day?

In what ways might the sperm in other species resemble the sperm that humans produce?



Sagittal section of a testis and Epididymis



Structure of a Spermatozoan

Spermatogonia - any of the cells of the gonads in male organisms that undergo mitosis to form spermatocytes

Spermatocyte - a diploid cell in the seminiferous tubule that undergoes meiosis to form four haploid spermatids

Spermatid - one of the haploid cells that result from the meiotic divisions of a spermatocyte and which mature into a spermatozoan or sperm cell

Spermatozoan - the male reproductive mature motile haploid sex cell, usually consisting of a round or cylindrical nucleated cell (head), a short neck (midpiece), and a thin motile tail (flagellum); also called a sperm cell

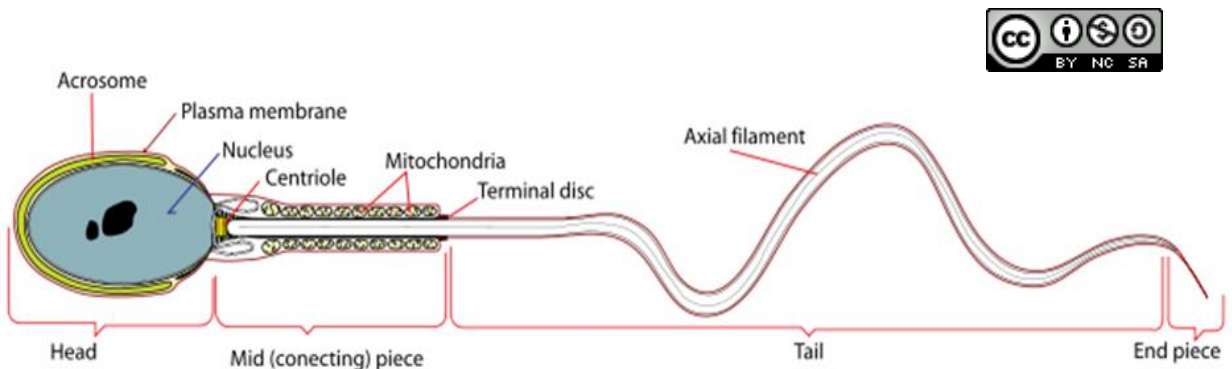
Acrosome - an organelle covering the head of animal sperm and containing enzymes that digest the oocyte cell coating, thus permitting the sperm to enter the oocyte

Middle Piece - contains energy-producing mitochondria to power the movement of the tail

Tail - allows the sperm to swim toward the oocyte

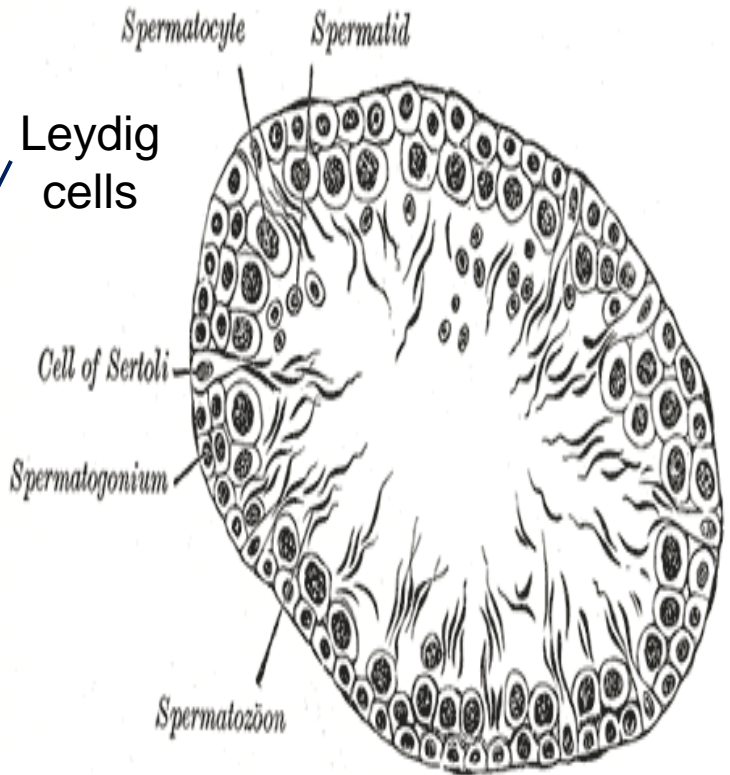
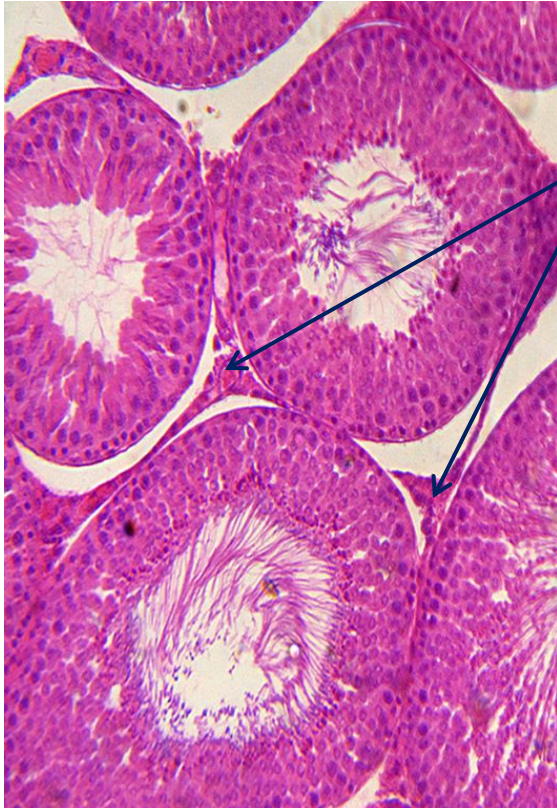
Sertoli Cell - elongated cells found in the seminiferous tubules of the testis where spermatids attach during spermatogenesis for nourishment

Leydig Cell - a cell in the testes that secretes the hormone testosterone



http://www.wikidoc.org/index.php/File:Simplified_spermatozoon_diagram_svg.png
<http://creativecommons.org/licenses/by-sa/3.0/> No changes were made.

Testis Cross Section Showing Stages of Spermatogenesis



Students Notes or Questions:

http://upload.wikimedia.org/wikipedia/en/7/71/Rabbit_testis.jpg
<http://creativecommons.org/licenses/by-sa/3.0/> No changes were made except to label Leydig cells.(left photo)
<http://www.wikidoc.org/index.php/Spermatogenesis>
<http://creativecommons.org/licenses/by-sa/3.0/> No changes were made. (right drawing)

Human Sperm Cells (Stained)



http://en.wikipedia.org/wiki/Sperm#mediaviewer/File:Sperm_stained.JPG
<http://creativecommons.org/licenses/by-sa/3.0/> No changes have been made.

Rhesus Monkey Sperm

White – alive Pink = dead

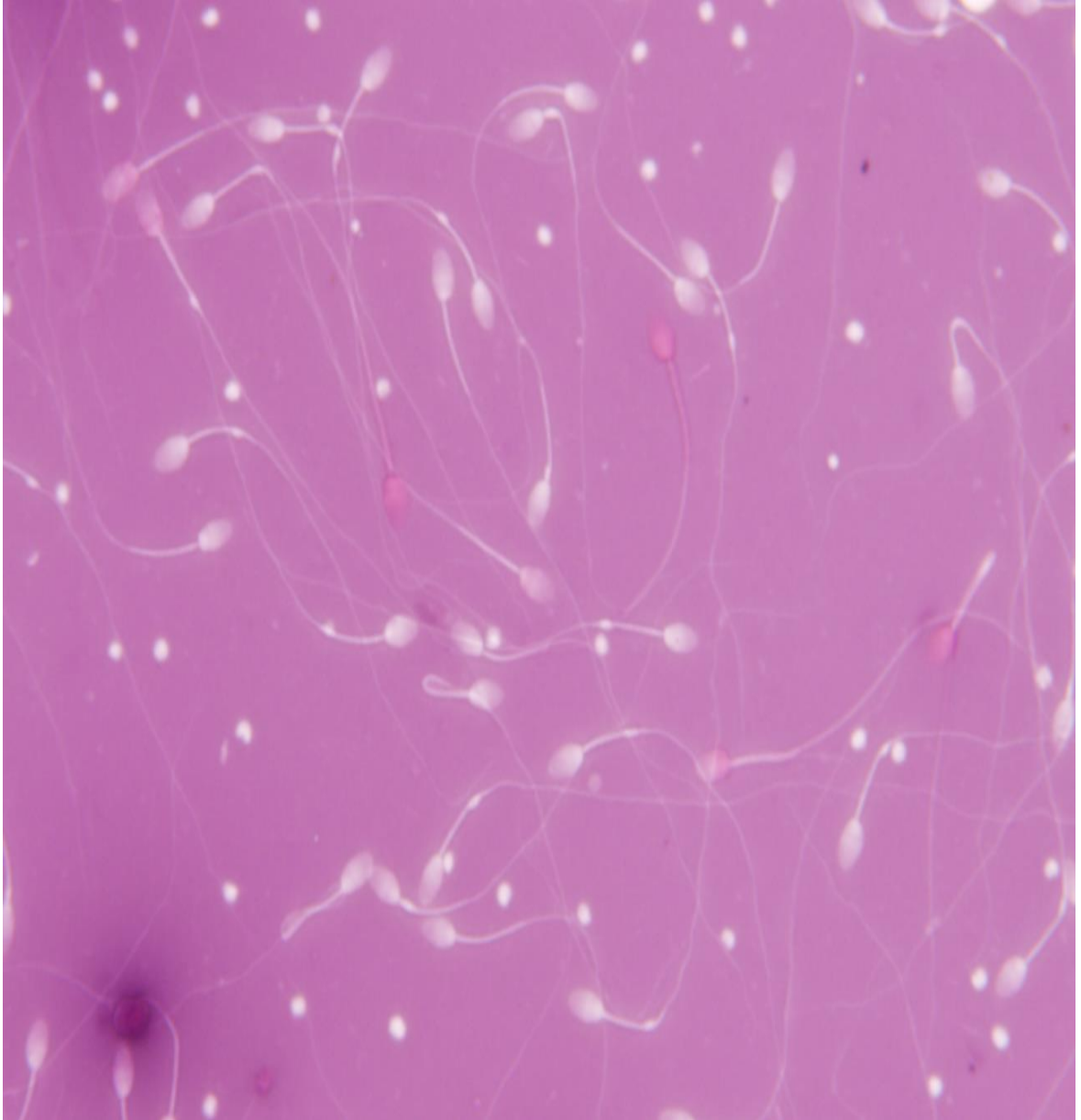


Photo: Mary Zelinski, PhD, ONPRC



Normal and Abnormal Mouse Sperm

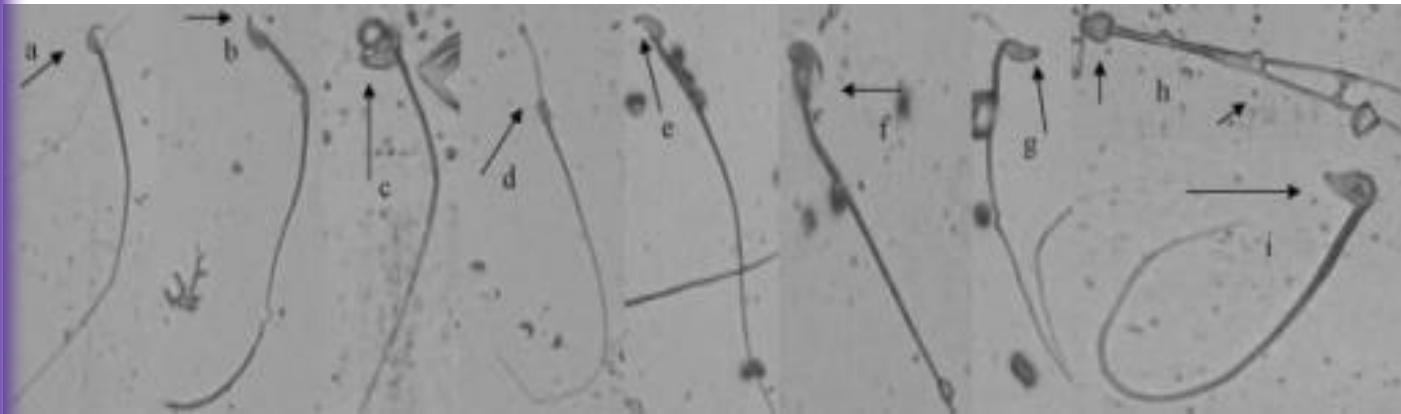
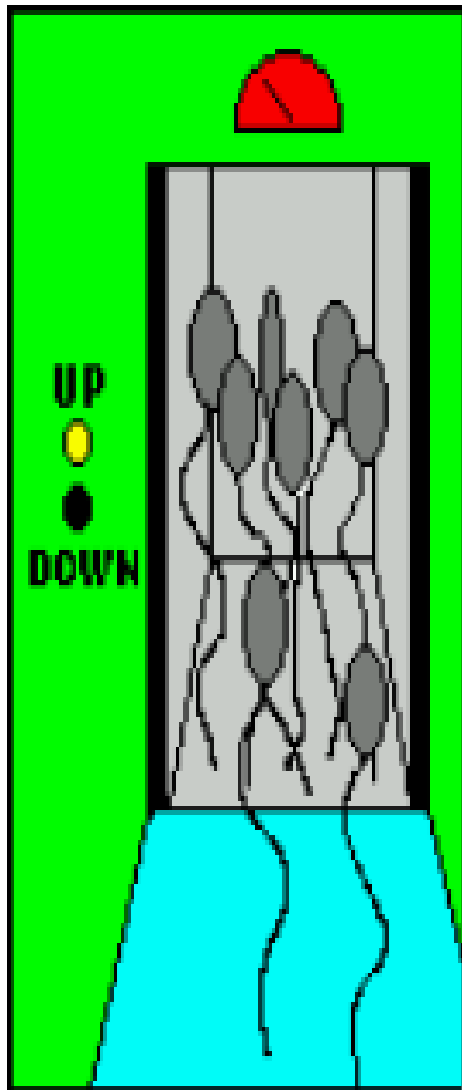


fig5: Abnormal sperm cells induced in mice exposed to different concentrations of the pharmaceutical effluent (a) normal sperm cell, (b) wrong-angled hook, (c) folded sperm, (d) pin head, (e) very short hook, (f) wrong tail attachment, (g) No hook, (h) double-tailed sperm with amorphous head, (i) amorphous head. Magnification 800x.

http://openi.nlm.nih.gov/detailedresult.php?img=3036925_gmb-32-2-373-gfig5&req=4

Sperm Transport in Female Reproductive Tract



Drawing: John Parrish, PhD,
University of Wisconsin

Sperm Capacitation

Sperm acquire the ability to fertilize the oocyte inside the female reproductive tract *in vivo*.

Involved is the destabilization of the sperm acrosomal head membrane through motility and a metabolic change in the sperm which removes steroids and glycoproteins from the acrosomal head, thus increasing permeability to Ca^{2+} so it will be able to penetrate the oocyte for fertilization.

In vitro, capacitation occurs by incubating sperm in a defined medium for several hours.

The Fertilizable Lifespan of Gametes

In most species, both sperm and oocyte have a short fertilizable lifespan.

Once they are delivered into the female tract, the clock starts ticking.

Mating or insemination must coincide closely with ovulation.

If sperm are deposited many days before the oocyte reaches the oviduct, there is little chance that they will survive to fertilize.

Why?

Conversely, if sperm reach the oviduct several days after ovulation, they will encounter an oocyte that has degenerated.

Why?

A human sperm can live 72 hours.

A human oocyte can live 24 hours.



Possibility of Fertilization If Sperm is Present

- 5 days before ovulation = 4% chance of conception
- 4 days before ovulation = 15% chance of conception
- 3 days before ovulation = 4 % chance of conception
- 2 days before ovulation = 35% chance of conception
- 1 day before ovulation = 32 % chance of conception
- Day of ovulation = 35% chance of conception
- Day after ovulation = <1% chance of conception

Explain the data in the above table.

A human sperm can live 72 hours.

A human oocyte can live 24 hours