# Fertilization

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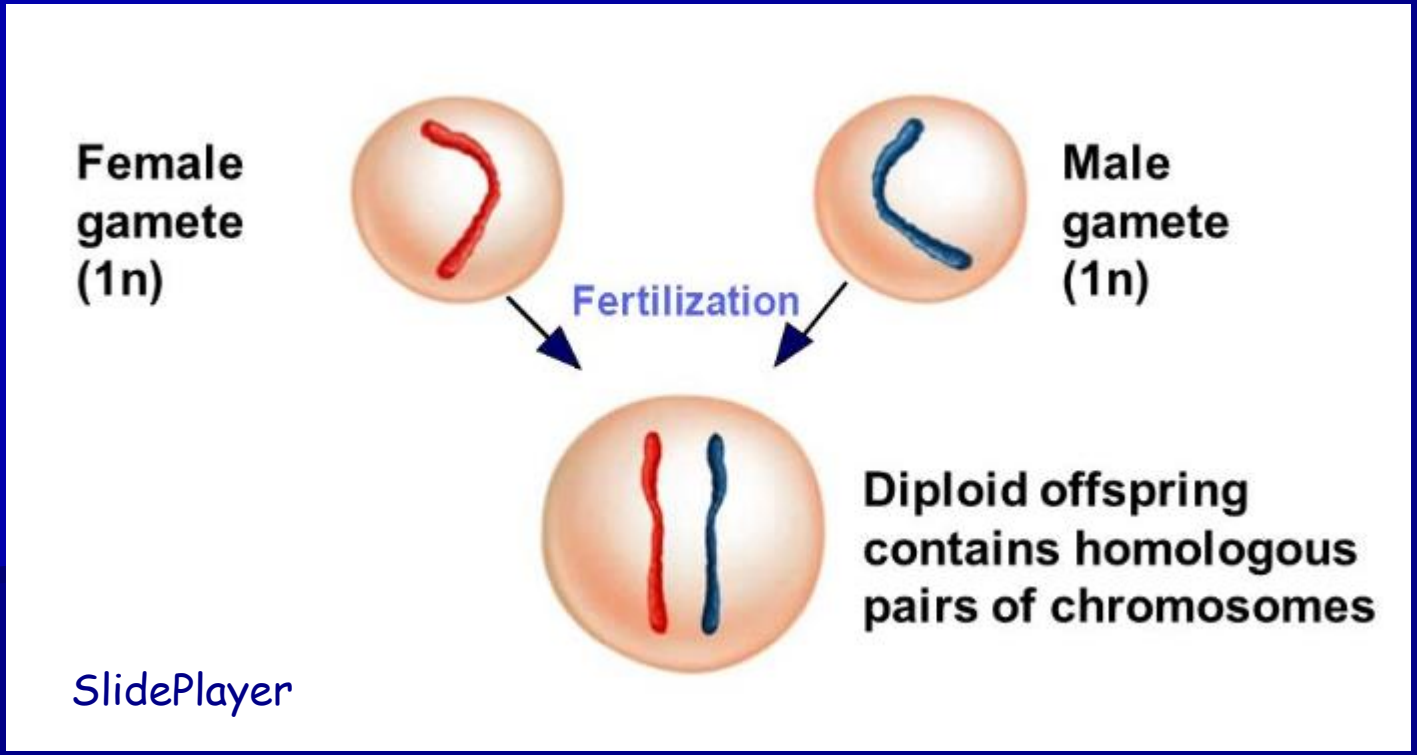
# Fertilization is fusion of gametes to form a new diploid individual

During fertilization two haploid cells – spermatozoon and oocyte fuse to form a new diploid cell – zygote. By serial mitotic divisions the zygote produces a new organism with combined heredity. Those organism carries homologous pairs of chromosomes. Each pair contains one maternal and one paternal chromosome.

According to the environment in which fertilization occurs, we distinguish external and internal fertilization.



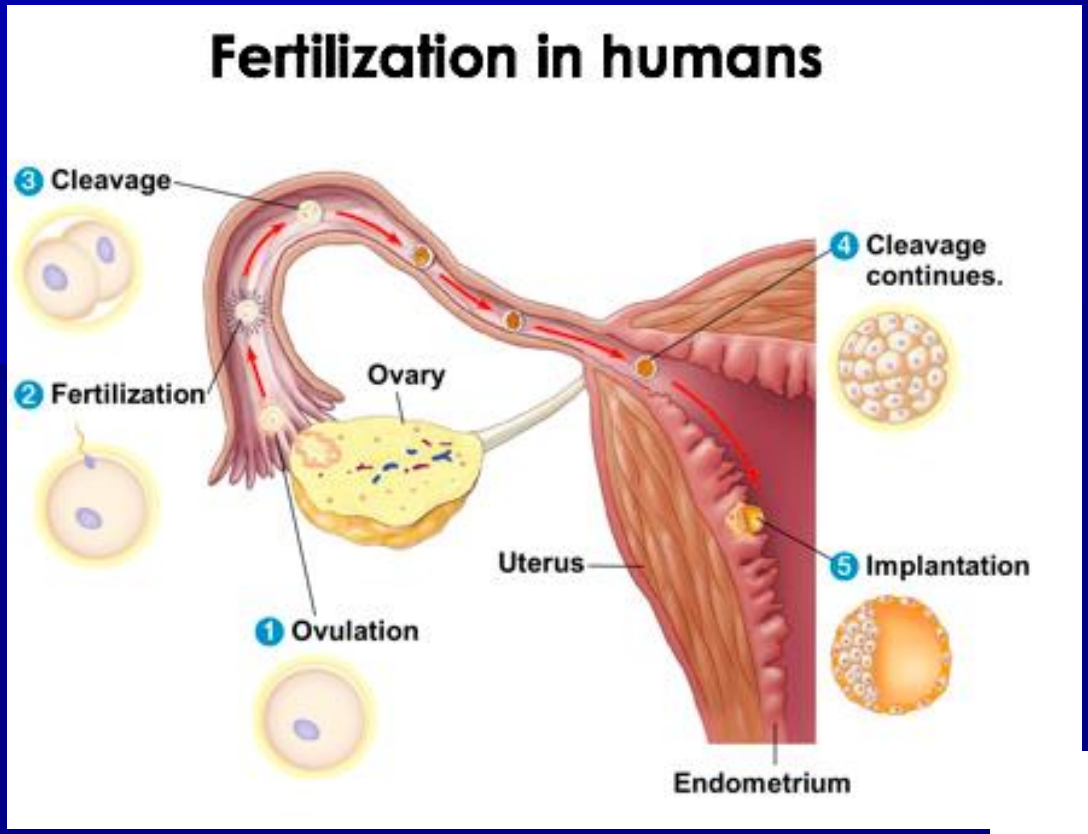
- External fertilization: gametes are released by parent organisms into water, where fertilization takes place. It is common in aquatic animals like aquatic snails, bivalves, sea urchins, fishes and amphibians.
- To have fertilization in the water is necessary partners to be close each other in order to release the gametes in close vicinity. After that spermatozoa move to the oocytes. Oocytes release special substances which attract spermatozoa from the same species. When spermatozoon finds the oocyte it releases the content of its acrosome. The acrosome of the sperm contain lytic enzymes which penetrate the envelopes of the oocytes. This process is called acrosome reaction.
- When spermatozoon is in the cytoplasm of the egg, it is necessary the pathway for next sperm to be blocked. It is made by cortical granules, stored in the oocyte. Penetration of the sperm provoke releasing of cortical granules. They contain enzymes that make the eggs envelope harder. This hardening of the egg surface blocks the road for next sperm. The process is called cortical reaction. It is crucial for successful fertilization, because if more than one spermatozoon penetrate the egg, it has more haploid sets of chromosomes. Fertilization with two sperm means three haploid sets of chromosomes in the egg. This triploid individual has no chance to develop and it dies.
- After cortical reaction the nuclei of the egg and the sperm migrate close each other and fuse to form the new diploid nucleus of the zygote.


# Examples for external fertilization

## Sea urchin

It is a marine organism which is a model for studying of external fertilization.

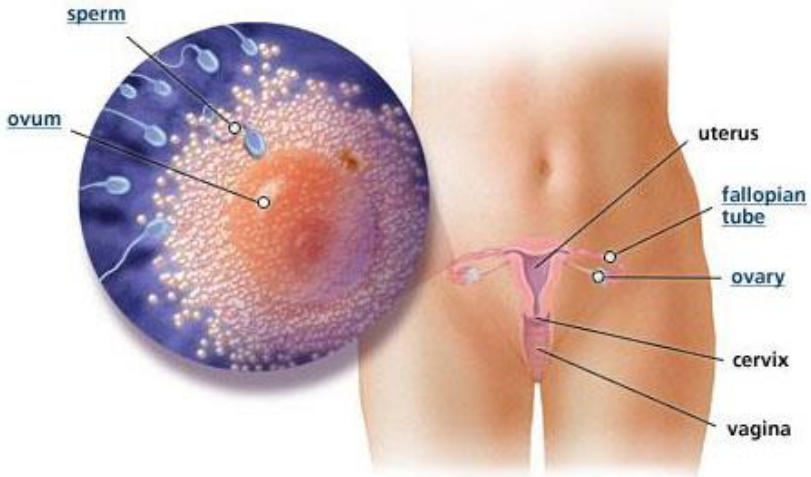
www.montereybayaquarium.org




All terrestrial animals have internal fertilization. It happens in the female reproductive tract. After ovulation, the oocyte reaches the oviduct (Fallopian tube). After copulation, sperm cells swim up the female genital tract to reach the same place.

Internal fertilization includes the same stages:

- meeting of sperm and egg;
- acrosome reaction;
- cortical reaction;
- migration of sperm and egg nuclei, but in the internal fertilization those nuclei do not exactly fuse.

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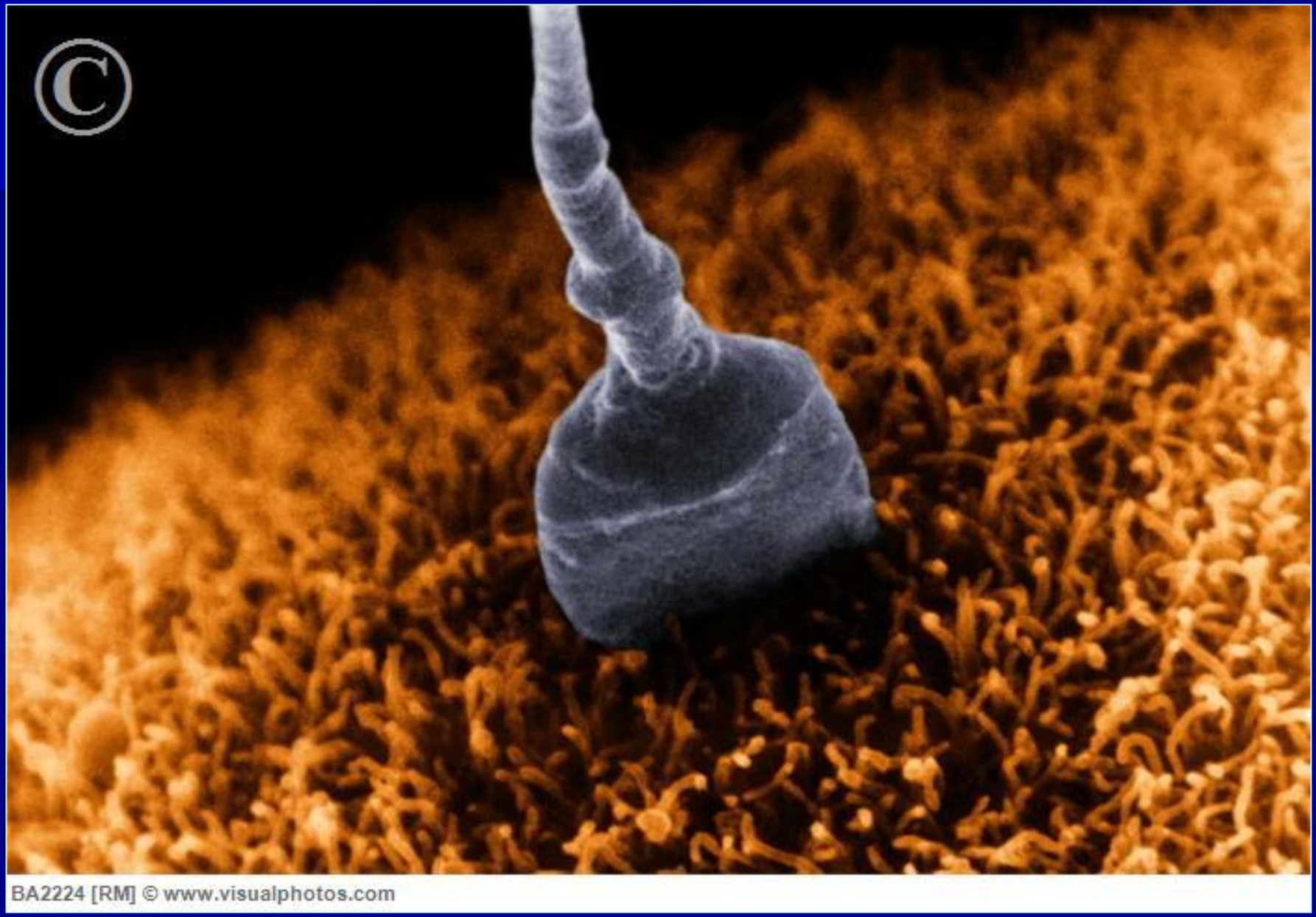
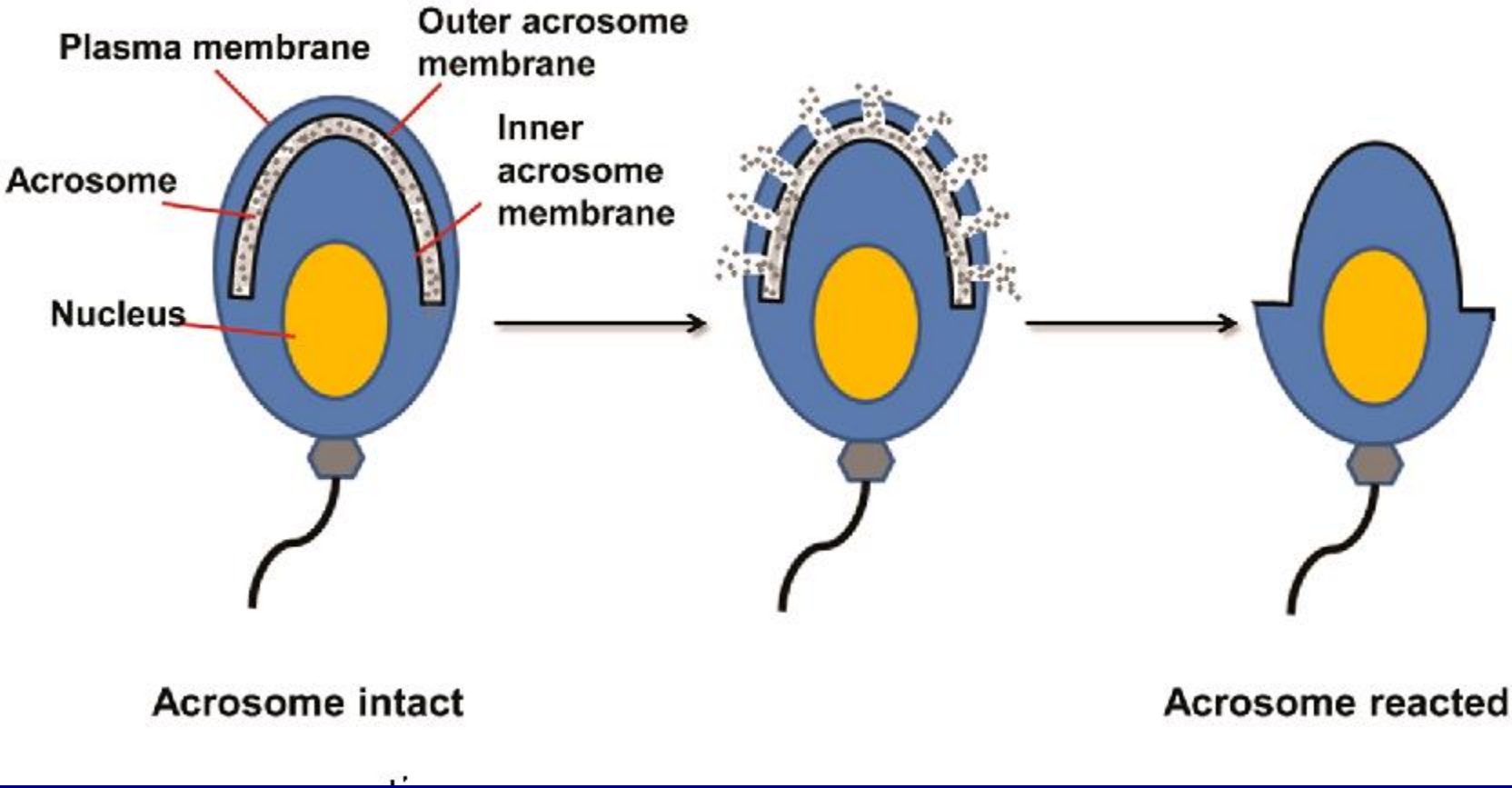
Multiple villi help membrane contacts.

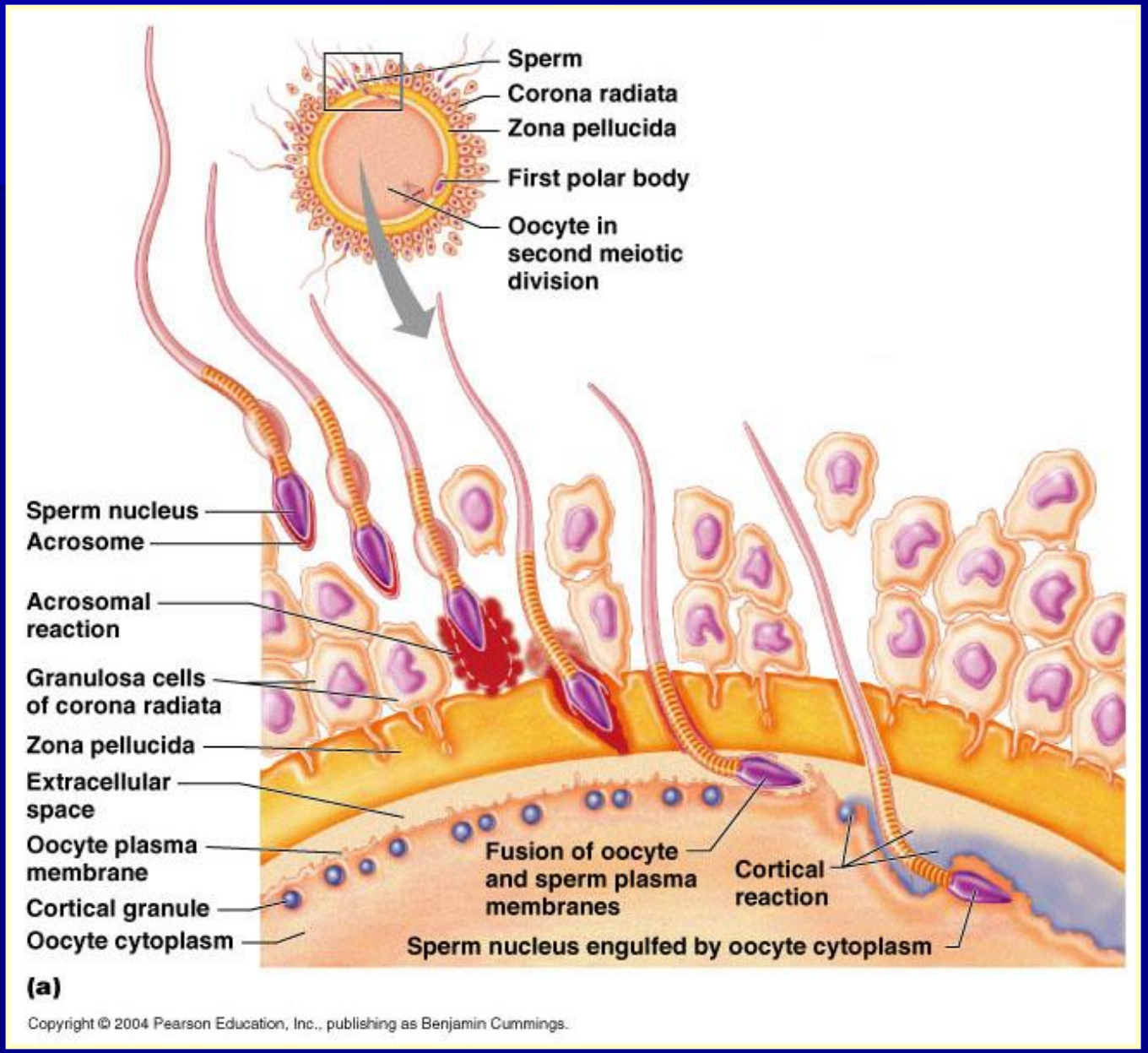


# Acrosome reaction

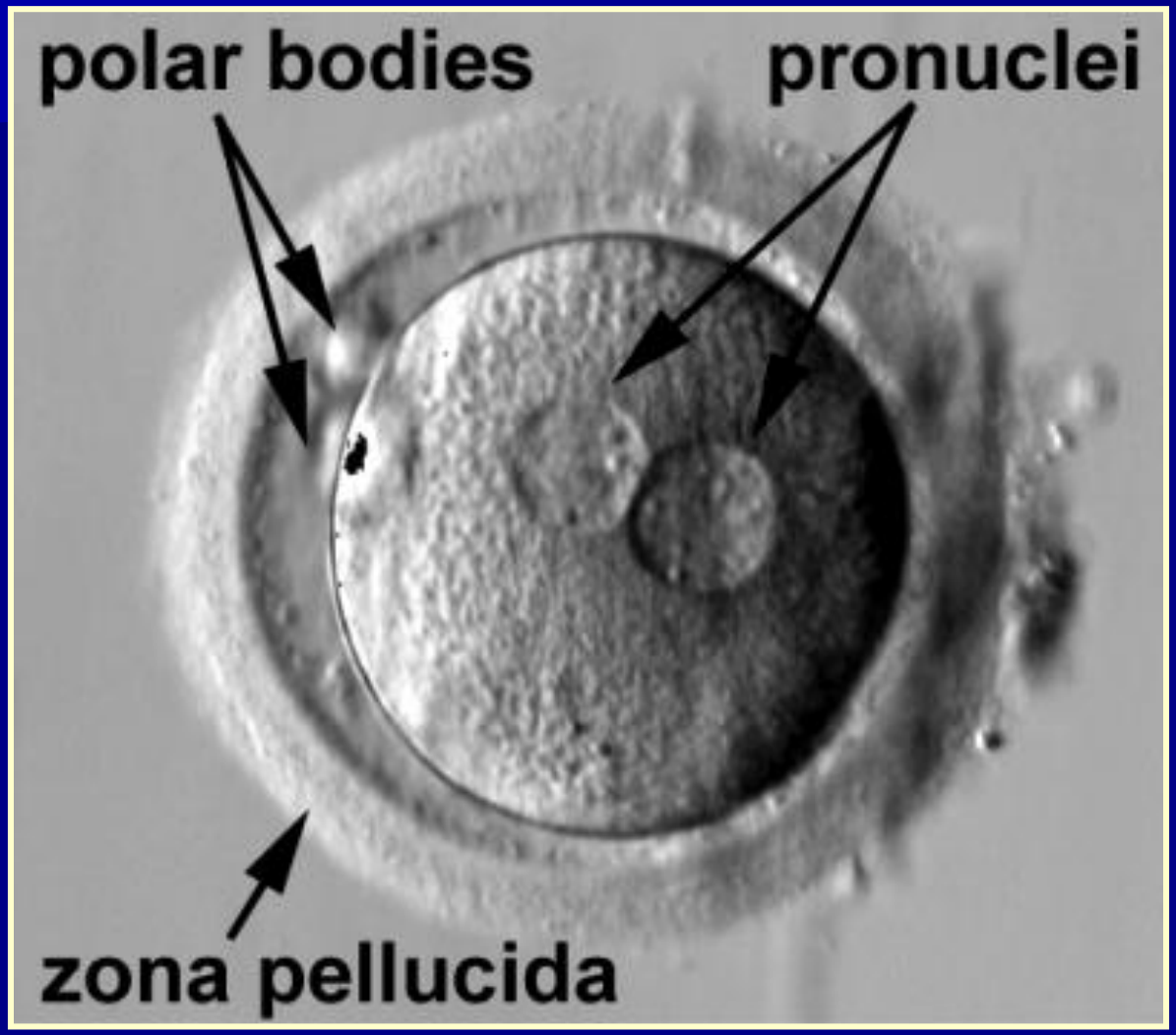



Linghui Wu, Nicole S Sampson (2014). Fucose, Mannose, and β-N-Acetylglucosamine Glycopolymers Initiate the Mouse Sperm Acrosome Reaction through Convergent Signaling Pathways

# Stages of fertilization



The diploid cell formed by fertilization is called zygote




http://php.med.unsw.edu.au/embryology

When sperm and egg nuclei are close each other, their DNA is already replicated. The zygote prepares for mitosis, this is already prophase. The nuclei never fuse. Maternal and paternal chromosomes are together for the first time in the mitotic spindle of the first cleavage.