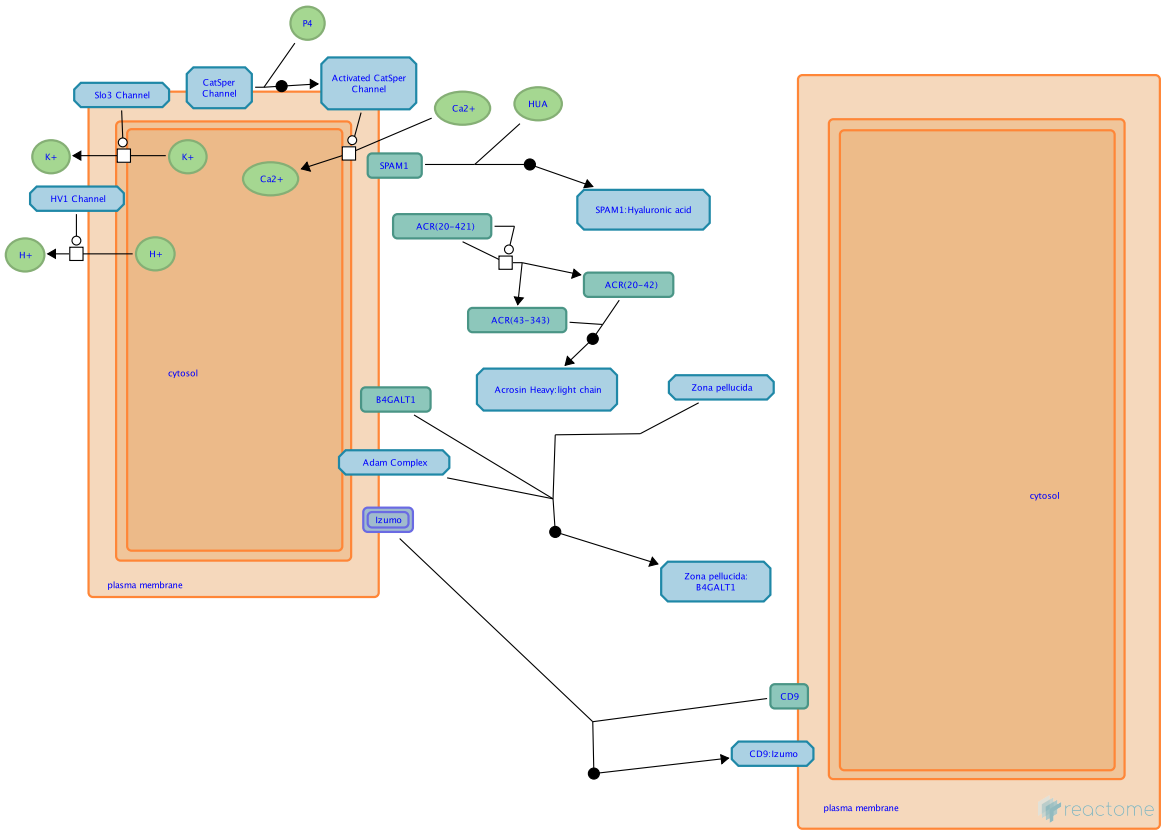
Fertilization



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14/09/2021

Introduction

Reactome is open-source, open access, manually curated and peer-reviewed pathway database. Pathway annotations are authored by expert biologists, in collaboration with Reactome editorial staff and cross-referenced to many bioinformatics databases. A system of evidence tracking ensures that all assertions are backed up by the primary literature. Reactome is used by clinicians, geneticists, genomics researchers, and molecular biologists to interpret the results of high-throughput experimental studies, by bioinformaticians seeking to develop novel algorithms for mining knowledge from genomic studies, and by systems biologists building predictive models of normal and disease variant pathways.

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Fabregat, A., Sidiropoulos, K., Viteri, G., Forner, O., Marin-Garcia, P., Arnau, V. et al. (2017). Reactome pathway analysis: a high-performance in-memory approach. *BMC bioinformatics, 18*, 142. ↗

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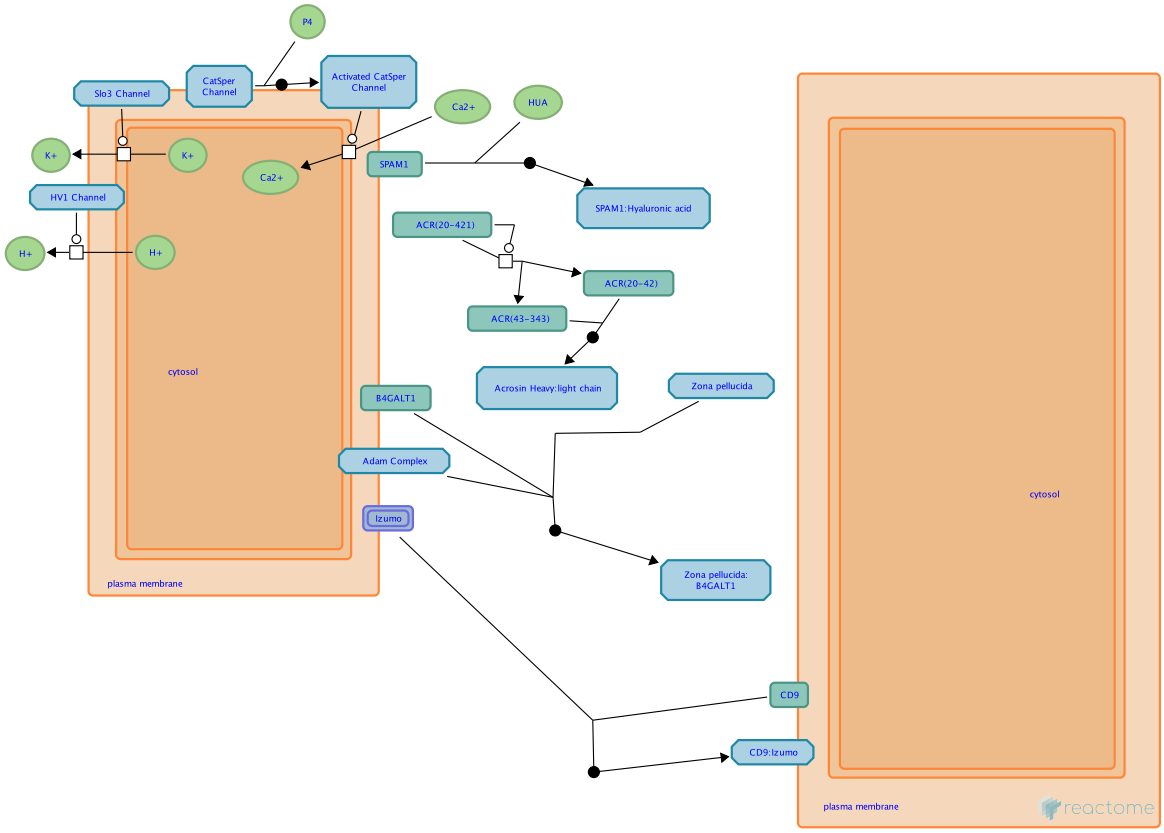
Fabregat, A., Korninger, F., Viteri, G., Sidiropoulos, K., Marin-Garcia, P., Ping, P. et al. (2018). Reactome graph database: Efficient access to complex pathway data. *PLoS computational biology, 14*, e1005968. ↗

Fertilization

Stable identifier: R-HSA-1187000



Mammalian fertilization comprises sperm migration through the female reproductive tract, biochemical and morphological changes to sperm, and sperm-egg interaction in the oviduct. Although the broad concepts of fertilization are well defined, our understanding of the biochemical mechanisms underlying sperm-egg binding is limited.

Literature references

Johnston, DS., Wooters, J., Kopf, GS., Qiu, Y., Roberts, KP. (2005). Analysis of the human sperm proteome. *Ann N Y Acad Sci, 1061*, 190-202.

Evans, JP., Florman, HM. (2002). The state of the union: the cell biology of fertilization. *Nat Cell Biol, 4*, s57-63.

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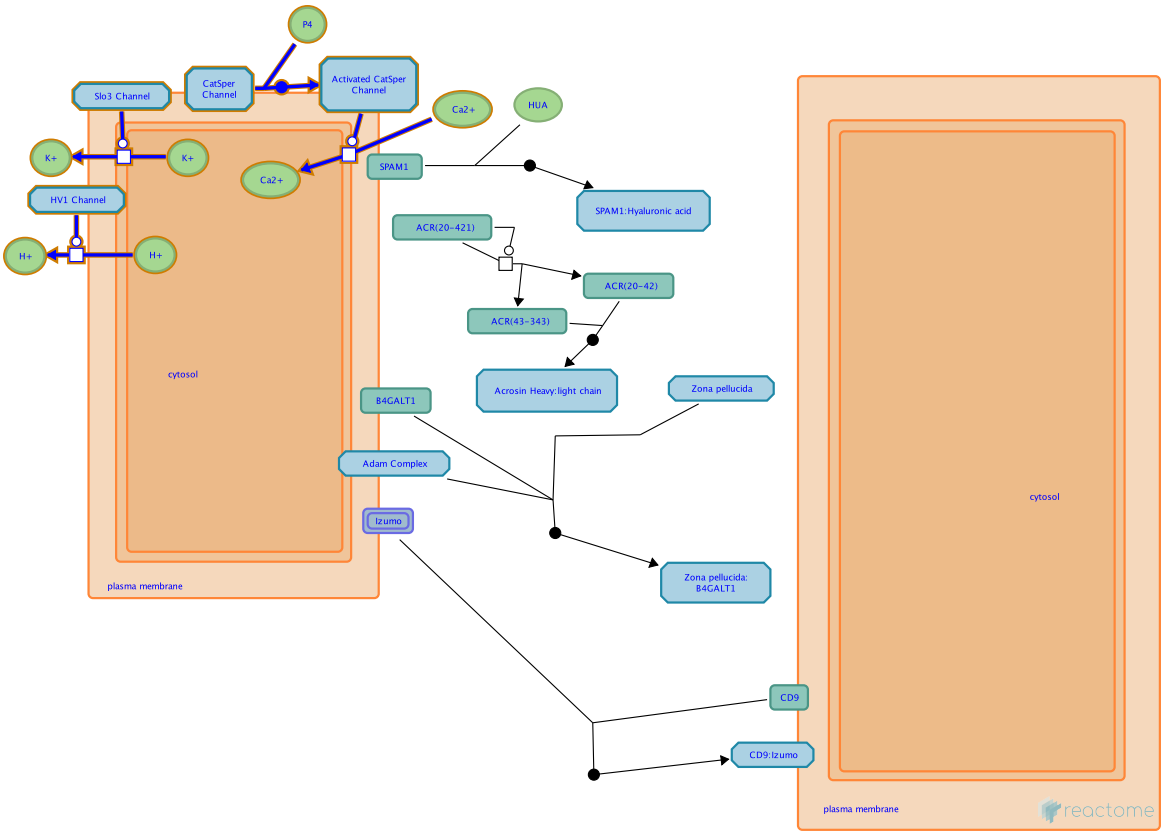
Sperm Motility And Taxes ↗

Location: Fertilization

Stable identifier: R-HSA-1300642



A series of receptor signaling pathways potentially govern chemical communication between sperm and egg, chemotactically guiding incoming sperm towards the oocyte. Though several substances are confirmed as sperm chemoattractant, progesterone (P) seems to be the best chemoattractant candidate for human sperm. Ion channels control the sperm ability to fertilize the egg by regulating sperm maturation in the female reproductive tract and by triggering key sperm physiological responses required for successful fertilization such as hyperactivated motility, chemotaxis, and the acrosome reaction. CatSper, a pH regulated, calcium selective ion channel, potassium channel KSper (Slo3), and Hv1, the voltage gated proton channel are involved in regulation of sperm hyperactivated motility. While progesterone, secreted by ovulated cumulus oophorus, may act as a chemoattractant for sperm cells over the short distances, a major determinant of sperm guidance over long distances in the mammalian female reproductive tract is rheotaxis.

Literature references

Guidobaldi, HA., Teves, ME., Uñates, DR., Anastasía, A., Giojalas, LC. (2008). Progesterone from the cumulus cells is the sperm chemoattractant secreted by the rabbit oocyte cumulus complex. *PLoS ONE, 3*, e3040. ↗

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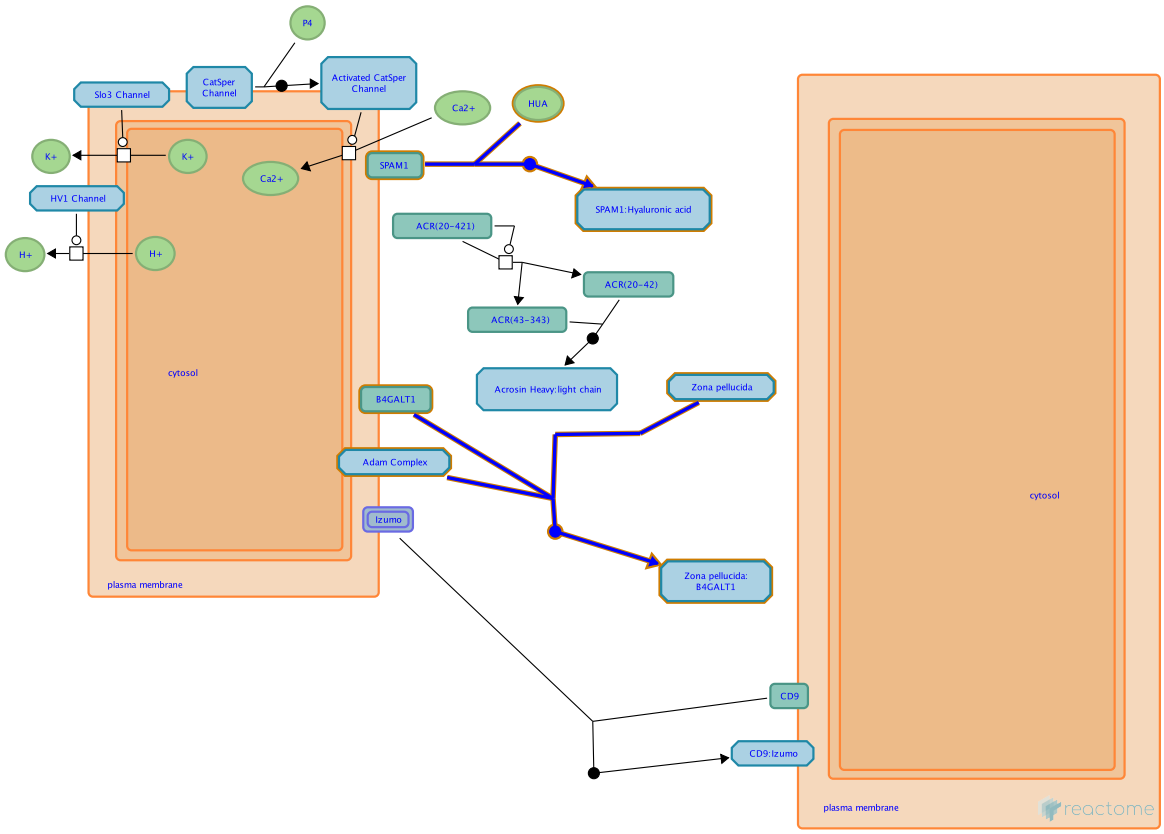
Interaction With Cumulus Cells And The Zona Pellucida ↗

Location: Fertilization

Stable identifier: R-HSA-2534343

Compartments: extracellular region



A typical mammalian egg is surrounded by an outer layer of about 3,000 cumulus cells embedded in an extracellular matrix rich in hyaluronic acid. It is suggested that the fertilizing sperm with it's acrosome intact, passes through the cumulus cell layer.

The zona pellucida (ZP), a glycoproteinaceous matrix surrounding the mammalian oocyte plays an important role in species specific sperm-egg binding, induction of acrosome reaction in the ZP bound spermatozoa, avoidance of polyspermy and protection of the embryo prior to implantation. The human ZP matrix is composed of 4 glycoproteins designated as ZP1, ZP2, ZP3 and ZP4.

Literature references

Lin, Y., Mahan, K., Lathrop, WF., Myles, DG., Primakoff, P. (1994). A hyaluronidase activity of the sperm plasma membrane protein PH-20 enables sperm to penetrate the cumulus cell layer surrounding the egg. *J Cell Biol, 125*, 1157-63. ↗

Ikawa, M., Inoue, N., Benham, AM., Okabe, M. (2010). Fertilization: a sperm's journey to and interaction with the oocyte. *J Clin Invest, 120*, 984-94. ↗

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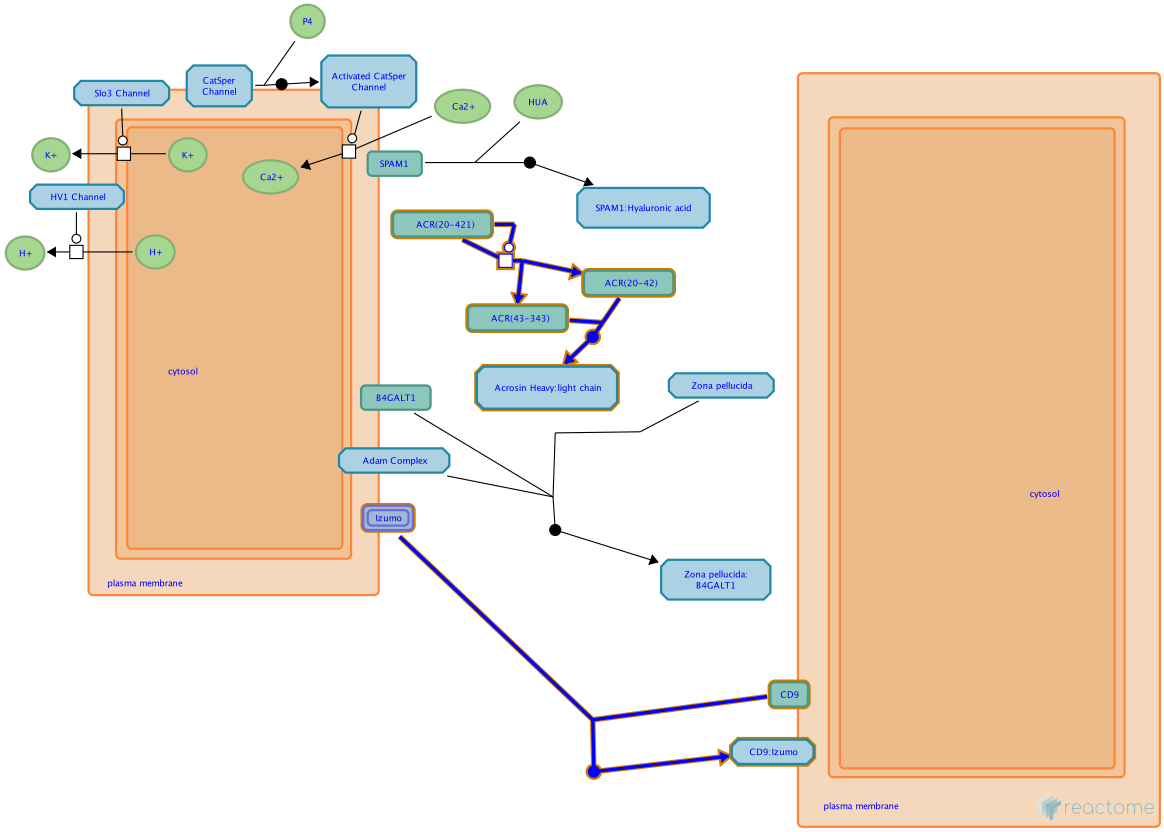
Acrosome Reaction and Sperm:Oocyte Membrane Binding ↗

Location: Fertilization

Stable identifier: R-HSA-1300645



The acrosome reaction is stimulated by zona pellucida binding and subsequent downstream events, including Ca2+ influx. Proacrosin cleavage is the hallmark event of the acrosome reaction.

After the acrosome reactome the sperm has passed through the cumulus cells and the zona pellucida. The membrane of the sperm head and the membrane of the oocyte are drawn together through the interaction of the sperm-bound protein Izumo and the ooctye CD9 membrane protein.

Literature references

Ikawa, M., Inoue, N., Benham, AM., Okabe, M. (2010). Fertilization: a sperm's journey to and interaction with the oocyte. *J Clin Invest, 120*, 984-94. ↗

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