

Fertilization

In all sexually-reproducing animals, the first step is **fertilization** – union of male and female gametes

Fertilization itself consists of three events:

- Sperm penetration and membrane fusion
- Egg activation
- Fusion of nuclei

The sperm: a stripped down machine for delivering DNA

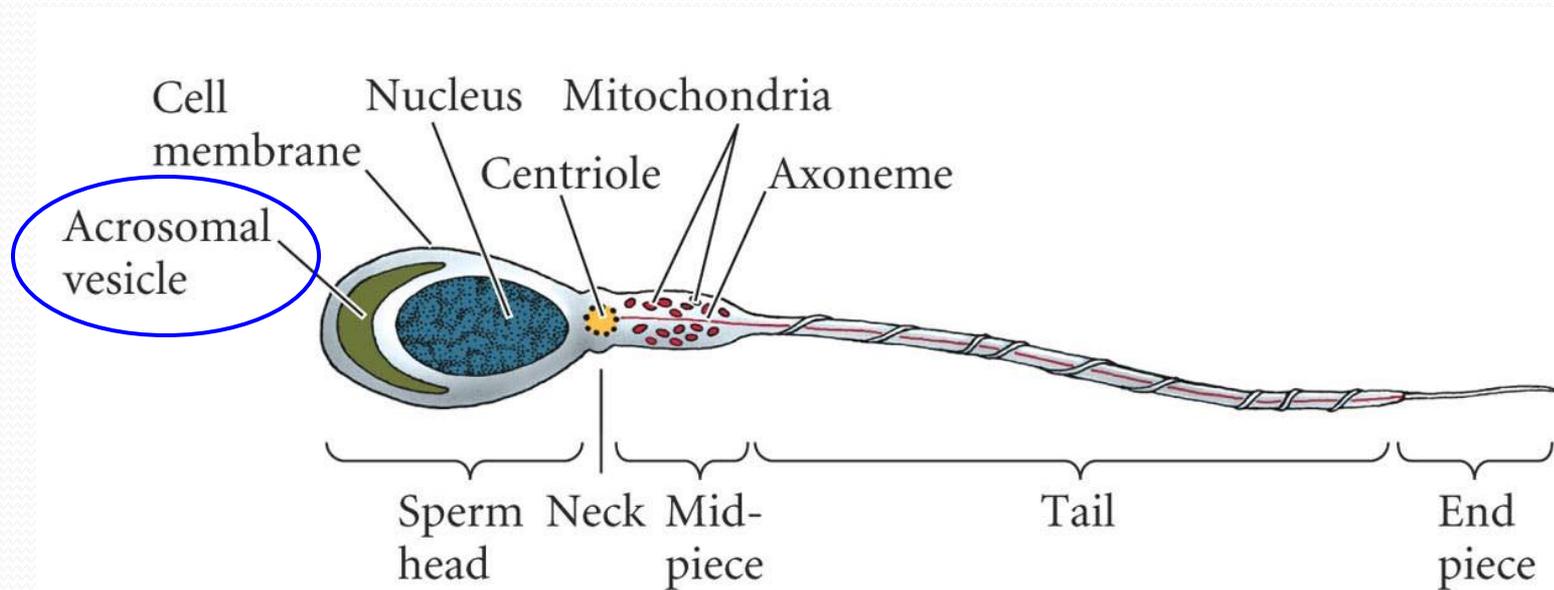


Figure 7.2

Chemical cues from the egg attract sperm

In sea urchins, the cue is **resact**

0 sec

20 sec

40 sec

90 sec

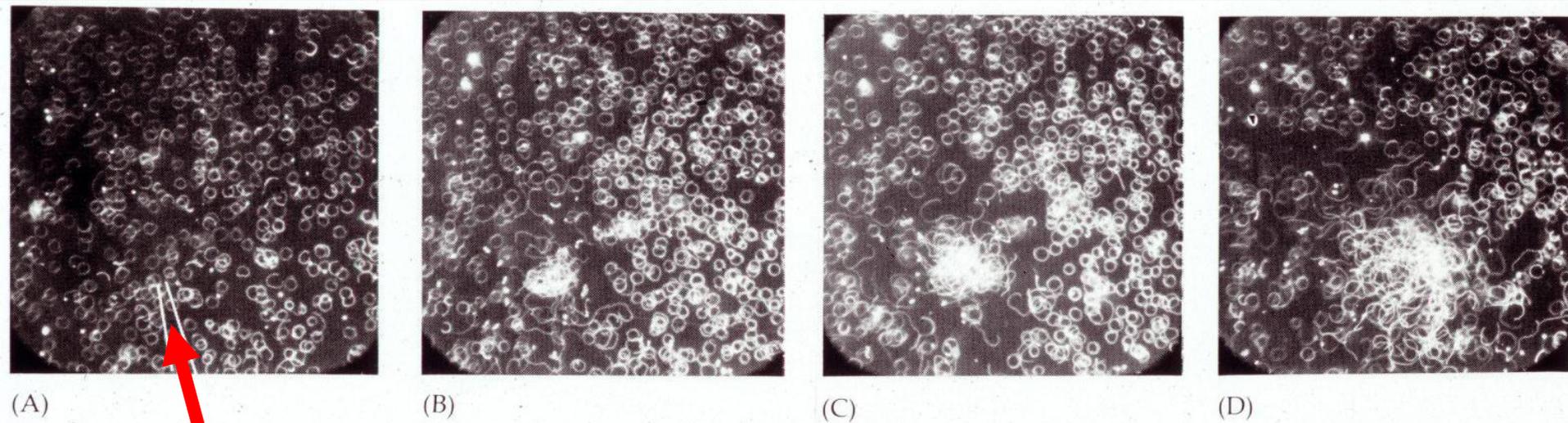
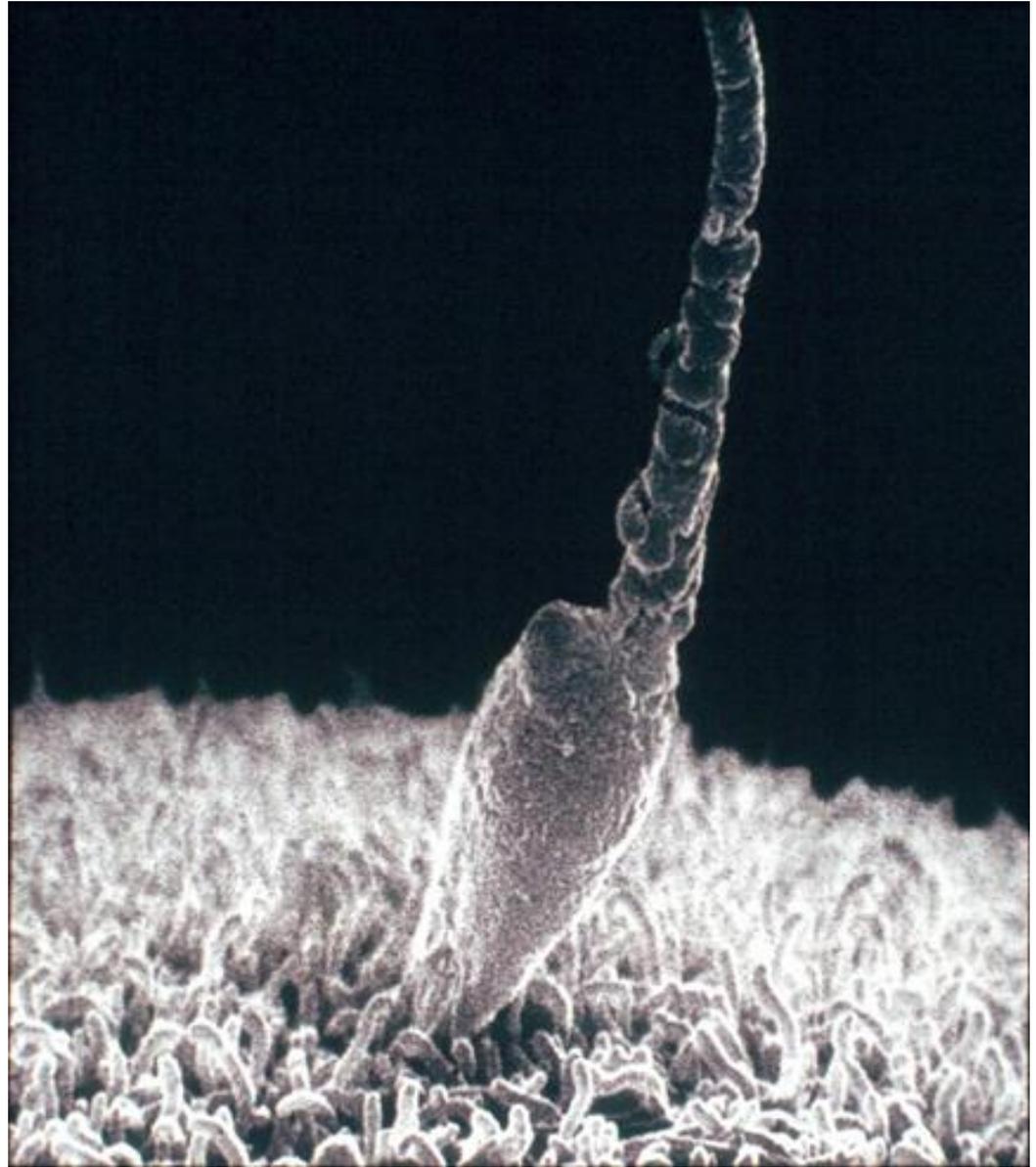


Figure 7.9 **Sperm chemotaxis**

Inject resact

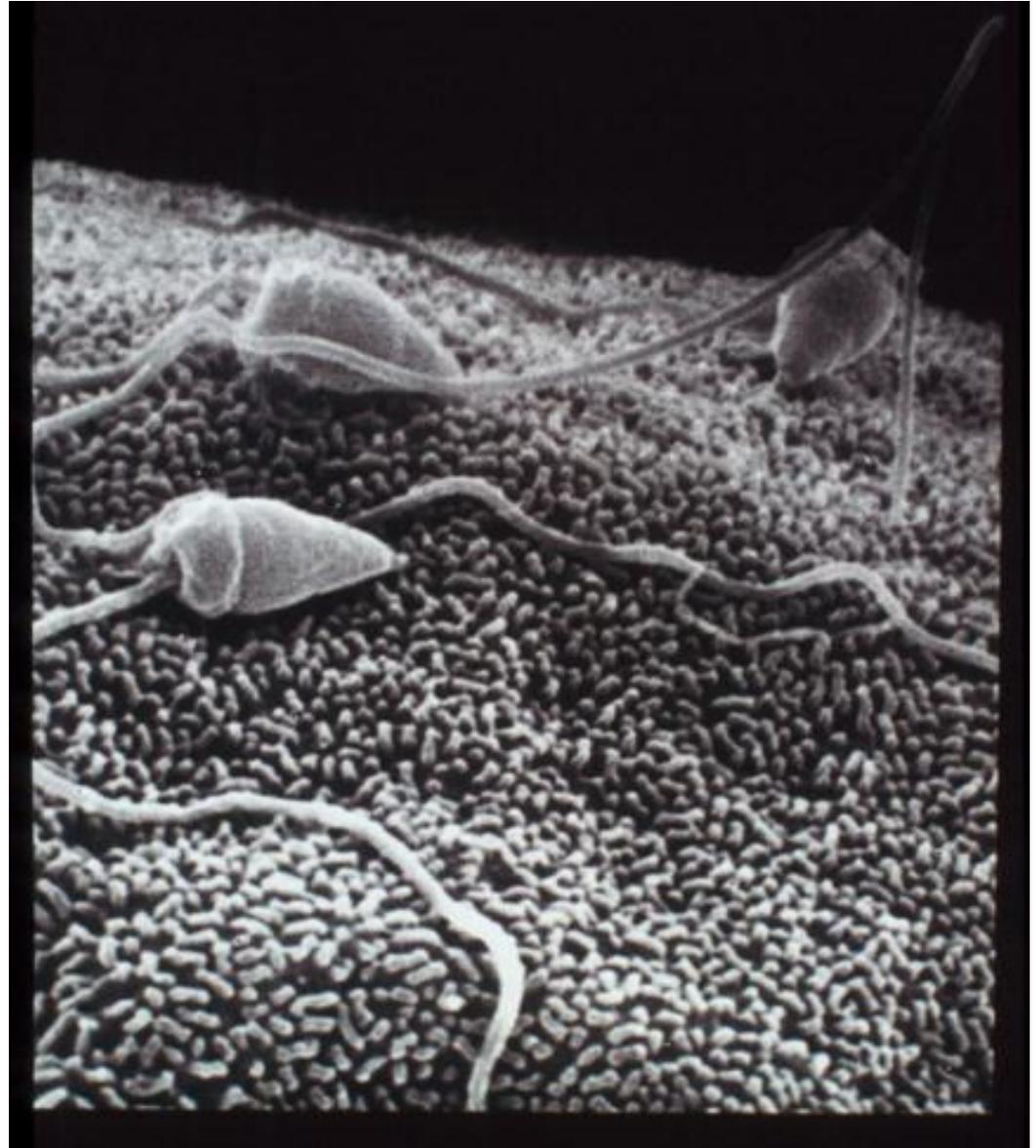
Step one:

**Contact between
the sperm
and the eggshell**



Step two:

**Contact between
the sperm
and the egg's
plasma
membrane**



Fertilization

Sperm penetration and membrane fusion

- Protective layers of egg include the **jelly layer** and vitelline envelope in sea urchins, and the **zona pellucida** in mammals
- The **acrosome** of sperm contains digestive enzymes that enable the sperm to tunnel its way through to the egg's cell membrane
 - Membrane fusion permit sperm nucleus to enter directly into egg's cytoplasm

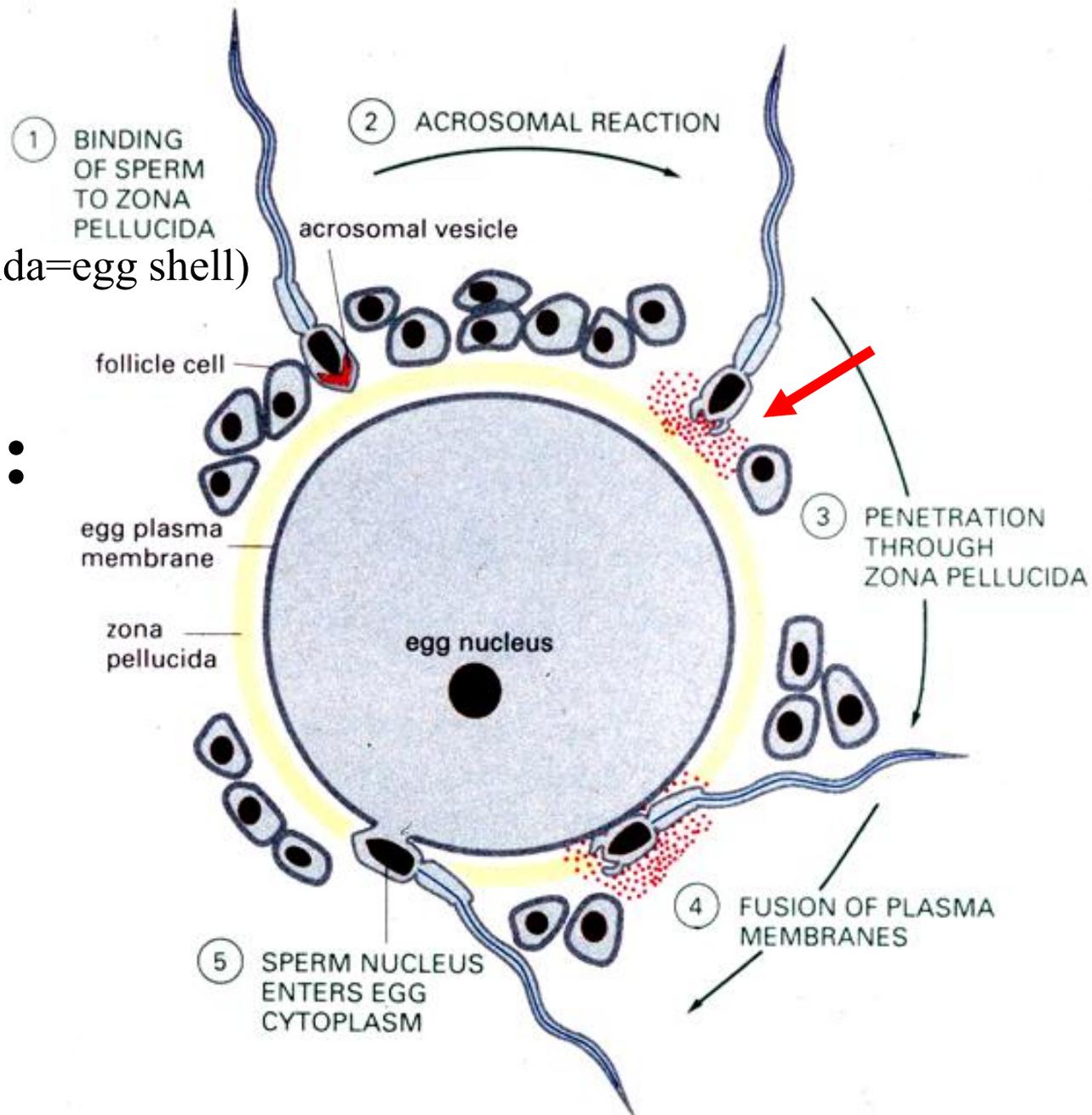
Fertilization

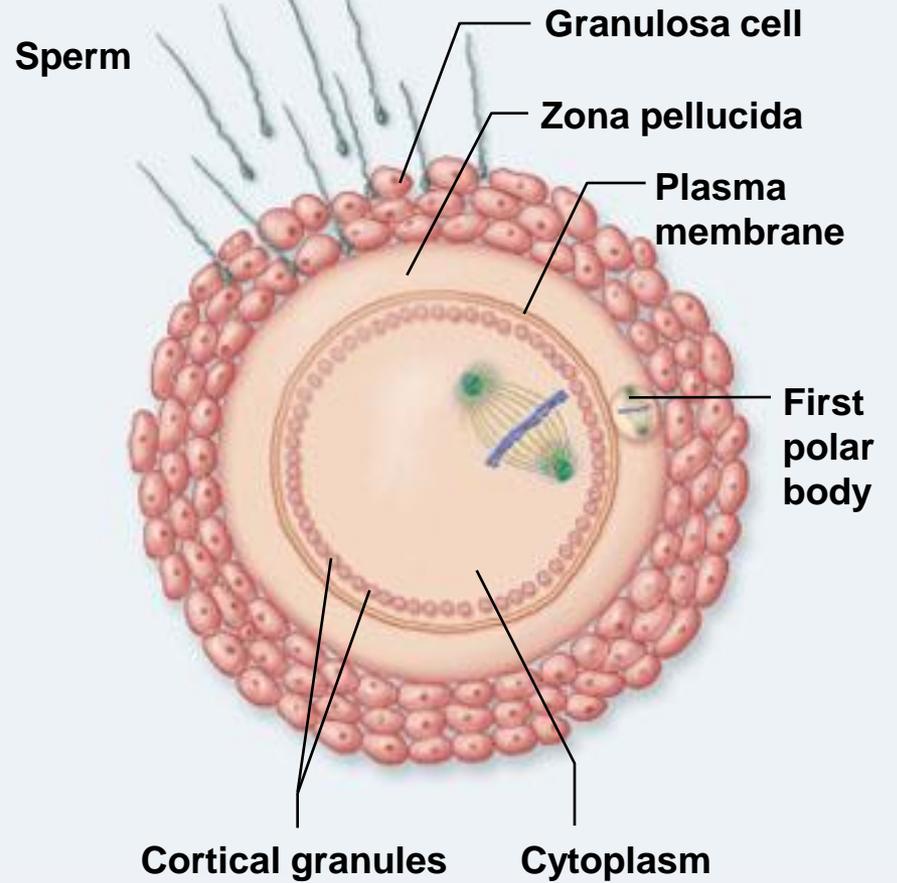
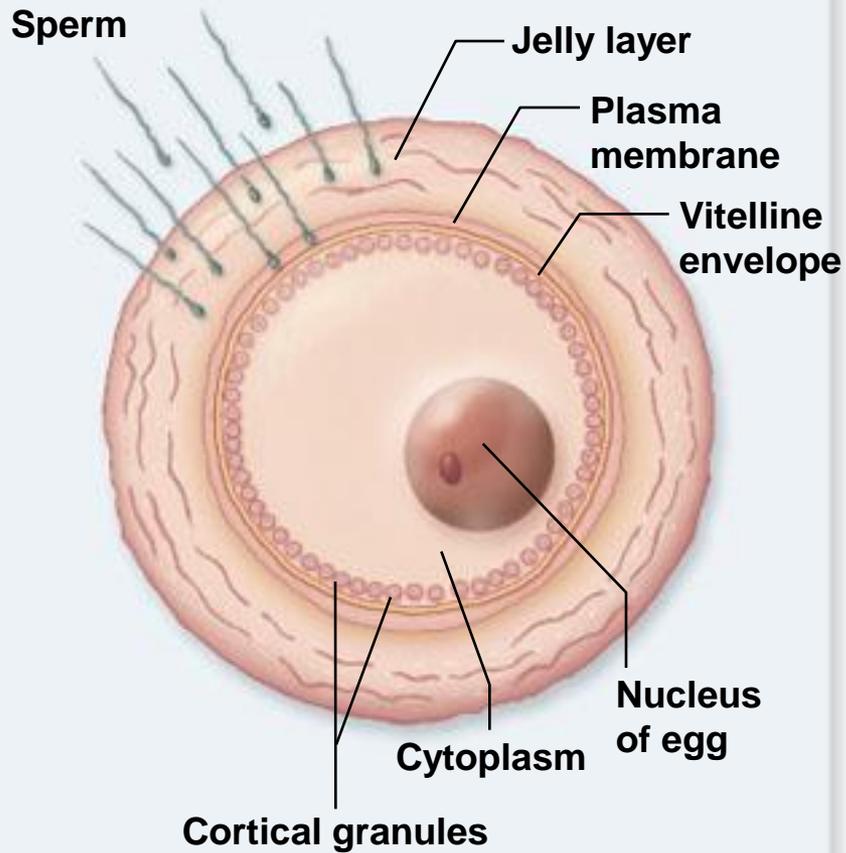
Egg activation

- Membrane fusion triggers egg activation by the release of Ca^{2+} which initiates changes in the egg
- A block to **polyspermy** occurs
 - Changes in egg's membrane potential
 - Alteration of egg's exterior coats
 - Enzymes from **cortical granules** remove sperm receptors

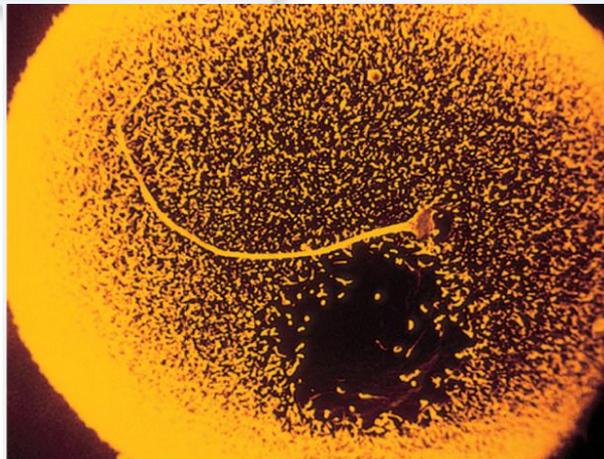
Fertilization: a multistep process

(zona pellucida=egg shell)





a.

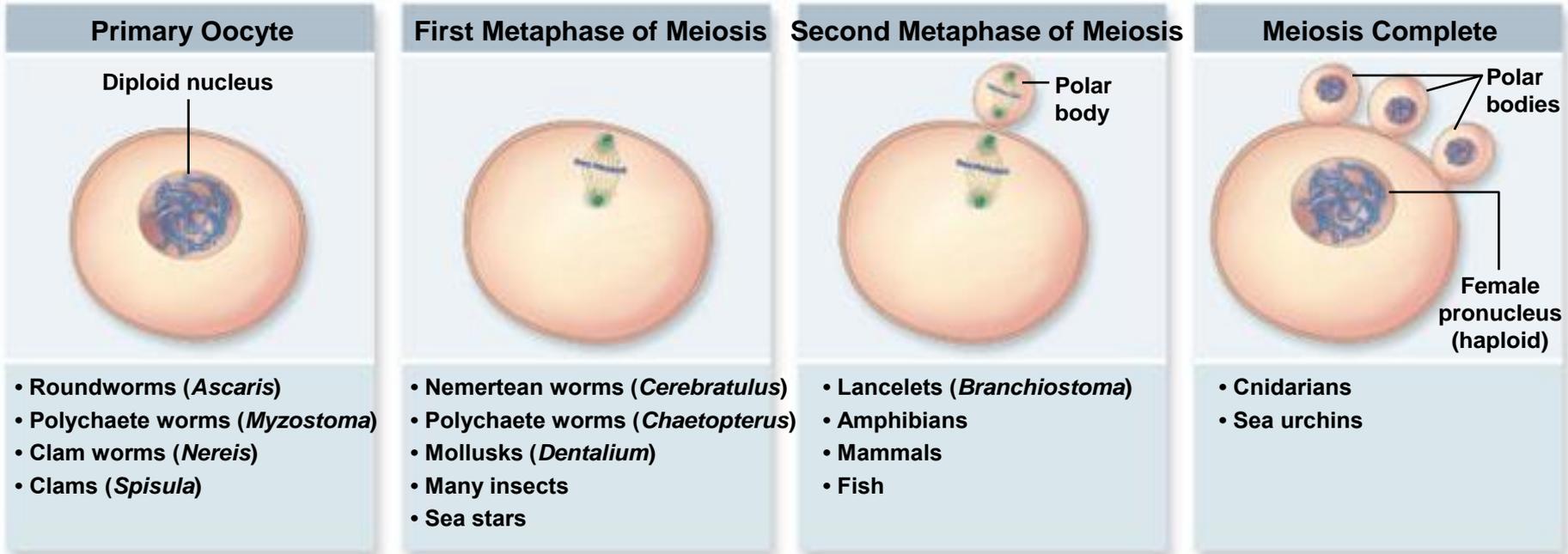


Fertilization

Egg activation

- Sperm penetration has three other effects
 1. Triggers the egg to complete meiosis
 2. Triggers a cytoplasmic rearrangement
 3. Causes a sharp increase in protein synthesis and metabolic activity in general

Fertilization

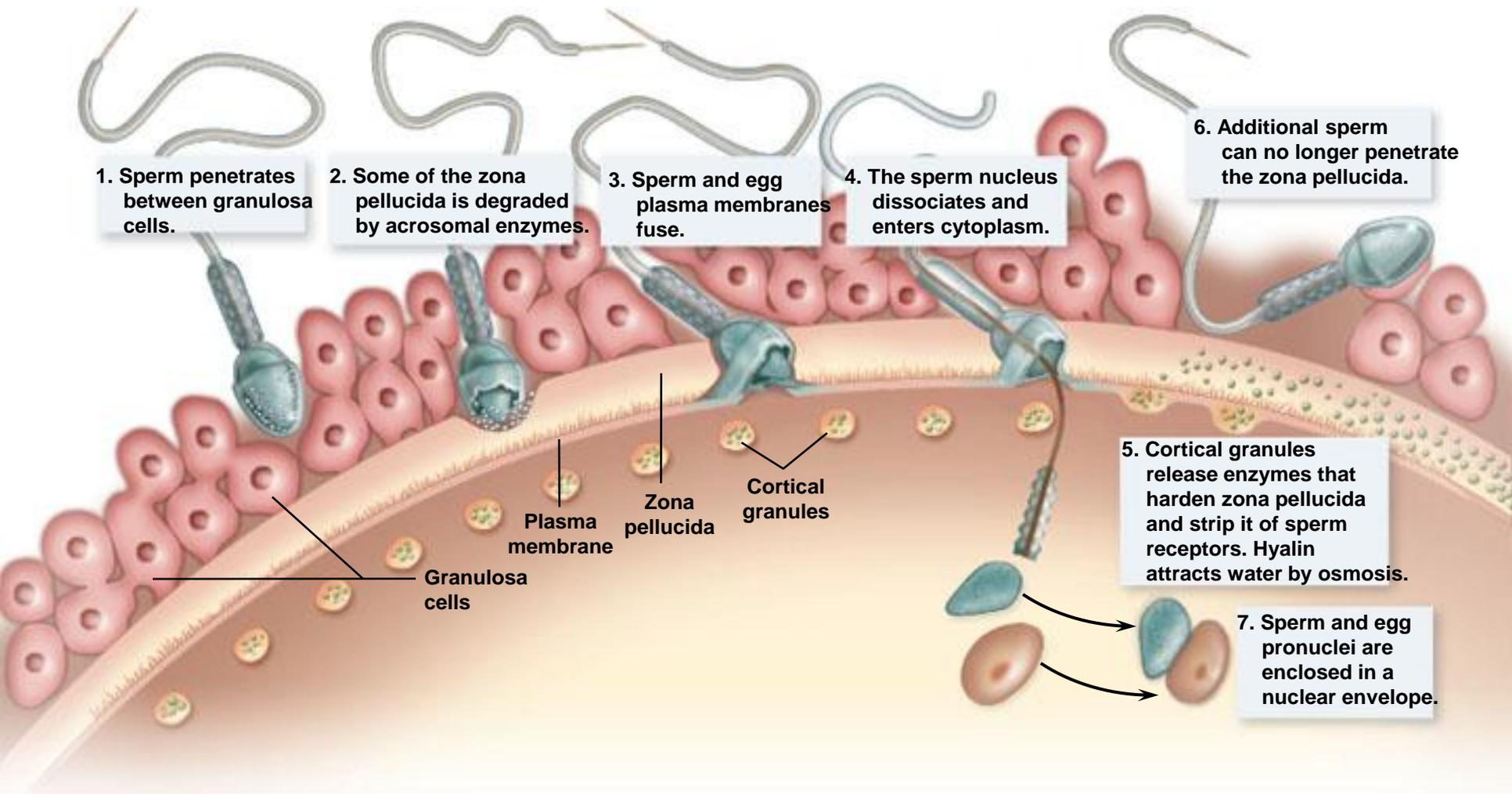


Fertilization

Fusion of nuclei

- The haploid sperm and haploid egg nuclei migrate toward each other along a micro-tubule based aster
- They then fuse, forming the diploid nucleus of the zygote

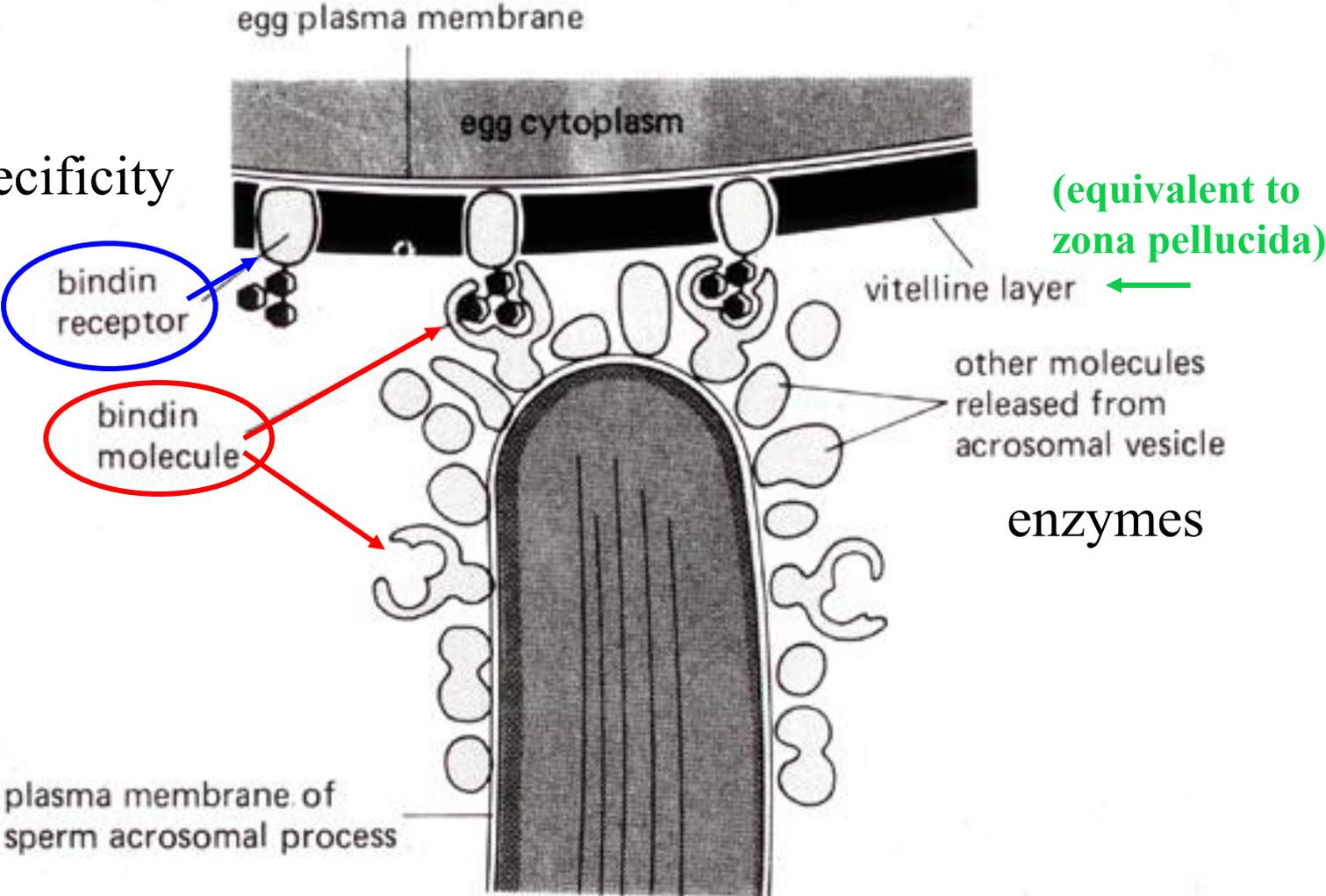
Fertilization



Sperm-eggshell contact triggers the acrosome reaction

Example 1-- the sea urchin

Species specificity



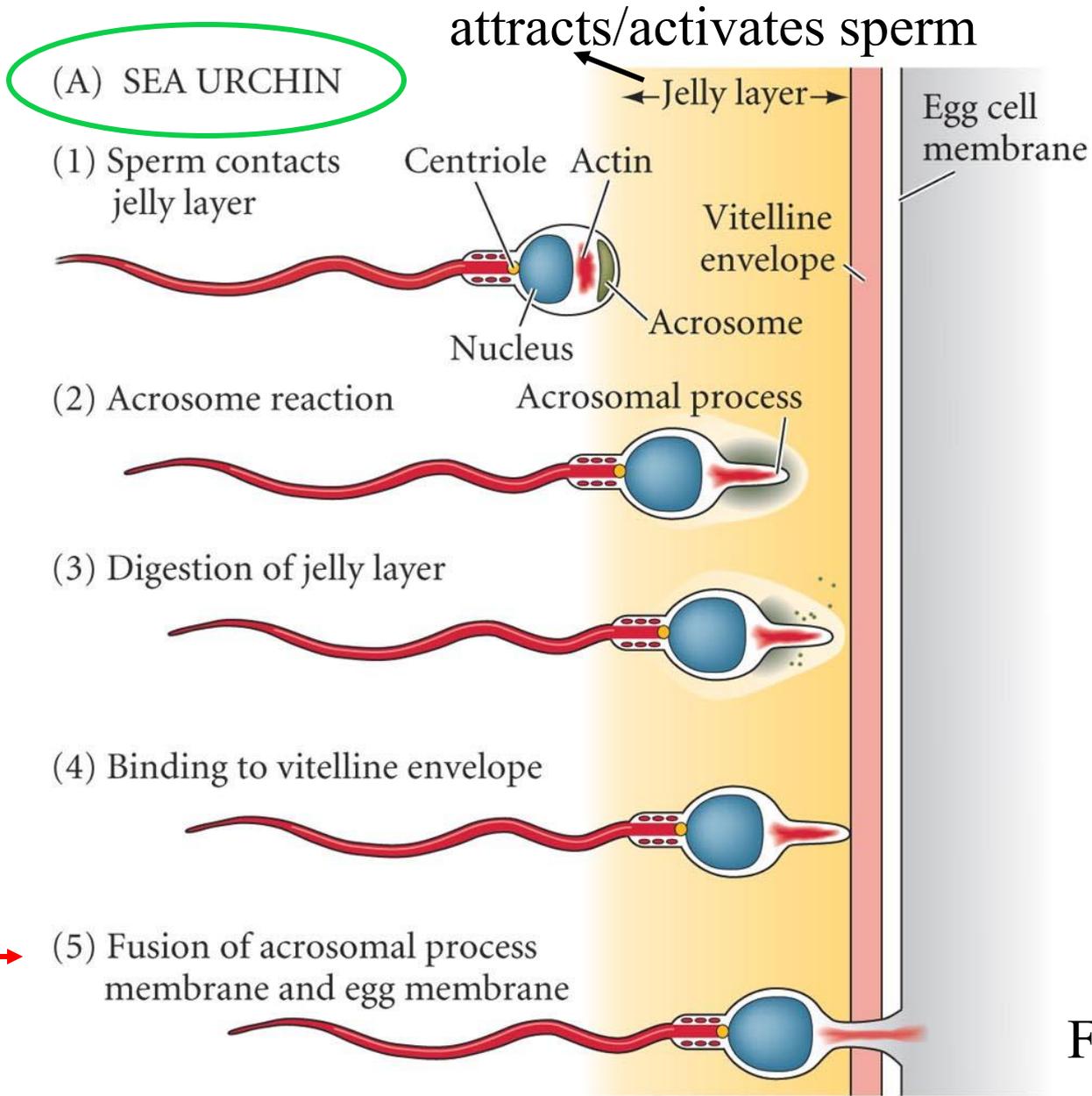


Figure 7.8

Sperm-eggshell contact triggers the acrosome reaction

Example 2: Mammals

Eggshell includes
ZP3/Sperm have
ZP3 receptor

