Fertilization and Cleavage: the start of making a new organism

Mitochondria in green, microtubules in red

Acrosomal protein

(B)  
(C)
7.4 Structure of the sea urchin egg at fertilization

7.9 Sperm chemotaxis in the sea urchin *Arbacia punctulata*

(A)  

(D)  

90 seconds later
7.11 The acrosome reaction in sea urchin sperm

7.17 Membrane potential of sea urchin eggs before and after fertilization (Part 2)
7.18 Formation of the fertilization envelope and removal of excess sperm
2.1 Developmental history of the leopard frog, *Rana pipiens*
10.3 Cleavage of a frog egg

Xenopus (frog) cleavages
Class 5, fertilization and onset of cleavage

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Diagram showing the stages of fertilization and cleavage in different species:

- **Fertilized Egg**
  - Sea urchin: Yolk platelets are evenly distributed.
  - Frog: Yolk is concentrated at the vegetal pole.
  - Chick: The embryo develops on top of the yolk as a disc of cells.
  - Drosophila: Multiple nuclear divisions result in a zygote with many nuclei.

- **2-Cell Stage**
  - Blastomeres

- **4-Cell Stage**
  - Blastomeres

- **8-Cell Stage**
  - Blastomeres

- **Complete Cleavage**
  - Early cleavage results in cells of similar size.

- **Incomplete Cleavage**
  - Cleavage is incomplete.

- **Superficial Cleavage**
  - The nuclei migrate to the periphery, and plasma membranes form between them.
8.1 Cell cycles of somatic cells and early blastomeres (Part 2)

Mitosis

Cyclin B

cdc2

Cyclin A

cdc2

Cyclin D

cdk

4/6

Interphase

G2

G1

S

8.1 Cell cycles of somatic cells and early blastomeres (Part 1)

Mitosis

Cyclin B

cdc2

Active cdc2 protein kinase

M

S

Inactive protein kinase

Cyclin degradation

Synthesis

Cyclin synthesis
The early embryonic cell cycle is different

- **standard cell cycle**
  - G₁
  - S
  - G₂
  - M
  - G₁
  - S
  - G₂
  - M

- **early embryonic cell cycle**
  - S
  - M
  - S
  - M
  - S
  - M
  - S

Rate of division changes

- **log₁₀ cells per embryo**
- **Gastrula**
- **Blastula**
- **Neurula**
- **Tailbud**
- **Tadpole**

- **hours 15°C**
- 0
- 2
- 4
- 6