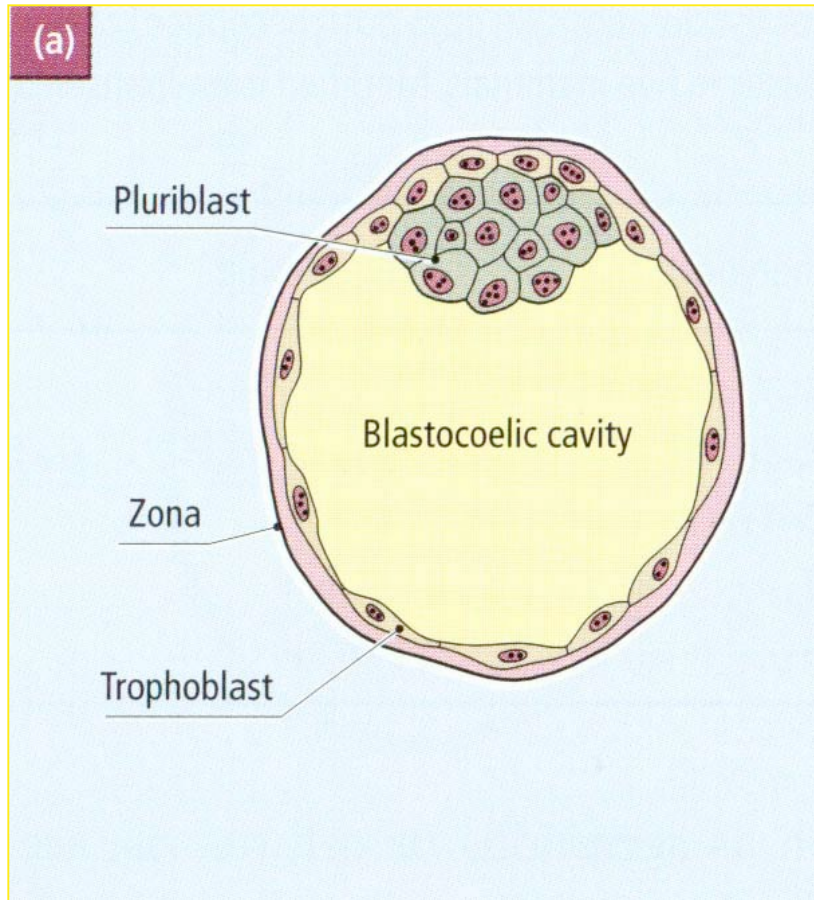




Early Embryonic Development

Zygote - Embryo

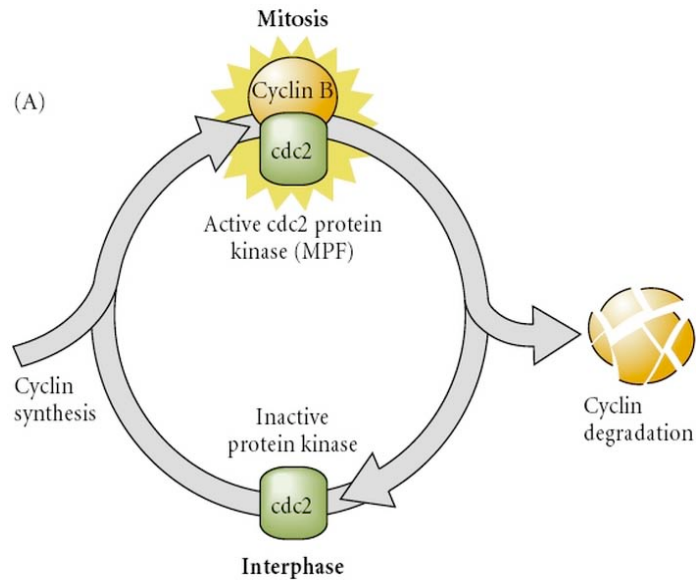
- two gametes fuse to produce **zygote**
- with first division **embryo** is produced

Cleavage

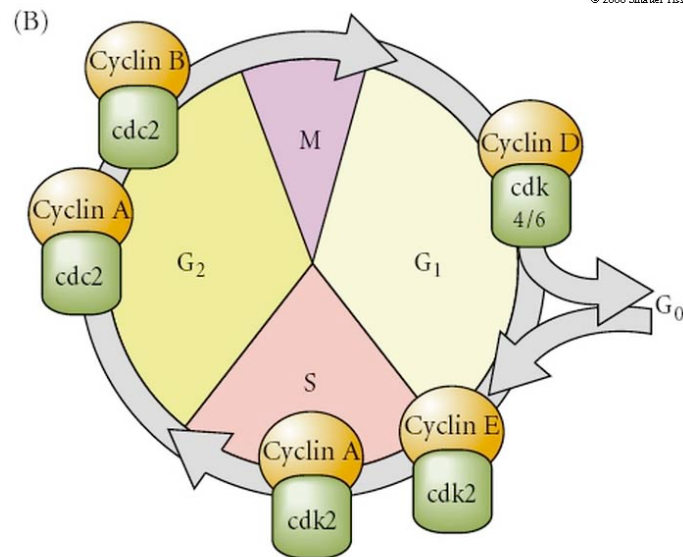
A series of mitotic divisions whereby a multicellular organism is formed

- Cells produced are called **blastomeres**
- Controlled by maternal mRNA and protein in most species
- Most species = no net gain in volume
 - allows rapid division
 - is accomplished by skipping the G1 and G2 growth period between mitotic divisions

Mitosis Promoting Factor

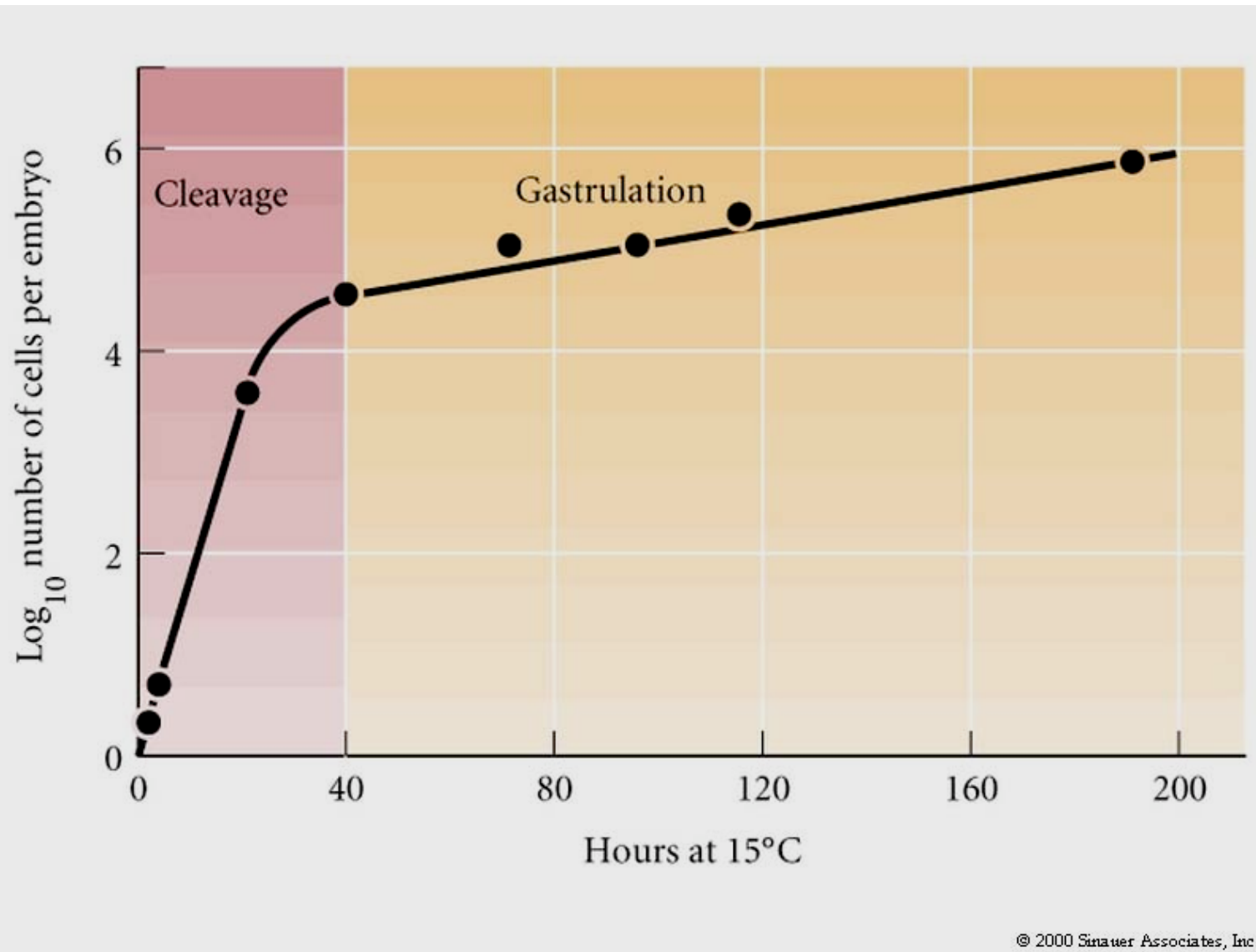


- Regulates biphasic cycle of early blastomeres
- Made up of two subunits
 - **Cyclin B**: accumulates during S phase and degrades following M phase
 - **Cyclin-dependent kinase (cdc2)**: phosphorylates key proteins involved w/ mitosis



Cleavage

- Rapid exponential increase in cell #
 - Frog egg divides into 37,000 cells in 43 hrs
 - 1 cleavage/hr
 - Drosophila-50,000 cells in 12 hrs
 - 1 division every 10 mins for 2 hrs
- Initially synchronous until mid-blastula transition
 - Growth phases added
 - Synchronicity lost
 - New mRNA transcribed

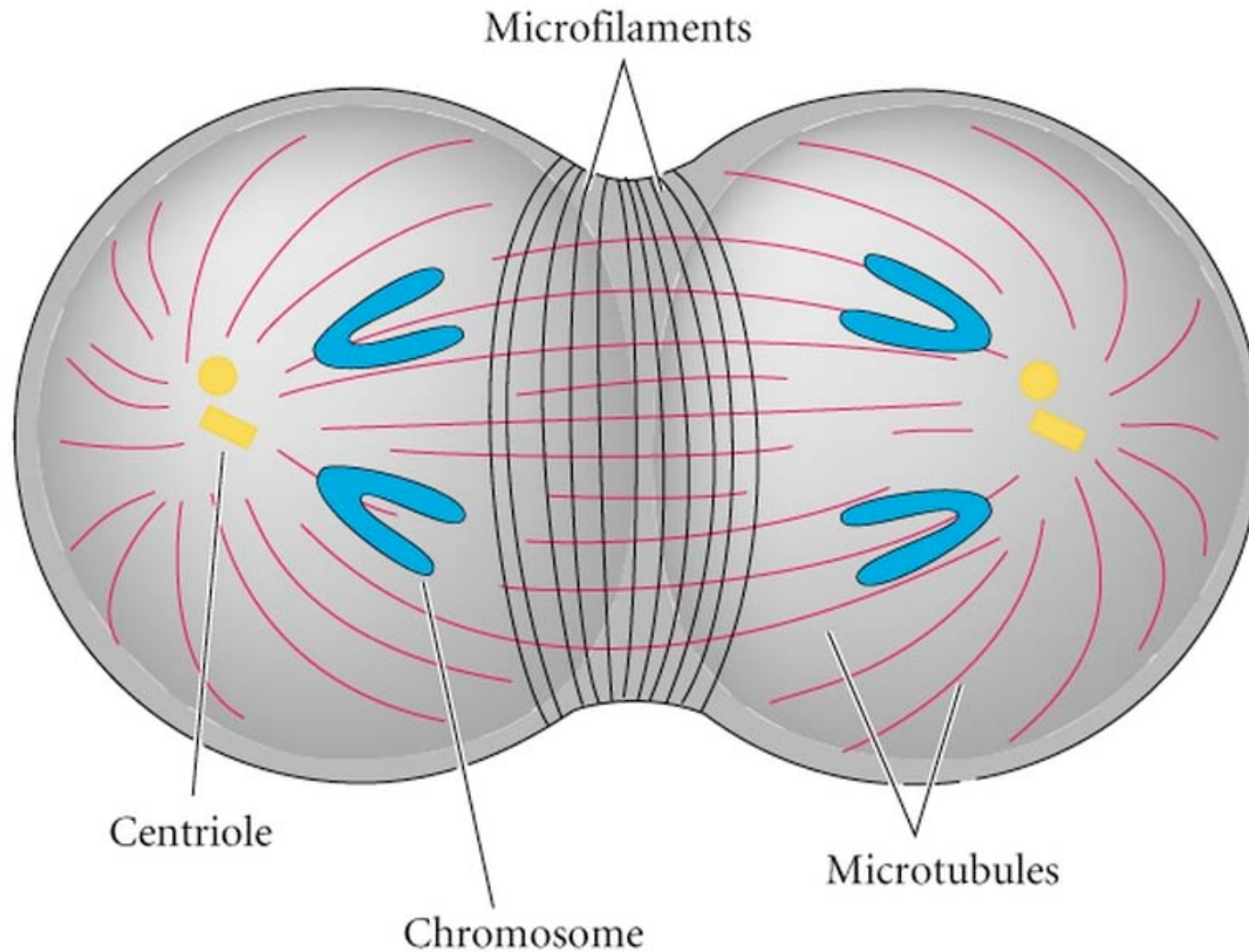


Rate of formation of new cells in the frog
Rana pipiens

Mechanism of Mitosis

- Result of two coordinated processes
 - Karyokinesis
 - Mitotic spindle of tubulin microtubules
 - Draws chromosomes to centrioles
 - Cytokinesis
 - Contractile ring of actin microfilaments
 - Creates cleavage furrow

Cleavage Furrow



Amount of Yolk in Oocyte

- **POLYLECITHAL or MEGALETHICAL** - large amount of yolk
 - found in elasmobranchs, teleost fishes, reptiles, birds
- **MESOLECITHAL** - moderate yolk
 - found in frogs and salamanders
- **OLIGOLECITHAL OR MICROLECITHAL** - little or no yolk
 - echinoderms, cephalochordates (*Amphioxus*), urochordates (tunicates), prototherian mammals

Location/Distribution of yolk

- a. **CENTROLECITHAL** - centrally located
 - found in arthropods, many insects
- b. **TELOLECITHAL** - at a vegetal pole
 - these eggs have animal pole with "active" cytoplasm thickened below which lies the maternal pronucleus
 - thickened regions called **BLASTODISC**
 - common in mega- and mesolecithal eggs
- c. **ISOLECITHAL OR HOMOLECITHAL** - yolk evenly distributed
 - common in oligolecithal eggs
 - marsupial mammals

General Patterns of Cleavage

- **HOLOBLASTIC CLEAVAGE**
 - complete, equal daughter cells
 - common in micro- and mesolecithal eggs
- **MEROBLASTIC OR DISCOIDAL CLEAVAGE**
 - only blastodisc divides
 - megalecithal eggs

For Example

Mammals

- Oligolecithal
- Isolecithal
- Holoblastic
- Rotational

-Amount-

-Distribution-

-Pattern-

-Symmetry-

Birds

- Megalecithal
- Telolecithal
- Meroblastic
- Discoidal

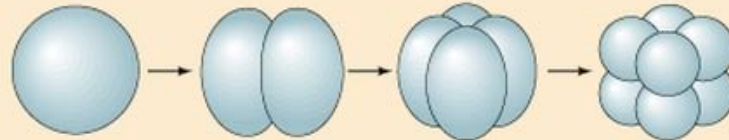
Patterns of Cleavage

I. HOLOBLASTIC

A. Isolecithal

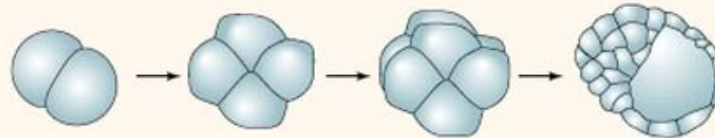
1. Radial

Echinoderms, amphioxus



4. Rotational

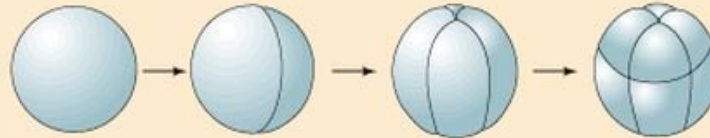
Mammals, nematodes



B. Mesolecithal

Radial

Amphibians

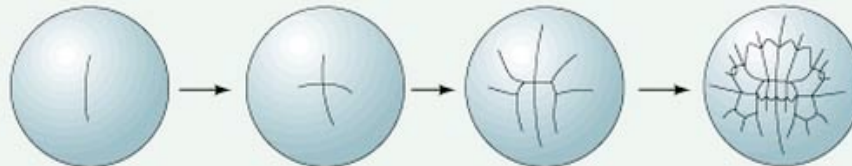


II. MEROBLASTIC

A. Telolecithal

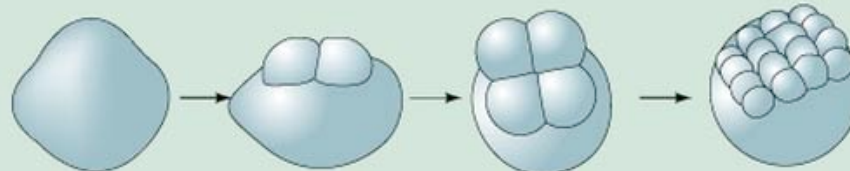
1. Bilateral

Cephalopod molluscs



2. Discoidal

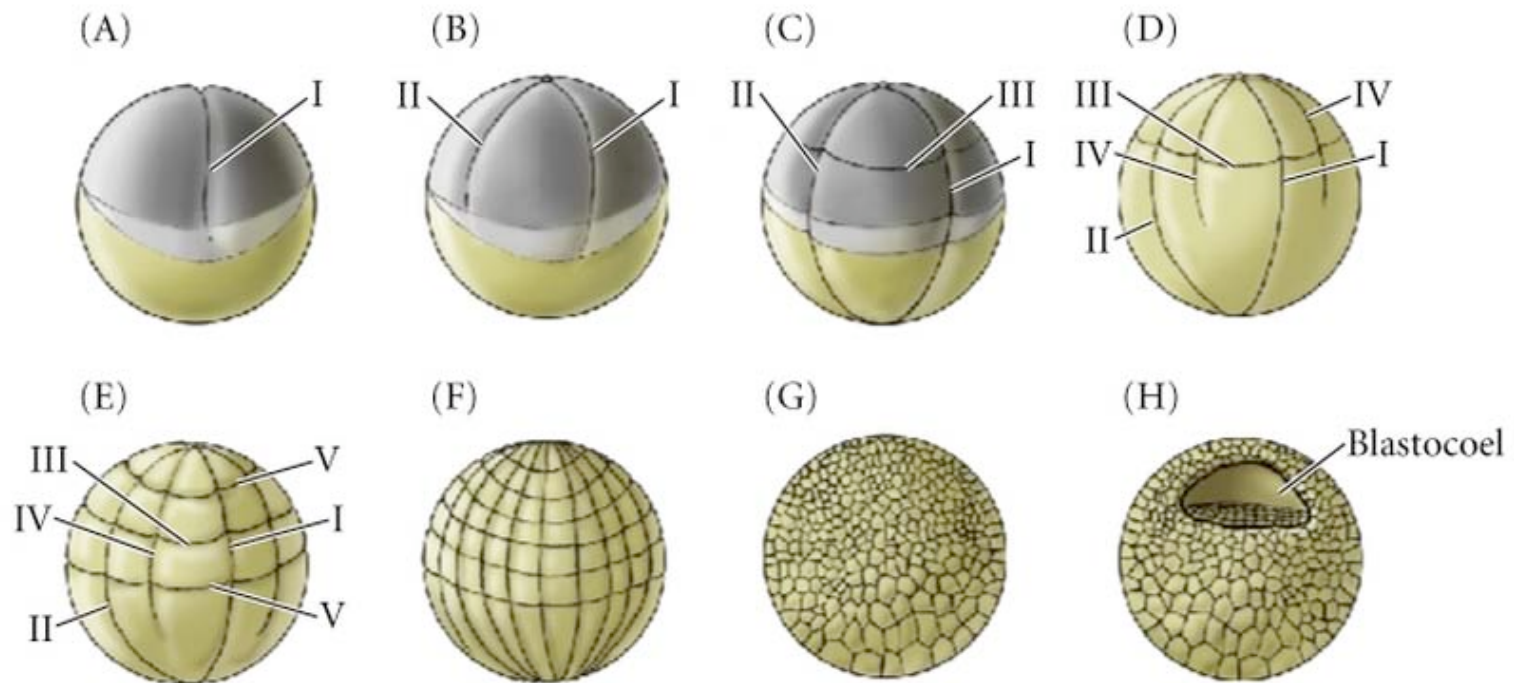
Fish, reptiles, birds



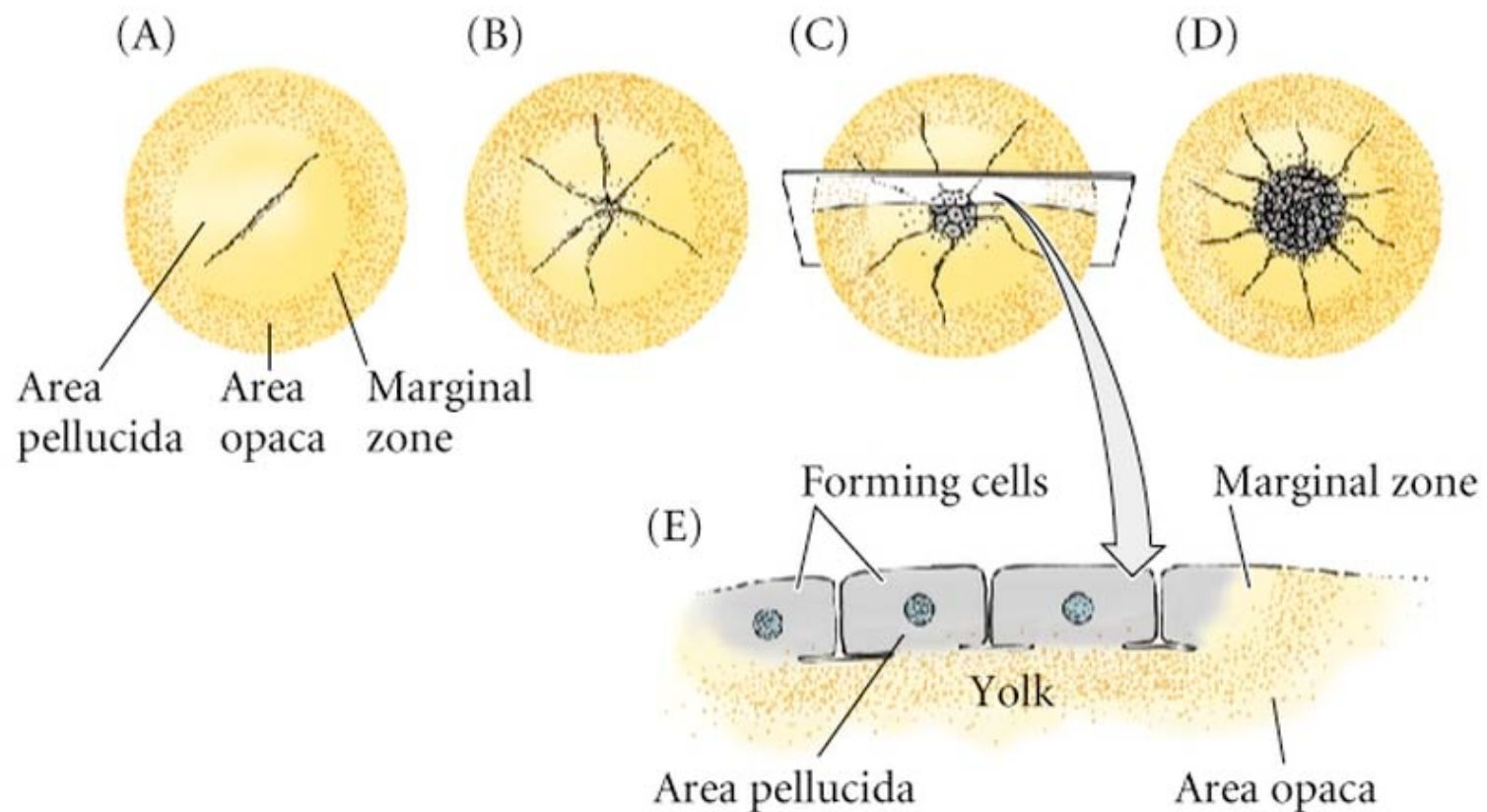
Cleavage-The Big Picture

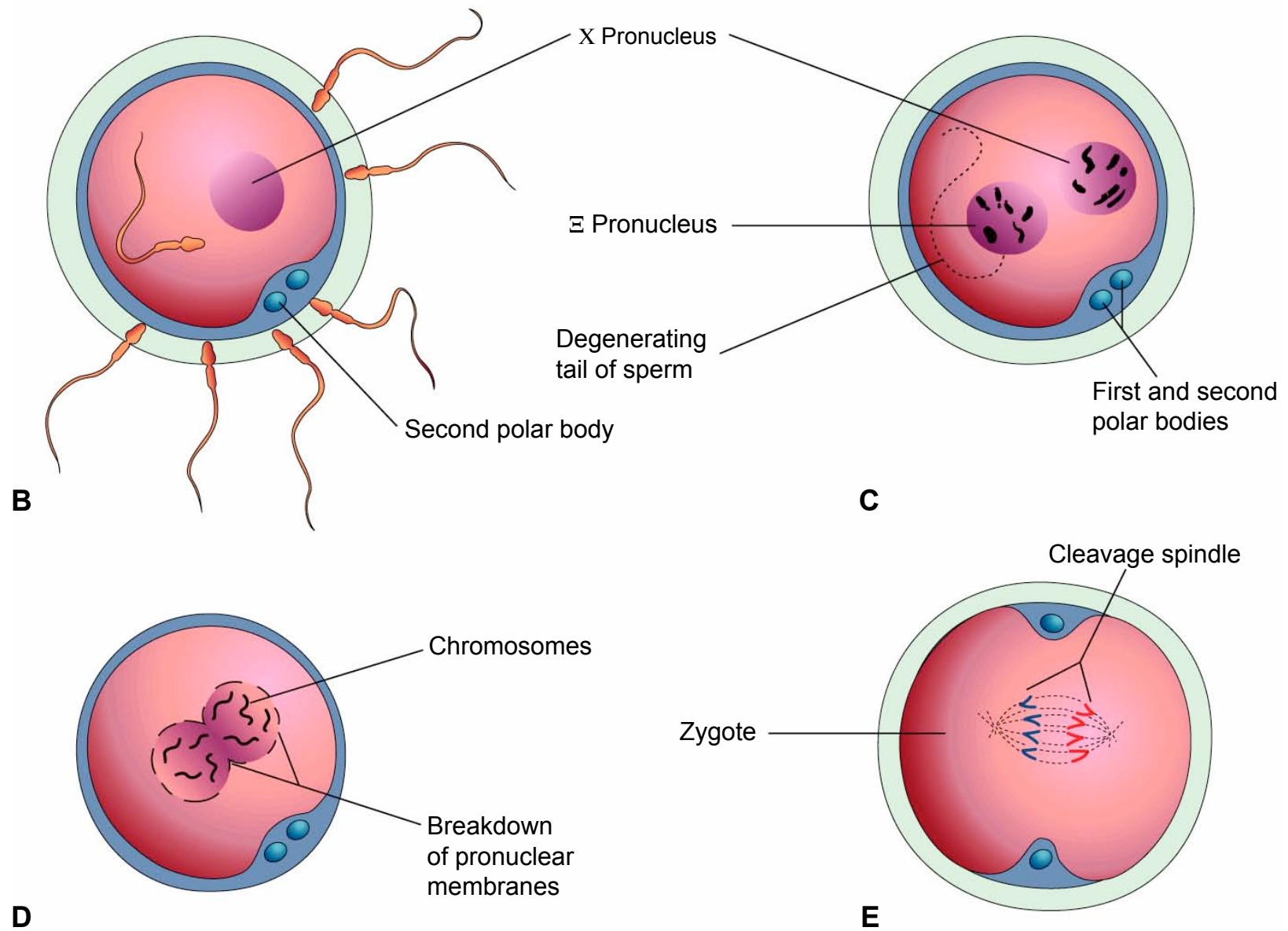
- Series of cytoplasmic divisions w/out growth
- Initially forms a solid mass of cells known as the **morula**
- A fluid-filled cavity forms w/in the morula called the **blastocoel**
- The hollow ball of cells is now known as the **blastula**

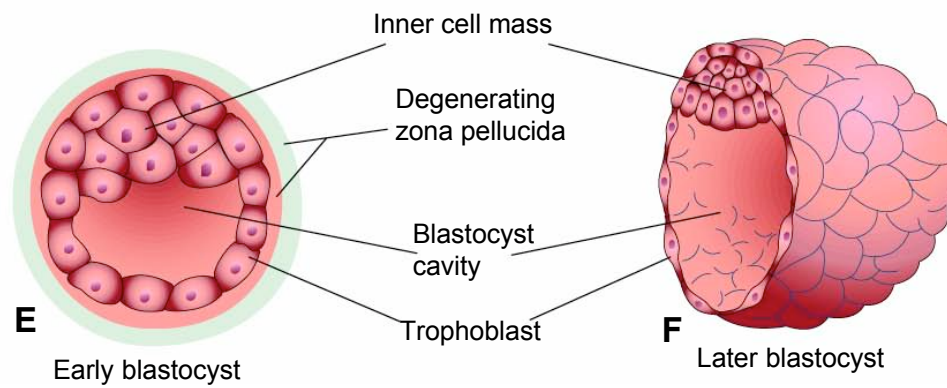
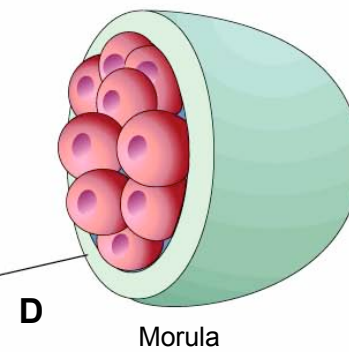
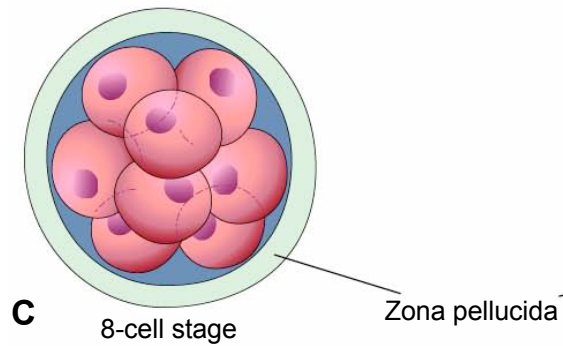
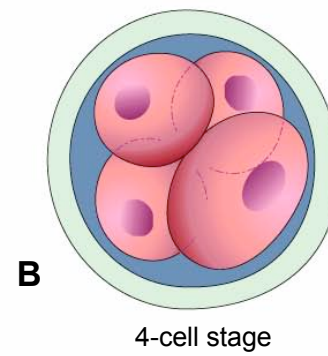
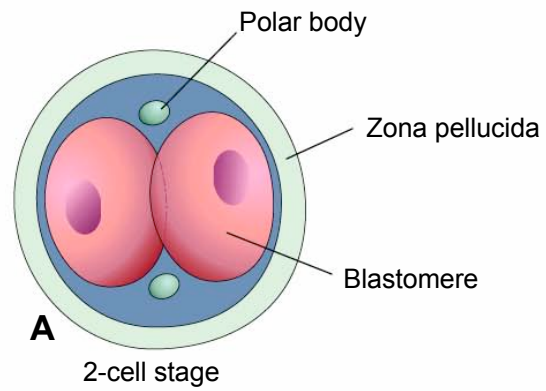
Meroblastic radial cleavage in frogs w/ mesolecithal yolk

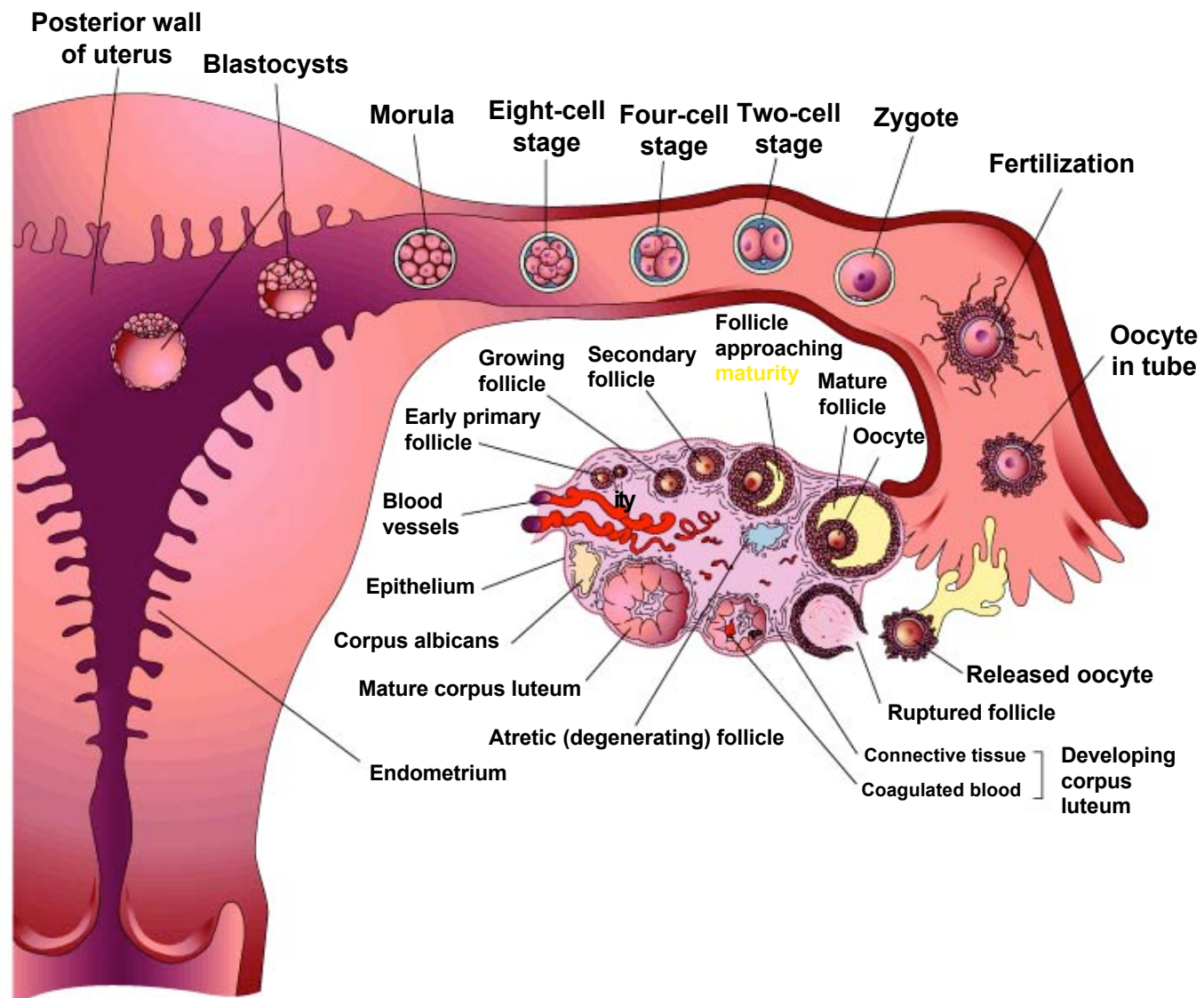


Meroblastic bilateral cleavage in birds w/ telolecithal yolk



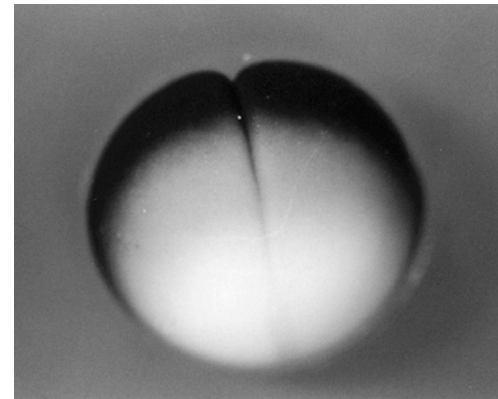






Mammals - Humans

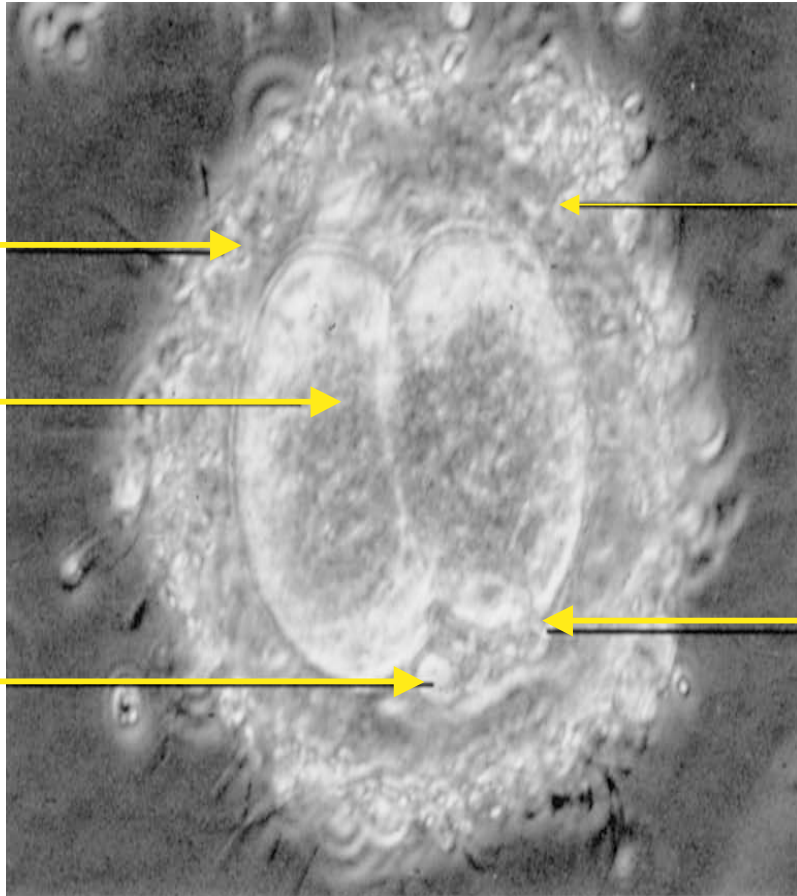
- Blastula also forms
 - Inner cell mass = embryo
 - Trophoblast - placenta



Corona radiata
(composed of follicular cells)

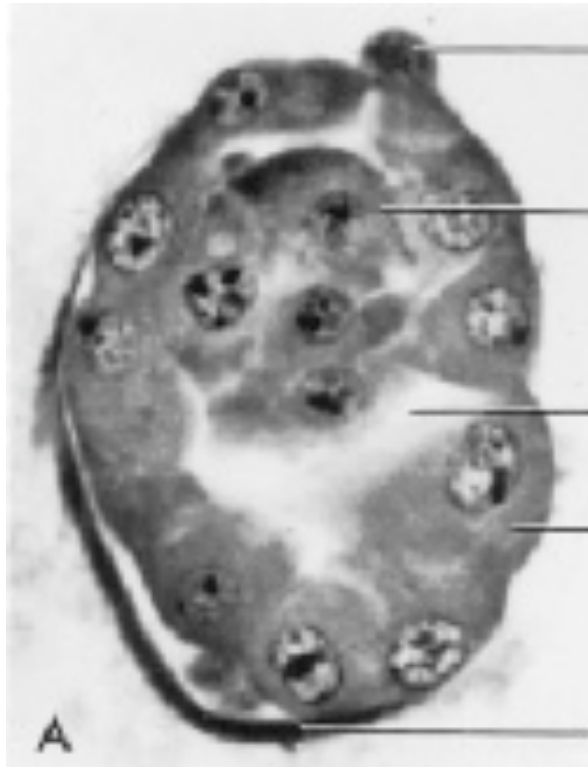
Blastomere

Polar body
(nonfunctional cell)



Degenerating sperm

Zona pellucida



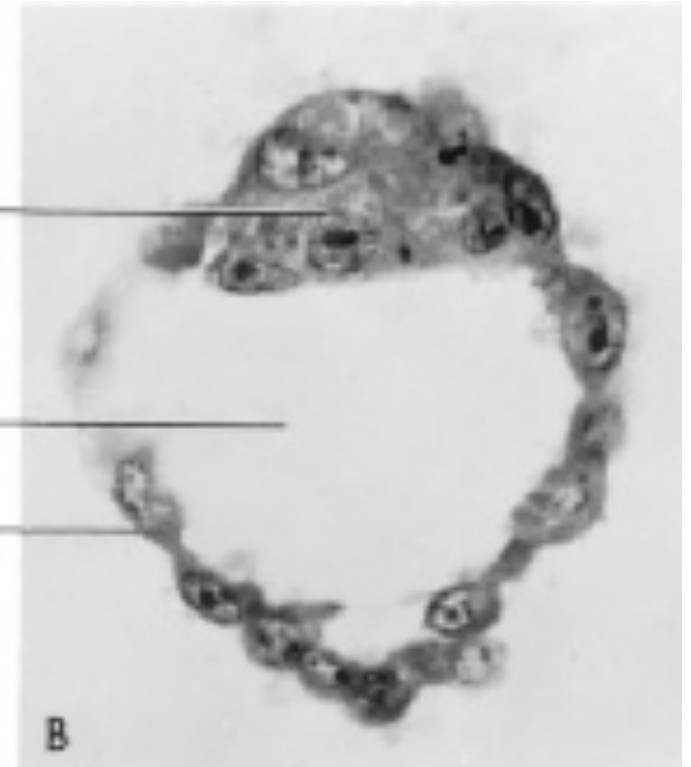
Polar body

Inner cell mass

Blastocyst cavity

Trophoblast

Remnant of zona pellucida



B