

Sea Star Development

- phylum Echinodermata → spiky skin animals
- gametes $\left\{ \begin{array}{l} \text{egg} \\ \text{sperm} \end{array} \right.$ → released into the sea water

- swarms of the sea stars will release the gametes to the sea water

↳ AKA spawning

→ the fertilization occurs externally (in the water)

→ the egg is hatched larvae form part of the plankton

↳ marine animals feed on

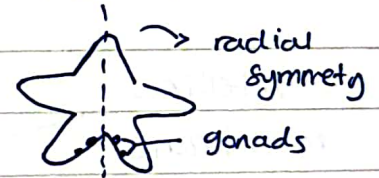
Sea Star Gonads

↳ can't know from the external part of the sea star

- The sea star has radial symmetry

→ each arm has 2 gonads

↳ located near the central disc



- The sperm & egg is released from the sea star through the gonopore

Sea Star unfertilized egg

↳ contain little amount of fine yolk-granules (oligolecithal/microlecithal) & distributed equally (isolecithal)

- why is the amount of yolk granules important?

↳ it affects the process of cleavage AKA the division of the fertilized egg

Type of cleavage

- 1) Holoblastic cleavage (complete cleavage)

↳ little amount of yolk-granules

→ result in two equal blastomeres

2) Meroblastic cleavage (incomplete cleavage)

↳ medium amount of yolk granules

→ result in two macro blastomeres & many micro blastomeres

Unfertilized egg shape

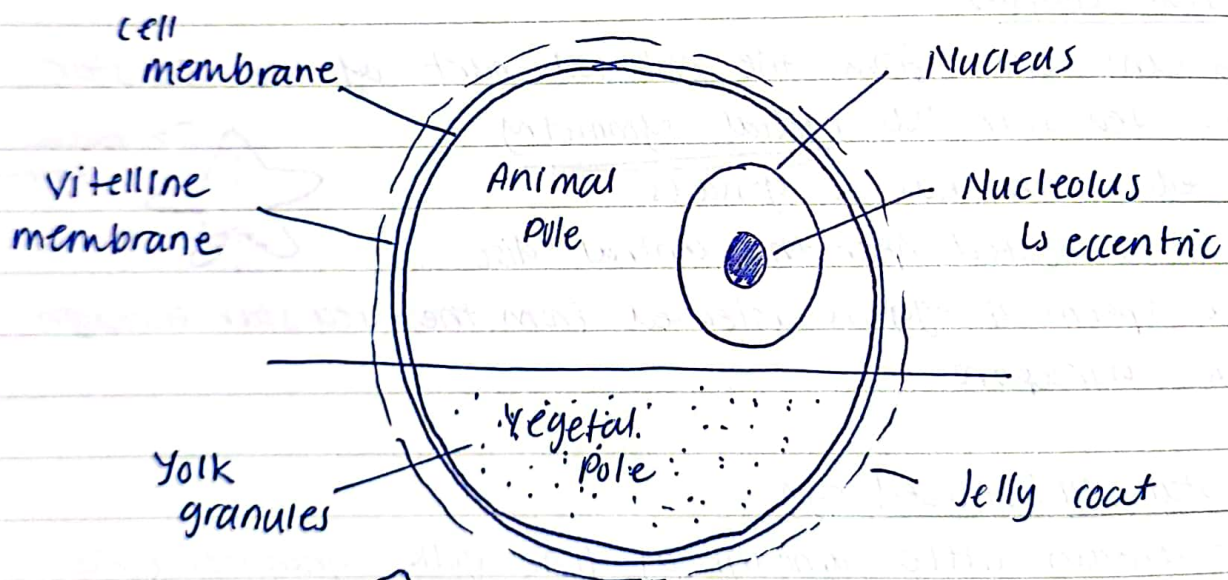
↳ spherical & enclosed in a jelly coat

→ jelly coat contain carbohydrates

↳ swell upon contact with water

→ contain chemotaxis

↳ attract & speed up the sperm swimming motion



acrosome - contain enzymes that will digest the vitelline membrane & cell membrane & the jelly coat

→ reside in a place called the spermatone

• How can unfertilized egg be identified?

1) Presence of a large nucleus (spherical) at the animal pole with eccentric nucleolus

2) lack of fertilization membrane

↳ elevated vitelline membrane

Fertilized egg shape

↳ after fertilization & cortical reaction

→ release of enzymes that will separate the vitelline membrane from the cell membrane

↳ the elevated vitelline membrane is now called the fertilization membrane

• The egg releases peroxides (H_2O_2) which prevent polyspermy

• How can fertilized egg be identified?

1) presence of the fertilization membrane

2) nucleus not easily detected

↳ due to the formation of the spindle microtubules

3) presence of a polar body

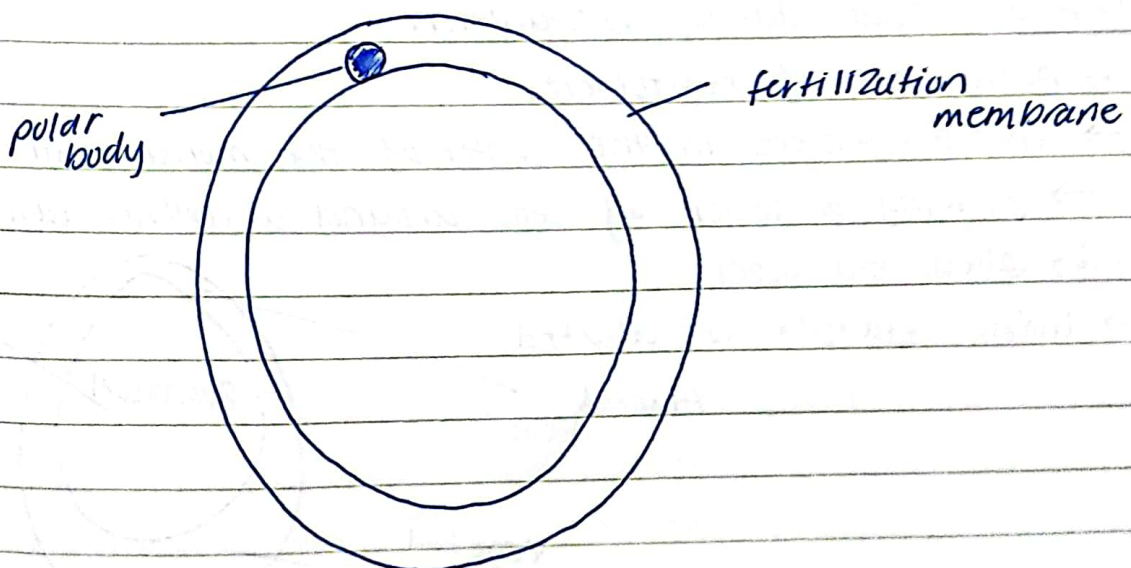
Significance of fertilization

1) restores the $2n$ of * chromosomes

2) induce genetic variation

3) activate the egg to start cleavage

↳ the * of blastomere will increase but the size of the blastomere will decrease

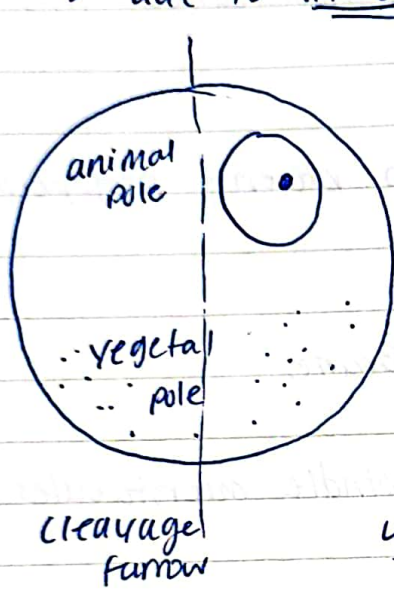


Types of cleavage in sea star egg

1) Holoblastic cleavage AKA Complete cleavage

↳ the cleavage furrow will pass from the animal pole to the vegetal pole

→ due to little amount of yolk



1st cleavage (vertical)

↳ result in 2 blastomeres

2nd cleavage (vertical)

↳ result in 4 blastomeres

3rd cleavage (equatorial / horizontal)

↳ result in 8 blastomeres

↳ perpendicular to the 1st & 2nd cleavage furrows

4th cleavage (vertical)

↳ result in 16 blastomeres

Morula - ball of solid cells

→ no cavity between the blastomeres

↳ 32, 64, 128 blastomeres

• WHY does the sea star have a larvae stage?

due to the little amount of yolk present in the cytoplasm

→ the larvae will swim in the water & feed it self

↳ later it will metamorphose into a sea star

Blastula - occurs during blastulation

↳ hollow ball of blastomeres

→ the blastomeres in the center of the morula will lose adhesion

→ forming a layer of cells around a central cavity

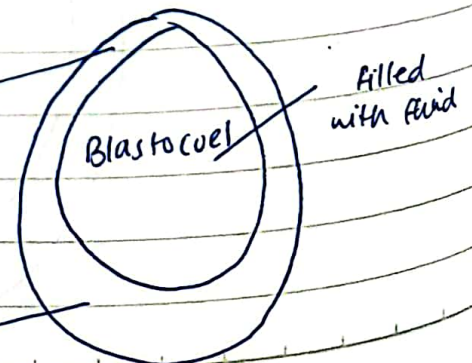
↳ called blastocoel

↳ living blastula is ciliated

Animal pole

Vegetal pole

↳ thicker



Gastrula - occur during gastrulation

↳ where the three primary germ layers will be formed

→ the vegetal pole flattens

→ the outer layer will form the ectoderm

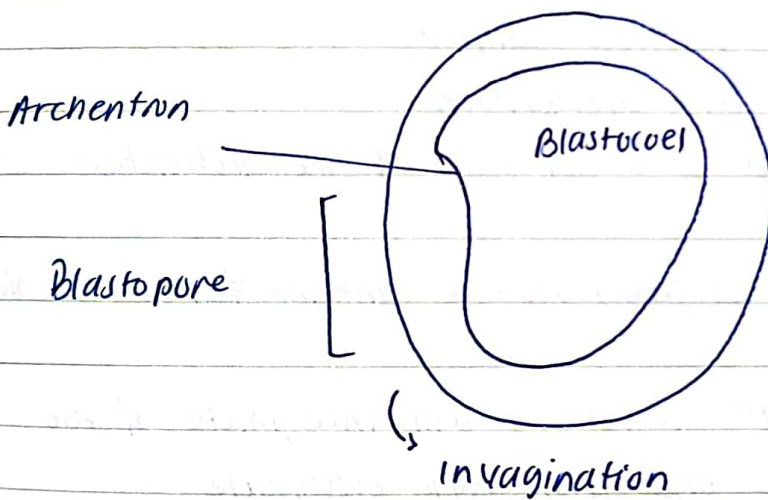
→ the invagination of the vegetal pole cells towards the blastocoel will form the endoderm

↳ continuous invagination will result in the formation of a tube with an opening → blastopore

↳ Archenteron → digestive system → future anus

↳ AKA primitive gut

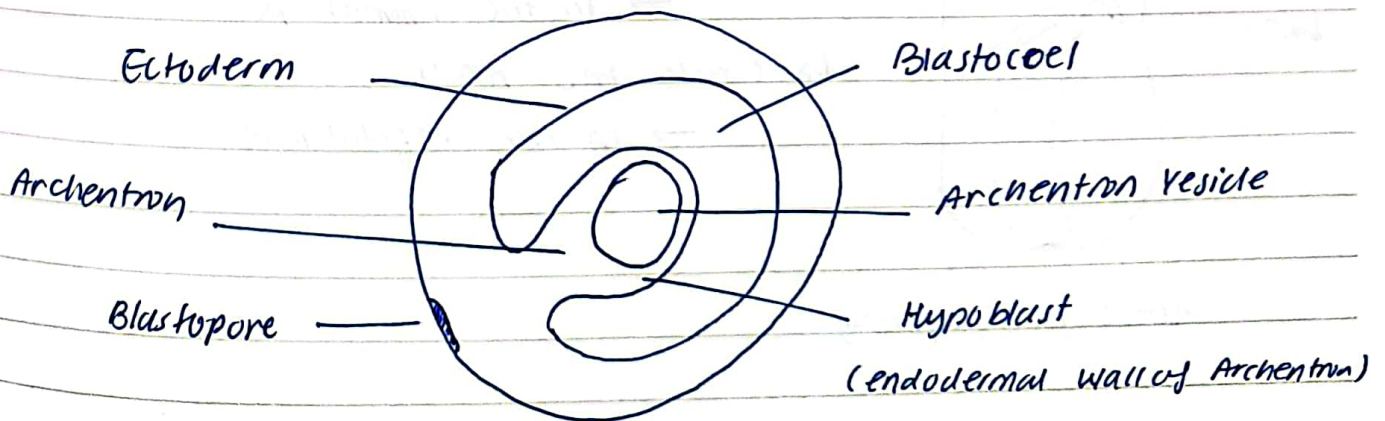
Early Gastrula



hypoblast - internal layer of cells

↳ give rise to endoderm and mesoderm germ layers

Mid Gastrula



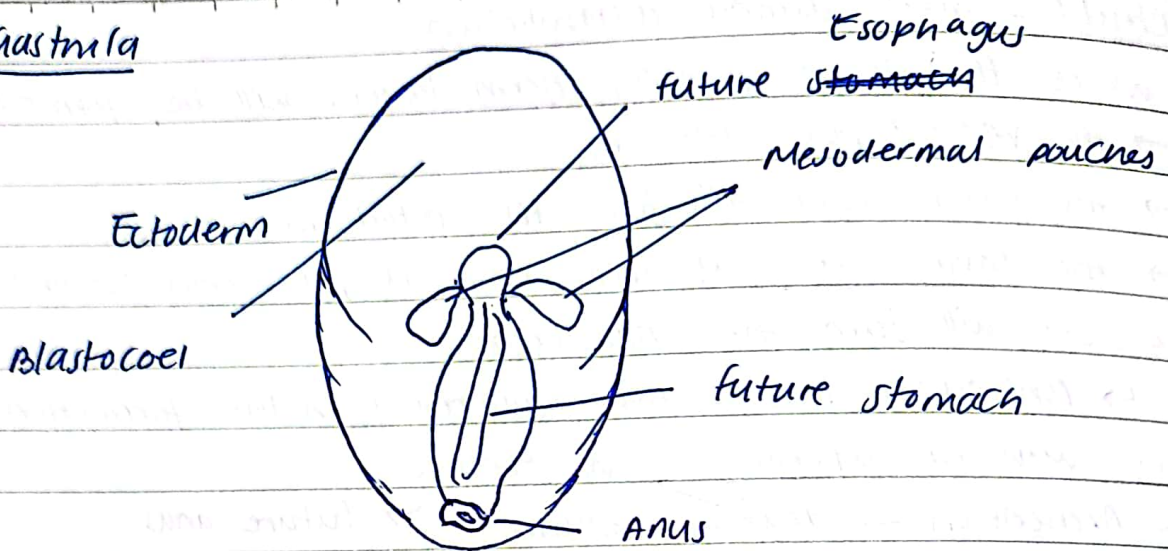
• evagination (protrusion) on each side to form mesoderm

↳ out-pockets (2 mesodermal pouches)

→ form the hypoblast

↳ AKA enterocoelic pouches

Late Gastrula



derm

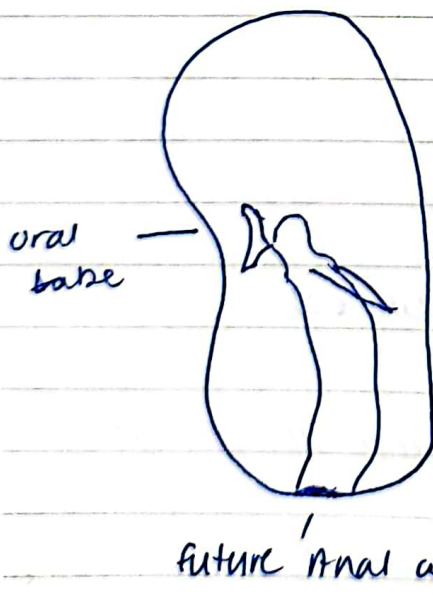
- All three ^ layers are visible

↳ ectoderm - form outside surface

↳ endoderm - line the archenteron

↳ mesoderm - located on either side of the archenteron

- The gastrula elongates (grow) in the anterior & posterior sides



The ectoderm will invaginate & the endoderm will evaginate

↳ creating the oral lobe

→ In the animal pole

↳ create the ANUS

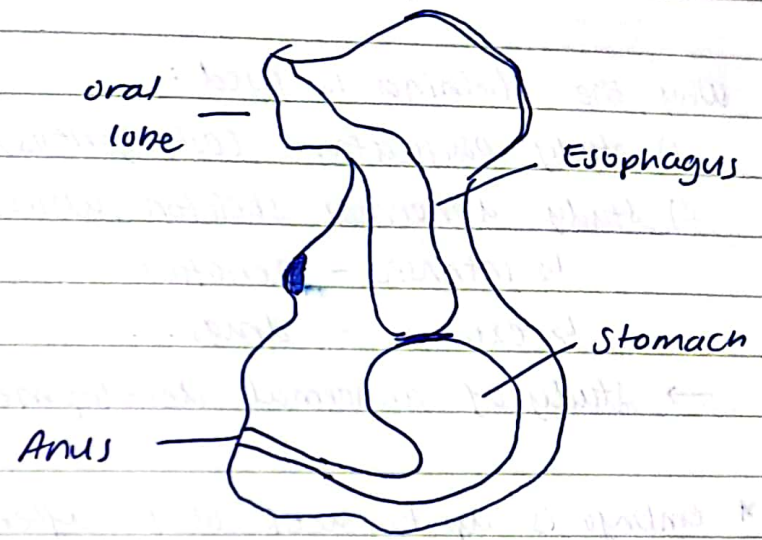
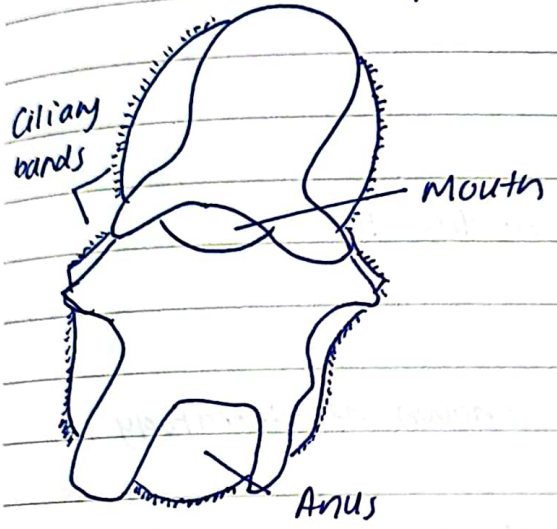
→ In the vegetal pole

Bipinnaria larvae (2-ciliary bands)

↳ ciliated stage & contain the

→ metamorphose into Brachiolaria larva

mouth
digestive system
anus



Brachiolaria larva

↳ adhesive arms with suckers

→ metamorphose into a sea star

↳ in 25 days