

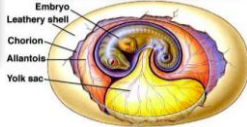





Chapter 42-43 Animal Reproduction

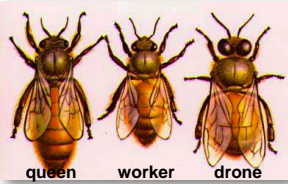
Sexual vs. Asexual Reproduction

- **Asexual**
 - ◆ offspring all have same genes
 - ◆ no variation
- **Sexual**
 - ◆ gametes (sperm & egg) → fertilization
 - ◆ mixing of genes → variation

Parthenogenesis


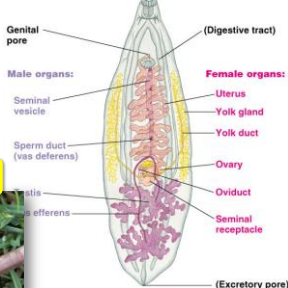
- **Development of an unfertilized egg**
 - ◆ honey bees
 - drones = males produced through parthenogenesis → haploid
 - workers & queens = females produced from fertilized eggs → diploid



Hermaphrodites

- **Having functional reproductive system of both sexes**

earthworms mating

flat worm


Fertilization

- **Joining of egg & sperm**
 - ◆ external
 - usually aquatic animals
 - ◆ internal
 - usually land animals



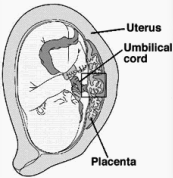

Development

- **External**
 - ◆ development in eggs
 - ◆ fish & amphibians in water
 - soft eggs = exchange across membrane
 - ◆ birds & reptiles on land
 - hard-shell amniotic eggs
 - structures for exchange of food, O₂ & waste
 - ◆ sharks & some snakes
 - live births from eggs
- **Internal**
 - ◆ placenta
 - exchange food & waste
 - ◆ live birth

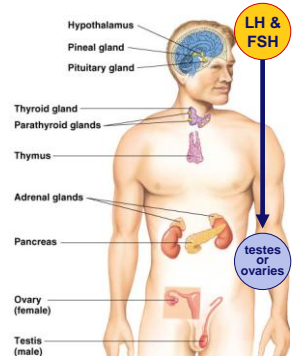
Adaptive advantages?

- What is the adaptive value of each type of sexual reproduction
 - ◆ number of eggs?
 - ◆ level of parental care
 - ◆ habitat?

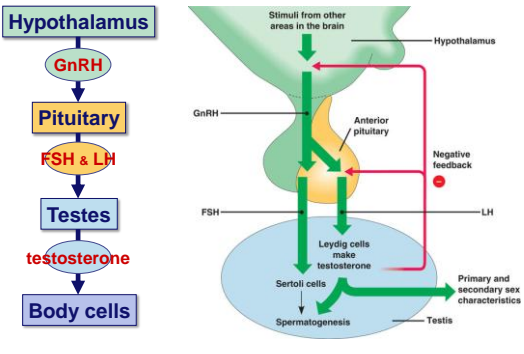


Reproductive Hormones

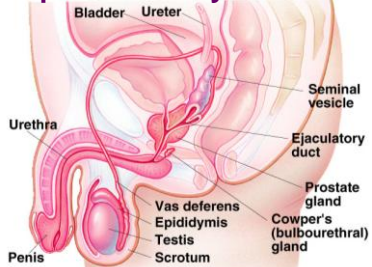
- **Testosterone**
 - ◆ from testes
 - ◆ functions
 - sperm production
 - 2° sexual characteristics
- **Estrogen**
 - ◆ from ovaries
 - ◆ functions
 - egg production
 - prepare uterus for fertilized egg
 - 2° sexual characteristics



Sex Hormone Control in Males



Male Reproductive System

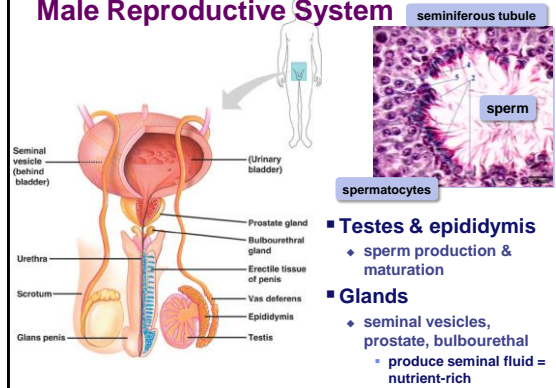


- **Sperm production**
 - ◆ over 100 million produced per day!
 - ◆ ~2.5 million released per drop!

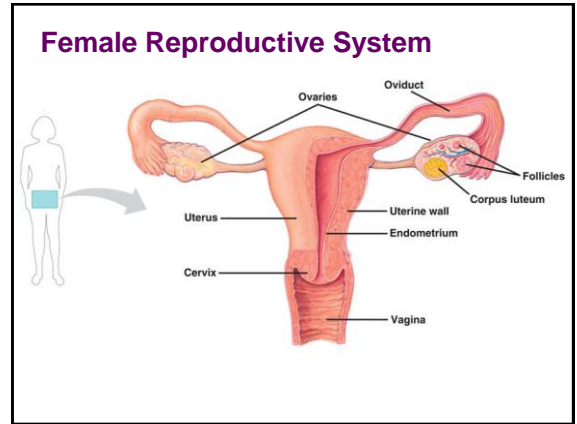
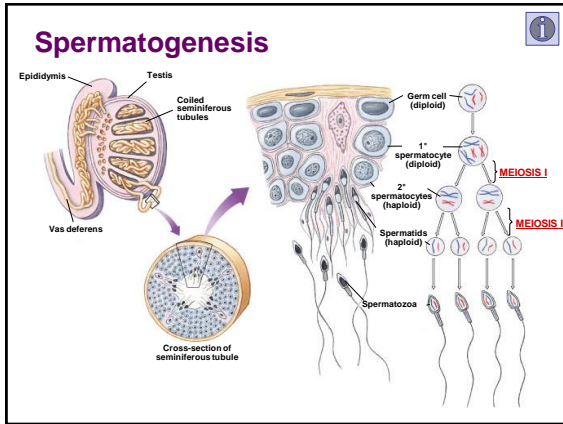
Male Reproductive System

- **Testicles**
 - ◆ produces sperm & hormones
- **Scrotum**
 - ◆ sac that holds testicles outside of body
- **Epididymis**
 - ◆ where sperm mature
- **Vas deferens**
 - ◆ tubes for sperm to travel from testes to penis
- **Prostate, seminal vesicles, Cowper's (bulbourethral) glands**
 - ◆ nutrient rich fluid to feed & protect sperm
 - ◆ buffer to counteract acids in vagina

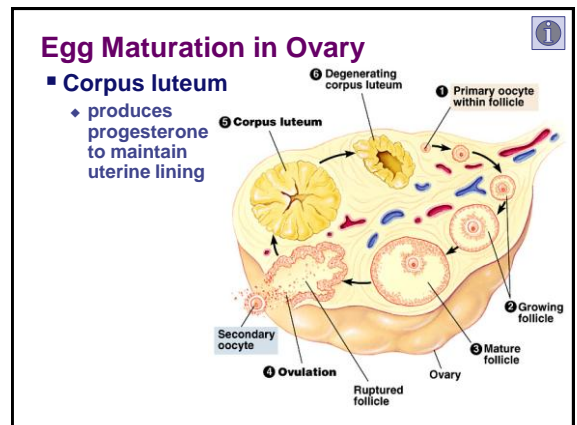
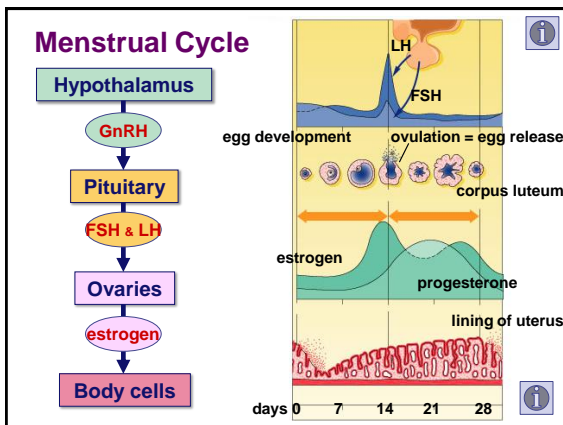
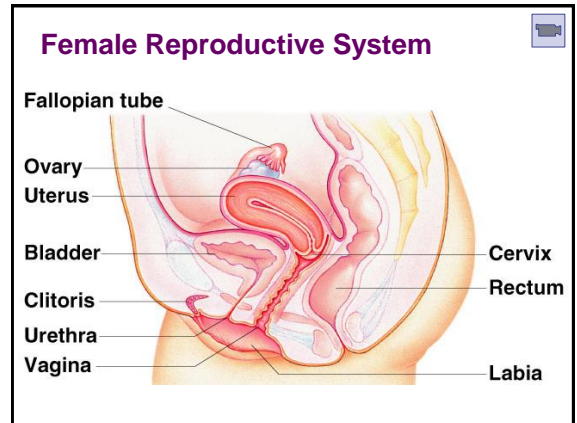
Male Reproductive System



- **Testes & epididymis**
 - ◆ sperm production & maturation
- **Glands**
 - ◆ seminal vesicles, prostate, bulbourethral
 - produce seminal fluid = nutrient-rich



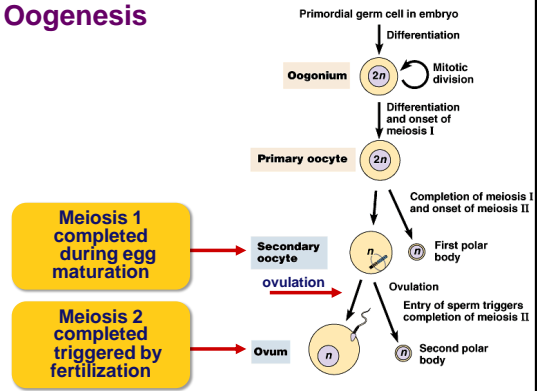
- ### Female Reproductive System
- **Ovaries**
 - ◆ produces eggs & hormones
 - **Uterus**
 - ◆ nurtures fetus; lining builds up each month
 - **Fallopian tubes**
 - ◆ tubes for eggs to travel from ovaries to uterus
 - **Cervix**
 - ◆ opening to uterus, dilates 10cm (4 inches) for birthing baby
 - **Vagina**
 - ◆ birth canal for birthing baby



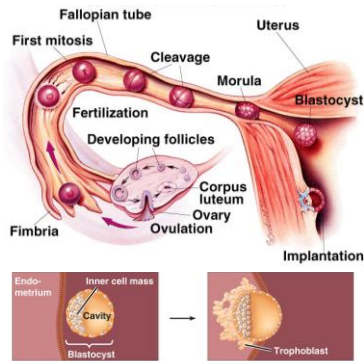
Female Hormones

- **FSH & LH**
 - ◆ release from pituitary
 - ◆ stimulates egg development & hormone release
 - ◆ **peak release = release of egg (ovulation)**
- **Estrogen**
 - ◆ released from ovary cells around developing egg
 - ◆ stimulates growth of lining of uterus
 - ◆ **lowered levels = menstruation**
- **Progesterone**
 - ◆ released from "corpus luteum" in ovaries
 - cells that used to take care of developing egg
 - ◆ stimulates blood supply to lining of uterus
 - ◆ **lowered levels = menstruation**

Oogenesis

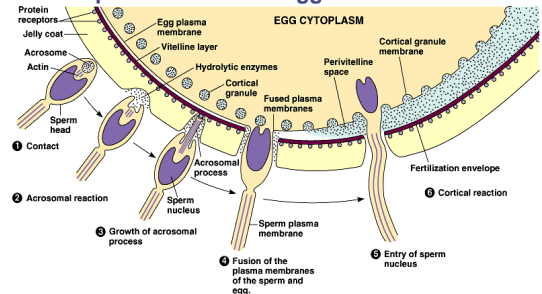


Fertilization



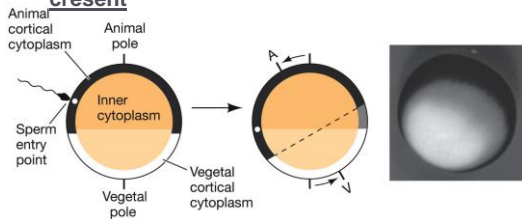
Fertilization

- **Joining of sperm & egg**
- ◆ **sperm head enters egg**

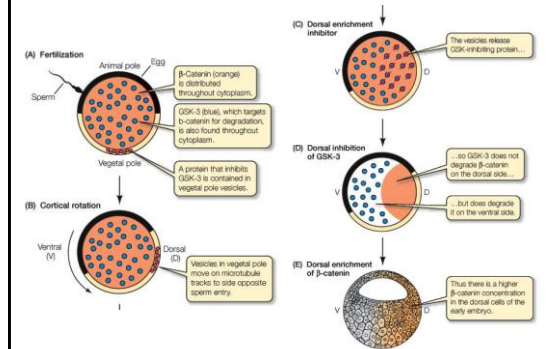


Fertilization causes changes...

- **yolk found at vegetal hemisphere**
- **embryo at animal hemisphere (pigmented)**
- **post fertilization, animal pole rotates to where sperm penetrates the egg—forming the gray crescent**




...which sets up signal cascades to help set up the body plan.



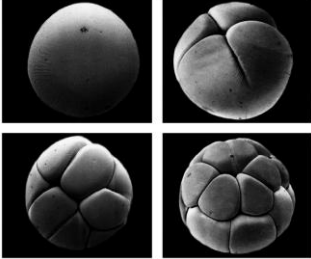
Cleavage

- Repeated mitotic divisions of zygote
 - 1st step to becoming multicellular
 - unequal divisions establishes body plan
 - different cells receive different portions of egg cytoplasm & therefore different regulatory signals



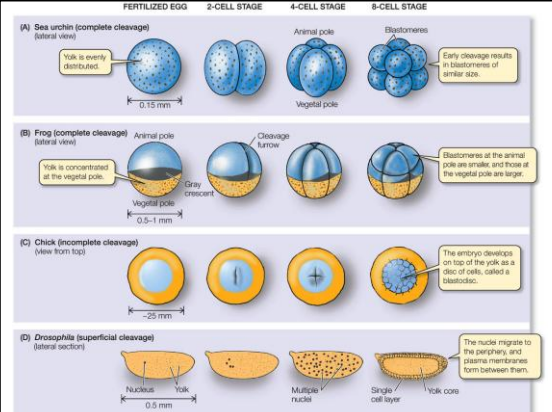
Cleavage

- zygote → morula → blastula
 - establishes future development



blastula
 blastocoel
 blastomere

variations of cleavage...



(A) Sea urchin (complete cleavage)
 (lateral view) Yolk is evenly distributed. 0.15 mm. Blastomeres. Early cleavage results in blastomeres of similar size.

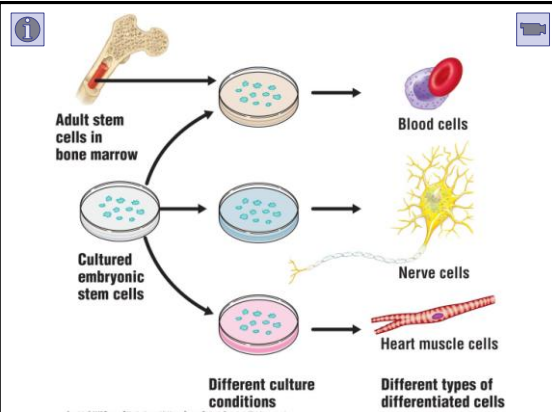
(B) Frog (complete cleavage)
 (lateral view) Yolk is concentrated at the vegetal pole. Animal pole. Cleavage furrow. Gray crescent. Blastomeres at the animal pole are smaller, and those at the vegetal pole are larger. 0.5-1 mm.

(C) Chick (incomplete cleavage)
 (view from top) The embryo develops on top of the yolk as a disc of cells, called a blastodisc. ~25 mm.

(D) Drosophila (superficial cleavage)
 (lateral section) The nuclei migrate to the periphery, and plasma membranes form between them. Nucleus. Yolk. Multiple nuclei. Single cell layer. Yolk core. 0.5 mm.



How could just a few cells cause such a controversy?



Adult stem cells in bone marrow → Blood cells

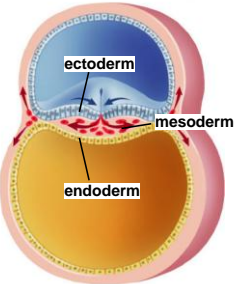
Cultured embryonic stem cells → Nerve cells

Cultured embryonic stem cells → Heart muscle cells

Different culture conditions → Different types of differentiated cells

Gastrulation

- Establish 3 cell layers
 - ectoderm
 - outer layers
 - skin, nails, teeth, nerves
 - mesoderm
 - blood, bone & muscle
 - endoderm
 - inner lining
 - digestive system



Neurulation

- 1st organ to form is notochord & nerve chord
- develop into nervous system

The diagram illustrates the process of neurulation. On the left, a neural groove is shown forming in the ectoderm above the notochord. On the right, the neural tube has closed, and the notochord is positioned directly beneath it.

Hox Genes

- genes that control differentiation on anterior-posterior axis
- hedgehog v. sonic hedgehog

This diagram shows a Hox gene cluster with genes labeled b1 through b9. It illustrates how the 3' end of the cluster is expressed in anterior positions, while the 5' end is expressed in posterior positions. A mouse embryo is shown with expression gradients of Hox genes along the anterior-posterior axis, with Hoxb1 expressed in the hindbrain and Hoxb9 in the spinal cord.

Hox Genes

- found in animals to determine body plan!

The diagram compares Hox gene clusters in a fly and a mouse. It shows how Hox genes in both species are expressed in similar patterns along the anterior-posterior axis, demonstrating their role in determining body plan across different species.

Organogenesis

This diagram compares the early stages of organogenesis in a bird embryo and a mammalian embryo. The bird embryo is shown with its yolk sac and allantois, while the mammalian embryo is shown with its chorion and amnion. Both diagrams highlight the presence of umbilical blood vessels and fetal blood vessels.

Placenta

- Materials exchange across membranes

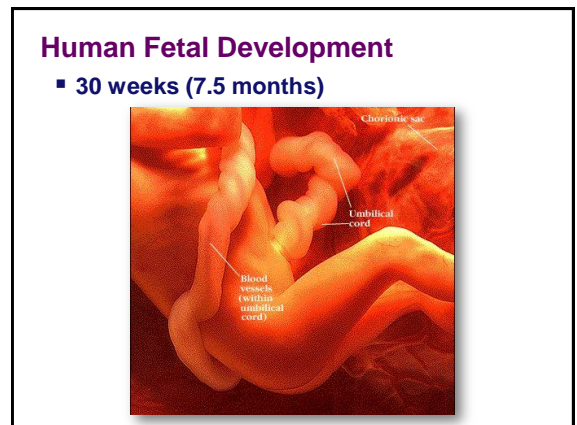
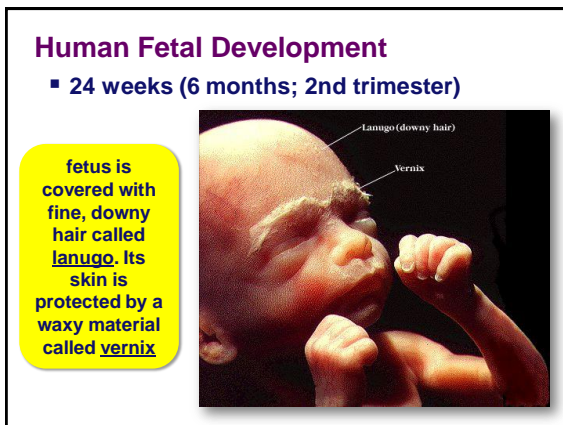
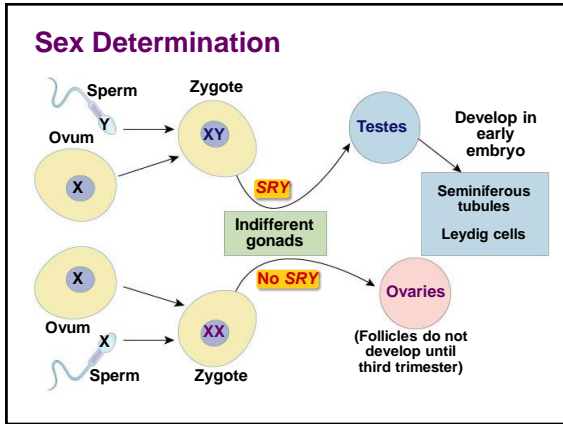
The diagram shows a cross-section of the placenta within the uterus. It details the maternal portion of the placenta, including maternal arteries and veins, and the fetal portion, which contains chorionic villi with fetal capillaries. The umbilical cord is shown connecting the fetus to the placenta, containing fetal arterioles and venules.

Human Fetal Development

4 weeks

7 weeks

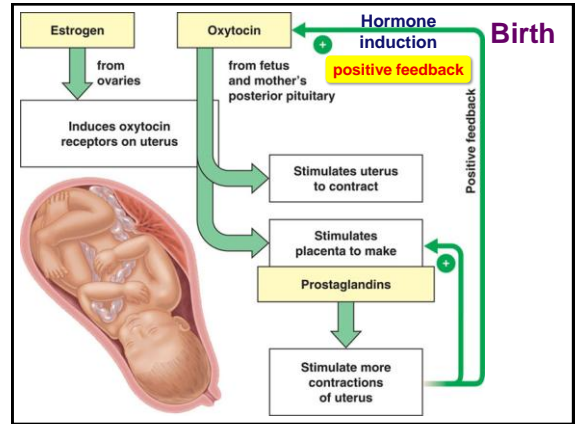
Two photographs showing the development of a human fetus at 4 weeks and 7 weeks. The 4-week fetus is a small, translucent ball of cells, while the 7-week fetus is more developed, showing distinct facial features and limbs.



Getting crowded in there!!

- 32 weeks (8 months)

The fetus sleeps 90-95% of the day & sometimes experiences REM sleep, an indication of dreaming



Birth (36 weeks)

- Dilatation of the cervix
 - Intestine
 - Placenta
 - Umbilical cord
 - Wall of uterus
 - Bladder
 - Cervix
 - Vagina
- Expulsion: delivery of the infant
 - Uterus
 - Placenta (detaching)
 - Umbilical cord
- Delivery of the placenta