

Biology Lecture 6.1 – 6.8

Sect. 6.1: Reproduction is essential for Life

I. Organisms grow, develop and mature enough to reproduce.

- Diff. organisms reproduce @ different rates. eg, humans outlive their reproductive years whereas other organisms continue to reproduce their whole lives like the giant tortoises of Galapagos Islands.

a. Reproduce – to have offspring; to pass on genetic information to offspring.

b. Life cycle – all the events in an organism's life between birth & death; they are continuous cycles.

- The secret to biological success for a species lies in the populations' ability to reproduce & pass on their genes before they die, or the species will become extinct!

Sect. 6.2: Reproduction may be Sexual or Asexual

I. Sexual reproduction – the reproduction of an organism that involves two parents (egg & sperm). ie, the union of cells other than body cells. eg. frogs, humans, flowering plants

- Ensures genetic variability among the species.

a. Gametes – special sex cells that unite to form a new organism; they are HAPLOID (n) cells.

- **gametes** (egg/sperm) contain chromosomes from each parent; the chromosomes are passed on to the offspring at fertilization. **1/2 the chromosomes from the dad & 1/2 from the mom.**
- Produces a *diploid* organism (2n) at **fertilization forms a zygote.**
- Ensures **genetic variability** among the species; many different combos result.

II. Asexual reproduction – a new organism develops from one parent's body cells.

- The new offspring is a clone of the parent.
- Some parents divide in two. eg. some plants, bacteria
- A new organism can bud off from parent's body. eg. sea urchins
- a. Regeneration – an entire body can grow from the arm of a sea star if part of the central body is intact.
- b. Vegetative Reproduction – an entire new plant “buds” from the parent plant's cells.

III. Some organisms can reproduce both sexually & asexually.

Example: potato plants, sea stars, sea urchins

- Some orgs. have the ability to produce both types of gametes [not at the same time though]; **hermaphrodites**, eg. the Blue-headed Wrasse or Sheep's Head (fish); Garden Snails

Question? What might be the biological advantage for organisms to reproduce both ways?

Sect. 6.3: Gametes are Reproductive Cells

I. Gametes – sex cells; found in the gonads (testes/ovaries).

1. Male gametes – sperm (spermatozoan); motile, whip-like tail; really small.
2. Female – egg (ova); way bigger than the sperm cell! It has a reserve supply of food.

Question? Why a reserve supply of cytoplasm (nutrients) in the egg?

- Some organisms have the ability to produce both types of gametes..[not at the same time]; ***hermaphrodites***. eg. the Blue-headed Wrasse; Sheep's Head (fish), and Garden Snails

Sect. 6.4: The Chromosome Number of a Species Remains Constant

I. Each species has its own # of chromosomes per each body cell.

- Eggs. humans = 46 chromosomes, or 23 pairs of chromosomes per cell, Dogs = 24 chromos.; 12 pairs per cell
- Chromosomes occur in matching pairs; like a pair of shoes.
- A one shoe from mom and the other shoe [in the pair] from dad; ie, "***Homologous Chromosomes***"
- Fertilization– when two gametes unite to form a ***zygote*** (2n).

Question? If each gamete contained 46 chromosomes and united, then the offspring would have 92 chromosomes. But, this is not so! WHY? Explain it to me!!

A. Haploid (n) – cells that contain a chromosome number that is half the # of the body cells, eg. humans n= 23

B. Diploid (2n) – cells that contain all the chromosomes from each parent cell, eg. humans 2n= 46

- A diploid organism(2n) formed at *fertilization is called a zygote*.
- See fig. 6.7; page 148

II. Meiosis "**reduction division**"– the cell division where sex cells(gametes) become haploid; gamete formation "*gametogenesis*" ie. $2n \rightarrow n$

- the (2n)***germline*** cells are in the gonads and become (n) gametes.
- meiosis begins at **puberty** because of sex hormones being produced.

Sect. 6.5: Gametes are Formed by Meiosis

I. Before **meiosis** begins, the chromosomes must replicate (*S-phase*) and produce copies of the chromosomes, ie, $2n \rightarrow 4n$;for humans $46(2n) \rightarrow 92(4n)$

- There are 2 divisions in meiosis; Division I & II
- Each division produces 2 daughter cells; a total of 4 gametes.

A. Division I: PMAT – ONE

- Prophase I – the matching pairs of chromosomes, ie. “**Homologous Chromosomes**” move close together and twist around each other exchanging genetic information = **Crossing over of chromosomes**.
- **Crossing over** = ensures a new combination of genes in the offspring!
- Occurs at random anywhere on the chromosome, 2–3X/meiosis
- See 6.8; page 149

Metaphase I – the chromosome pairs line up in the middle of the cell.

Anaphase I – the chromosome pairs move to opposite ends of the cell. Law of Segregation occurs here.

Telophase I – the cell splits into two cells; each containing half the chromosomes number of the parent cell. ie. $2n$

Cytokinesis – cells split into two cells.

B. Division II: PMAT – TWO

1. the same general characteristics as Division I, but the end result is 4 haploid cells each w/ different genetic information.

Prophase II –

Metaphase II –

Anaphase II –

Telophase II –

Cytokinesis –

II. Meiosis Provides for Genetic Variation:

2. Cells made from *mitosis* are identical to each other and their parent cells
 - Meiosis produces cells (egg/sperm) that have different genetic information from the parent cells, ie, a “shuffling of the chromosomes” leads to *genetic variation*

IN: How might the reproductive system help in the continuation of a species? Explain.

Sect 6.6: Gamete Development Differs in Males and Females

Reproduction - process by which genetic info. is passed from one generation to the next. Maintains the continuation of the species.

?? What are the two types of reproduction?

?? Which type of reproduction do humans use?

Gonads - testes & ovaries; produce and house gametes (egg & sperm).

- Meiosis occurs here! It is regulated by hormones
- involved in secreting sex hormones such as testosterone and estrogen. Note: the production of eggs and sperm (gametes) is regulated by the endocrine system, ie, hormone system. See figure 6.13, page 155

- a. *Ovaries* (house the eggs) - two almond-shaped gonads on either side of the uterus.
- Meiosis (Oogenesis) occurs here; produces sex hormones progesterone and estrogen.
 - Oogenesis – the formation of an haploid egg(ova) in the ovaries. Involves meiosis & mitosis.
 - primitive eggs(2n), are formed in the 3rd month of female fetal development.
 - A female has thousands of eggs, but only 400 – 500 are released in her lifetime
 - Ovulation – the release of an egg from the ovary. Occurs once/month
- b. *Testes* (testicles) - paired oval glands. Descend from abdominal wall into scrotum ~ 7 months of embryonic development. They produce sex hormones.
1. *Lobules* - each testicle contains 200-300 "compartments". Lobules contain seminiferous tubes, (where sperm production occurs)
- Spermatogenesis – the process by which the seminiferous tubules produce haploid(n) sperm in ~74 days. Includes meiosis and mitosis.
 - Spermatozoan (mature sperm) - are produced or matured at ~300 million/day, and once ejaculated have a life expectancy of 24 - 48 hours.

Sect 6.7: Hormones Control the Reproductive Cycle

I. Hormones – chemical signals that travel in the body via the blood stream.

a. Feedback mechanism (loop) – a set of complex interactions between a stimulus and a response; involves hormones.

* One way the various parts of the body can communicate with one another. eg, communication between the brain & sex organs.

b. Hormonal Control and Male Puberty:

Hormones – chemical messages released by glands [and the brain] into the blood stream. They regulate different body functions, eg, metabolism, homeostasis, and sperm production.

c. Male puberty: ~ 13 – 16 years of age for sexual maturity; regulated by hormones. Brought on by increased levels of GnRH in the hypothalamus(region of the brain) which stimulates the pituitary gland(region of the brain) to release the hormones FSH and LH. The hormones FSH and LH regulate sperm production in the testes by a **Negative Feedback System**.

Male Menopause – don't think so!

II. Puberty in Females: ~12 to 15 years of age.

3. increased production of FSH and LH from the pituitary gland; the beginning of *menarche* (*menstrual & ovulatory cycle*).

4. The hormones FSH and LH regulate egg production in the ovaries by a **Negative Feedback System**.

a. Ovulatory Cycle: a cycle which regulates the release of an ovum(egg) “*ovulation*”.

b. Menstrual Cycle: a monthly release of the uterine blood lining “*a period*”.

NOTE: the two cycles above are in concert w/ one another, and regulated by the same hormones.

* See figures 6.13 on page 155.

c. *Oogenesis* – the formation of an haploid egg(ova) in the ovaries. Involves meiosis & mitosis.

* primitive eggs(2n), are formed in the 3rd month of female fetal development.

* 1^o oocytes(2n), remain in *Prophase I* of meiosis until puberty.

* Oogenesis produces one viable egg, unlike spermatogenesis (4 viable sperm are produced).

d. *Ovulation* –the release of one egg from the ovaries. Occurs on the 14th day of the cycle.

5. Events that take place in the uterine wall after ovulation depend on whether or not fertilization occurs!

6. See figure 38.10 on page 1036

e. *Menopause* – the end of menses and ovulation.

- Marked by declined estrogen levels.
- Usually between 46 – 54 yrs. of age.
- Ovaries become nonfunctional.

III. Human Male Anatomy (the parts): testes, ducts(tubes), & sex glands.

* see figure 6.11 page 152

A. Where sperm forms:

1. *Scrotum* - an out-pouching of the abdomen consisting of loose skin. It is the supporting structure of the testes.

Location: outside of the body cavity which provides for 3 degrees below body temp. for production & survival of sperm.

Muscles: *Cremaster* contracts to elevate the testicles during sexual arousal and cold temp. The opposite is true during warmer temps.

1. Testes (testicles) - paired oval glands. Descend from abdominal wall into scrotum ~ 7 months of embryonic development. They produce sex hormones.

a. *Lobules* - each testicle contains 200-300 "compartments". Lobules contain seminiferous tubes, (where sperm production occurs = spermatogenesis, ie. meiosis).

Spermatogenesis – the process by which the seminiferous tubules produce haploid(n) sperm in ~74 days. Includes meiosis and mitosis.

- Spermatozoan (mature sperm) - are produced or matured at ~300 million/day, and once ejaculated have a life expectancy of 24 - 48 hours.

* Testosterone a male *sex hormone* produced in the testicles; it has many effects on the body:

1. Controls growth.
2. Maintenance of sex hormones
3. Sexual behavior
4. Muscular/skeletal development
5. Body hair/hairline recession
6. Enlargement of cartilage
7. Descent of testes prior to birth

- How sperm leave the testes:

1. Ducts - tubes that transport substances eg, fluids & sperm.

- a. *Seminiferous tubules* —in the testes.

- b. *Epididymis* - lies along the posterior border of the testis and consists of tightly coiled tubes, "ductus epididymis" ~20 ft. long.... Wow!

Function: stores maturing sperm for ~2 weeks & can remain there for up to 4 weeks.

- c. *Vas Deferens* - a continuation of the epididymis which ascends posterior to the border of the testis, and enters the pelvic cavity.

Function: stores mature sperm and is a transport system from epididymis to the urethra.

Clinical: Vasectomy - a method for sterilizing males.

- d. *Spermatic cord* - a collective term for the testicular arteries, veins, nerves & lymph vessels that travel along side the vas deferens.

- e. *Ejaculatory Duct* (aka. *urethra*) – the tube that runs through the penis.

Urethra - begins at the prostate gland and continues through the penis. It is the terminal duct of the system.

* the only organ in which both semen & urine pass through.

- f. *Penis* - a depository organ used to introduce sperm into the vagina.

* contains *erectile tissue* permeated by blood vessels.

* Sexual Stimulation - influences an erection, eg., visual, auditory, tactile, olfactory, gustatory and imagination.

Erection: * increase stimulus causes an increase blood supply to arteries of penis and the veins become compressed so that most of the entering blood is retained. ie. an erection is maintained.

Clinical: Circumcision (removal of the foreskin)

B.C method: condom

2. Sex Glands -secrete most of the liquid portion of the semen; prevents drying out of sperm.

- a. *Seminal vesicles* - 60% of the volume of semen.

* secretes an alkaline fluid which helps to neutralize the acidic female reproductive tract.

* viscous fluid rich in fructose for nutrients.

- b. *Prostate Gland* – donut shaped (about the size of a chestnut)

* secretes 33% of semen volume.

* milky-white fluid which contains citric acid and prostaglandins which contribute to sperm motility & viability.

Clinical: Prostate Cancer

- c. *Cowper's Gland* (bulbourethral) - pea-sized gland

* secretes 2-3 drops of an alkaline pre-ejaculate to cleans the urethra of acidic urine.

Semen (Seminal Fluid) ~Ph is 7.2 to 7.6

* a mixture of sperm, and secretions from the following glands:

seminal vesicles, prostate, & Cowper's gland.

GEE WHIZ!
~2.5 ml / ejaculation
150 million sperm / ml
< 20 million sperm / ml is considered infertile
1 sperm fertilizes an egg

Function of Semen: provides nutrients, and acts as a transport medium for the sperm; contains enzymes that stimulate sperm activity after ejaculation.

* contains antibiotics that can destroy bacteria which can cause infection and threaten fertilization.

II. Human Female Anatomy (the parts): - ovaries which produce eggs, sex hormones, Fallopian tubes, vagina, uterus, and mammary glands (breasts)

* see figure 6.12, page 154

a. *Ovaries* (house the eggs) - two almond-shaped gonads on either side of the uterus..

b. *Fallopian tubes* (2) "oviducts" - tubes which transport the ovum(eggs) from ovaries to uterus. * the site of fertilization.

Clinical: Tuba Ligation – permanent sterility

c. *Uterus* – “the womb”

* site of menstruation (inner lining sheds or sloughs off).

* site of implantation of fertilized egg.

* part of the pathway for sperm to reach the fallopian tubes(oviducts).

* B.C methods: IUD (not safe!)

* *Clinical:* Hysterectomy

d. *Cervix* - the region(opening) between the uterus and vagina; it dilates during child birth.

* B.C. methods: cervical cap, sponge, diaphragm

Clinical: Pap Smear

e. *Vagina* "birth canal" – the link between the outside environment and the uterus.

* sperm is deposited here during intercourse.

7. release of menstrual flow.

8. releases a lubricant for intercourse.

* B.C method: spermicidal foam, film, suppository

f. *Vulva* - collective term for external genitalia of female.

Includes: mons pubis, labia, clitoris & urethra

g. *Clitoris* – erogenous zone for females. Becomes engorged with blood “erect” during sexual stimulation. A homologous structure to the head of the penis on a male.

Erection: * increase stimulus causes an increase blood supply to arteries of clitoris and the veins become compressed so that most of the entering blood is retained. ie. an erection is maintained.

h. *Mammary glands* - modified sweat glands

* mostly adipose tissue (fat).

* contains milk = lactation (response to sucking) & hormones.

Clinical: Mammogram/breast cancer