REPRODUCTION

MALE REPRODUCTION

I. Male Reproductive Anatomy (figure 1; Reece page 348)

   a. Testis:

      1. 2 functions

         a. Produce sperm

         b. Produce hormones: principally testosterone

      2. Cell types: 3 in testis (figure 2; Reece page 346-347)

         a. Leydig cells: make testosterone

         b. Sertoli cells: Nourish developing sperm

         c. Spermatocytes: develop into sperm

   B. Epididymis:

      1. 3 parts head, body, tail or caput, corpus, cauda

      2. involved in sperm storage and transport

   C. Vas Deferens:

      1. also called Ductus Deferens

      2. Involved in sperm transport

      3. Cut in vasectomized males which then can be used for heat checking purposes.
D. Scrotum:

1. pouch of skin containing testes

2. Made from same embryonic tissue as Vulva in female

E. Tunica Vaginalis:

1. inner membrane covering testicles

F. Accessory Sex Glands:

1. 4 glands, provide seminal fluid
   a. sugar (fructose)
   b. metal ions
   c. buffers
   d. gel

2. glands
   a. Ampulla: Junction of urethra and vas deferens
   b. Seminal Vesicles
   c. Prostate
   d. Bulbourethral or Cowper’s glands:
      1. gel fraction in boars and stallions

G. Penis: copulatory organ

1. 2 types in livestock: Fibroelastic and Vascular
   a. Bull, Boar, Ram: Fibroelastic with Sigmoid Flexure
   b. Stallion: vascular, Cavernosum tissue fills with blood
during erection

H. Prepuce or Penile sheath

1. Most of penis is in sheath.

2. Free end is called glans penis

I. Blood and Nerve Supply

1. Through spermatic cord

2. Blood important in erection

3. Sensory nerves highly concentrated on glands penis

II. Spermatogenesis

Takes place in the seminiferous tubules of the testes

Begins during puberty

Increases until sexual maturity

A. Mitosis and Meiosis and Production of Spermatozoa

1. Mitosis: Division into 2 identical cells,

2. Spermatogonia divide through mitosis to provide constant supply of sperm throughout male’s life

3. Several stages of spermatogonia divide through mitosis until the stage called Primary spermatocytes.

4. These begin Meiosis which will produce haploid cells (one set of chromozones).

5. Each primary spermatocyte produces 2 Secondary spermatocytes which are diploid.

6. Each secondary spermatocyte divides into spermatids which are haploid.
7. These undergo Spermiogenesis which is transformation into specialized shaped cell with characteristic sperm appearance.

B. Epididymal function

1. Transport of sperm
2. Maturation of sperm
3. Concentration of sperm
4. Storage of sperm: main storage site

C. Spermatogenic Wave

1. Different parts of the seminiferous tubules will be at different stage of sperm production
2. Maintains a constant supply of new sperm

D. Hormonal Control:

1. GnRH from the Hypothalamus stimulates LH and FSH secretion from the Anterior Pituitary.
2. FSH is required for the initiation of spermatogenesis testosterone is required for maintenance.
3. FSH stimulates Sertoli cell function
4. LH increases Testosterone secretion.

E. Testosterone Effects

1. Maintains spermatogenesis
2. Maintains libido
3. Growth of accessory sex glands
4. Male secondary sex characteristics
5. Testosterone has negative feedback effects on GnRH and LH secretion.

F. Other androgens

III. Physical Considerations

A. Erection

1. Extension and blood filling of penis

B. Mounting and Intromission

1. In most species mounting requires a receptive female

2. Intromission in the term for introduction and maintenance of the penis in the vagina during mating

3. Time of intromission varies widely with species.

C. Emission and Ejaculation

1. Emission is release of the sperm from the epididymis

2. Ejaculation is release of the sperm and seminal fluids from the penis

IV. Factors affecting testicular function

A. Puberty

1. No sperm production until puberty

B. Male with undescended testes: Cryptorchid, Sterile

C. Temperature Regulation in the Testis:

1. Testis must be cooler than body temperature for spermatogenesis to occur on average 3 degrees C.

2. Cremaster muscle raises and lowers testis to regulate heat from body
3. Scrotum: contains many sweat glands

4. Pampiniform Plexus: network of blood vessel which cools arterial blood entering testis by counter-current exchange

**Female Reproductive**

**Anatomy** (figure 1; Reece p 370)

I. Ovaries (figure 2, Reece p 384)

A. Follicle: contains Oocyte and Produces Estrogen

1. Oocyte (figure 3)

   a. female gamete

   b. highest number-before birth

   c. largest cell in mammalian body (100-150 um in diameter)

   d. anatomy

      1. zona pellucida

         a. nonliving protein structure surrounding the oocyte

         b. barrier to fertilization

      2. vitalline membrane

         a. cell membrane surrounding oocyte

         b. secondary barrier to fertilization

B. Corpus Luteum (CL):

1. formed from follicle after Ovulation,
2. Produces Progesterone

II. Oviduct

A. connects ovary and uterus
B. Site of fertilization and early embryo development
C. Parts (figure 1)
   1. Infundibulum,
   2. Ampulla,
   3. Isthmus

III. Uterus:

A. site of most of embryo development
B. Layers
   1. Endometrium: secretory layer, produces Prostaglandin F2 alpha
   2. Myometrium: smooth muscle layer, uterine contractions
C. There are 2 types of uteri in farm species (Figure 4)
   1. Bicornuate: sow
   2. Bipartite: cow, ewe, mare

IV Cervix:

A. cartilaginous tissue,
B. connects uterus and vagina
C. Filled with mucous
1. barrier to sperm and infection
2. at estrus, transport for sperm

V. Vagina:

A. copulatory organ
   1. site of sperm deposition in most species

B. muscular tissue

C. Acidic pH to help protect against infection
   1. low pH limits sperm live.

VI. External Genitalia:

A. Vulva
   1. protective covering

B. Clitoris
   1. highest concentration of sensory nerves

Physiology

I. Female Reproductive Hormones:

A. Estrogens
   1. Causes Estrus behavior
   2. Causes LH surge
   3. Thins cervical mucous
   4. Stimulates uterine motility

B. Progesterone
1. Blocks Estrus behavior

2. Blocks LH surge

3. Thickens cervical mucous

4. Inhibits uterine motility

5. Maintains uterine lining
   a. during luteal phase
   b. during early stages of pregnancy

C. Gonadotropins: LH and FSH

1. FSH
   a. stimulates follicle growth
   b. estrogen secretion

2. LH:
   a. Needed for later stages of follicular growth
   b. triggers Ovulation
   c. Maintains CL

D. PGF2-alpha:
   1. regresses CL so estrous cycle will repeat and female has another chance to become pregnant

II. Estrous Cycle (Figure 5)

A. 3 parts:

B. Follicular Phase:
   1. CL from previous cycle regressed
2. Period of follicle growth and selection

3. Estrogen increasing as follicles grow larger

4. Progesterone low

5. slight increase in LH

C. Estrus:

1. sexually receptive period (standing heat)

2. Estrogen levels peak

3. LH surge occurs

4. Ovulation occurs: release of oocyte

5. Cervical mucous thin

6. Uterine contractions to transport sperm

III. Pregnancy

A. Fertilization:

1. Sperm moved through oviduct by fluid and contractions

2. Oocytes moved by cilia of oviduct

3. 1 sperm fertilizes the oocyte.

   a. After sperm crosses ZP and vitalline membrane they change to prevent others crossing

   b. Polyspermy: lethal

4. Forms single cell called zygote

5. Which chromosome (X or Y) is carried by sperm determines sex of embryo.
a. Sperm sorting may make sex selection possible.

6. Embryo moved to uterus by fluid and contractions
   a. Trip takes 2-5 days
   b. Embryo undergoes numerous divisions
   c. Early cells are Totipotent: each cell capable of producing complete organism

7. Later Stages of Embryonic Development
   a. Morula: solid ball of cells, up to 32 cells
   b. Blastocyst: Differentiation of cells become visible as fluid filled cavity develops.
      1. Trophectoderm: outer layer of blastocyst cells gives rise to Chorion: part of placenta
      2. Inner cell mass: gives rise to fetus and other parts of placenta
   c. Embryo enters uterus and contacts uterine wall as blastocyst
   d. Enlarging embryo exits ZP (hatching)

B. Implantation:
   1. Chorion makes contact with endometrium
   2. Some erosion of endometrial tissue and contact between blood supplies are established.

C. Placental Membranes
   1. Chorion-outermost layer
   2. Allantois-connects fetal and maternal circulation
   3. Amnion-innermost layer, protects against shocks
D. Placental Types (Figure 6)

1. Caruncle-Cotyledonary: Ruminants
   a. caruncle: maternal areas for nutrient transfer
   b. cotyledon: fetal, areas which fuse with capillaries
   c. The 2 together are called a Placentome.

2. Diffuse: Mare, Sow No specialized areas for nutrient transfer

E. Placental Hormones

1. Pregnant Mare Serum Gonadotropin: PMSG
   a. Produced by chorionic girdle cells
   b. Stimulates formation of Accessory CL’s which secrete progesterone needed for maintenance of pregnancy.

2. Progesterone: made in ewes and mares, later in pregnancy

3. Placental Lactogen: ruminants
   a. Also called Chorionic Somatomammotropin
   b. Regulates growth of fetus and development of mammary gland.

F. Maternal Adaptations

1. Increased cardiac output and blood volume to supply fetus.

2. Glucose sent preferentially to fetus.

3. Calcium needs of fetus take preference over mother.
G. Pregnancy Toxemia

1. Seen in ewes carrying multiple fetuses.

2. Because glucose is sent to fetus mother may have to rely on fats for energy.

3. Fat breakdown leads to formation of ketones which can cause acidosis.

4. Can be fatal.

5. Seen late in gestation when fetal growth is highest.

6. Prevent by feeding ewes with multiple Lambs well fed

IV. Parturition = birth

A. Decreasing progesterone leads to parturition because progesterone inhibits uterine contractions.

B. Estrogen and PGF2-alpha are increasing.

1. These stimulate uterine contractions.

C. Stages of Labor

1. Dilation of cervix: longest stage
   a. Caused by relaxin

2. Expulsion of fetus
   a. Abdominal and uterine contractions
   b. Oxytocin secretion is stimulated by entry of fetus into cervix
   c. Neuroendocrine Reflex from nerves in cervix to the spine which carries information to the brain and causes release of oxytocin.

3. Expulsion of placenta:
a. In pigs stages 2 and 3 occur together

b. Retained placentas a problem in ruminants

D. Postpartum Events

1. Involution of the Uterus: repair of uterus, more rapid in sows and mares

V. Postpartum Anestrus:

A. Females do not have cycles for a period of time postpartum

1. Main reason for reproductive failure.

2. Mare is an exception, Foal Heat 8-15 days after parturition

a. Fertility is somewhat lower.