Male Reproduction
Anatomy & Reproductive Problems

Composed of the testes, scrotum, epididymis, vas deferens, accessory sex glands, & penis

a) Testis
The primary sex organ
Two main functions
   i) Sperm production within the seminiferous tubules.
   ii) Production of testosterone (male sex hormone) - in Leydig cells located between the seminiferous tubules.
Develop in the fetus in the abdominal cavity (near the kidneys)
At or just before birth descend through the inguinal canal into the scrotum.
Failure of one or both testes to descend into the scrotum is known as cryptorchidism - leads to infertility
If part of the intestinal tract descends into the scrotum the condition is known as a scrotal hernia.

b) Scrotum:
Muscular sac housing the testes
Acts as a thermo regulator.
   For sperm production, the temperature of the testes must be 4 to 7 °C cooler than the body. In warm weather scrotal muscles relax and the testes fall away from the body. In cold weather they are held closer to the body.

c) Epididymis:
   Long convoluted tube
   Carries the sperm from the testicle to the vas deferens
   Sperm continue to develop (mature) in the epididymis
   And are stored there
Sperm removed from the head epididymis are generally not capable of fertilization

d) **Vas deferens:**
Muscular tube carrying sperm from the epididymis to the urethra during ejaculation
Runs from the tail of the epididymis to the neck of the bladder where it joins the urethra
Removal of a section of each vas deferens is known as **vasectomy** – prevents passage of sperm from epididymis

e) **Accessory sex glands:** ampullae, seminal vesicles, prostate gland, bulbourethral (Cowper's) gland.

i) **Ampullae:**
Glandular enlargement of the terminal parts of the vas deferens
Secretes fluid into semen
Serves as a storage area (except in the boar)

ii) **Seminal vesicles:**
Paired glands (one per vas deferens)
Empty into pelvic urethra at the junction of the vas deferens
Adds fluid and nutrients (i.e. fructose) to the semen (except in the dog)

iii) **Prostate gland:**
Surrounds the pelvic urethra and empties into the pelvic urethra
Produces an alkali secretion to raise the pH of the ejaculate to about 6.0 (optimum for sperm activity)
Acts as a buffer
Produces characteristic odor
In older animals and man it can become enlarged and block urine flow

iv) **Bulbourethral (Cowper's) gland:**
Paired glands caudal to the pelvic inlet at root of the penis.
Secrete thick mucous to assist in lubrication at coitus (copulation, mating)

f) **Penis:**
Function is to deposit semen in the female reproductive tract
i) Develops around the urethra
Contains **cavernous** (spongy) tissue surrounded and supported by connective tissue
Erection is primarily under the control of the parasympathetic nervous system. 
Achieved by dilation of the arteries (allowing blood to fill the cavernous tissue) 
Contraction of the small veins and muscular occlusion of the large dorsal vein restricts venous return 
Degree of increase in size (of the penis) is controlled by the ratio of cavernous to connective tissue 
Horse & human - relatively little connective tissue, allowing an increase in all directions 
Pig, ram and bull, the penis is S shaped (sigmoid flexure) and has relatively more connective tissue 
Relaxation of the penis retractor muscle & the increase in blood pressure in the penis allows the sigmoid flexure to straighten and so extend the penis 

Ejaculation is under the control of the sympathetic nervous system 
Achieved by rhythmic contractions of the accessory sex glands and urethra

Glans penis: 
Represents the distal end of the penis 
Has different shapes in different farm animals
Boar - **corkscrew** shaped - allows it to lock into the sow’s cervix. Pressure of this lock stimulates ejaculation into uterus

Ram - **filiform** appendage that is an extension of the urethra and serves to spray semen around the opening of the ewe’s cervix

iii) **Prepuce**:

   Fold of skin that surrounds the free end of the penis
   In boars the dorsal diverticulum (pouch) contains urine, sperm and bacteria producing boar odor

**Spermatozoa** (Sperm)

   Made up of head, mid section & tail

   **Sperm head**
   Contains the nucleus
   Has half the **chromosomes** of the future embryo.
   Between nucleus & sperm cell membrane is the **acrosome** - a thin sac, containing **enzymes**
   Enzymes digest a passage for the sperm to allow it access to the egg

   **Mid piece**
   located below the sperm head
   Packed with **mitochondria** to provide energy to the sperm

   **Sperm tail**
   Allows motility - necessary for egg penetration

**Abnormalities** in sperm structure do occur

   Abnormal sperm are not viable
   If proportion of abnormal sperm in ejaculate is too high, male will be sub-fertile or sterile

   Fertility checks of male animals also include an assessment of the proportion showing normal motility
   Too many non-motile sperm will also cause fertility problems.
Sexual Development in Males

**Testicles Enter Scrotum:**
- Bull & Ram: ½ way through fetal life
- Boar: Last ¼ of fetal life
- Stallion: Before or after birth

**Spermatozoa in Seminiferous Tubules (weeks):**

<table>
<thead>
<tr>
<th></th>
<th>Bull</th>
<th>Boar</th>
<th>Stallion</th>
<th>Ram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>32</td>
<td>20</td>
<td>56+</td>
<td>16</td>
</tr>
</tbody>
</table>

**Spermatozoa in Ejaculate (weeks):**

<table>
<thead>
<tr>
<th></th>
<th>Bull</th>
<th>Boar</th>
<th>Stallion</th>
<th>Ram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42</td>
<td>22</td>
<td>&gt;60</td>
<td>18</td>
</tr>
</tbody>
</table>

**Separation of Penis & Prepuce (weeks):**

<table>
<thead>
<tr>
<th></th>
<th>Bull</th>
<th>Boar</th>
<th>Stallion</th>
<th>Ram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>32</td>
<td>20</td>
<td>4</td>
<td>&gt;10</td>
</tr>
</tbody>
</table>

**Sexual Maturity (weeks):**

<table>
<thead>
<tr>
<th></th>
<th>Bull</th>
<th>Boar</th>
<th>Stallion</th>
<th>Ram</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>150</td>
<td>30</td>
<td>90-150</td>
<td>&gt;24</td>
</tr>
</tbody>
</table>
Reproductive Failure in Males

Male fertility is related to several phenomena:

- sperm production
- viability and fertilizing capacity of ejaculated sperm
- sexual desire &
- the ability to mate.

Sub-fertility or complete sterility can result from:

- disease, congenital (developmental) malformations, high temperatures, high mating frequency, pathological conditions, physical disabilities – inability to copulate, hormonal & physiological disorders, & nutritional factors

i) Disease

Normally blood has no contact with the seminiferous tubules (blood/testis barrier). If barrier is broken (i.e. due to mumps in humans), the immune system does not recognize sperm & attacks them.

Brucellosis: The brucellosis organism localizes in the testicles of the bull and produces an orchitis (inflammation of the testicles).

Tubercullosis: a chronic infectious disease. Inflammatory changes in testis can lead to degeneration of seminiferous tubules.

ii) Congenital (Developmental) Malformations

Testicular hypoplasia

- Characterized by undersized testicles & very low semen production
- Diagnosed by semen, testicular palpation, & high return rate

Cryptorchidism

- failure or one or both testes to descend from the abdominal cavity into the scrotum
- Incidence is higher in swine and horses than other livestock species
iii) High temperatures
due either to climate or body heat in cryptorchidism (the elephant is an exception).

iv) High mating frequency
In bulls, 8 ejaculations in one hour results in
  a drop in seminal volume from 4.2 to 2.9 ml
  a drop in sperm count (sperm per ml) from 17 to 10 million
  a possible increase in the proportion of immature spermatozoa

v) Pathological Conditions
Testicular Degeneration
Most common cause of acquired infertility and reduced semen quality
Caused by infection, nutrition, lesions, aging, toxins
Semen Characteristics:
  immature and abnormal sperm,
  low sperm concentration,
  no sperm,
  degenerated sperm
Abnormal sperm structure
Includes 2 tails, 2 heads, coiled tail and no tail.
Some abnormal sperm will always occur, but too many (i.e. up to 50%) results in infertility

vi) Physical Disabilities - Inability to Copulate
May impede or prevent mating.
Include abnormalities of the penis
  Frebulum- downward deviation of the penis
  Hair rings or Growths
  Hematoma- caused by thrust against the perineum of the cow
Failure to Mount
  Associated with locomotor dysfunction

vii) Hormonal and Physiological Disorders
Failures in: Erection or Ejaculation
Lack of Libido (sexual desire)
    May be hereditary or may originate from endocrine imbalance or environmental factors

viii) Nutritional Factors
    Underfeeding
    retards sexual development (suppression of endocrine activity).
    Overfeeding
    reduces libido

Vitamin Deficiencies
    Vit A deficiency leads to testicular degeneration

Mineral Deficiencies
    trace minerals are important for male reproductive functions

Toxic Agents
    Estrogenic plants
    Alkaloid poisoning (Ergot)

** End *