INTRODUCTION

Reproduction is the process by which animals produce ________________ for the purpose of continuing the species. The process begins with the mating of a male and female of the species, a process called ________________. During copulation, ________ cells (spermatozoa) are transferred from the male reproductive tract to the female reproductive tract. In the female reproductive tract, the sperm unite with the egg cell (ovum) produced by the female to form an _______________. The embryo attaches to the wall of the uterus of the female reproductive tract where it is protected, receives nourishment, and develops until the new offspring is delivered from the female reproductive tract in a process called ________________. For a complete understanding of the reproductive process, a basic knowledge is required of the ________________ tract structure and function.

STRUCTURE AND FUNCTION OF THE MALE REPRODUCTIVE SYSTEM

Male Macrostructure and Function

The major function of the male reproductive system is the production, ____________, and deposition of sperm cells. It also functions by producing male sex hormones and serves as a passageway for expelling ________ from the urinary bladder. The male reproductive tract is made up of several organs, ____________, and muscles, each having a specific function.
Testes

The testes are paired, ovoid-shaped organs that produce sperm cells and the male sex hormone _________________. Testosterone causes the development of secondary male characteristics and sex behavior (____________). The testes are suspended from the body by the spermatic cord. The spermatic cord is a protective fibrous _____________ consisting of smooth muscles, blood vessels, and nerves. The scrotum protects and ________________ the testes. The spermatic cord extends through the ________________ ring and attaches to the testes to suspend them within the scrotum. The cremaster muscle, spermatic cord, and tunica dartos muscle in the wall of the scrotum raise or lower the testes to maintain a constant testicular temperature of approximately four to ______ degrees below body temperature, because sperm must develop under conditions cooler than body temperature.

Epididymis

The epididymis is a _____________ tube connected to each testis and is responsible for the maturation, storage, and transportation of sperm cells. The ________________ duct (vas deferens) originates from the epididymis and serves as a passageway for sperm to the urethra. The urethra is the passageway or tube that extends from the ________________ to the end of the penis and serves as the transportation route for semen and urine The ________________ are enlargements of the deferent ducts that open directly into the urethra. The location of the testes varies among the different livestock species, and as a result, the position of the epididymis varies as well.

Accessory Glands

Accessory glands are responsible for the production of secretions that contribute to the liquid non-cellular portion of semen known as the _____________ plasma. Semen and ejaculate are terms given to the sperm plus the added ________________ fluids. The vesicular glands (seminal vesicles) are paired accessory glands that secrete seminal fluid that adds fructose and ________________ acid to nourish the sperm and functions as a protection and transportation medium for sperm upon ejaculation. The ________________ gland secretes a thick, milky fluid that mixes with the seminal fluid and also provides nutrition and substance to the ejaculate. Just prior to ejaculation, the ________________ glands (Cowper’s glands) secrete a fluid similar to the seminal fluid, which cleanses and neutralizes the urethra from urine residue that can kill sperm cells.
Penis

The penis is the organ that allows for deposition of ___________ into the female reproductive tract. The penis of the bull, ram, and boar are termed _________________. The penis of the stallion is termed _______________. The stallion’s vascular type of penis has less connective tissue and depends on the engorgement of ___________ within certain tissues for erections to occur, and it forms no sigmoid flexure when relaxed. The penis of the bull, ram, and boar are termed fibroelastic because they are primarily composed of _______________ tissue and depend little upon blood for erections. When the penis is in a relaxed state in species with the fibroelastic penis type, the rear portion of the penis forms an S-shaped curve or ______________ flexure. This curve allows for the retraction and protection of the front portion (glans) of the penis. The _________________ penis muscles of the penis contract during the retraction of the penis, while the muscles relax and extend the penis upon sexual excitement. The sheath is the external portion of the male reproductive tract that serves to protect the penis from _____________ and infection.

Male Microstructure and Function

Within the testes are microscopic cellular parts that function in the production of sperm cells and the male hormone _________________. The development of sperm cells, called spermatogenesis, is a process of cell division and maturation that begins with stationary cells called spermatogonium and ends with motile spermatozoa.

Seminiferous Tubules

The seminiferous tubules are _______________ structures that coil throughout the testes. The process of ________________ takes place within the seminiferous tubules. The resulting spermatozoa, or sperm cells, are _______________ and tadpole-like. Once the maturation process has completed, the sperm cells proceed to the epididymis where they are stored until ejaculation or are _______________ by the body. Unusual climatic conditions (extremely high temperatures) or _____________ on a male can temporarily halt sperm cell production causing reproductive failure upon breeding.

Interstitial Cells

Between the seminiferous tubules are groups of _________________ cells (cells of Leydig) that function in the production of the male sex hormone, testosterone. Testosterone is an
hormone that directs the development of secondary male characteristics and influences libido. Secondary male characteristics include coarse hair, horns that are long and large at the base, a deep voice, and pronounced ________________.

STRUCTURE AND FUNCTION OF THE FEMALE REPRODUCTIVE SYSTEM

Female Macrostructure and Function

The purpose of the female reproductive system is to produce the __________ (ova) to be fertilized by sperm. It also serves as a receptacle for the ___________ during copulation and houses and nourishes the fetus until parturition. The female reproductive tract is made up of several organs, each having a ________________ function.

Ovaries

Two ovaries function to produce eggs and the female hormones, estrogen and _________________. The ovaries, along with the remainder of the female reproductive tract, are supported in the abdominal cavity by the ___________ ligaments. The arteries, veins, and _____________ of the ovaries are also located in these ligaments.

Oviducts

The oviducts (fallopian tubes) are the _____________ tubes that transport the eggs from the ovaries to the uterus. The oviduct is the site where the ___________ and the ova meet and where fertilization occurs. Two funnel-like openings, called infundibulums, pick up the eggs at ________________ and direct them into the body of the oviducts.

Uterus

The uterus consists of a ___________ and horns. The embryo attaches to the uterine body, or to the ___________ of the uterine horn, depending on the species of the animal. The uterus varies in shape among livestock species from long uterine horns in the ________ to relatively short uterine horns in the mare. The uterus functions as a ________________ for sperm during copulation, incubates the embryo during pregnancy, and contracts to expel the fetus during parturition. It is in the uterus that the embryo receives nourishment and develops until parturition.

Vagina
The vagina serves as the receptacle for the penis during copulation and as the birth ________ at parturition. The vagina also serves as a passageway for expelling liquid wastes, as the urethra joins the _____________ to the vagina prior to the opening at the vulva. The cervix is a thick-walled mass of ________________ tissue with a small tube-like opening that joins the uterus and the vagina. The cervix serves as a _______________ for the semen from the vagina to the uterus at copulation. It also contains glands that secrete a waxy-like substance that seals off the uterus during _______________ and between heat periods to protect against infection, disease, or entrance of foreign matter.

The vulva is the ________________ portion of the female reproductive tract that serves to protect the internal system from infection, to initially receive the penis at copulation, and to act as a passageway for urine. Just inside the vulva is a sensory ______________ organ called the clitoris.

**Female Microstructure and Function**

Just as the male testes produce sperm cells, the female ovaries produce ova in the process of _______________. Cells called oogonia develop in the ovaries of a ___________. By the time of birth, these oogonia have matured into ______________. There are thousands of oocytes at the time of birth; however, only a small proportion of these develop into ________ or reach ovulation.

*Follicle*

The follicle appears as a clear ______________-like on the surface of the ovary. The function of the follicle is to hold the growing ________ and to produce and store the hormone estrogen. Estrogen is secreted from the ________________ as a signal to the remainder of the reproductive anatomy to prepare for the ovulation of an ovum. The follicle remains relatively hard throughout the development of the ovum, but it becomes very soft, ruptures, and expels the ovum at the time of ovulation. The ovum enters the _________________ and then the oviduct to await fertilization.

*Corpus Luteum*

After ovulation, the ruptured follicle collapses and a small ________________ occurs. This blood-clotted area is called a _______________ hemorrhagicum and only lasts two to three days. This area begins to be filled by a ______________ mass of cells. This yellow body is called the corpus _______________. Its cells have the primary purpose of producing the female sex hormone,
Production of progesterone prepares the female reproductive anatomy for pregnancy and lasts approximately ___________ days unless the ovum is fertilized (in which case the corpus luteum remains until parturition). A degenerating corpus luteum becomes covered by connective tissue and is called a corpus ________________. The function of the corpus albicans is to remove the yellow cells of the corpus luteum and return the ovary to its normal shape and function.

The process of oogenesis is a part of the _____________ cycle. This cycle includes estrus, a period in which a female shows outward signs of receptivity to breeding as a result of the hormones secreted; this period is also referred to as “heat.” A cow or mare normally produces one ovum per ___________. A ewe produces two ova, and a sow produces eight to ____________ ova.

STRUCTURE AND FUNCTION OF THE MALE REPRODUCTIVE SYSTEM IN POULTRY

The male reproductive anatomy of poultry ____________ when compared to that of other animal species. The poultry anatomy consists of two testes (each with an epididymis and vas deferens) that lead to papillae and a ________________ copulatory organ.

The testes are unique in that they are located along the ______________ within the abdominal cavity. The epididymis is small in relation to the size of the _____________ but still functions in sperm storage. The vas deferens extend from the epididymis to the _____________ and are located on each side of the vertebral column. They function in _________________ of sperm and as sperm reservoirs. The cloaca is the portion of the lower end of the avian digestive tract that provides a ______________ for products of the urinary, digestive, and reproductive tracts.

The copulatory anatomy consists of two papillae and the rudimentary copulatory organ called the phallus. The papillae are located at the end of the vas deferens and on the ____________ of the cloaca. They are the organs that emit ____________ into the cloaca. The rudimentary copulatory organ is primarily used for sex identification in young chicks, but it is more developed and becomes engorged with lymph during mating in ducks and geese. During copulation, the sperm is passed from the papillae into the oviduct opening or cloacal wall of the female.

___________ is the male sex hormone produced by the testes. It not only directs sexual activity and the production of sperm, but it also controls ________________ sexual characteristics of the male. Social rank or “__________ order” is also influenced by the rate of androgen secretion. The secondary
sexual characteristics include comb growth, crowing or gobbling, spur development, and male feathering.

**STRUCTURE AND FUNCTION OF THE FEMALE REPRODUCTIVE SYSTEM IN POULTRY**

The functional parts consist of an ovary, an ____________, and the cloaca. The female of most animal species has two functional ovaries, but mature female poultry have only one ________________ ovary. Before the bird reaches sexual maturity, the _________ ovary and oviduct degenerate and cease function. The ovary appears as a cluster of tiny, ________ balls that are oocytes. At maturity, the ovary contains up to 4,000 tiny oocytes from which yolks or ova (__________) may develop over time. An ovum develops by collecting lipid particles from the blood to form the yolk.

The yolk contains fat for energy and some protein and other nutrients needed by the developing embryo, as well as a small, white dot called the blastodisc that contains the genetic information supplied by the female.

Each oocyte is enclosed in a thin sac called the follicle and is attached to the ovary by a vascular stalk. The oocyte will mature in the follicle to become a yolk. When the yolk is ____________, it is released from the follicle and then engulfed by the funnel-like infundibulum. The yolk enters a coiled _____________ that is about 25 inches long and consists of five clearly defined parts. The first part is the ____________________. The infundibulum functions in receiving the _________ and is the site of fertilization. The second part is the _____________ that secretes the thick white or albumen. Third, the _____________ adds the two shell membranes. Then fourth, the _____________ secretes the thin white, the shell, and the shell pigment. Last is the _____________ that holds the egg until it is laid. The egg passes from the oviduct to the cloaca and then out of the body through the ___________ at the time of laying.

_________ is the female sex hormone produced by the ovary. The ovary also secretes the hormone _______________. This hormone stimulates comb growth and works with other hormones in ______ production. Estrogen stimulates the growth of the oviduct and causes the cloaca to ____________ in size during egg laying. It also modifies the feather shape and ________________ of the female. Estrogen increases the level of fat, phosphorus, and ________________ in the blood, as this is necessary in egg production.
THE REPRODUCTIVE PROCESS IN MAMMALS

The estrous cycle is measured as the time between two consecutive ____________ periods. This time ____________ among the various species of livestock. The estrous cycle begins with the ________________ of a follicle. When the follicle erupts and releases the egg to the oviduct, the follicle becomes a ____________ hemorrhagicum and then a corpus ____________ that secretes the hormone progesterone. The corpus luteum develops, matures, and eventually ________________ if the female’s ovum is not fertilized. During the regression of the corpus luteum, a new developing follicle on the ovary begins to release _________________. Estrus will occur in response to the increasing amount of estrogen produced by the maturing follicle, and also by the decreasing amount of progesterone produced by the regressing corpus luteum. Estrus ends with ovulation of the ________________ follicle and the estrous cycle starts again.

Different species of livestock show outward signs of _____________ in various ways. For example, cows and ewes will stand to be ______________ by other animals of their species, sows will stand still when pressure is placed on their loin area, and mares will act nervous and urinate frequently. The ____________ of the heat period is also determined by the species of animal.

After ovulation has occurred, the egg or ovum is received by the infundibulum and ________________ into the oviduct. If the female has been bred during the heat period and a _____________ sperm reaches the fallopian tube and fertilizes the ovum, then the result is pregnancy. If fertilization occurs, the corpus luteum persists on the ovary and produces progesterone throughout the pregnancy so that an estrus period does not occur until after the pregnancy has terminated. The hormone progesterone also helps to implant and nourish the embryo and to develop the ______________ system of the female.

Fertilization is the union of the sperm and the ovum and is the actual beginning of _________________. During estrus, the female is either bred naturally or _________________ inseminated. When bred naturally, the semen containing the sperm is deposited into the _____________ of the female. The sperm make their way through the _____________ into the uterine body, both uterine horns, and finally into the oviducts. If the sperm were deposited into the reproductive tract at the proper time in relation to ________________, the sperm and ovum should unite and fertilization will occur.

The fertilized ovum, or _____________, begins a process of cellular division and becomes an embryo. The embryo floats freely for a time in the uterus where it obtains its ________________ from the fluids secreted by the uterine walls. After about twenty days in cattle (this period differs with each
species of livestock), the embryo will attach to the _________ of the uterus and begin to take a recognizable form, at which time it becomes a fetus. The embryo is encompassed in a fluid filled membrane called the ____________ that protects the embryo from mechanical disturbances. The amnion is surrounded by the ____________ that functions as a protective coat and point of nutritive exchange. The chorion develops raised button-like ____________ on its surface called fetal cotyledons. At the time of attachment to the uterus, these nodules attach themselves to raised prominences in the uterine wall that arise from caruncular regions in the uterus. During fetal development, the ____________ is nourished by the mother through these attachments. The membranes that surround the embryo and attach to the uterus during pregnancy are known as the __________________.

In some species of mammals, several ova are produced and fertilized during a single cycle resulting in ____________ births. If two or more ova are fertilized, the resulting offspring are called ____________ twins and are no more genetically alike than are full brothers and sisters resulting from single births. Sometimes two offspring are produced from a single ovum fertilized by a single sperm resulting in ____________ (identical) twins.

A normal pregnancy is terminated by ____________. At the time of parturition, the fetus is expelled from the uterus and passes through the ____________ and vagina out of the reproductive tract. The membranes that had formed around the fetus are also expelled at birth and are collectively called the ________________. After parturition, the corpus luteum on the ovary begins to regress, a developing follicle on the ovary begins to release ________________, estrus occurs, and the estrous cycle begins once again.

THE REPRODUCTIVE PROCESS IN POULTRY

Poultry reproduction begins when sperm are introduced into the oviduct in the cloacal wall of the female by the papillae of the male. The sperm move up the oviduct to the ________________ where fertilization takes place. Eggs that are already forming in other parts of the oviduct upon mating are not ________________. Therefore, the first few eggs that are laid after ____________ may not be fertile. Sperm cells will remain in the oviduct for two to three weeks, though viability decreases as time passes.

As each yolk is released from the ovary of the hen, it falls into the ________________ of the oviduct where the female germ cell on the outer edge of the yolk is fertilized by sperm. The fertilized
yolk or embryo then moves through the reproductive tract, acquiring the normal egg components (albumen, shell membranes, ________ white, and shell). With the proper temperature and ______________ after the egg is laid, the embryo continues to develop. The embryo is nourished by the egg contents during ______________ and for three to four days after the chick has hatched.

**REPRODUCTION FAILURES IN LIVESTOCK**

_______________, either permanent or temporary, may be caused by a number of reasons. Specific physical defects, particular diseases, environmental factors, or ________________ aspects can halt or hinder reproduction.

**Anatomical Factors**

Cryptorchidism – this is the failure of one or both of the testes to ______________ into the scrotum. The testes are retained in the abdominal cavity resulting in complete ________________. Sometimes only one testis is retained and the defect is referred to as ________________ cryptorchidism. This does not cause complete sterility but results in a ________________ in the number of viable sperm produced.

Scrotal hernia – this condition may not cause ________________ but can cause an animal not to breed. If the hernia is large enough to allow part of an ________________ to drop through, it can be very dangerous.

Malformed penis – results from an injury or ____________ defect, the penis can be malformed to the extent that copulation cannot be performed.

**Ovarian Dysfunction**

Freemartin – in the case of twin calves born of opposite sex, the female calf is sterile _____% of the time. The female ________________ tract does not completely develop in a freemartin.

Infantile or absence of ovaries – sometimes during development, because of a hormone ________________, the ovaries fail to develop enough or will not function. In some cases, they may be absent.

Endocrine disturbances – some female reproductive disturbances are hormonal or glandular in nature, often the result of cystic ovaries in which one or both ovaries contain one or more
that may alternatively grow and regress but fail to ovulate. The cysts cause the female to exhibit abnormal estrous or anestrus.

**Diseases**

**Bacterial and Protozoal Infections of the Reproductive Tract**

Brucellosis – also known as “_____________ disease.” Brucellosis causes the destruction of the cotyledons of the uterus and may result in abortion in the latter months of _______________. Affects cattle, swine, sheep, goats, dogs, horses, and some ________________. Vaccinations are an effective means of _________________. Animals with the disease must be ________________.

Vibriosis (Campylobacteriosis) – a ______________ disease found in cattle that causes infertility, early embryonic death, and abortion. Recovery is often spontaneous. ________________ are an effective means of prevention. A similar type of organism can also infect ____________.

Trichomoniasis – a veneral protozoal disease of cattle characterized by early ________________ death and abortion. A vaccine is available but is not always an effective means of ________________.

Leptospirosis – Causes loss of body weight, ________________ anemia, and abortion. Affects cattle, swine, sheep, goats, __________, and horses. ________________ are an effective means of prevention.

**Viral Infections of the Reproductive Tract**

Infectious Bovine Rhinotracheitis (IBR) – a respiratory __________ disease that causes pneumonia, fever, infertility, impaired fetal circulation, and eventually abortion. ________________ are an effective means of prevention.

Bovine Viral Diarrhea (BVD) – a viral disease that causes ________________ throughout the digestive tract, fever, and diarrhea. Abortion is caused by infection of _________________. Vaccinations are an effective means of _________________.

**Environmental Factors**
Mechanical injury – physical _____________ to reproductive organs. Injuries usually occur because of improper handling, unsafe facilities, ______________ among animals, or complications during parturition or copulation.

Stress – severe climatic conditions (primarily extreme heat), high population density, rough handling, and other stressful ________________ factors can cause reproductive distress.

**Other Factors Affecting Reproduction**

Nutritional deficiencies – reproductive failure can be caused by insufficient levels of feed intake and quality of nutrients needed to meet the high demands put on the body’s ________________ due to fertility requirements, pregnancy, lactation, and other events involved in reproduction. Lack of condition or __________ condition usually reduces reproductive efficiency. During periods of low nutrition, the body lacks the __________ stores necessary for reproductive activities. During periods of obesity, fatty deposits collect in and around the reproductive organs, impairing _______________ and productivity.

Certain quantities of vitamins and minerals are essential for efficient reproduction. The following vitamins and minerals, if not ________________ in the animal’s diet, are known to affect reproduction in the following ways:

- **Vitamin A** – shortened periods of gestation, higher incidence of retained placentas, stillbirths, abortions, ________________, calves born blind and uncoordinated.
- **Vitamin E** – poor conception rates, higher incidence of ________________ and newborn mortality.
- **Phosphorus** – poor conception rates, delayed ______________, lower weaning rates, erratic heat.
- **Calcium** – increased calving difficulty, uterine ________________, retained placenta.
- **Cobalt** – poor ________________ rates, general reproductive failure.
- **Iodine** – retained ________________, delayed puberty, arrested fetal development, irregular or suppressed heat, abortion, stillbirths; calves that are blind, hairless, and have enlarged thyroid glands.
- **Copper** – delayed puberty, ________________, retained placentas.
- **Iron** – general reproductive failure, ________________ young.
- **Manganese** – ________________ or suppressed heat.
Ingestion of toxic plants – poisonous plants can also cause reproductive ___________ or abortion. Ingestion of ______________, ponderosa pine needles, and snakeweed can cause abortion and birth defects in cattle. Ingestion of lupines, sweet clover, and ___________ grass can cause abortion in sheep and goats.

Genetic factors – some bloodlines are known to have a high genetic factor or weakness for sterility or low _________________. Inbreeding also may result in lowered _________________. 