



Cornell Institute for Biology Teachers

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Title:

Dissection of the Pregnant Cow Reproductive Tract

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Appropriate Level:

Life Science, Biology, Honors, AP, and Tech prep, depending upon the level of discussion and types of questions asked.

Living Environment

4-Content: 4-Reproduction and Development: 4.1 a,e,f

Abstract:

The instructor will dissect an early to mid-pregnant bovine reproductive tract. Data on crown rump length and fetal mass can be collected for use with CIBT's *Fetal Development* lab. Some appreciation of the form and function of the various organs should be developed by students. This exercise will also serve as a comparative reproduction lab and highlight some of the differences between human and bovine anatomy.

Time Required:

Teacher preparation time: Minimal. The uterus will need to thaw for about 24 hours before dissection. Plan on thawing time similar to a turkey of equivalent size. It can also be thawed by placing it into a sink full of water. This technique takes about an hour. Or, a final alternative would be to place it into a microwave on defrost.

In class time: The exercise as scripted is designed to take 20 to 30 minutes (Time varies based on student involvement and questions). The exercise can be used as an introduction to the CIBT *Fetal Development* and/or *Hormones of the Menstrual Cycle* labs.

Special Needs:

Cow uterus (available from West Hill Biological Resources. See information at <http://www.westhillbio.com/>).

Teacher Information

Preparation Instructions

On the day of the dissection, you will want to rinse the uterus (avoid splashing water off the uterus) and lay it out on the tray so that you have “oriented” yourself. It is good to spend a few minutes locating the major features, since the specimens are not consistent.

Materials

- Large dissection tray or cafeteria tray. Additionally, a dishpan may be useful for catching the amniotic fluid, depending on the size of the uterus.
- Latex or rubber gloves for all participants handling the specimen
- Space to gather entire class around the tract. Alternately, a video hook-up or “flex cam” could be used. Flex cams are available through the CIBT Lending Library.
- One pregnant bovine reproductive tract
- Scalpel, dissecting needle, dissecting pan and forceps
- (optional) set of photographic slides of the dissection

Safety Precautions

The reproductive tracts used are harvested from cows being slaughtered for human consumption. The cows were not specifically killed to collect the reproductive tracts. No preservatives were used in the preparation of tissues. The cows passed USDA inspection; however, gloves should be used whenever handling animal tissue because accidental contamination of tissue can occur. Students should be instructed not to touch their faces or other “clean” surfaces with contaminated gloves. If they touched the preparation, they should thoroughly wash their hands with soap afterwards, even if they were wearing gloves. Good lab practices should be followed including: no food or drink in the lab.

Helpful Hints

- It can be helpful to show slides of the dissection in advance to orient students to what they will see.
- You might want to write the terms you wish to introduce during the demonstration on the blackboard. This will help to give students an outline of what they should be seeing as well as a list of which vocabulary they would be responsible for. Alternately, these terms might be given to students in advance in the form of a glossary.

Terms you might want to include:

- amnion/amniocentesis
- caruncles
- cervix
- chorion/chorionic villus sampling
- corpus luteum
- CVS
- myometrium/endometrium
- cotyledons
- DES (diethylstilbestrol)
- umbilical cord
- contralateral
- ipsilateral
- prostaglandins

Observations

This is an outline of topics you might want to discuss with students as you do the demonstration.

External:

- Size and shape of uterus. Contrast human uterine shape (pear) to cow (Y), to pig (much bigger uterine horns). Relate this to number of offspring produced at one time. Animals that have multiple births have bigger uterine horns.
- Shape and structures of ovaries and their location in relation to the uterus. Can you tell which ovary has ovulated most recently?
- Corpus luteum. It will be a rounded, yellow body on the ovary. Determine if the implantation was **ipsilateral** (in the horn on the same side as where ovulation occurred) or **contralateral** (in the opposite horn from where ovulation occurred).
- Broad ligaments. They extend wing-like from the sides of the uterus to attach it to either side of the pelvic wall.
- Ovarian bursa and oviduct. The oviduct can be very difficult to find as it is a very tiny tube (about the width of a piece of yarn). Remind students that fertilization occurs in the oviduct. You may be able to point out the vascularization in this area. This allows for the transfer of prostaglandins from the uterus to the ovaries.
- Feel the uterus. Can you feel a fetus? How many fetuses are present? (Palpation is the most common way of checking for pregnancy in cows. Be careful if the uterus is not totally thawed, since ice chunks may be mistaken for a fetus.) Is the wall muscular? (Yes.) What type of muscle is present in the uterine wall? (Smooth.)
- Feel the cervix and examine its structure. Point out the pleated structure of the cervix. Discuss its function. You may be able to point out cervical mucus.
- **Diethylstilbesterol** (DES) and its effects on the cervix, role of cervix. Daughters of mothers who used DES have an increased rate of cervical deformities. This includes incompetent cervix that

results in the inability to carry a pregnancy to term.

Internal:

- Chorion. Discuss **chorionic villus sampling** (CVS). This is an alternative to amniocentesis. It can be done earlier in pregnancy, but has an increased risk of miscarriage.
- Amnion. You will be able to locate this as a bag inside the chorion. Discuss **amniocentesis**: removal of a sample of the amniotic fluid. The fluid can then be used to make a karyotype for DNA profiling.
- Thickness of uterine wall and its layers. The **myometrium** is the muscle wall, the **endometrium** is the inner, lining layer that gets shed during menses.
- Caruncles (from the mother) and cotyledons (from the fetus). They are small round discs. The two sides attach together like velcro and function like the discoid placenta in humans. This type of placenta is referred to as a cotyledonary placenta.
- Embryo/fetus: umbilical cord (2 arteries and 1 vein). Remind students that the fetal circulation is separate from the mother. Note the fetal structures. These will vary depending upon the age of the fetus; hooves, eyes, ribs, the extent of calcification of the bones (they become harder and appear whiter).
- You may notice many small bumps on the umbilical cord as well as on the internal chorionic membrane. These are structures that did not totally form into cotyledons and are referred to as adventitious plantation.

Extensions

- If you are lucky enough to get twins, you may want to discuss **free martins**. A free martin is a sterile female calf. This occurs with fraternal twins of the opposite sex. The transfer of male androgens to the female calf causes it to become sterile. This is probably related to the cotilydonary placenta that allows more intermingling of fetal blood. This does not happen in humans due to the presence of a discoid placenta.
- If the fetus is large enough, students may find it interesting to dissect it. The most obvious difference from a fetal pig will be the presence of the multiple stomachs in the calf. This might be a good alternative for students who object to the dissection of pigs for religious reasons.
- Ovarian vascular arrangement of the uterine vein and ovarian artery.
- Compare total mass of the pregnant uterus to the mass of the fetus. This could be compared to human weight gain during pregnancy, i.e., normal weight gain during pregnancy exceeds the mass of the neonate.
- Measure fetus to estimate fetal age from crown-rump length.

Age(days) = 2.46 x length(cm) + 54. Works for ages 56 to 200 days.

- Students could do research projects to study the effects of DES, amniocentesis, and karyotyping and CVS.

If you plan to do the CIBT *Fetal Development* lab, be sure to measure and record the crown-rump

length as well as the mass of the fetus.

Cow and Human Reproductive Anatomy: Differences

Uterine Shape: The cow has a uterine body with two distinct uterine horns whereas the human uterus lacks distinct uterine horns. The human uterus resembles an upside down pear. This structural difference is due to the fact that humans typically have single babies, whereas multiple births are more common in cows. Animals such as pigs and mice that have litters of offspring have a “Y” shaped uterus with more distinct horns. The non-pregnant human uterus is about 7.5 cm long and the cow uterus is about 40 cm long.

Type of placenta: Placental shapes vary by species. Humans, rats, mice, and primates have a discoid, or round placenta. Pigs and dogs have a zonary placenta. Ruminants have a cotyledonary placenta. In the ruminants placental transfer occurs at specific predetermined sites. These sites are visible as bumps on the endometrial surface and are called caruncles. There are many caruncles present on the endometrium. The embryonic chorion forms cotyledons and attaches to the caruncles forming a functional unit called a placentome. A normal cow will have 70-120 placentomes. The placentomes are the functional equivalent of the disc shaped placenta in humans. Unlike humans, where a new placental attachment forms each pregnancy, these same maternal caruncles will be used for each pregnancy. The cotyledons should be visible as round, whitish, textured areas on the chorion, or outer fetal membrane. In older fetuses the chorion will actually be fused with the caruncles and it will be difficult to separate the layers. However, when peeled apart it will appear almost like Velcro®. In humans the amnion and chorion fuse; however, in the cow you can see the amnion which will appear like a separate bag inside the chorion.

Dairy Cattle Reproduction

Domestic cattle breed year round. This is important for a constant milk supply and has been accomplished by selective breeding. Another important feature of dairy cattle reproduction is the lack of lactational anestrus. Dairy farmers strive to have a cow calf at 24 months of age and then once per year after that. To achieve this goal the cow must resume cycling and be bred at 85 days postpartum; this will allow a 305 day lactation to be followed by a 60 day dry period prior to the next calving. This takes excellent nutrition, careful management, and good care of the cows by the farmer.

References

- Bobak, Irene and Jensen, Duncan and Marianne K. Zalar. (1989) *Maternity and Gynecologic Care*. C. V. Mosby Company, St. Louis, Missouri
- Hafez, E. S. E. (1993) *Reproduction in Farm Animals*, 6th ed. Lea & Febiger, Philadelphia, PA
- Van Tienhoven, Ari. (1983) *Reproductive Physiology of Vertebrates*, 2nd ed. Cornell University Press, Ithaca, NY

New York State Learning Standards Pregnant Cow Dissection

Standard 4: Living Environment

Key Idea 4: The continuity of life is sustained through reproduction and development.

4.1- Explain how organisms, including humans, reproduce their own kind

a. Reproduction and development are necessary for the continuation of any species

e. Human reproduction and development are influenced by factors such as gene expression, hormones, and the environment. The reproductive cycle in both males and females is regulated by hormones such as testosterone, estrogen and progesterone.

f. The structures and functions of human female reproductive system, as in almost all other mammals, are designed to produce gametes in ovaries, allow for internal fertilization, support the internal development of the embryo and fetus in the uterus, and provide essential materials through the placenta and nutrition through milk for the newborn.