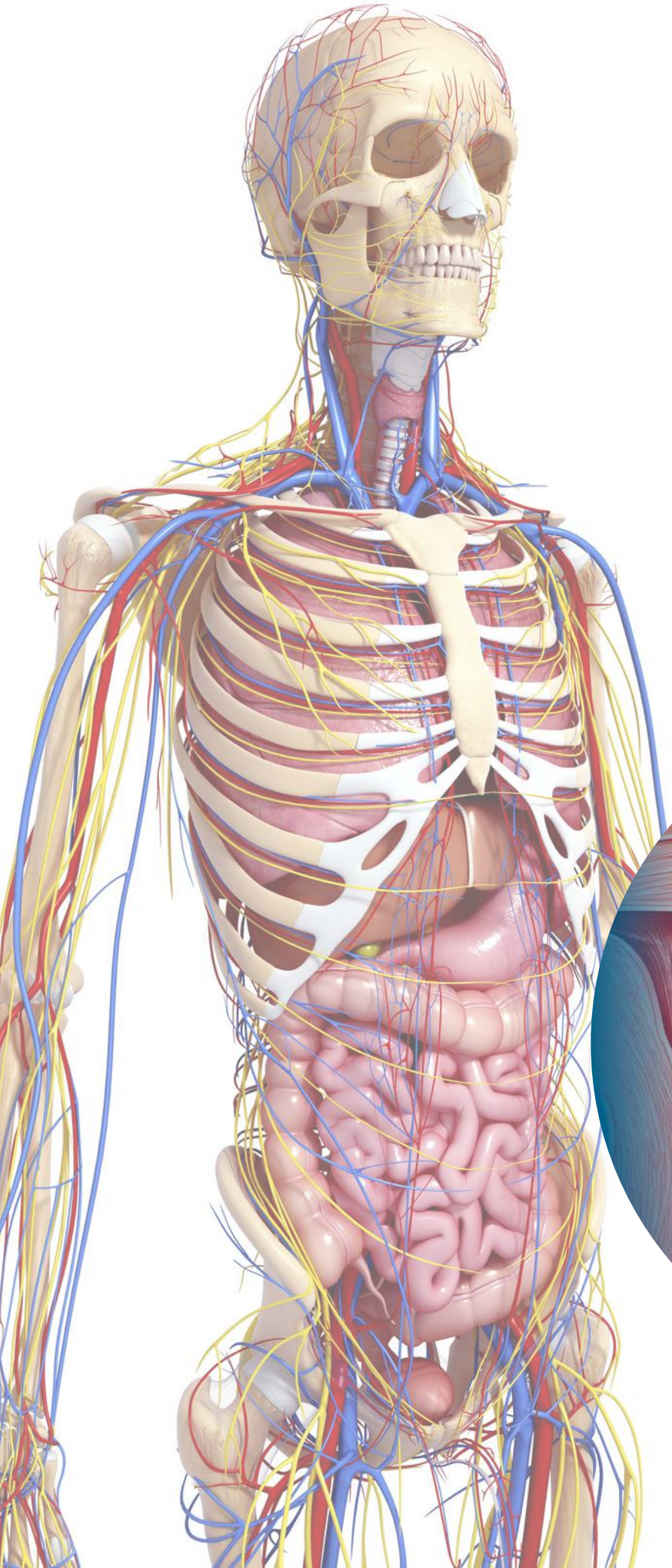
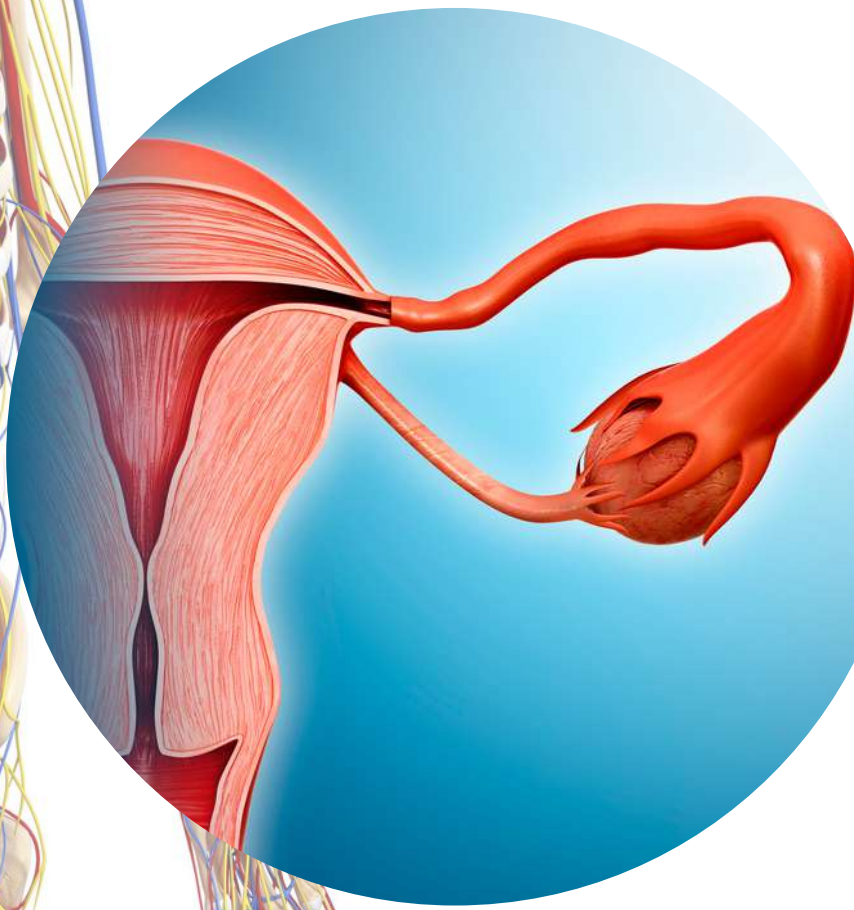
Reproductive System Lesson Plan Grade 12





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The following unit plan was created in accordance with the Canadian Council on Animal Care's recommendations to replace any present procedures involving the use of animals in teaching, testing and research.

The Three Rs principle of Replacement states, if you can meet your scientific or educational goals without the use of animals, it is your ethical obligation to use non-animal methods. Grade 12 anatomy content is often taught using fetal pigs - here we offer an effective and humane alternative.

This is in alignment with the public's concern for animal welfare and a cultural respect for animals passed down from the Aboriginal perspectives of the First Peoples.

Elisabeth Ormandy created this unit plan and series of lesson plans for your use in teaching life science content to Grades 12 based on the BC Science Curriculum.

These Humane Science Education materials were developed to provide equivalent or greater standards in education for Canadian youth, without the use of animals.

Curriculum Alignment

This lesson plan can be used to create classes for Grades 12 based on the BC Science Curriculum. Specific **Big Ideas** covered in this lesson plan include:

Grade 12 - Organ systems have complex interrelationships to maintain homeostasis.

ORGAN SYSTEMS:

- Structure and function
- Structural and functional interdependence
- Maintenance of homeostasis

We have recommended specific virtual anatomy tools to use to get the most out of the unit plan. You'll find links to those on pages 5 & 6.

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Lesson Plan Overview

Subject: Science

Unit Overview: Anatomy and Physiology

Unit Duration: ~90 minutes

Grade: 12

Big Idea: Organ systems have complex interrelationships to maintain homeostasis

Curricular Competencies

- *Analyze cause-and-effect relationships*
- *Construct, analyze, and interpret graphs, models, and/or diagrams*
- *Consider the changes in knowledge over time as tools and technologies have developed*

Content

- By the end of this lesson, students are expected to demonstrate understanding of the following:
  - *human reproductive system:*
    - *structure and function*
    - *structural and functional interdependence*
    - *maintenance of homeostasis*

Recommended Education Tools

Hardware & Workbooks:

This inventory is for a regular in-person class - use x1 iPad/tablet per student for responsible physical distancing. If teaching online, teachers can screen share their iPad/tablet or desktop.

- 6 (or more) iPads or other tablets
- 6 (or more) 3D Anatomica workbooks

Recommended Software:

- 3D Anatomica: https://3danatomica.com
- 3D4Medical Complete Anatomy: https://3d4medical.com

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Lesson Plan Overview

Topic: Organ systems have complex interrelationships to maintain homeostasis. Homeostasis is maintained through physiological processes.

Content: The human reproductive system: organs, structure and function

Goals	Students will be able to: • Describe the function of the reproductive system and its major components. • Describe the relationships between the different components of the reproductive system. • Explain how the reproductive system is interdependent with the nervous system. • Explain how the reproductive system maintains homeostasis in the body.
Objectives	After this lesson students will state the structure and function of each tissue in the reproductive system and explain how the reproductive system is interdependent with other body systems.
Materials	• 3DAnatomica • 3D4Medical
Introduction	Using the 3DAnatomica and/or 3D4Medical app(s), the teacher will introduce the topic of the reproductive system.
Development	Questions to support inquiry-based learning: • What is the advantage of having specialized tissues in the reproductive system? • How does the reproductive system help the body maintain internal balance during exercise? • What are the impacts of external stimulants (e.g. alcohol, caffeine) on the reproductive system? • What lifestyle decisions would you make to improve your reproductive health? • How does the reproductive system respond to infection by a pathogen?
Practice	Students will work independently or in pairs to navigate 3DAnatomica and/or 3D4Medical to learn about the structure and function of the reproductive system.

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Lesson Plan Approach

If teaching regular in-person classes:

- Split students into **6 groups**.
- Give each group a **Reproductive System workbook** to refer to, and one (or more) iPad(s) or tablet(s) with the **3D Anatomica app**, and **3D4Medical Complete Anatomy app** loaded and ready to use.
- Your **introduction** should include discussion of the function of the reproductive system, identifying its major components, and the vocabulary you would like students to learn (~ 15 mins). Have the students follow along using the 3D4Medical Complete Anatomy app.
- Have students **label "Major Structures"** diagram using 3D4 Medical
- **Discuss the function** each major structure in the reproductive system. Have students use the 3D Anatomica and 3D4Medical Complete Anatomy app to fill their 3D Anatomica workbook and/or handouts provided. This can be student or teacher led. (30 mins)
- Go through organ anatomy and function as a group, following along using the **models in the apps,** then ask students to summarize each stage .
- Ask students to brainstorm **ways the reproductive system interacts with other systems,** and go over the specific examples provided
- Discuss different ways the reproductive system helps maintain homeostasis using examples provided, then ask students to provide their own examples using what they've learned.
- **Close the class with a 20-minute recap** of what the students have learned, discuss how the parts of the reproductive system work together, and check for understanding. Begin a **conversation on ethics** of animals in science using the questions provided.

If teaching a physically-distanced class:

- Use x1 iPad for each student and proceed as per the directions above.

If teaching online:

- Lead the students through the reproductive system by screen sharing your own iPad/tablet or desktop with the 3D4Medical Complete Anatomy app installed, filling out the tables, and labeling the models as you go
- Proceed as per the directions above

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Detailed Lesson Plan & Teaching Notes

Introduction to the Lesson

Include a First Nations land acknowledgement and ask students to reflect on what respect for animals means to them. Provide an introduction to the apps and models that will be used in class. Provide an overview of how to access student anatomy workbooks if teaching remotely.

What is Homeostasis? Discuss with Students

In biology, **homeostasis** refers to the body's ability to maintain a stable internal environment despite changes in external conditions.

Introduction to the Topic

Students will use the **3D4Medical Complete Anatomy** app to explore the urinary system at large. If you are teaching remotely (i.e. online), you can use this time to do a Kahoot quiz! We recommend covering the function of the reproductive system, identifying the major components of the system, and discussing the vocabulary you would like the students to learn early in the lesson.

THE REPRODUCTIVE SYSTEM AT-A-GLANCE

Function	The reproductive system functions to produce egg and sperm cells, to transport and sustain these cells, and to nurture the developing offspring.
Components	Ovaries, fallopian tube, uterus, cervix, vagina, vulva, testes, scrotum, epididymis, vas deferens, seminal vesicle, prostate, penis, sperm, eggs
Important vocabulary	Ovaries, fallopian tube, uterus, cervix, vagina, vulva, testes, scrotum, epididymis, vas deferens, seminal vesicle, prostate, penis, sperm, eggs, menstruation, progesterone, estrogen, menopause, testosterone, ejaculation

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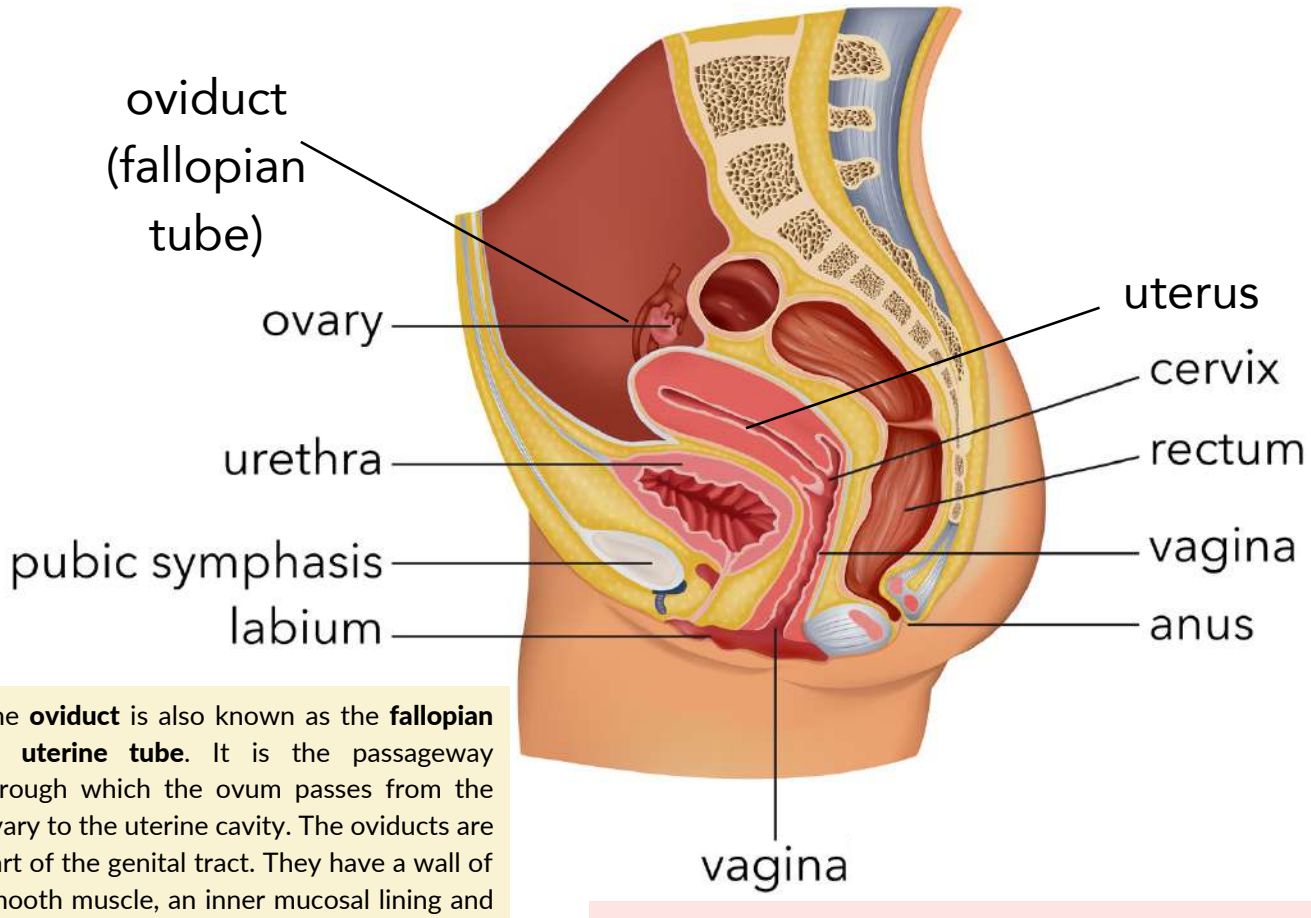
Components in Detail:

Reproductive system overview: female (teacher copy)

The **uterus** is made up of an external layer of smooth muscle called the **myometrium**, and an internal layer called the **endometrium**. The endometrium has three layers: **stratum compactum**, **stratum spongiosum** (which make up the stratum functionalis) and **stratum basalis**. The stratum compactum and stratum spongialis develop into the stratum functionalis during the first half of the menstrual cycle (proliferative phase). The wall of the uterus changes during the menstrual cycle.



The **oviduct** is also known as the **fallopian** or **uterine tube**. It is the passageway through which the ovum passes from the ovary to the uterine cavity. The oviducts are part of the genital tract. They have a wall of smooth muscle, an inner mucosal lining and an outer layer of loose supporting tissue (**serosa**). The proximal part is called the **infundibulum**, which is flared and 'fringed' (**fimbriated**).This leads into a longer, thin walled **ampulla**, which has primary, secondary and tertiary longitudinal mucosal folds. This leads into a short thicker-walled **isthmus**, which has fewer longitudinal mucosal folds. This leads into an intramural portion, that extends through the uterine wall, and opens into the uterine cavity.

The vagina is a muscular tube. The lining **epithelium** is stratified squamous. Underneath the epithelium is a layer of **lamina propria,** which is rich in elastic fibres, and does not have any glands. Under the lamina propria layer is a layer of **smooth muscle**, which has an inner circular and outer longitudinal layer. Finally, there is an **adventitial layer**, which merges with that of the bladder (anteriorly) and rectum (posteriorly). The elastic LP and smooth muscle enable the vagina to distend, particularly during birth.

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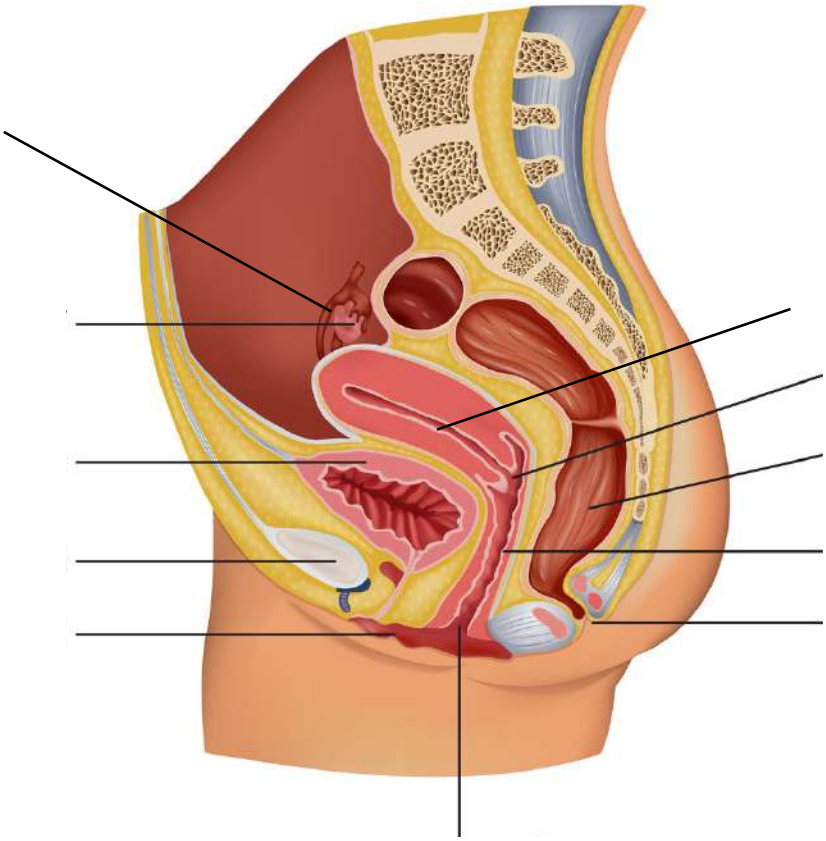
Components in Detail:

Reproductive system overview: female (student copy)



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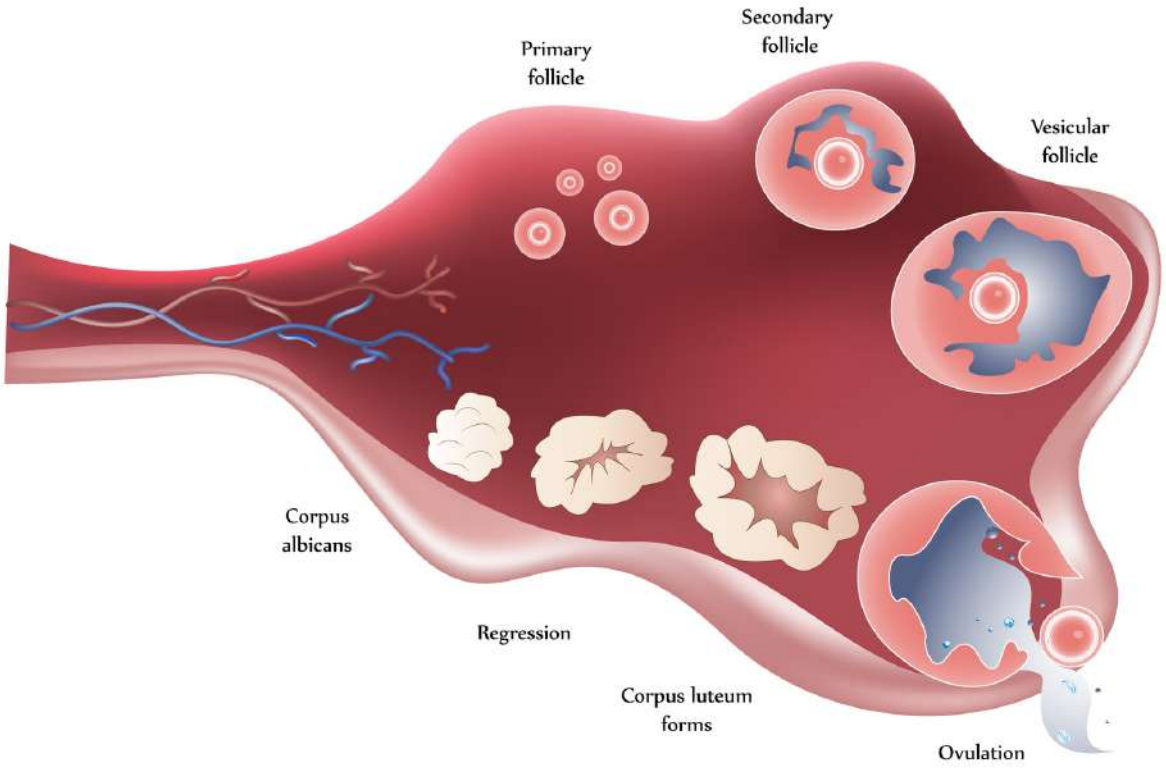
Components in Detail:

Ovary



The ovary is where **oogenesis** occurs Ovaries are stimulated by **gonadotrophin** from the **anterior pituitary**. Ovaries also have an endocrine function - they release **estrogen and progesterone**. The genital tract makes up the rest of the female reproductive system: **fallopian tubes** take the ova to the **uterus**. The uterus is a muscular organ, and its mucosal lining undergoes hormone dependent changes. The vagina is a muscular tube that leads to the outside. The ovaries are small almond shaped structures, covered by a thick connective tissue capsule - the **tunica albuginea**. This is covered by a simple squamous mesothelium called the **germinal epithelium**. The ovary has a cortex, which is where the **ovarian follicles** can be found, and a highly vascular **medulla**, with coiled arteries called **helicrine arteries**. The **oocytes (eggs)** are surrounded by epithelial cells and form follicles. The ovary contains many primordial follicles, which are mostly found around the edges of the cortex. There are fewer follicles in different stages of development.

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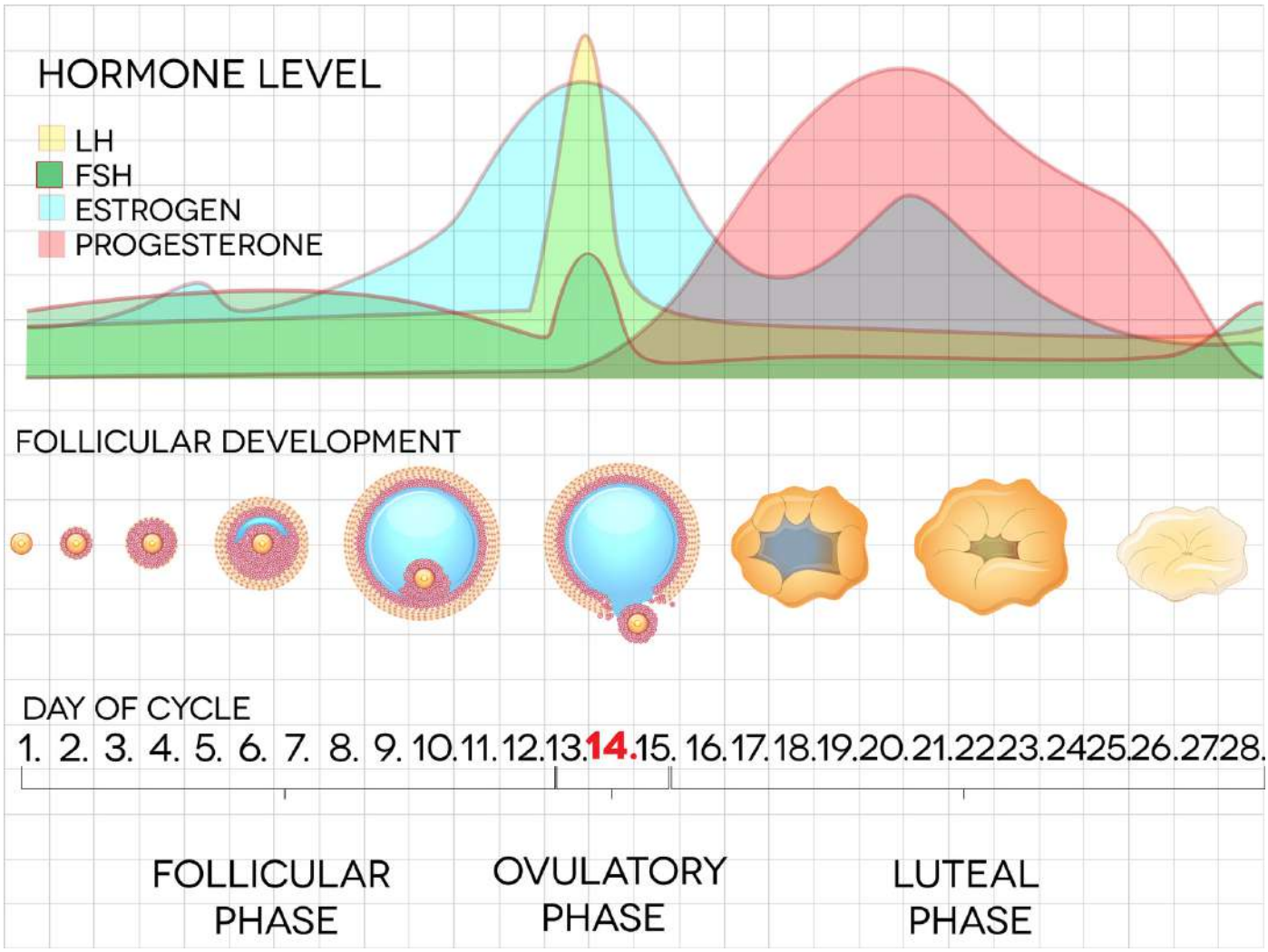
Components in Detail:

Menstrual cycle



Development of the follicles is stimulated by production of **follicle stimulating hormone (FSH)** by the **pituitary gland**. Ripening of the follicles then results in an **increase in estrogen levels**, as estrogen is secreted by **follicular cells**. This increase in oestrogen levels feeds back to the pituitary, and suppresses further release of FSH (**negative feedback**). The follicles also release a second hormone called **inhibin**, which also suppresses further production of FHS. As the oestrogen levels rise, this triggers a a mid cycle surge in a second pituitary hormone called **Lutenising hormone (LH)**, which causes the follicle to rupture (**ovulation**). LH also causes ruptured follicles to lutenise, forming a transitory endocrine organ called the **corpus luteum**. This looks yellow, due to its pigmented lutein cells (luteus is latin for yellow). The corpus luteum secretes **progesterone and estrogen**. The progesterone levels feed back to the pituitary and suppress further release of LH. If fertilisation does not occur, the corpus luteum degenerates into a small white fibrous scar called the **corpus albicans**. The resulting decline in progesterone (and to some extent oestrogen) levels precipitate **menstruation.** The decline in oestrogen levels, feeds back to the pituitary and there is a corresponding increase in FSH to being the cycle all over again.

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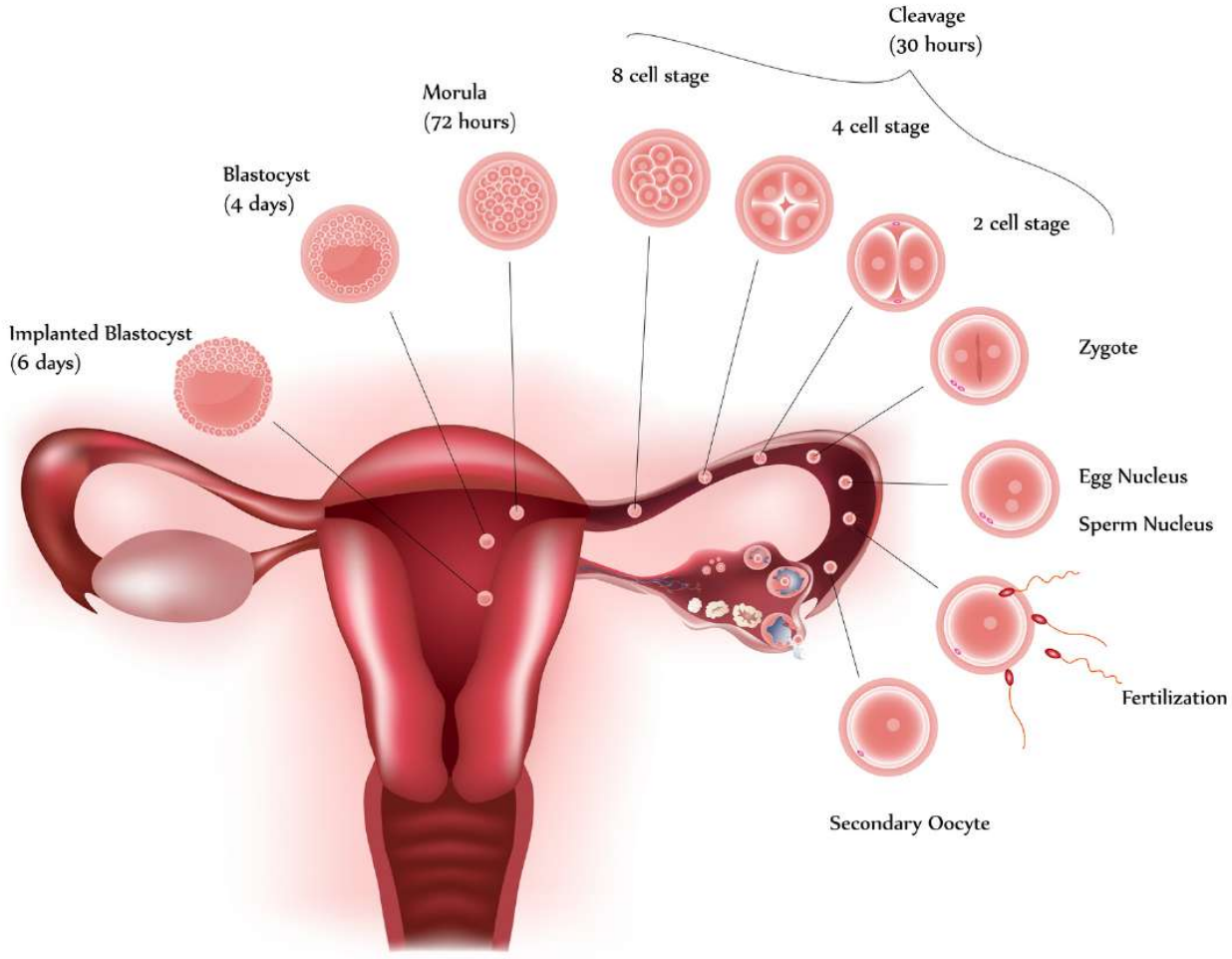
Components in Detail:

Ovulation, fertilization, implantation (teacher copy)



The development of multi-cellular organisms begins from a **single-celled zygote**, which undergoes rapid cell division to form the **blastula**. The rapid, multiple rounds of cell division are termed **cleavage**. After the cleavage has produced over 100 cells, the embryo is called a **blastula**. The blastula is usually a spherical layer of cells (the blastoderm) surrounding a fluid-filled or yolk-filled cavity (the blastocoel). Mammals at this stage form a structure called the **blastocyst**, characterized by an inner cell mass that is distinct from the surrounding blastula. During cleavage, the cells divide without an increase in mass; that is, one large single-celled zygote divides into multiple smaller cells. Each cell within the blastula is called a **blastomere**.

In mammals, the blastula forms the blastocyst in the next stage of development. Here the cells in the blastula arrange themselves in two layers: the **inner cell mass**, and an outer layer called the **trophoblast**. The inner cell mass is also known as the **embryoblast** and this mass of cells will go on to form the **embryo**. At this stage of development, the inner cell mass consists of **embryonic stem cells** that will differentiate into the different cell types needed by the organism. The trophoblast will contribute to the **placenta** and nourish the embryo.

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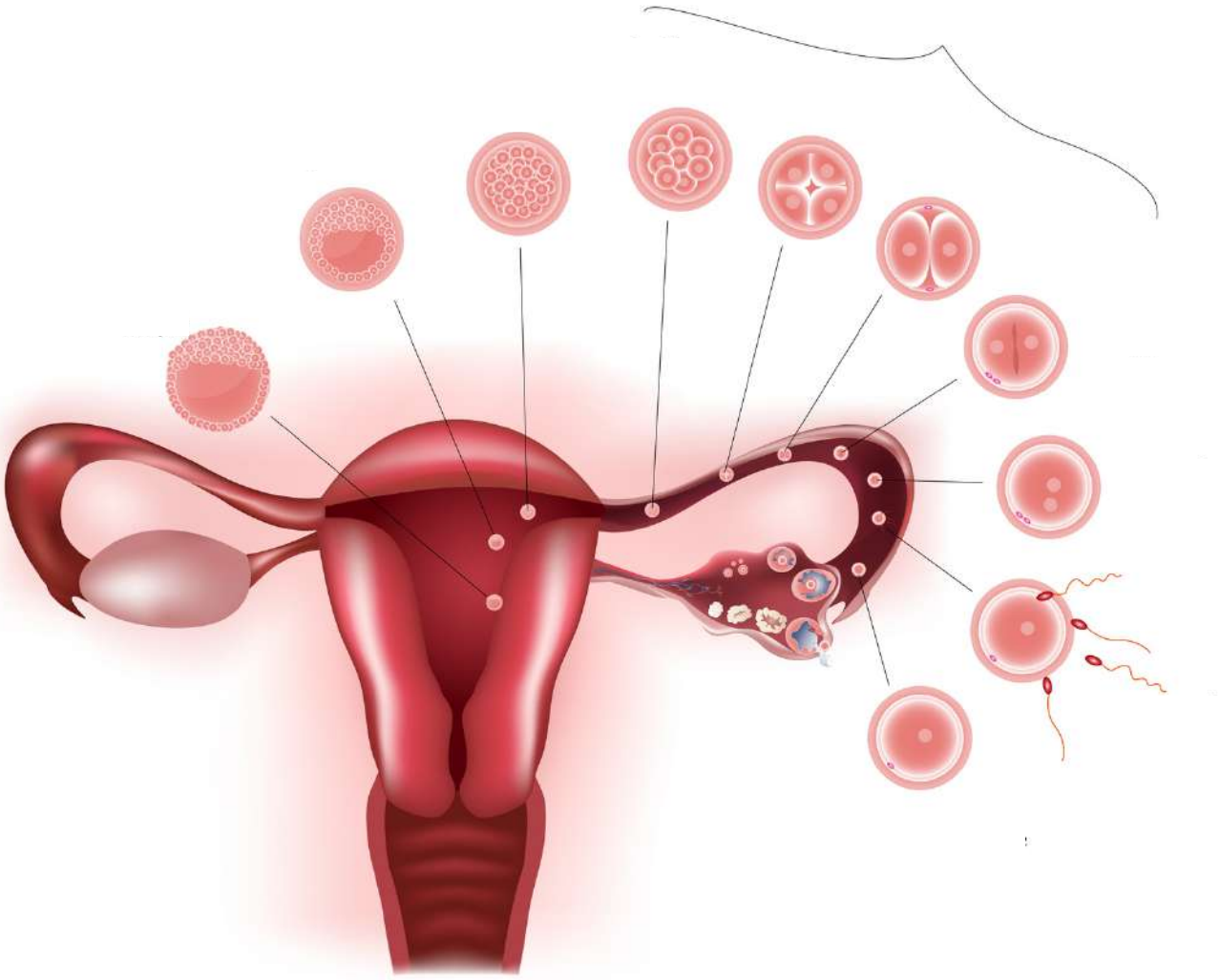
Components in Detail:

Ovulation, fertilization, implantation (student copy)



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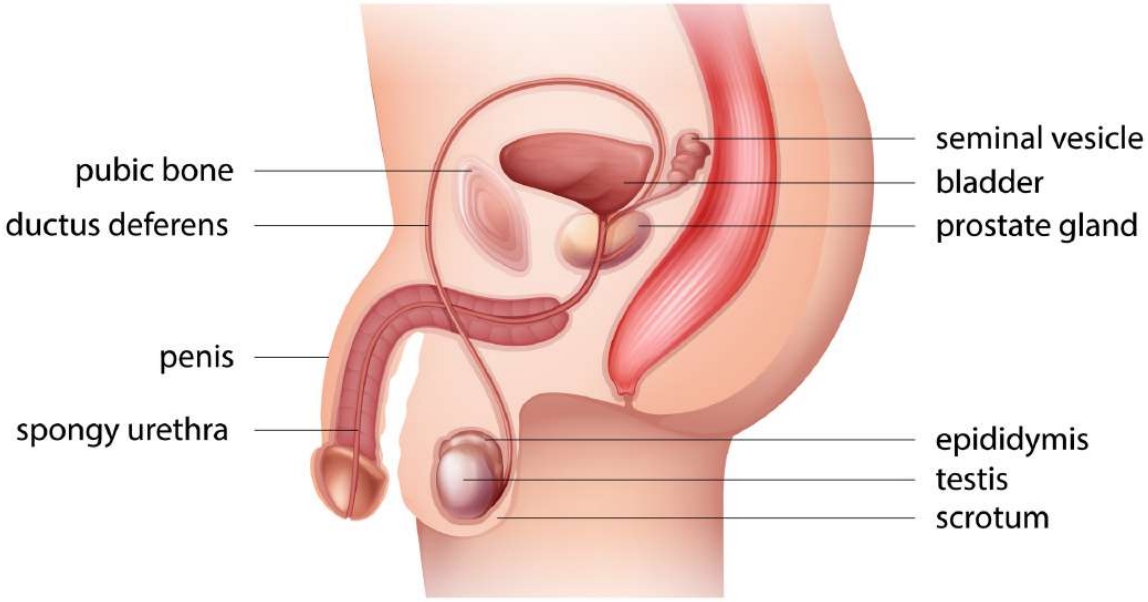
Components in Detail:

Reproductive system overview: male (teacher copy)



In the male reproductive system, the **scrotum** houses the **testicles** or testes (singular: testis), including providing passage for blood vessels, nerves, and muscles related to testicular function. The testes are a pair of male reproductive organs that produce **sperm** and some **reproductive hormones**. Each testis is approximately 2.5 by 3.8 cm (1.5 by 1 in) in size and divided into wedge-shaped lobules by connective tissue called septa. Coiled in each wedge are **seminiferous tubules** that produce sperm.

When the sperm have developed flagella and are nearly mature, they leave the testicles and enter the **epididymis**. This structure resembles a comma and lies along the top and posterior portion of the testes; it is the site of **sperm maturation**. The sperm leave the epididymis and enter the **vas deferens (or ductus deferens)**, which carries the sperm, behind the bladder, and forms the ejaculatory duct with the duct from the seminal vesicles.

The **penis** is an organ that drains urine from the renal bladder and functions as a copulatory organ during intercourse. The penis contains three tubes of erectile tissue running through the length of the organ. These consist of a pair of tubes on the dorsal side, called the **corpus cavernosum**, and a single tube of tissue on the ventral side, called the **corpus spongiosum**. This tissue will become engorged with blood, becoming erect and hard, in preparation for intercourse.

The walnut-shaped **prostate gland** surrounds the urethra, the connection to the urinary bladder. It has a series of short ducts that directly connect to the urethra. The gland is a mixture of smooth muscle and glandular tissue. The muscle provides much of the force needed for ejaculation to occur.

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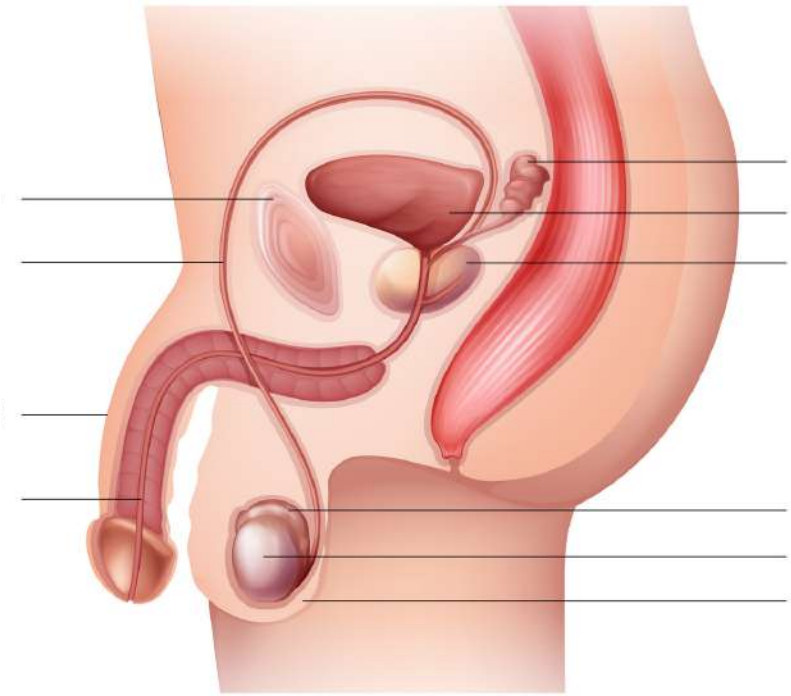
Components in Detail:

Reproductive system overview: male (student copy)



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How Does the Reproductive System Work Together With Other Organ Systems?

Respiratory System: The reproductive system requires oxygen in order to work properly, and the respiratory system provides the reproductive system with the oxygen it needs.

Digestive System: The digestive system works with the reproductive system by providing it with nutrients. The digestive system is the body system which breaks down food into small soluble nutrients which can be absorbed by the blood stream. The reproductive system needs energy and nutrients to perform its function and these are both provided by the digestive system.

Musculoskeletal System: The female reproductive system significantly strengthens the skeleton in women by stimulating acquisition of bone mass and biomechanical strength at puberty, but also presents significant challenges to the skeleton during pregnancy and lactation.

Endocrine system: Endocrine glands in the reproductive system produce sex hormones that are responsible for secondary sex characteristics in men and women. Sex hormones also contribute to the production of sex cells, or gametes. Female sex hormones regulate ovulation, the menstrual cycle, and pregnancy.

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How Does the Reproductive System Help Maintain Homeostasis?

The reproductive system does little for the homeostasis of the organism itself. The reproductive system relates instead to the maintenance of the species. However, sex hormones do have an effect on other body systems, and an imbalance in sex hormones can lead to various disorders. For example, a woman whose ovaries are removed early in life is at higher risk of developing osteoporosis, a disorder in which bones are thin and break easily. The hormone estrogen, produced by the ovaries, is important for bone growth. Therefore, a woman who does not produce estrogen will have impaired bone development.

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Closing Check-In and Discussion

During the check closing in:

Recap with the students the musculoskeletal system and the structure and function of bones, muscles and connective tissues. Go over ways the reproductive system interacts with other body systems, as well as how it helps maintain homeostasis. Ask the following questions:

- **How might virtual dissections and models compare with using real specimens?**
- **Were you able to successfully learn the structure and function of individual parts of the musculoskeletal system?**

Closing - Discussion on Ethics

The knowledge to create these accurate virtual models of the reproductive system had to initially come from real humans and or animals. However, now that we have such a plentiful resources for accurate models of these structures, as well as the ability to perform dissections virtually, do you think we need to continue using animals? Why or Why not?

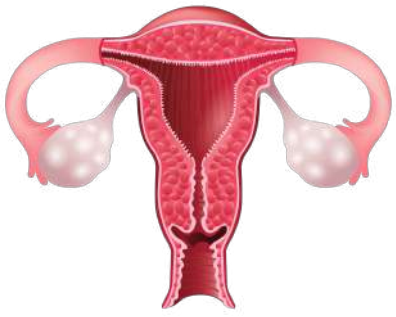
Think

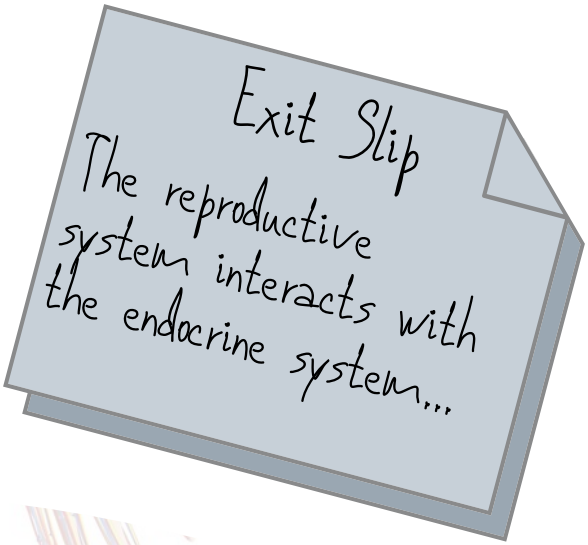
Ask the students to think about where they stand on the subject of animal dissections and the use of animals in science. They don't need to answer right away, rather, this is to get them to start forming their own ethical opinions.

Formative Assessment

The formative assessment can be in the form of an exit slip. This involves asking each student at the end of the class to answer 2-3 questions on a sheet of paper and hand it in, with their names on it, to ensure understanding of the main concepts covered. Examples of questions to include:

- **What is one way the reproductive system maintains homeostasis within the body?**
- **What is one way the reproductive system interacts with other body systems?**
- **Name three major components of the female reproductive system and three major components of the male reproductive system.**





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These Humane Science Education materials were developed by Elisabeth Ormandy for the Canadian Society for Humane Science (2015-2022) working to achieve better science without animals. By choosing us, you have joined a growing family of Humane Science Educators!

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