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Rapid Learning Center Presenting ...

Teach Yourself
Anatomy and Physiology in 24 Hours



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Anatomy and Physiology Series
Introduction to Human Physiology

Rapid Learning Core Tutorial Series

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Learning Objectives

The objectives of this core tutorial are to:



- Relate basic human body functions and life processes.
- Name the major human body systems and relate their functions.
- Name the major components of each system.
- Describe the anatomical location of the body's systems, the structures which comprise the system, and their physiological functions.
- Understand cells, tissues, and membranes that make up the human body, in terms of their anatomical structure and their physiological functions.

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What You Will Learn.....

By completing this tutorial, you will learn about:



- **Basic Physiology Terms & Concepts**
 - Levels of Organization of the Human Body
 - Systems of the Human Body
 - Homeostasis & Feedback Systems
 - Basic Anatomical Terms, Planes, & Sections
 - Body Fluid & Cavities

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What is Physiology?

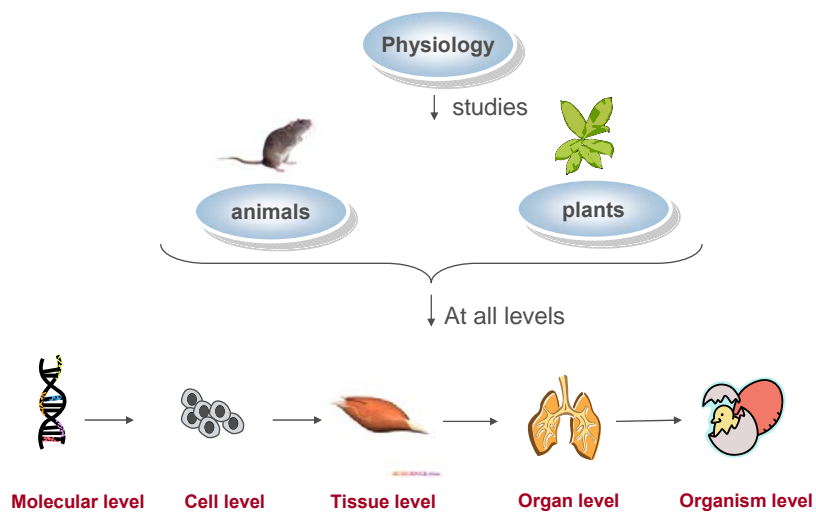
The study of functionality of living organisms at the cellular, organ and systemic levels

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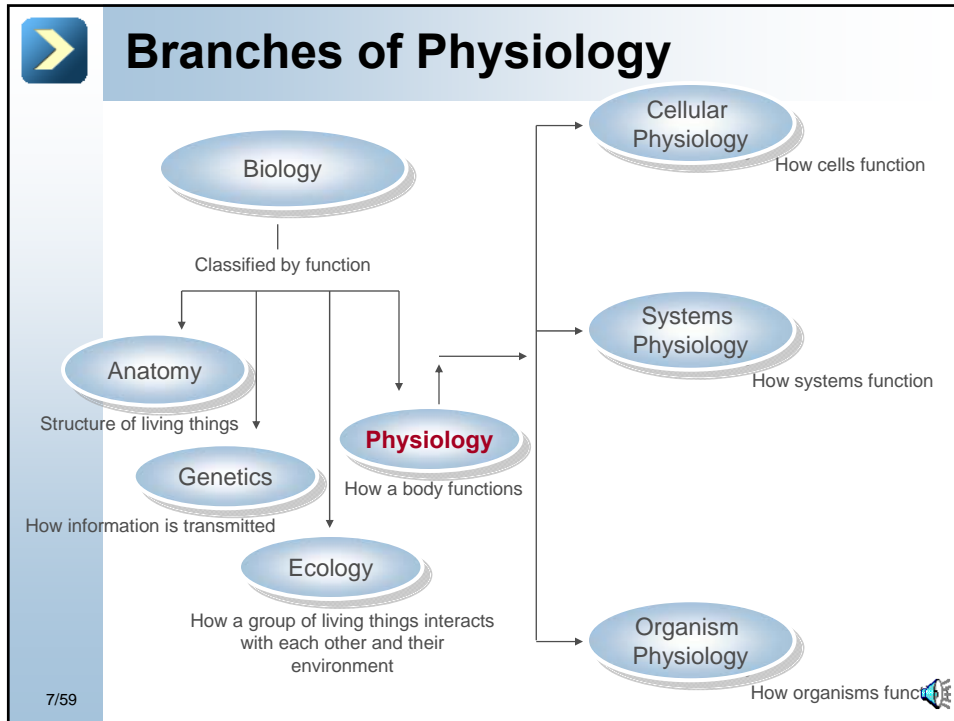
Visual Definition of Physiology

Physiology is the study of life.



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> Introduction

What is Physiology?

Greek origins:
physis- nature + *ology*- branch of learning

Physiology is the science of body functions.

It is the study of mechanical, physical and biochemical properties of living organisms.

Physiology incorporates a significant amount of anatomy; anatomy is the science of body structures and their inter-relationships.

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Levels of Organization of the Human Body

1. The Chemical Level
2. The Cell
3. The Tissue
4. The Organ
5. The System
6. The Organism

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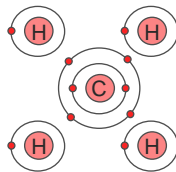
The Chemical Level

The chemical level is the basic structure of which all substances are composed.

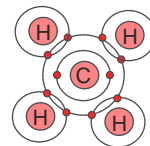
Includes:

Atoms - The smallest unit of matter that participates in reactions

Molecules - Two or more atoms joined together



4 hydrogen & 1 carbon atoms



Methane Molecule

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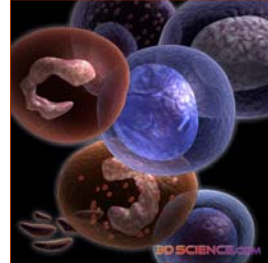




The Cell

The most basic structural and functional unit of an organism is the **cell**.

It is the smallest living unit of the human body.



There are many different types of cells in the body including:

- Nerve cells
- Blood cells
- Muscle cells
- Fat cells

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The Tissue

Tissues are groups of cells, and the surrounding environment, which work together to produce a specific function.

There are only four types of tissues in the body:

1. Epithelial tissue
2. Connective tissue
3. Muscle tissue
4. Nervous tissue



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This is an illustration of muscle tissue. The muscle cells and surrounding matrix make up the structure that works in concert with the brain to produce movement in the body.

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The Organ

Organs are structures that are made of two or more different types of tissues.

They have specific functions and a defined shape.



The heart is an example of an organ.

It is made of muscle, as well as connective and nervous tissue.

The tissues work in concert to move blood through the body.

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The System

A **system** consists of related organs that have a common function.

There are **eleven** organ systems in the body:

1. The Integumentary System
2. The Skeletal System
3. Muscular System
4. Nervous System
5. Endocrine System
6. Cardiovascular System
7. Lymphatic & Immune System
8. Respiratory System
9. Digestive System
10. Urinary System
11. Reproductive System



The cardiovascular system is illustrated here.

The cardiovascular system is made of the heart, blood and blood vessels

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The Organism

An **organism** is the highest level of organization.



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Systems of the Human Body

1. The Integumentary System
2. The Skeletal System
3. Muscular System
4. Nervous System
5. Endocrine System
6. Cardiovascular System
7. Lymphatic & Immune System
8. Respiratory System
9. Digestive System
10. Urinary System
11. Reproductive System

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Human Body Systems

There are eleven organ systems in the body:

- | | |
|---|--------------------------------------|
| 1. The Integumentary System | The skin & derived structures |
| 2. The Skeletal System | Bones & joints |
| 3. Muscular System | Skeletal muscle |
| 4. Nervous System | Brain, spinal cord & nerves |
| 5. Endocrine System | Hormone-producing cells & glands |
| 6. Cardiovascular System | Blood, heart & blood vessels |
| 7. Lymphatic & Immune System | Lymphatic vessels & fluid |
| 8. Respiratory System | Lungs & airways |
| 9. Digestive System | Organs of the gastrointestinal tract |
| 10. Urinary System | Kidneys, bladder and ureters |
| 11. Reproductive System | Male & female reproductive organs |

In this course, we will examine each one in depth and discover how they function.

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The Integumentary System

The Integumentary System



The skin & derived structures

It protects internal organs & helps maintain body temperature.

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The Skeletal System

The Skeletal System



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The bones and joints

It provides support and protection to internal organs.

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The Muscular System

The Muscular System



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Skeletal muscle

It provides movement.

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The Nervous System

The Nervous System



Brain, spinal cord, nerves

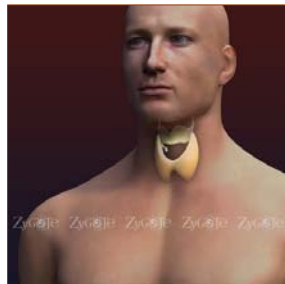
It provides regulation of body functions and sensory perception.

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The Endocrine System

The Endocrine System



Hormone-producing cells and glands

Regulation of homeostasis, growth & development.

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The Cardiovascular System

The Cardiovascular System



Blood, heart and blood vessels

Delivery of oxygen and nutrients to the tissues.

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The Lymphatics & Immune System

The Lymphatics & Immune System



Lymphatic vessels and fluid

Defense against infection

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The Respiratory System

The Respiratory System



Lungs & airways

Absorption of oxygen and
release of carbon dioxide

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The Digestive System

The Digestive System



**Organs of the gastrointestinal
tract**

Absorption of nutrients

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The Urinary System

The Urinary System



Kidneys, ureters and bladder

Electrolyte balance and waste removal

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The Reproductive System

The Reproductive System



Reproductive organs in males and females

Controls the biological process by which new individuals are produced



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Homeostasis & Feedback Systems

1. What is homeostasis?
2. How is homeostasis monitored & controlled?
3. What is a feedback loop?
4. Negative feedback in the human body
5. Positive feedback in the body

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What is Homeostasis?

Homeostasis

A vital concept in human physiology

The process through which a nearly stable internal environment is maintained in the body so that cellular functions can proceed at maximum efficiency.

Every body structure contributes to maintaining the internal environment within a normal range of temperature, pH, oxygenation, etc.



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How is Homeostasis Maintained & Controlled?

Homeostasis is a highly complex process.

Homeostasis is maintained through the regulatory process called “feedback”.

A feedback loop is a cycle of events in which a body condition (such as temperature) is continually monitored and adjusted to be within specific limits.



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What is a Feedback Loop?

A Feedback loop has three main components:

1. A receptor that monitors a particular aspect of physiology
2. A control center that sets the normal range, receives input from the receptor and sends output when changes are needed.
3. An effector that produces a response or effect that changes the physiology.

There are two types of feedback loops:

1. Positive loops - where the response enhances the condition
2. Negative loops - where the response counteracts or antagonizes the condition

Most feedback loops in the body are negative feedback loops.

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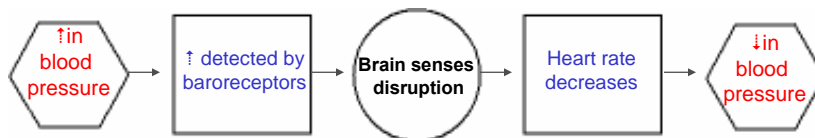


Negative Feedback Loops in the Body

Negative feedback loops are very common in the human body.

Negative feedback loops are excellent mechanisms of controlling parameters and allow for the “fine-tuning” of physiological processes, such as blood glucose, oxygenation level and blood pressure.

A negative feedback loop tends to bring a system back to equilibrium...



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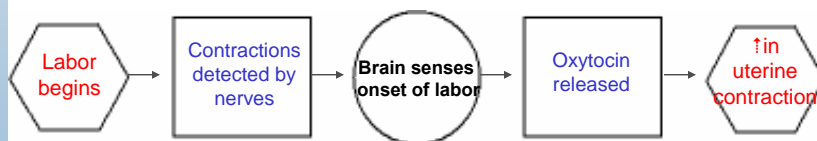


Positive Feedback Loops in the Body

Positive feedback loops are rare in the human body.

A positive feedback loop tends to push a system away from equilibrium.

The classic example of a positive feedback loop in the body is the action of oxytocin during labor...



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Basic Anatomical Terms, Planes and Sections

1. Body Positions
2. Directional Terms
3. Anatomical Planes and Sections

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Body Positions

In anatomy, descriptions of body structures assume the body is in a specific orientation, called the anatomical position.

In the anatomical position, the subject is facing the observer with the head level and eyes facing forward.

Feet are flat on the ground, arms are down at the sides with palms turned forward.

If a body is laying down, two positions are possible:

Prone - when the body is face down
Supine - when the body is face up



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Directional Terms

To locate body structures, specific directional words are used to describe the position of one structure in relation to another.

Most directional terms that describe the human body can be grouped into pairs that have opposite meanings.

These terms are fundamental ideas in anatomy and physiology and it is critical to have a thorough understanding of their meaning.

As you learn each term, refer to the diagram to be sure you fully understand its meaning and relationship to the other terms.

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Anterior versus Posterior

Anterior - toward the front of the body

Posterior - toward the back of the body

This is also referred to as **Ventral**.

This is also referred to as **Dorsal**.



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Superior versus Inferior

Superior - toward the top of the body

Inferior - toward the bottom of the body

The neck
is **superior**
to the abdomen

The thigh
is **inferior**
to the abdomen



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Proximal versus Distal

Proximal - toward the trunk of the body

Distal - toward the edge of the body

The shoulder
is **proximal**
to the wrist

The ankle
is **distal**
to the knee



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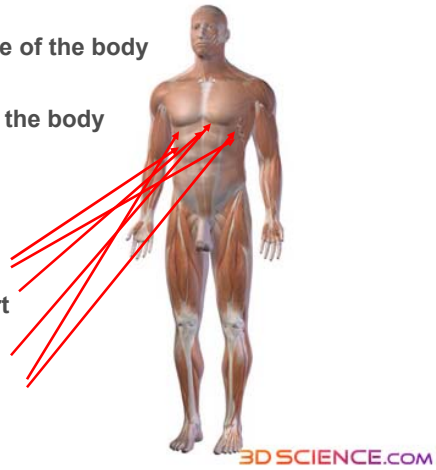
Lateral versus Medial

Lateral - away from the midline of the body

Medial - toward the midline of the body

The lungs are **lateral** to the heart

The heart is **medial** to the ribs



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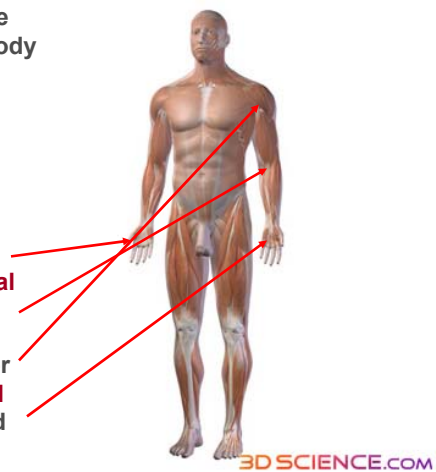
Contralateral & Ipsilateral

Contralateral - on the opposite side of the body

Ipsilateral - on the same side of the body

This hand is **contralateral** to this arm

This shoulder is **ipsilateral** to this hand



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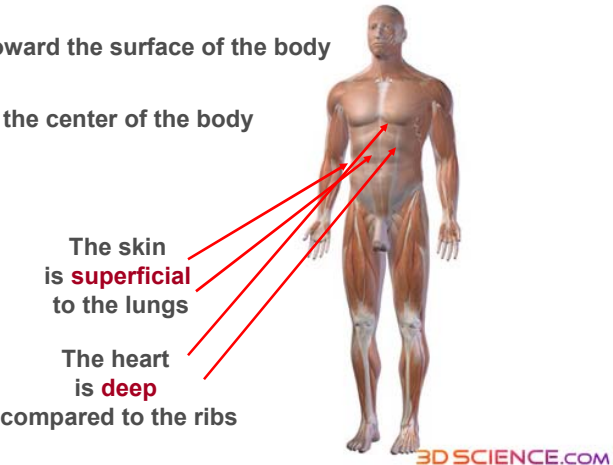
➤ Superficial versus Deep

Superficial - toward the surface of the body


Deep - toward the center of the body

The skin is **superficial** to the lungs

The heart is **deep** compared to the ribs

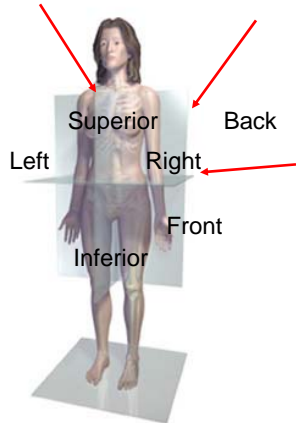


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➤ Anatomical Planes and Sections

- ☞ Structures of the body are sometimes discussed in terms of anatomical planes.
- ☞ **Anatomical planes** are imaginary flat surfaces that pass through the body.
- ☞ The **coronal plane** separates the body into front and back halves.
- ☞ The **sagittal plane** separates the body into left and right halves.
- ☞ The **transverse plane** separates the body into superior and inferior halves.



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Body Fluid and Cavities

1. Body Fluids
2. The Dorsal Cavity
3. The Ventral Cavity

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Body Fluids

Body fluids are dilute, watery solutions found in and around cells.

Intracellular fluid is the fluid found inside a cell.

Extracellular fluid is the fluid found outside a cell; there are two types:

- **Interstitial fluid** is a type of extracellular fluid that fills narrow spaces between the cells of tissues.
- **Plasma** is the extracellular fluid in blood.



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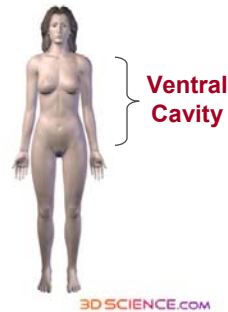
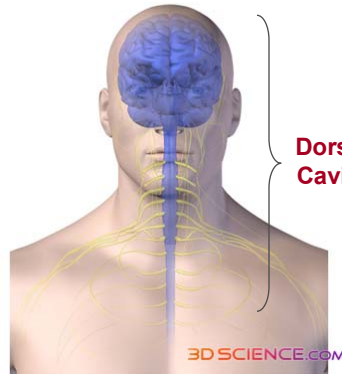




Body Cavities

Body Cavities - Spaces within the body that protect, separate and support the internal organs. Muscles, bones and ligaments separate the cavities from each other.

The two cavities of the human body are the **dorsal** - the brain & spinal canal and **ventral** - large anterior cavity.



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The Dorsal Cavity

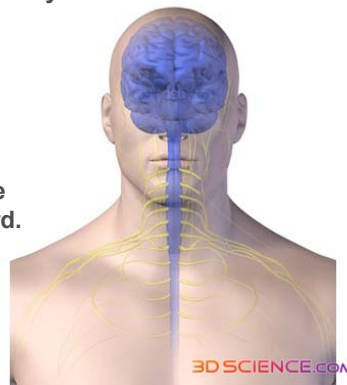
The Dorsal Cavity is found on the dorsal (posterior) side of the body and is small, compared to the ventral cavity.

The dorsal cavity has two subdivisions:

The Cranial Cavity - is formed by the skull and contains the brain.

The Vertebral Cavity - is formed by the spine and contains the spinal cord.

The Dorsal cavity is lined by the meninges.



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The Ventral Cavity

The Ventral Cavity is located on the ventral (anterior) side of the body and is the larger body cavity.

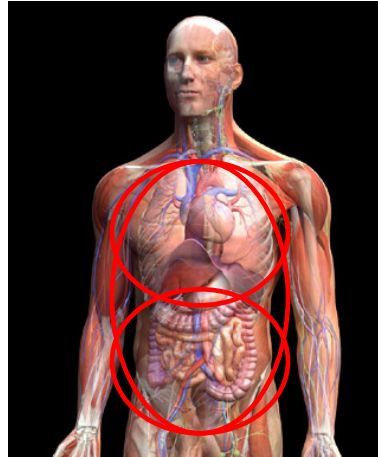
Organs within the ventral cavity are called **viscera**.

This cavity also has two main subdivisions:

The Thoracic Cavity

The Abdominopelvic Cavity

The diaphragm separates the thoracic & abdominopelvic cavities.



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The Thoracic Cavity

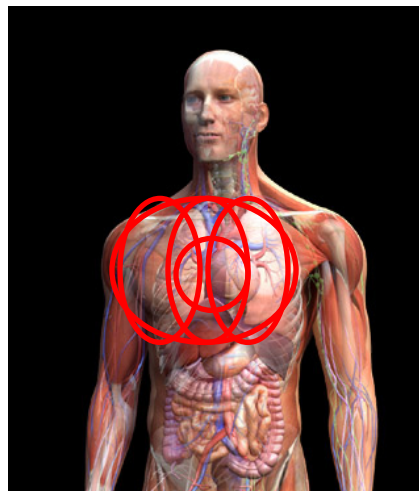
The Thoracic Cavity, also called the chest, is the superior part of the ventral cavity.

This can be further subdivided into three sections:

The **pericardial cavity** - a fluid-filled space around the heart

Two pleural cavities - surround each lung.

The **mediastinum**, in the center of the thoracic cavity, houses all the thoracic viscera except the lungs (heart, esophagus, trachea, thymus and large blood vessels).



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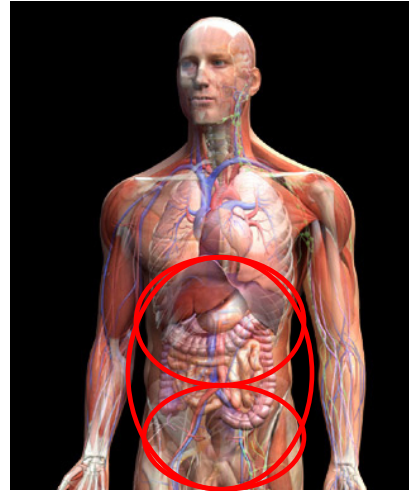
The Abdominopelvic Cavity

The Abdominopelvic Cavity is the inferior part of the ventral cavity.

This subcavity has two subdivisions:

The abdominal cavity - the superior portion containing the stomach, spleen, liver, gallbladder, small intestine, and most of the large intestine.

The pelvic cavity - the inferior portion containing the bladder, some of the larger intestine, and the reproductive organs.



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Cavity Membranes

A thin serous (or fluid-producing) membrane lines the ventral cavity.

The membrane that lines the pleural cavities is called the **pleura**.

The membrane that lines the pericardial cavity is called the **pericardium**.

The membrane that lines the abdominal cavity is called the **peritoneum**.

Visceral membranes line the organs and **parietal** membranes line the cavity walls.

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Tips for Studying Physiology

- ✓ **Memorize basic information to save time later**
 - e.g., commonly used terms and concepts, the four tissues, eleven body systems, etc.
- ✓ **Learn vocabulary quickly, for understanding when it's used later**
 - Make cheat sheet or flashcards if needed
- ✓ **Brush up on your basic biology**
 - Don't try to remember every variation of each process.
- ✓ **Look for the commonalities between processes and functions**
 - Don't treat each one as different

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More Tips for Studying Physiology

- ✓ **Take each system in steps**
 - Identify the information "given" and "wanted"
- ✓ **Try to understand why processes happen and look for patterns**
- ✓ **Connect each thing you learn with previous concepts**
- ✓ **Keep up with the work**
 - Physiology builds on prior knowledge
- ✓ **Ask for help when you need it**
 - Don't be afraid to seek out help early...find an instructor, TA, tutor or friend that can help!

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Mnemonics

How to Create Your Own Mnemonics...

Typically, in science, keyword mnemonics are a great way to memorize what is needed for class. Here is a simple 3-step process to do so:

Step 1: List the keywords in a logical order.

Step 2: Write down the first letter of each keyword.

Step 3: Create a word, phrase or sentence from the first letters of these keywords.

For example: To remember the order of bones in the spine:

Cervical Thoracic Lumbar Sacrum Coccyx



Canned Tuna Looks So Cramped

That's it!

If you ever get stuck in hard-to-remember terms, try to create a mnemonic.

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Review Questions

The fundamental unit of all living things is the...?

cell

The two main body cavities are...?

The dorsal and ventral cavities.

The term "superior" refers to a structure of the body closer toward the...?

Top of the body

What is homeostasis?

Homeostasis is the process by which internal body equilibrium is maintained.

An organ is...?

A structure made of two or more different tissues.

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Summary

The body has many levels of organization.

Homeostasis is an important and complex process.

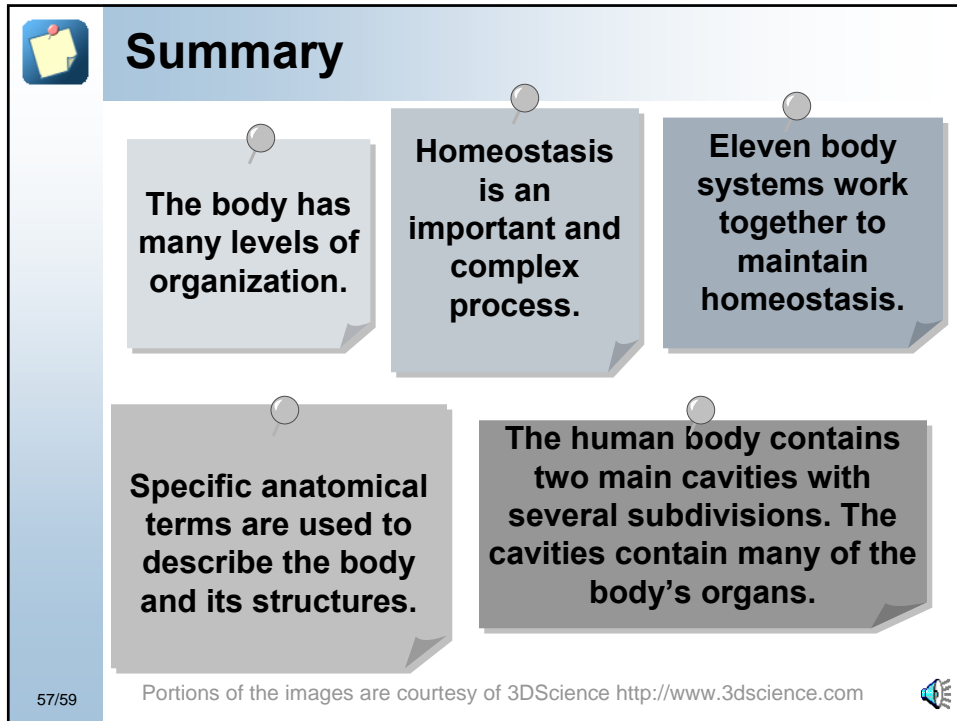
Eleven body systems work together to maintain homeostasis.

Specific anatomical terms are used to describe the body and its structures.

The human body contains two main cavities with several subdivisions. The cavities contain many of the body's organs.

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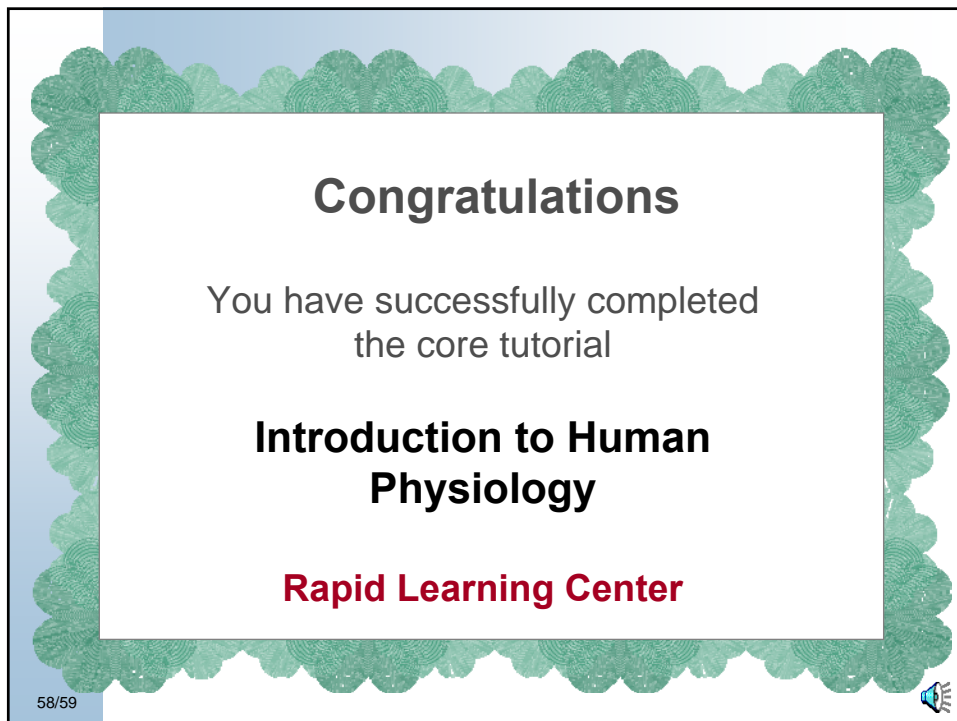
Congratulations

You have successfully completed the core tutorial

Introduction to Human Physiology

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What's Next ...

Step 1: Concepts – Core Tutorial (Just Completed)
→ Step 2: Practice – Interactive Problem Drill
Step 3: Recap – Super Review Cheat Sheet

Go for it!



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