Anatomy and Physiology (0-1) Class Notes—Orientation to the Class: The Structure of Anatomy and Physiology

Preassessment: on a 3 x 5 index card tell me what the phrase "structure reflects function," means to you.

Learning Target

what: *the student will be able to provide a definition of the sciences of anatomy and physiology and demonstrate a functional understanding of the key relationship between them at all levels of biologic organization*

why: *the understanding that structure reflects function is one of the single most important concepts in the study of anatomy and physiology*

how: *the student will be able to provide examples of how structure reflects function at the molecular, cellular, tissue, organ, organ system and organism levels of biologic organization.*

As the name of this course would imply, there are two major components to the study of human anatomy and physiology.

Anatomy

Anatomy can be simply defined as the study of the structure and shape of the body and body parts and their relationships to one another. (vocab) Because we are "describing" structure and relationships we say that anatomy is primarily _____ in nature. An important term to learn right away is the term **morphology.** The root, "morph," means "the form of," or "the structure of." So, **morphology is the study of form or structure of a biologic organism. (vocab)** We will be studying the morphology of the human body not only at the "gross" level (with the unaided eye or "naked" eye) but also at the "microscopic" and "ultrastructural" levels. Accompanying the study of anatomy, and one of the most difficult parts, is the learning of a whole new vocabulary related to parts and positions of the body, organs, tissues and cell types.

However, it is not enough to just simply describe parts of the body—we will also relate the structure of body components to the _____ of those components. We will always be asking the questions, how does the structure of this component relate to its function? What does the physical appearance, or morphology of the structure tell me about how it works. Our constant theme in this class will be that **ANATOMY REFLECTS PHYSIOLOGY**—this is **the concept that the morphologic structure of a component of an organism always tells us something about, or reflects, the physiologic function of that component. (vocab)**

Consider an axe—what does its structure tell you about its function? (I'm not asking you to understand the physics of this—just see the large amount of information you can gain about function by looking at structure)

Sharp Edge:_____
Wedged Sahpe:_____
Hardness of Metal:_____
Heavy Mass:_____
Long Handle:_____

Lets apply this in living organisms at the **cellular level—the white blood cell:**

Function:_____
Reflecting Morphology:_____

at the **tissue level—the skin:**

Function:_____
Reflecting Morphology:_____
_____

at the **organ level—the heart:**

Function:_____
Function:_____
Reflecting Morphology:_____
Reflecting Morphology:_____
_____

at the **organ system level:**

Function:_____
Reflecting Morphology:_____

Function:_____
Reflecting Morphology:_____
_____

Function:_____
Reflecting Morphology:_____
_____

Postassessment: Homework A, Question 1

Preassessment:

Which body functions accomplish the major biologic goal of acquiring energy and biomaterials?

_____
_____

Which body functions accomplish the major biologic goal of maintaining a stable internal environment?

_____
_____
_____
_____
_____

Which body functions accomplish the major biologic goal of persisting in the environment as an individual and as a species?

_____
_____

Learning Target

<u>what</u>: The student will understand the importance of and be able to use an organizational framework—a graphic organizer—to organize course content in a useful, meaningful way

<u>why</u>: knowing WHAT YOU NEED TO KNOW, especially in the format of a graphic organizer, enhances learning

<u>how</u>: students will be able to create a graphic organizer that organizes the content of this course without notes

For a really good short article about how and when to use graphic organizers see https://www.cultofpedagogy.com/graphic-organizer/

Learning Target

<u>what</u>: the student will be able to define and state the difference between an anabolic and catabolic process

<u>why</u>: important terms describing biochemical processes

<u>how</u>: students will correctly identify and use these terms in various types of questions regarding these processes

Learning Target

<u>what</u>: students will be able to define the term homeostasis and illustrate the use of positive and negative feedback in maintaining homeostasis; students will understand that homeostatic feedback occurs in response to a stressor—that is, when a homeostatic system becomes unbalanced

<u>why</u>: homeostasis is a major goal of all biologic organisms

<u>how</u>: students will list the major steps in a homestatic control mechanism in correct sequence; students will correctly identify instances of negative and positive feedback and correctly use glucose control and childbirth as examples

Physiology

The other component of this course is **physiology**—which is defined as the **study of how the body and its parts work or function. (vocab)** The overriding theme of physiology, and the concept that will help you organize most of your thinking about anatomy and physiology, is that living organisms are constantly interacting with their environment—an environment that is strikingly different from the internal body environment. Virtually everything we can learn about living organisms is geared toward making this interaction successful.

From this single point or idea, we can ask ourselves appropriate questions that allow us to build a concept map outlining those concepts that will guide many of our efforts during the year. I cannot emphasize enough how important the skill of taking a central broad theme and breaking into smaller and smaller, more specific parts is in helping you to organize your thinking—please take this effort seriously.

If all organisms, including humans, are constantly interacting with their environment, it may occur to you that an important question regarding this interaction is—what are the major goals of the interaction—there are three:

1. _____
2. _____
3. _____

Once we know what these goals are, the next question that might be reasonable to ask would be, what functions that an organism can perform can accomplish these goals? Lets look at each goal and see if the body has a set of functions that accomplishes these goals

Goal 1: *To extract energy and biomaterials from the environment.*

Most importantly in our interactions, we have to be able to extract energy and biomaterials from our environment and that is where most of our efforts are directed.

Biomaterials are any materials an organism must extract from its environment in order to survive, including:

_____
_____
_____
_____
_____
_____
_____ **(vocab)**

Recognize that the first three of these are three of the four major classes of biologic macromolecules—what is the fourth? _____ _____

There are two main functions that all organisms perform in order to extract energy and biomaterials from the environment—one of these is obvious, the other not so obvious. They include:

Function 1. _____
Function 2. _____

Function 1: D**igestion is the process of ingesting and breaking down food into simple molecules that can be absorbed into the blood for delivery. (vocab)** This is the body function that gets most of the energy and biomaterials from the environment into the body. Can you think of two other minor ways that biomaterials might get into the body?

_____
_____

Function 2: Metabolism is the entire set of chemical reactions that occur in the body. (vocab).

It includes—

chemical reactions that break down larger molecules to obtain energy and building block materials, which is specifically called catabolism (vocab); and

chemical reactions that build new molecules from building block materials and require energy to perform, which is specifically called anabolism. (vocab)

Goal 2: *To maintain a stable internal body environment.*
The ability to maintain a stable internal environment is called _____(vocab) You are aware of the fact that we need to have a stable body temperature of 98.7 degrees F. You are probably also aware that the inside of our body has a significantly different composition than the surrounding environment and that levels of many chemicals inside our body need to remain constant. Is there a set of functions the body performs that helps maintain this stability?

Homeostasis centers around the use of systems called _____ _____ _____,

List some examples of control mechanisms that you are aware that keep conditions of any kind stable—

_____
_____
_____

These homeostatic control mechanisms (a) _____ changes or imbalance in either the internal or external environment using _____, and send information about the changes to a _____ _____; (b) this information is then _____ in the control center which then decides what to do and sends signals to structures that can (c) carry out or _____ the decision in order to restore balance—the structures that "do" the effecting are called _____.

The "effect" or action that occurs to restore balance is called_____. If the feedback acts to increase the change it is called_____ feedback—this is fairly uncommon—increasing the strength of contractions during childbirth would be an example. If the feedback acts to decrease the change it is called _____ feedback—this is usually the case. An example would be the release of insulin into the blood in response to increased glucose in the blood-the insulin causes glucose to move into the cells and out of the blood, lowering the blood glucose level.

Lets practice our understanding of the concept a little (see homeostatic control mechanism diagram).

The concept of a homeostatic control mechanism is hugely important in physiology--we have now recreated it in a simplified diagram form that follows a logical pattern. Learning to organize your thinking about a complex topic in sequences of logical questions will be immensely helpful in this course.

Now that we know what homeostasis is and the basis for a homeostatic control mechanism, what major body functions support this goal? As we've already determined, in total, there are five major body functions that work to accomplish maintaining homeostasis. Lets see if we can think about these in some kind of logical sequence that makes them easier to remember.

Function 1: It should make sense to you that if we are going to maintain a stable internal environment the first thing we need to do is _____ the inside of the body from the outside of the body. We also separate the inside of cells from the outside of cells. _____ _____ **is the body function in which an internal environment (the inside of the body or a cell) is separated from an external environment. This is accomplished by an anatomic structure called a membrane, the type depending on the environment separated. (vocab)**

Functions 2, 3: Once we have our internal environment separated from the external environment we have to set up our homeostatic control mechanisms to monitor or react to both the internal and external environment. We call this function or this ability to _____ to changes, _____. A large part of responsiveness is the ability to _____ away from things we don't want to associate with, or toward things we do want to associate with—we call this major body function, _____.

Function 4: It's all well and good to have these homeostatic mechanisms in place, but it would be very difficult to make them work adequately if we didn't have a way to get materials that help maintain homeostasis throughout the body—we have to be able to move biomaterials from place to place or _____ them in order for the right materials to act or be acted on. So, another major body function that supports homeostasis is _____ _____ _____.

Function 5: Finally, we have to be able to get rid of or_____ things we don't want in our body. **Excretion is the body function by which an organisms removes toxic or unwanted materials from its body. (vocab)**

Goal 3: To persist in the environment as an individual and as a species.

To say that we want to persist in the environment as individuals simply means that we want to continue to exist in the environment and interact with it indefinitely—we want to live, we want to be. . .for as long as possible. To say that we want to persist in the environment as a species means that we want our species to "carry on" through generations indefinitely. We don't want our species to "die out" or vanish.

As an individual organism goes through its life, in order to persist in its environment it must _____. The major body function that corresponds to this is _____ and _____. **Growth is defined as the increase in size of an organism due to _____ _____. (vocab)** This is distinguished from **development which refers** not to increase in size but **to an increase in functional capability of a tissue due to maturation of the cells making up the tissue. (vocab)**

To persist in the environment over long periods of time as a species an organisms must be able to _____. Obviously the body function associated with this is reproduction. So the set of body functions related to persistence in the environment includes:

1. Growth and development
2. Reproduction

So, now we know that--

-We interact with the environment;
-There are three major goals of this interaction;
-Each of these goals is associated with a set of body functions that help accomplish the goal

The final piece of this model is that, although all of the body's anatomic systems are intimately connected and work together, they can all be predominantly associated with one of the above functions, making memory and understanding of these systems more logical and easier to accomplish—lets see how this works.

Goal 1: We have said that in our interaction with the environment, acquiring energy and biomaterials is accomplished primarily by the functions of _____ and _____. We defined digestion above. It would make sense that the organ system most closely related to digestion would be the _____ system. This system is also given the name gastrointestinal system (gastro referring to the stomach). Metabolism (the breaking down of biomaterials to obtain energy and small building block materials **and** the rebuilding of these building blocks into new biomaterials) occurs in all cells, so we will say that the function of **metabolism is associated with all cells**, not just a specific organ system. However, because oxygen, which enters the body through the respiratory system, is required for metabolism to take place and the major waste

product of metabolism is carbon dioxide, which exits through the respiratory system, we can say that **metabolism is most closely associated with the respiratory system**.

Goal 2: We have said that maintaining homeostasis begins with _____ _____ between the inside and outside of the body. This is accomplished primarily by the _____ system, which consists mainly of the skin. Additionally, we must be able to monitor our surroundings and internal environment with various receptors, integrate the information the receptors receive, and make adjustments and responses to changes in our external and internal environment. The major functions of responsiveness and movement are accomplished by the _____ _____, _____, and _____systems, and _____ and _____ systems respectively.

In order to distribute the various biomaterials throughout the body we need a system of tubes connecting all of the various places in the body through which these materials can flow. This function of distribution is accomplished primarily by the _____ system. A secondary system of tubes called the _____ system, drains and collects tissue fluid, called _____, from the body's tissues and empties it back into the cardiovascular system. This system also contains the lymph nodes which are filters in the path of lymph vessels that check the lymph for foreign "particles" and activate the body's immune system if necessary. The fluid flowing through the cardiovascular system is also actually a tissue because it is made up of cells. This fluid is called _____.

In order to maintain homeostatic balance, the body needs to eliminate or excrete three types of wastes. _____ wastes from indigestible food products, _____ _____, which is a waste product of energy production, and nitrogen-containing or _____ wastes, which are toxic products of the break-down of nitrogen-containing biomaterials like proteins and nucleic acids. The wastes are excreted by the _____, _____, and _____ systems respectively.

Goal 3: As we accomplish the major function of growth and development, _____ body systems work together. During adult life, the major function of reproduction is accomplished primarily by the _____ system.

Postassessment: Homework A, Questions 2-13; Question of the day next class period—be able to complete a blank graphic organizer without a word bank..

Principle of Emergent Properties

Preassessment: on a 3 x 5 note card list the eight levels of structural organization of a biologic organism.

Learning Target

what: *students will be able to list the eight levels of structural organization of a biologic organism and understand that this organization is an example of the principle of emergent properties*

why: *understanding how different levels of biologic structural organization build on subordinate levels of organization is key in understanding the relationship between biologic structure and function*

how: *students will correctly list in order the eight levels of biologic structural organization; students will be able to give examples of how structure and function level arises from the structures/functions of the subordinate level*

Another "big picture" theme that will help shape our objectives and organize information is that we can identify discrete levels of biologic organization and at each of these levels of organization, properties or features that characterize that level of organization, only come about as a result of the combination of properties or features at a lower level of biologic organization (You know this drill).

If you add atoms (which have limited properties) together you get

_____ (which have more properties), and if you add these

together you get _____ (which have more properties), and if

you add these together you get _____ (which have even more

properties) and so on. . . .

This principle that at each higher level of biologic organization we get new properties or capabilities is called the principle of emergent properties. (**vocab)**—at each new level of organization, new properties or capabilities emerge. If we start with the lowest level of biologic organization that has meaning—which is the atom—we can create the entire scheme of biologic organization simply by asking the question, "if I add these things together what new thing, that has new properties, do I get." Lets try this.

If I add atoms together, what do I get? Molecules
If I add molecules together, what do I get? Organelles
If I add organelles together, what do I get? Cells
If I add cells together, what do I get? Tissues
If I add tissues together, what do I get? Organs

If I add organs together, what do I get? Organ systems
If I add organ systems together, what do I get? Organisms

So, another organizational structure of anatomy and physiology can be summed up with this chart

Organism
Organ Systems
Organs
Tissues
Cells
Organelles
Molecules
Atoms

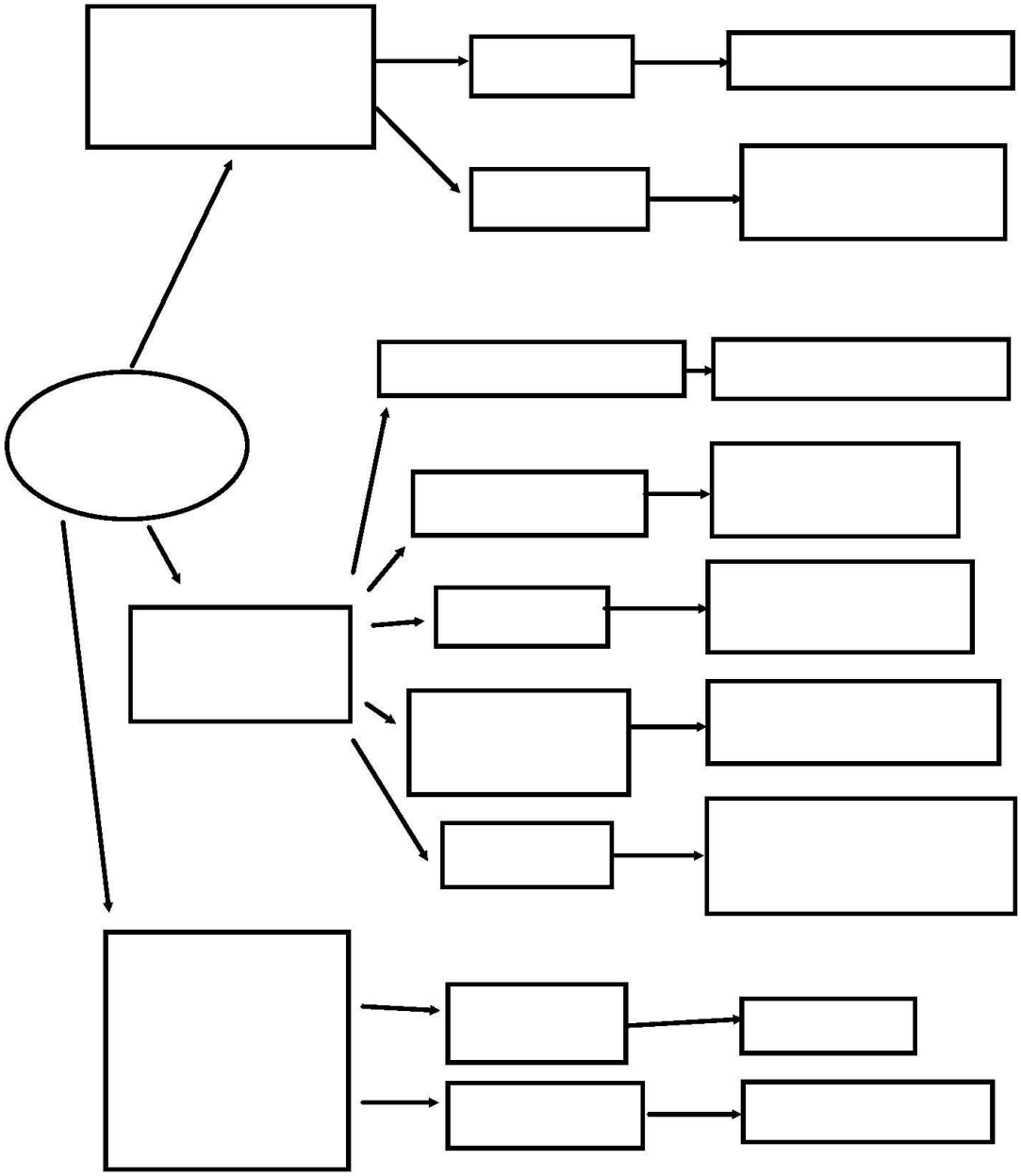
So, in this section we—

Defined anatomy
Discussed the concept that anatomy (structure) reflects physiology (function)
Defined physiology
Provided a framework to begin to organize our thinking about the bodies functions and systems based on goals of our interaction with the environment
Discussed the concept of homeostasis and homeostatic control mechanisms as a means to help maintain a stable internal environment
Discussed the principle of emergent properties as another framework which will help organize out thinking regarding levels of biologic organization

Vocabulary—write definitions for the following in your vocabulary journal.

Anatomy	Digestion	Maintaining boundaries
Morphology	Metabolism	Excretion
Anatomy reflects physiology	Catabolism	Growth
Physiology	Anabolism	Development
Biomaterials	Homeostasis	Principle of emergent properties

Interaction With Environment Concept Map



Homeostatic Control Mechanism