Introduction to Anatomy and Physiology Lecture (Script)

Slide 2

Beginning in the mid to late 1500s, philosophers began to conduct scientific inquiry in a more systematic way. Francis Bacon and Rene Descartes were two who pushed science more into the public realm and argued for cooperation within the community and support from the government. While they were not scientists themselves, they did alter the course of science and move it into the direction of its modern form.

The scientific method is a set of procedures and steps that allows for scientists to collect and analyze data (or information) to form a conclusion. What makes the scientific method different from other ways of looking at the world is that it works to remove personal and/or institutional bias from the results. That is, we want to end up with objective results. Each scientific discipline approaches the method in slightly different ways, but the basic steps are: 1) Form a question or observation, 2) Create a method to gather information regarding your questions, 3) interpret the gathered information, 4) Formulate a conclusion based on the information and 5) Assess your study to alter and redo it or continue it to gather more information.

Most methods fall into one of two categories, the inductive or hypothetico-deductive method. The Inductive Method observes the world around us and collects observations to form generalizations and predictions. In this method, we rarely alter or manipulate our surroundings. We just watch and learn. A great deal of what we know about anatomy is based on this method.

The hypothetico-deductive method starts with a hypothesis (an educated speculation or prediction) and then develops an experiment, or procedure, to test it. A good hypothesis is based on previously established and credible information and is testable. If you can't test it, then it is not a scientific hypothesis. A large portion of what we know about physiology has been from the hypothetico-deductive method.

There are a couple of things to keep in mind about the scientific method. First, we can never fully prove something, but we can get really, really close so that with the current information available, we can say this is true beyond a reasonable doubt. Second, the conclusions we make are subject to change based on new information. Third, this is a circular process. Scientists are constantly redoing, reanalyzing, and recreating hypotheses and tests

Slide 3

There are a few things to consider when putting together a properly constructed experiment.

First, is sample size, or the number of people or things we are investigating. You need an adequate sample size to make the test statistically significant and to provide enough information to formulate a good and reasonable conclusion.

Second, we need controls, especially in biomedical and psychological studies. A control is a group within the study that is very similar to the treatment group (the ones actually undergoing the experiment), but the control group is not actually being tested. For example, if you wanted to test out a new drug, you would have one group within the experiment that received the pill and another group that would receive a fake or sugar pill. You can then compare the two groups to see if the treatment group was helped by the drug or not.

A third consideration is psychosomatic effects. A person's state of mind can have a large impact on whether a test works. If we think about our drug test previously mentioned, the control group's fake pill would look very similar to the actual pill, a placebo. This ensures that the participants do not who is the control and who is in the treatment group.

Sometimes the person administrating the test can unwittingly influence the outcome of the test. This is called experimenter bias. To make sure this doesn't happen, a double-blind method is used. This is when the researcher does not know who is in the control and treatment groups so they are all treated the same.

A good experiment also includes statistics. Researchers spend a great amount of time making sure that their results are more than just coincidence and that they have properly dealt with bias. Statistics can help with this and let us predict what may happen in the future.

Slide 4

One of the big keys to a well done scientific study is that is reviewed by outside sources. These sources will look to see if you did your methods and statistics properly. They will also question your assumptions and hypothesis. All of this ensures that the best possible results are presented and talked about. Also, if your test cannot be replicated, then it is not a good experiment and needs to be reconsidered.

Slide 5

There are a few terms around the scientific method that need some clarification.

A scientific fact is supported by extensive and comprehensive data, they occur the same way every time, and maintain the same properties and behaviors. These can be verified by any trained person

A Law of Nature is a generalization about the ways in which nature operates. These are the result of the inductive method and allows you to make future predictions.

A Theory is an explanatory statement or set of statements derived from facts, laws, and confirmed hypotheses.

The terms theory and law can have different meanings in science than they do in everyday use. To non-scientists, a theory is a guess, but for scientists it is a summary of things we know to be currently true. Also, with laws, most people think of them as a hard-set rule. This is not the case with laws nature where they simply describe what is being seen.

Slide 6

Here is a fun little video about using the scientific method.

As you are watching it, answer the following questions:

Which would be the treatment plant and the control plant?

Is this an inductive or hypothetico-deductive experiment?

Note that this method is applied to an everyday problem that someone noticed in their house. While the scientific method is useful in science, the primary steps can be used in all aspects of our lives to answer questions.

Slide 8

Anatomy is the study of structure (morphology) and form. We focus on where an object is located and what it is called. For example, in anatomy we study the structures of the heart, the layers of skin, where the digestive organs are located, etc.

Physiology is the study of function. How does it work? Why does it work? An example of physiology would be how muscles contract or how nerve impulses are sent and received.

These are not mutually exclusive ideas. It is impossible to separate one from the other. Form follows function and visa-versa. In fact, if you ever get stuck trying to remember what something is, try thinking about what it does. Often, this can lead you to the answer you want.

Slide 9

We can look at the body from many different angles. We can look at the body from a chemical point of view, an organ point of view, or as a system as a whole. Because of this, we have a hierarchy of complexity.

The levels of complexity, going from smallest to largest are:

1. Atom are the fundamental units of matter, or the most basic building block in the human body. An example of an atom would be Carbon or Hydrogen.

2. A molecule is two or more atoms placed together. A Micromolecule is a smaller molecule, water for instance. It is made of 2 atoms of hydrogen and 1 atom of oxygen. Macromolecule are collections of molecules. These are really large and often make up the essential, more complex molecules of the body. For examples, proteins, DNA, carbs, etc.

3. Organelles are structures within a cell that carry out metabolic functions. Each organelle has a specific role and function and are made of a multitude of molecules. We'll go into greater detail during the cell presentation, but examples would be mitochondria which synthesizes ATP or a nucleus that houses DNA.

4. The next level is Cells. This is the first living level of the hierarchy! Cells carry out all functions of life.

5. Tissues are collections of specialized cells that carry out a specific function.

6. Organs are a collection of 2 or more tissues that work together to perform a function. Organs have definite boundaries and are visibly distinguishable from one another. Examples of an organ would be your lungs and stomach.

7. Organ Systems are a collection of organs with a unique function. Usually the organs within a system are physically connected.

8. An Organism is a single complete individual.

For the most part, each level is very, very similar in each individual. BUT, variation does exist and is what makes human biology and medicine interesting.

When studying, try to organize each system by these levels. It will help put everything in context.

Slide 10

In this diagram, we can see how the hierarchy builds on the previous organizational level before it. We start with the atoms which work to build molecules like DNA which then create organelles that when combined make a functioning and living cell. Cells pull together to form tissues which then create an organ. An organ works with another systematically and we ultimately end up with a functioning organism.

Slide 11

Homeostasis is the maintenance of a stable, internal environment regardless of changes in the external environment.

Failure to maintain homeostasis results in illness or death. A stressor is anything that moves us away from homeostasis. These can be physical or chemical. For instance, a sudden drop in air temperature or Homeostasis is the maintenance of a stable, internal environment regardless of changes in the external environment.

Failure to maintain homeostasis results in illness or death. A stressor is anything that moves us away from homeostasis. These can be physical or chemical. For instance, a sudden drop in air temperature or coming into contact with a toxic substance.

The primary mechanism for maintaining homeostasis is negative feedback. Negative feedback loops counter act change. Think of the thermostat in your. When the temperature of the house starts to become too cool, the heat kicks on. When the temperature has come back up, the heat shuts off. It is a constant adjustment and balancing around a desired point. Your body does the same thing to maintain the perfect internal temperature. Other examples are blood sugar and hydration levels.

There are three components to a negative feedback loop. First is the receptor, or the structure that senses and detects a change in the body. Next is the integrating center. This is the part of the nervous system that takes in the perceived information and decides what needs to be done with it. Finally, the effector is the cell or organ that responds and acts to counter act the change.

The primary mechanism for maintaining homeostasis is negative feedback. Negative feedback loops counter act change. Think of the thermostat in your home. When the temperature of the house starts to become too cool, the heat kicks on. When the temperature has come back up, the heat shuts off. It is a constant adjustment and balancing around a desired point. Your body does the same thing to maintain the perfect internal temperature. Other examples are blood sugar and hydration levels.

There are three components to a negative feedback loop. First is the receptor, or the structure that senses and detects a change in the body. Next is the integrating center. This is the part of the nervous system that takes in the perceived information and decides what needs to be done with it. Finally, the effector is the cell or organ that responds and acts to counter act the change.

Slide 12

In this diagram, we can see how our body is like a thermostat working to stay around our preferred body temperature. Both the thermostat and our bodies provide counter measures to maintain a temperature for an optimal environment.

What would be the sensor, integrating center, and effector for the thermostat example? Our sensor would be the thermometer in the thermostat; the integrating center would be part of the thermostat that controls the furnace/ac; and the effector would be the furnace or AC itself.

Our bodies are constantly employing negative feedback loops in order to maintain homeostasis. In the previous slide, blood sugar and hydration levels were mentioned as other examples of negative feedback. Can you think of any other examples of negative feedback?

Slide 13

Another mechanism of the body that we need to mention is positive feedback. Positive feedback amplifies change and does so rather rapidly. Childbirth and fever are examples. A baby will start to push on the cervix of the uterus. That action triggers an impulse to be sent to the brain that says "Hey! Let's get this baby out!". The brain responds by stimulating the pituitary gland to release a hormone called oxytocin. Oxytocin then stimulates the uterus to contract. When the uterus contracts, it causes the baby's head to push on the cervix more and that starts the entire cycle over. This cycle will continue until the child is born.

Slide 14

Here is a visual for our positive feedback example. The baby starts to push on the cervix which sends an impulse to the brain. The brain responds by stimulating the pituitary gland to release the hormone oxytocin. Oxytocin then travels to the uterus and causes it to contract. The contractions cause the baby to push more on the cervix which starts the entire cycle over again and again, further amplifying the effect until the child is born.

Another example of a positive feedback would be a fever. A fever is one mechanism our bodies have for fighting off infections. The temperature in our body increases to make the environment less hospitable for the microorganism. A short-term fever can be good for this reason, but since it has an amplifying effect, the further and longer we move away from our resting state, it can switch to a dangerous situation. The same can be said for a birth that goes on and on, as the body continues to move away from its normal, the more likely it is for complications to arise.

Slide 15

The purpose of anatomically correct position is to provide a consistent frame of reference. This allows people from different parts of the room or world to talk about the body in a way that is uniform with minimal confusion. Everyone is on the same page when it comes to describing the locations and position of a structure.

In anatomically correct position the person is standing upright with feet flat on the floor, arms to their sides, with palms and eyes facing forward.

Slide 16

In this picture, we can see how the three planes work to dissect the body into different views. You will be learning about these planes and other anatomical terms in the lab portion of this class. The woman is also standing in anatomically correct position with her hands and eyes forward.