Human Anatomy & Physiology General

Biology is the study of life but, what exactly is life?

how are living things different from nonliving things
- eg. a human from a rock
- eg. a a human from a robot
- eg. a living human from a corpse

also, how are all living organisms similar
→what do we have in common with
- eg. a bacterium
- eg. a fish
- eg. a frog
- eg. an armadillo

So one of the most basic questions is: **What is Life?**

<u>What is life</u>

a highly organized interaction of matter and energy

can't define in one sentence

must consider several **properties of life** or life functions:

each property taken individually is NOT unique to living things

many nonliving things do one or more of them

eg. viruses don't quite fit

<u>Properties of Life</u>

1. maintaining boundaries:
   -internal versus external environment
2. movement
3. responsiveness
   -functions are regulated within and between cells
4. assimilation & digestion
5. metabolism
   -anabolism & catabolism
6. excretion
7. reproduction
   -survival of genetic information
8. growth

Survival needs:

1. **nutrients**
   -solids, liquids, gasses
2. **gasseous oxygen, O_2**
   (is actually a nutrient)
   needed for energy reactions in cells
3. **water**
   solvent
   reactant
4. **temperature range near 37º** [~0º - 100º]
   need liquid water
   proteins (enzymes) sensitive to temp
5. **atmospheric pressure near 760mm Hg**
   gas exchange

   lowest atm humans can survive is about $1/5^{th}$ of an atmosphere;

   would become starved for oxygen if pressure were much lower;
   some bacteria can survive in "vacuum packed" foods

   not enough oxygen gas at low pressures
   high pressures cause implosion
6. **gravity**
   space science – gravity is essential for normal
   bone and muscle maintenance and cardiovascular fitness

What are you?

8-10 major organ systems
Dozens of tissues and organs
A conglomeration of trillions of cells (75 Trillion)
A collection of carefully arranged atoms and
molecules interacting in millions of different ways

How does your body work?

all physiology from organism to cell involves **chemical reactions**

cells functions by manipulating energy and matter = **metabolism**

the physiology of the organism is just the sum
total of all the chemical reactions (metabolism) occurring in
individual cells

the whole process is regulated by your "**genes**"
– the genetic information contained within each cell

→ tells what to do and what is needed to do it
→ provides assembly instructions

To maintain yourself you must continually replenish **nutrients**
→and this requires **energ**y

as long as you give your body the **energy** and
nutrients it needs it can run "automatically"

"**homeostasis**" keeps all systems and processes in balance

Differences between anatomy and physiology:

Anatomy [greek: 'to cut up']
the study of parts and their interrelationships
how the body is organized
provides a standardized language
eg "stomach" means different things to different people

nomenclature was standardized in 1895

Physiology
is the study of biological functions
cause/effect
interactions

More conceptual approach, interactions stressed

Relationship between anatomy and physiology

biology is very complex
How can we organize and study such complex processes?

→must **simplify** to understand but

→lose something in the translation

Use ***models*** to understand complex processes

eg. physicists *model* of the body:
"the body is natures way of learning about itself"

<u>Some examples of models in physiology:</u>

1. Major Organ Systems

need "organs and organ systems" to coordinate
and control all this activity

but these systems can mean different things to
different people

eg. immune system, lymphatic system, integumentary
system, neuroendocrine system

even within a system there can be variations:

anatomy texts present the anatomy seen in
~70% of individuals → the most common versions

eg. some people completely lack certain organs (palmaris
longus in forearm, plantaris in leg)

eg. most have 5 lumbar vertebrae but some have 4 or 6

eg. most have one spleen, but some have 2

eg. most kidneys are supplied by a single renal artery and
drained by one ureter, but some have 2 arteries or ureters

2. Levels of structural organization:

[Hierarchy of complexity]

matter, energy and their interactions can be
applied at many levels in biological systems

moving up scale each level is more complex than one below it

each level includes all those below it

new properties emerge from each level

in terms of energy, each unit is more unstable than the one below

atoms –smallest structural units of matter
(protons, neutrons, electrons)
molecules – interaction of atoms to form
compounds
organelles – specialized components of cells
performing specific cellular functions

cells – basic unit of life
tissues – groups of cells carrying out a specific function
organs – groups of organs performing given functions
organ systems – group of interacting organs
organism – total functioning unit

[**population** – association of same species living in same habitat]
[**community** – popyulations osf several different species livng in same place]
[**ecosystem** – highest level of biological organization]
most complex
environment and community and all interactions]

Learn different things by studying at different levels:

eg	stomach	digests food, ulcers
	tissues/cells	mucous cells, endocrine cells etc
	chemicals	enzymes, hormones,

3. Homeostasis

<u>Homeostasis</u>:
ability to maintain a constant internal environment regardless of fluctuations in the external environment
→ boundaries needed

main factors of the internal environment that must be maintained in homeostasis:
→concentration of nutrient molecules
→concentrations of O2 and CO2
→concentrations of waste products
→pH
→concentrations of water, salts and other electrolytes
→temperature
→blood volume and pressure

<u>Requires</u>:
receptor → control center → effectors

receptors can be:
- complex sense organs
- individual cells
- receptor molecules on cells

control center can be:
- brain
- individual organs

effectors can be:
- muscles (smooth, skeletal, cardiac)
- glands

homeostasis is maintained mainly by process of negative feedback

Negative Feedback

→ a change in one direction triggers a response in the opposite direction

has **intrinsic** controls and **set points**

examples

In some instances, **positive feedback** works to return body to homeostasis
= **cascades**
must have an end point

eg. clotting, immune response, labor,

uncontrolled Positive Feedback causes Homeostatic imbalances, disease and even death

The Language of Anatomy:

to study the body we need to establish landmarks and common terminology

1. anatomical positions and directional terms

Body Regions –

A. axial
- head
- neck (cervical)
- trunk
  - thorax
  - abdomen

B. appendicular
- upper limbs
- lower limbs

2. Body landmarks

– surface landmarks: anterior and posterior

3. Body Planes and sections

- sagittal
- frontal (coronal)
- transverse (cross)

4. Body Cavities

viscera (~body organs) are contained within distinct cavities within the body

- dorsal:
  - cranial
  - vertebral canal
- ventral:
  - thoracic
  - abdominopelvic:
    - abdominal
    - pelvic
- minor cavities:
  - oral cavity
  - nasal cavity

5. Subdivisions of abdominopelvic cavity:

quadrates

9 regions

6. Surface examinations:

a. palpation – feeling with firm pressure
   For: all bones – good landmarks
   many muscles
   some veins and arteries
   nerves
   lymph nodes
   glands
   some internal organs, eg liver

b. percussion - tapping sharply
   For: fluid concentrations
   organ densities

c. auscultation - sounds that various organs make
   For: breathing
   heartbeat
   digestive sounds

d. reflexes - condition of nervous system
   uses tendon tapping