CHARACTERISTICS OF LIFE

PRE-AP BIOLOGY: UNIT 1 TOPIC 1

Objectives:

- I can tell the difference between organisms and nonliving things
- I can list and explain the characteristics all living things share
- I can explain why some things are considered nonliving, even though they meet some characteristics of life

WHAT IS BIOLOGY?

- Biology is the study of life
  - Bio = life ; **ology** = study of

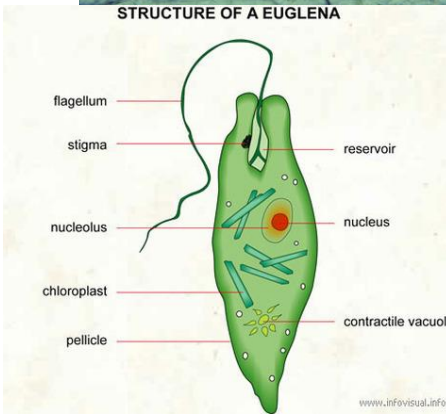
Biologists recognize that all living things share certain characteristics. They use these characteristics to classify things as living, nonliving, or once-living (dead).

WHAT IS AN ORGANISM?

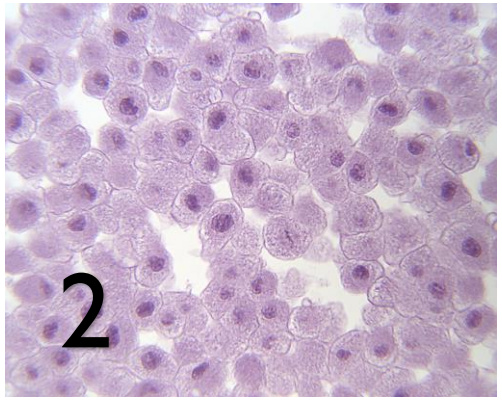
- Organism= anything that has or once had all of the characteristics which define life

CHARACTERISTIC OF LIFE #1:
MADE OF ONE OR MORE CELLS

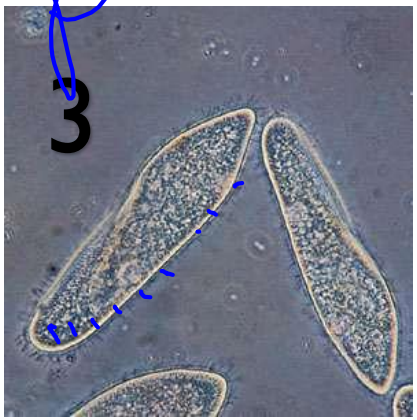
- Cells are the ***smallest unit capable of <u>all</u> life functions***. (a mitochondria, cell membrane, or an atom by themselves are not capable of <u>all</u> life functions)
  - **<u>Unicellular:</u>** organisms composed of <u>one</u> cell (ie bacteria, protists like amoeba, and certain fungi like yeast)
  - **<u>Multicellular:</u>** organisms composed of <u>more than one</u> cell (ie animals, plants, all fungi other than yeast)

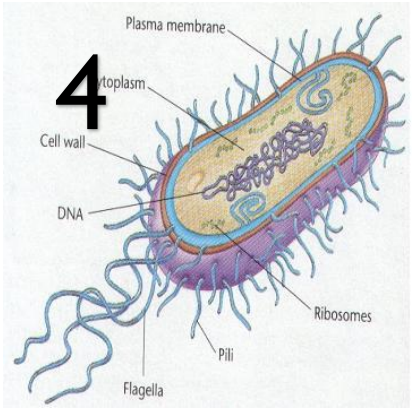


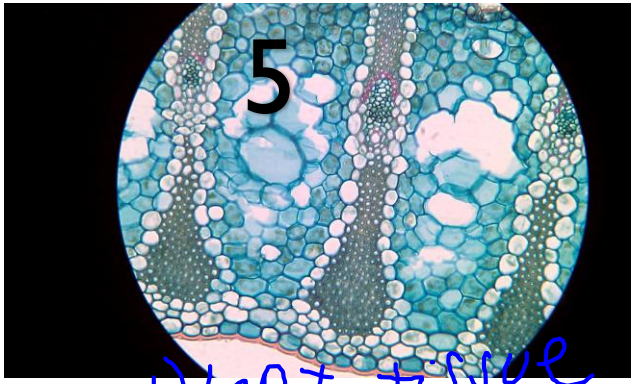
UNI OR MULTI?



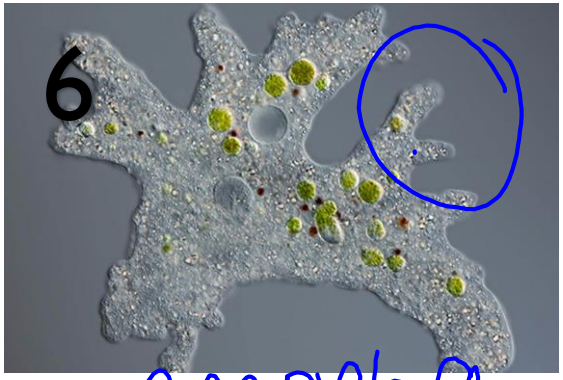
Paramecium



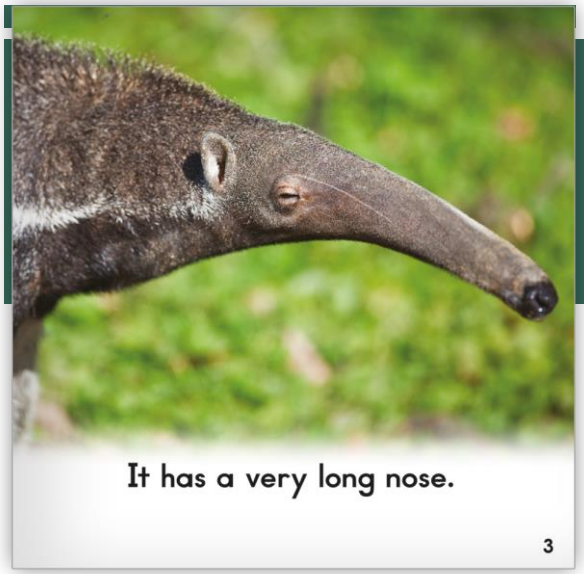




plant tissue

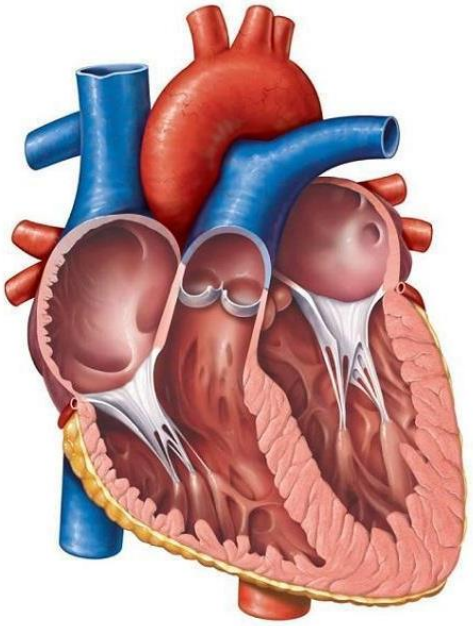


amoeba



CHARACTERISTIC OF LIFE #2: ORGANIZATION

- Organization = living things are arranged in an orderly way
- Each organized structure in an organism has a specific function
  - Ex – an anteater's snout is made of different tissues specialized to hold its long tongue
  - Ex – a human heart is made of muscle tissue and has four chambers to keep blood with oxygen and blood without oxygen separated.

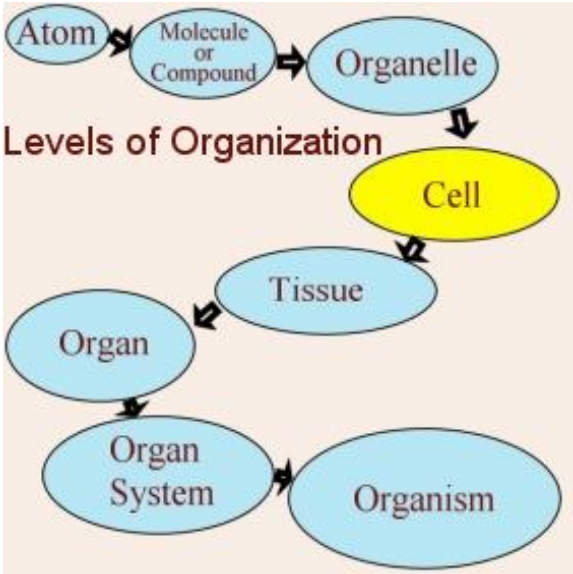


UNICELLULAR VS. MULTICELLULAR ORGANIZATION

- Unicellular organization = atoms like carbon, hydrogen, and oxygen are grouped into larger molecules like carbohydrates, proteins, and fats.
- Large multicellular organisms like have additional levels of organization. These levels are given below.

Atom → Molecule → Cell →

Tissue → Organ → Organ System → Organism



Level	Definition	Example in Humans
Atom	The smallest unit of matter	Carbon
Molecule	Groups of atoms that are bonded together	Protein
Cell	The smallest unit of life (composed of atoms and molecules)	Muscle Cell
Tissue	Groups of cells that work together to perform a particular function	Muscle Tissue
Organ	Groups of cells and tissues that work together to perform a particular function	Heart
Organ System	Groups of cells, tissues, and organs that work together to perform a particular function	Circulatory System

The levels of biological organization from smallest to largest are:

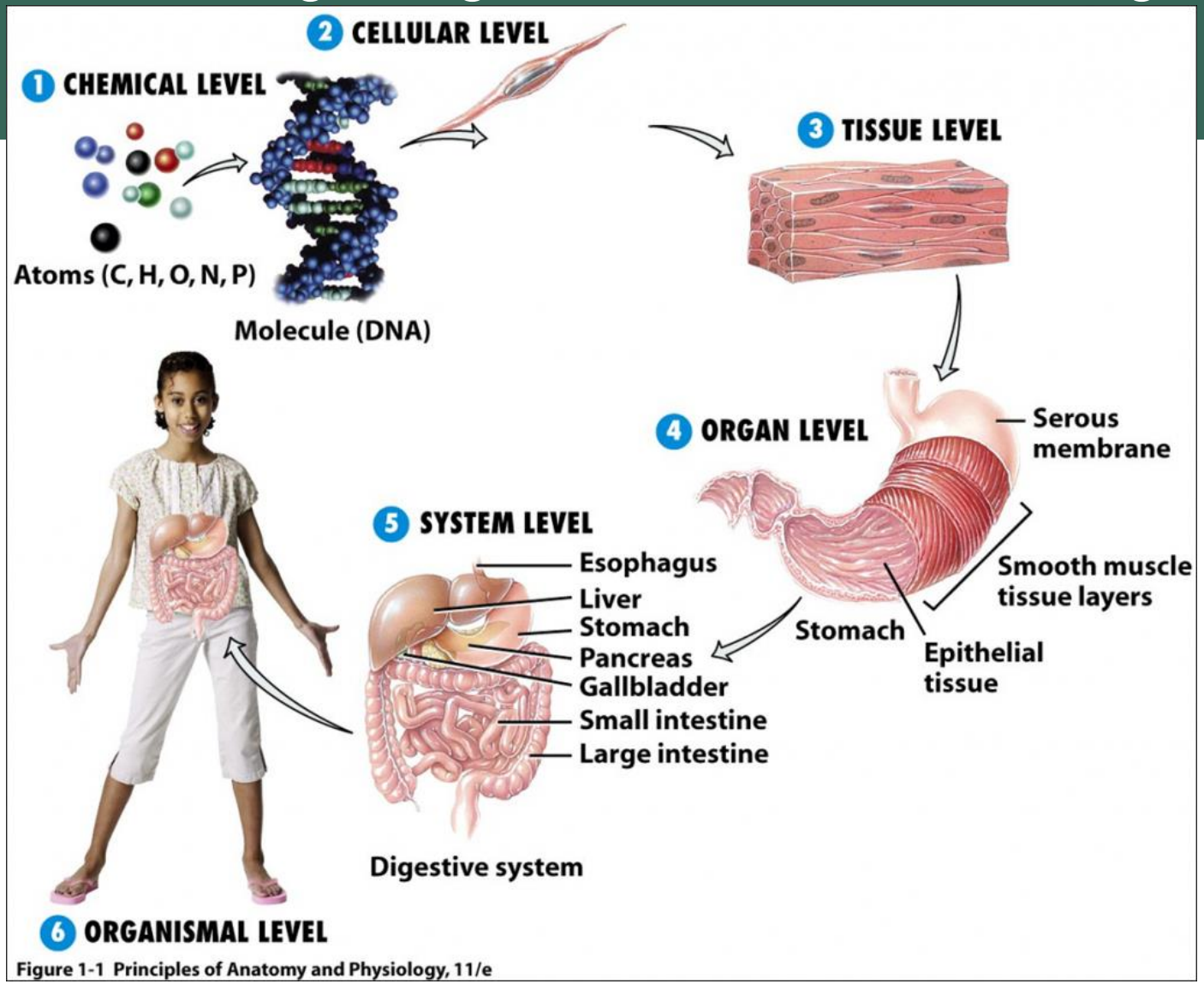
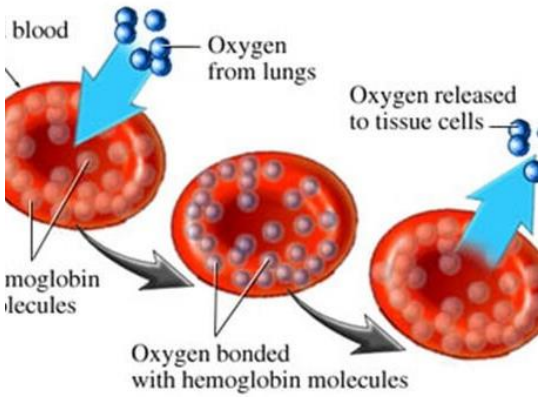


Figure 1-1 Principles of Anatomy and Physiology, 11/e

CHARACTERISTIC OF LIFE #3:
REGULATION (HOMEOSTASIS)



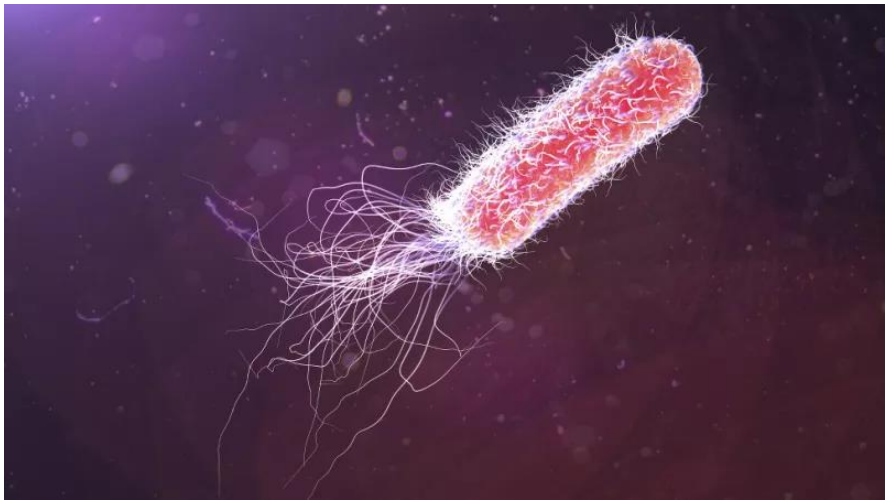
Regulation: maintaining stable internal conditions despite changes in external conditions

- ***Homeostasis*** *is when internal conditions are stable.*
  - Example – Whatever the air temperature is outside, a human's internal temperature should remain stable at 98.6°F. Your body can **REGULATE** internal temperature by sweating when you're hot or shivering when you're cold to reach stability again.
- Other conditions that must be kept stable include **water, oxygen, salt, sugar, and calcium** levels in the blood.

CHARACTERISTIC OF LIFE #4:

GROW AND DEVELOP

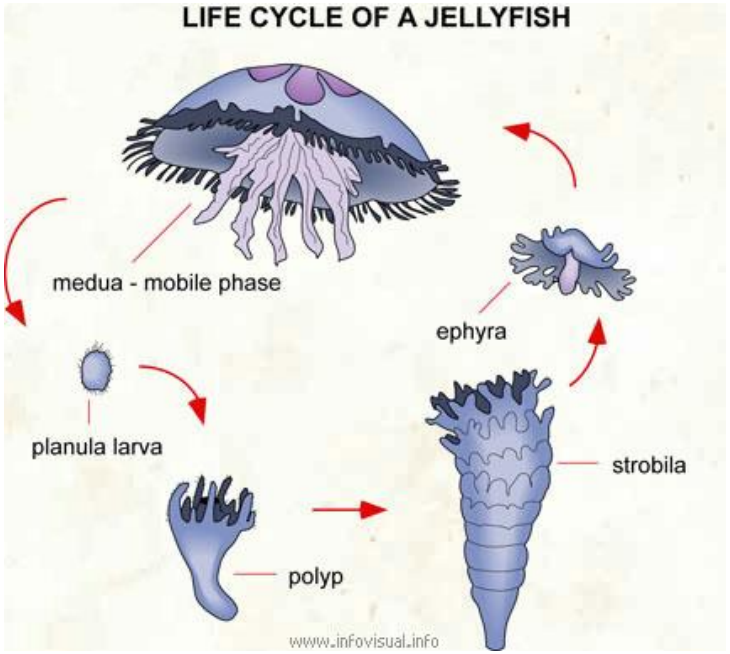
- Most organisms begin as one cell!
- Growth = results in the addition of mass and/or new cells

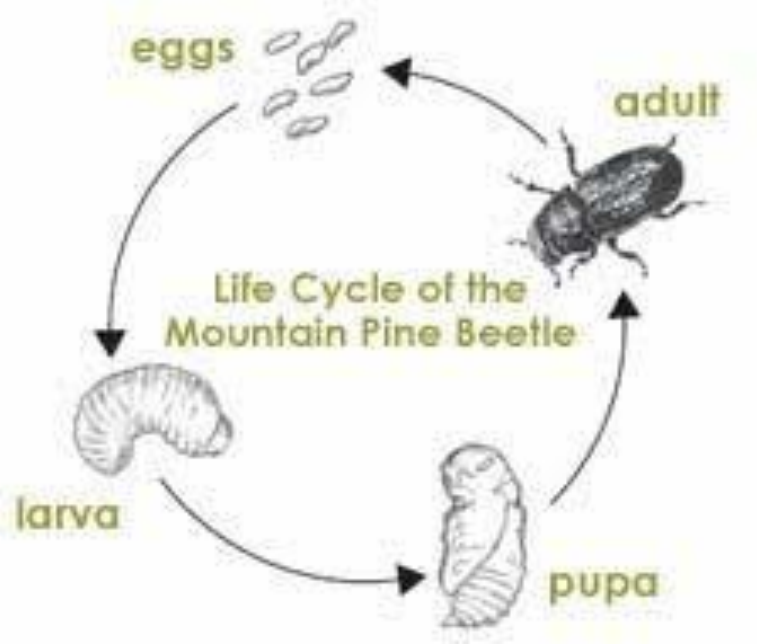


CHARACTERISTIC OF LIFE #4:

GROW AND DEVELOP

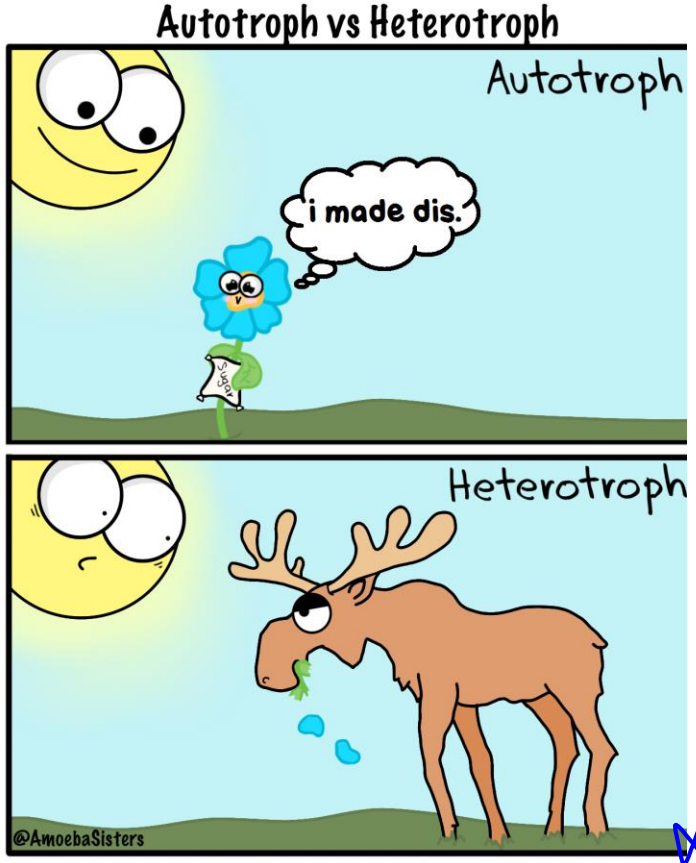
- Development = changes that take place to bring an organism to maturity





CHARACTERISTIC OF LIFE #5:

REQUIRES ENERGY

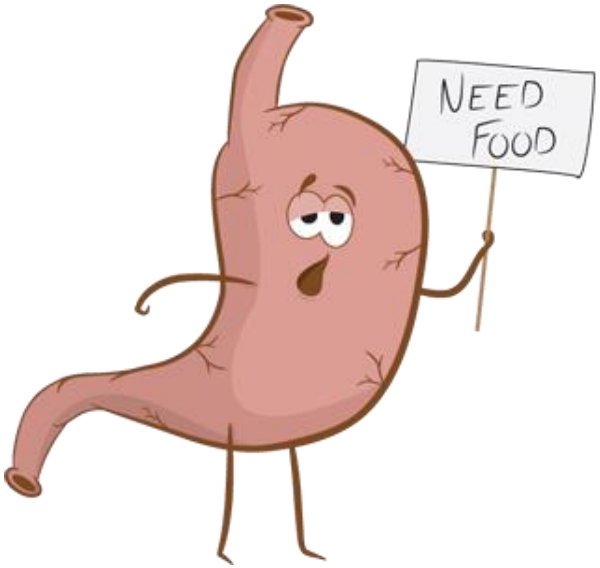


- All chemical reactions carried out within an organism require energy. There is energy stored in food, and that food is broken down when energy is needed.
- **Autotrophs** = organisms that **make** their own food (using energy from sunlight during photosynthesis)
- **Heterotrophs** = organisms that get their energy from **consuming** other organisms
- All energy organisms use originally came from the SUN!

CHARACTERISTIC OF LIFE #6:

RESPONDS TO STIMULI

- Organism's Internal Environment = all things inside of an organism

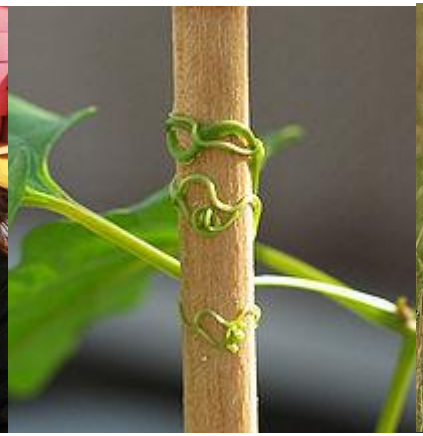


- Organism's External Environment = all things surrounding an organism

CHARACTERISTIC OF LIFE #6:

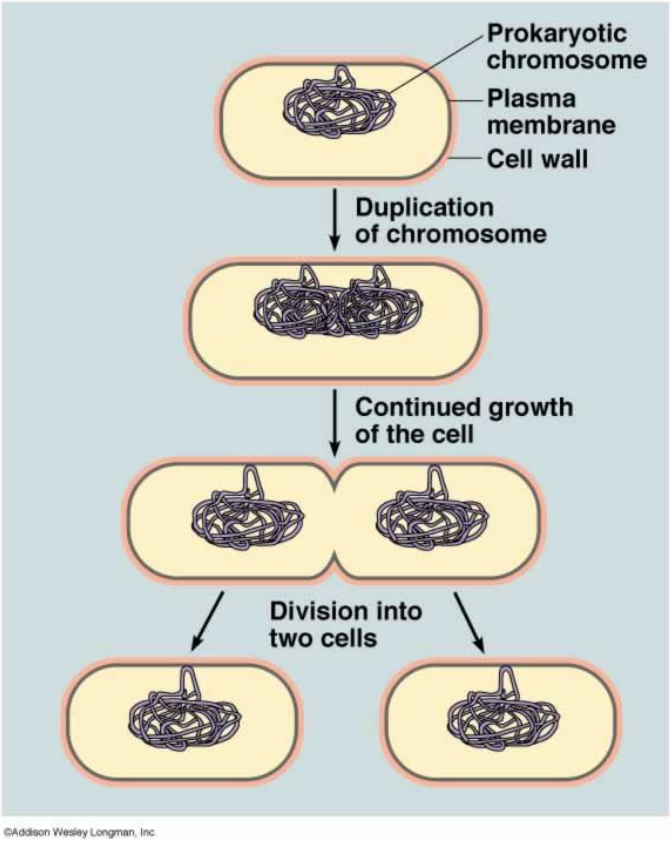
RESPONDS TO STIMULI

- Stimulus = anything that is part of either an organism's external or an organism's internal environment that causes a reaction
- Response = an organism's reaction to a stimulus

CHARACTERISTIC OF LIFE #7:

REPRODUCTION



- Reproduction = the production of offspring

No organism lives forever, so reproduction is how they ensure their genes "live on" after they die.

  - Two types: asexual vs. sexual

  - ← What type is represented by the picture to the left?

SEXUAL VS. ASEXUAL REPRODUCTION

	Sexual	Asexual
How many parent organisms are needed?	Two	One
Are the offspring genetically identical to the parent(s)?	No (remember, you have a mix of your parents' DNA, so you are not identical to either one).	Yes

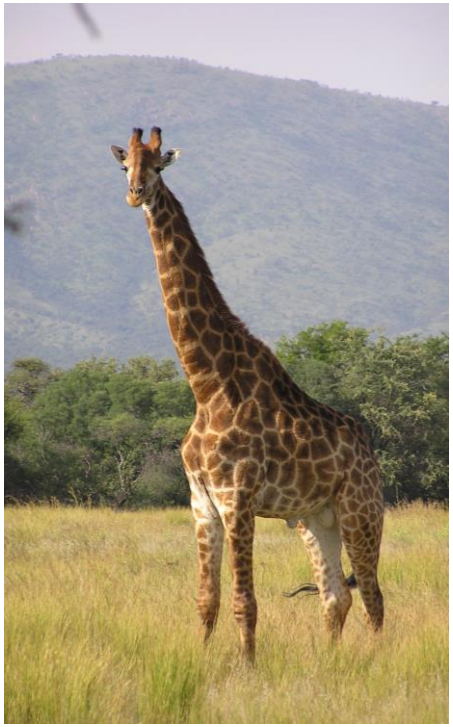
CHARACTERISTIC OF LIFE #7:

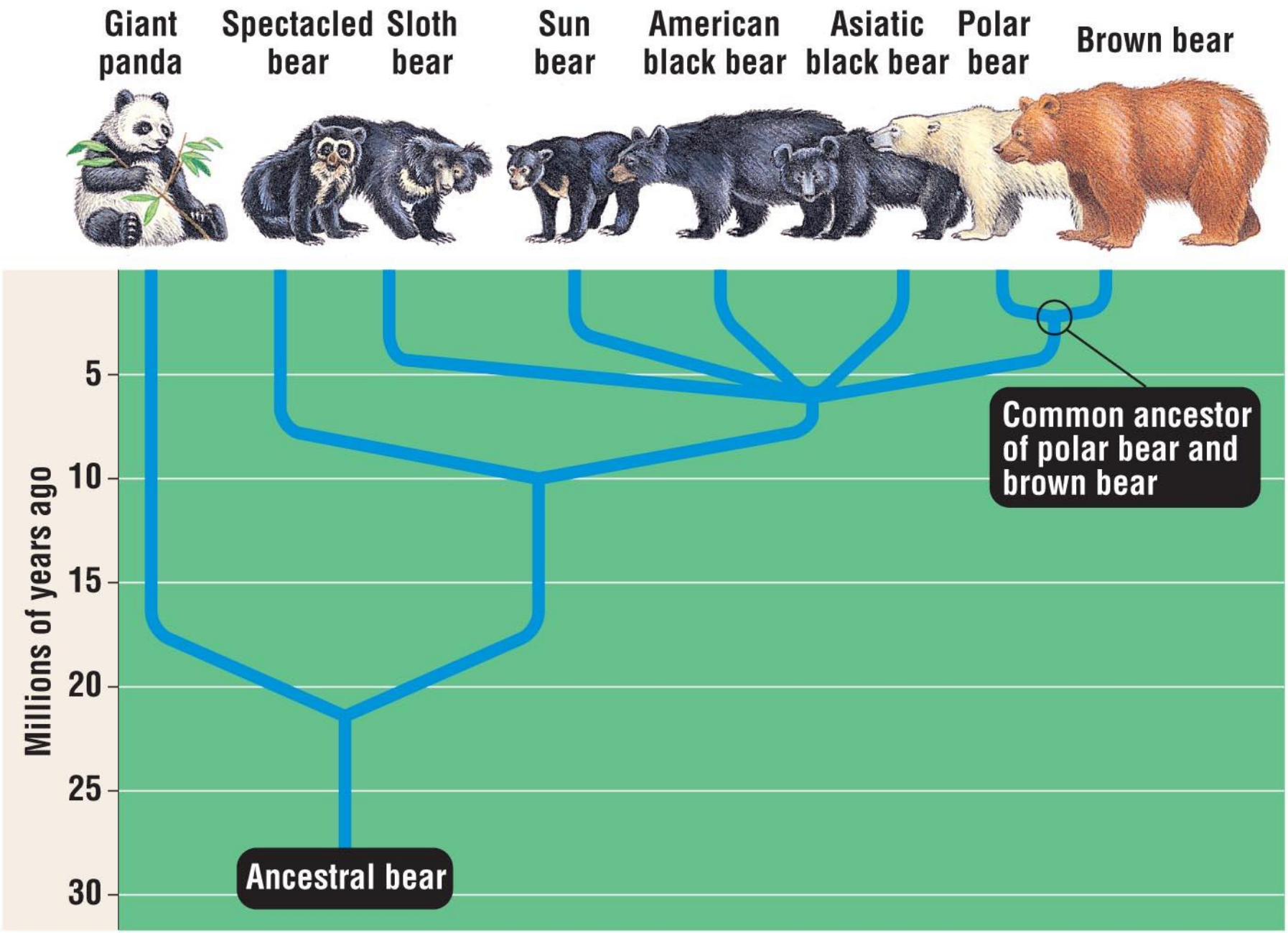
REPRODUCTION

- Species = a group of organisms that can breed with one another and produce fertile offspring
- What happens when two different species mate with each other?
  - Hybrids = offspring of two different species which interbreed

CHARACTERISTIC OF LIFE #8: GROUPS OF LIVING THINGS **EVOLVE** OVER TIME

- ***Evolution*** is defined as **change** in a population of organisms over many generations.
  - A ***population*** is a group of organisms of the same species that live in a particular area.
- ***Adaptation*** = any inherited characteristic that results from changes in a species over time
  - Example – giraffe necks





CHARACTERISTIC OF LIFE #9:

HAS A GENETIC CODE (DNA)

- All organisms store the complex information they need to live, grow, and reproduce in a genetic code written in a molecule called DNA.
  - What percentage of human DNA is shared with chimpanzees???

HOW DO I TELL: LIVING OR NOT?

Living

- Must have ***all 9 characteristics*** of life currently!
- No exceptions!!

Once-Living

- Does not currently have all 9 characteristics, but once did.
- "Dead"
- Usually still have DNA and cells.

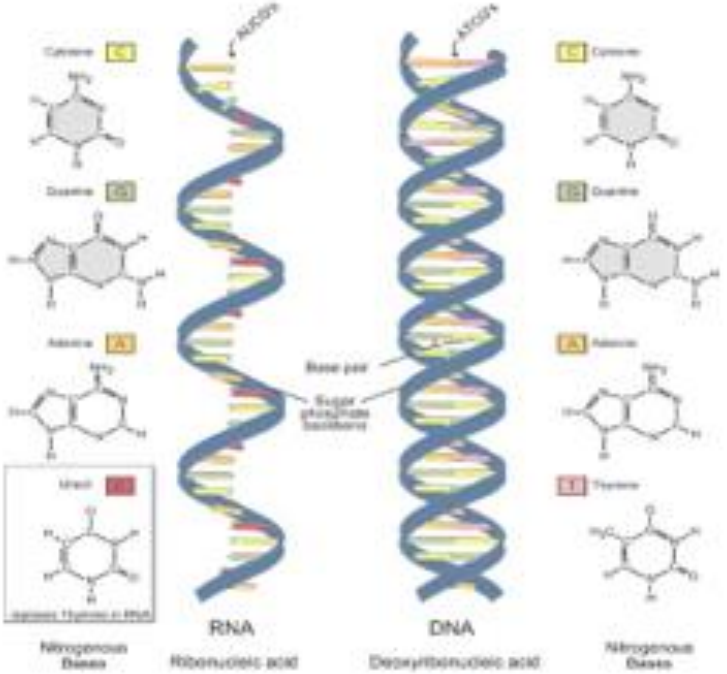
Nonliving

- Does not have all 9 characteristics of life.
- Never did in the past.
- Never will in the future.

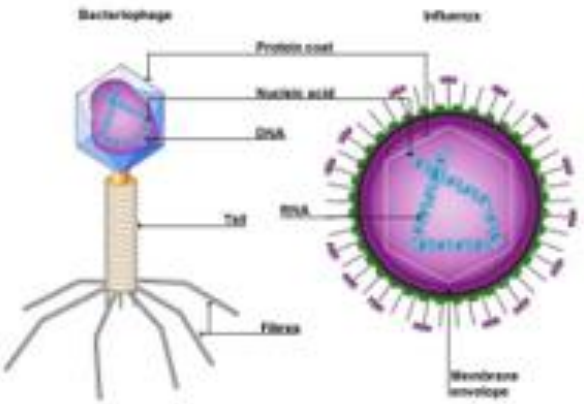
Are Viruses Alive? Writing Prompt

Background Information: For years, scientists have debated whether or not viruses should be considered alive. Viruses include disease-causing agents in humans such as influenza, rhinovirus (the cold virus), and HIV (human immunodeficiency virus). Viruses are made of two molecules commonly found in cells—protein and genetic material. Unlike other organisms, not all viruses contain DNA as their genetic material. Instead, some viruses contain a molecule similar to DNA called RNA. The structures of the DNA and RNA molecules are shown side-by-side below and to the right.

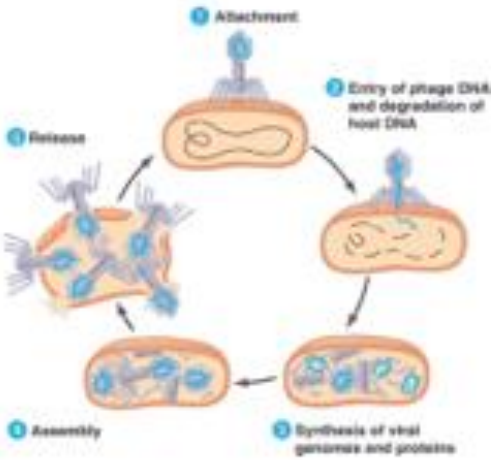
Their protein outer coating typically surrounds and protects their genetic material (molecules which determine the traits of the virus and are passed on to any baby viruses / virus offspring). Though they are made of some molecules typically found in cells, they do not contain all the essential parts of a typical cell.



Viruses can reproduce only by infecting other organisms (ex: bacteria, plants, and animals). The image below shows a bacteriophage—a type of virus that infects bacteria cells—and the influenza virus. Though they look different from each other, they have the same basic structure—a protein coat surrounding genetic material.



To infect the cells of other organisms, viruses use a needle-like structure that is part of their protein coat to inject their genetic material (either DNA or RNA) into the host cell. They then use the host cell's tools to make baby viruses based on their genetic material. These baby viruses then burst out of the host cell, killing it in the process. The image to the right shows the infection process.



Viruses do not make or use energy molecules of their own. Instead, they use

Qualities of Communication

Write the explanation so others can understand it.

- ✓ Use precise and accurate scientific language.
- ✓ Write clearly so that anyone interested in the explanation can understand it.
- ✓ Explain your logic to help share your knowledge.

Explanation Tool Layout

The Question: *Initial question based on an observed phenomenon or situation.*	
Our Claim: *Your claim is a statement that expresses the answer or conclusion to the question.*	
Our Evidence: *Your evidence should always include collected data (Numbers!) and/or observations*	**Our Justification (Reasoning) of the Evidence:** *Your justification explains why the evidence supports the claim. Provide a logical connection between the evidence and claim.*

The Question:	
What do plants need to grow?	
Our Claim:	
Plants need water, carbon dioxide, and light to grow.	
Our Evidence:	**Our Justification of the Evidence:**
On average, for the six plants that received constant light, carbon dioxide, and water, they grew 20 cm, had six yellow flowers, had fifteen leaves, and they were all bright green. On average, for the six plants that received 12 hours of light, limited carbon dioxide and water, they grew 8 cm, had two yellow flowers, and had four leaves. Also, two of the plants had zero flowers. These plants were still bright green, but they were smaller and with fewer flowers and leaves.	*Photosynthesis is the process during which green plants produce sugar from water, carbon dioxide, and light energy. Producing sugar is essential for plant growth and development. That is why the plants that received a constant source of water, carbon dioxide, and light grew the most.*

This example is complex in that the group has decided to investigate **multiple variables** that impact plant growth. This question requires a greater **understanding of the science concepts** related to plant growth and that water, carbon dioxide, and light are necessary for photosynthesis to occur. Not only does the reasoning become more complicated, but the claim that the group is justifying has also become more complex. This example uses **specific** quantitative and qualitative **evidence** in order to support the claim.

CER GRAPHIC ORGANIZER

Question: Should viruses be classified as living organisms? Or Are viruses alive?

Claim: full sentence stating either yes, they are alive or no, they are not	**Evidence:** at least (very minimum) three pieces of evidence supporting your claim

Reasoning: — JUSTifying

The evidence shows:

I know (relevant disciplinary ideas – i.e., scientific facts and concepts that help answer the question):

that to be considered living...

I can apply (relevant crosscutting concepts – i.e., big ideas that connect the concepts and evidence):

Cell theory; Natural selection; DNA = mast

Therefore, I can conclude that:

	4 Advanced	3 Proficient	2 Progressing	1 Beginning
Claim *A statement or conclusion that answers the original question/ problem.*	• Makes a claim that is relevant, accurate, and complete. • Contrasts the claim to an alternative claim.	Makes a claim that is… • Relevant (Directly & clearly responds to question) • Accurate (Consistent with evidence and scientific principles) • Complete (Complete sentence that stands alone)	• Makes a relevant and accurate but incomplete claim.	• Does not make a claim, or makes an inaccurate or irrelevant claim.
Evidence *Scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.*	• Provides appropriate and sufficient evidence to support claim. • Discusses evidence that would support alternative claim.	Provides evidence to support the claim that is… • Appropriate (Scientific data or information from observations, investigations, data analysis, or valid scientific sources) • Sufficient (Enough evidence to support the claim)	• Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	• Does not provide evidence, or only provides inappropriate evidence (Evidence that does not support claim).
Reasoning *A justification that connects the evidence to the claim. It shows why the data counts as evidence by using appropriate and sufficient scientific principles.*	• Provides reasoning that clearly connects the evidence to the claim. • Includes appropriate and sufficient scientific principles to explain why the evidence supports the claim. • Explains why the alternative claim is inaccurate.	Explanation provides reasoning that is… • Clear (Clearly communicated and goes beyond repeating claim and evidence) • Connected (Explains why the evidence is important or why it is relevant) • Integrated (Links the evidence to an important disciplinary idea and crosscutting concept)	• Provides reasoning that connects the evidence to the claim. May include some scientific principles or justification for why the evidence supports the claim, but not sufficient.	• Does not provide reasoning, or only provides inappropriate reasoning.

Characteristics of living things

Are both complex and organized.

Acquire and use both materials and energy.

Exhibit some capacity to regulate their internal conditions (homeostasis).

Show the capacity for growth.

Respond to stimuli.

Reproduce themselves.

Have the capacity to evolve.

Which 2 characteristics of life are missing from this list?

CORG-E RRED

- Cells
- Organization
- Regulation (Homeostasis)
- Grows and Develops
- Energy
- Respond to Stimuli
- Reproduction
- Evolution
- DNA

DOG RACERR

- DNA
- Organization
- Grows and Develops
- Reproduction
- Adaptation
- Cells
- Energy
- Respond to Stimuli
- Regulation (Homeostasis)

LIVING, ONCE LIVING, OR NONLIVING?
1 2 3

- Rock

- Piece of Wood

- Frog

- Leaf (fallen off the tree)

LIVING, ONCE LIVING, OR NONLIVING?
1 2 3

- Worm

- Water

- Salmonella

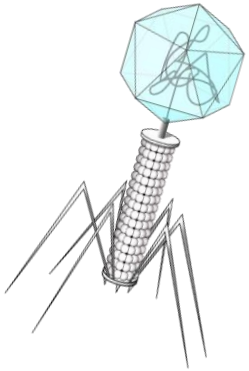
- Paper

LIVING, ONCE LIVING, OR NONLIVING?
1 2 3

- Fruit Fly

- Steak

- Virus



CHARACTERISTICS OF LIFE ACTIVITY
PRE-AP BIOLOGY

Are viruses considered living?

- Read the provided information
- Respond to the prompts
- Develop a clearly written response, citing at least three characteristics that led you to your decision