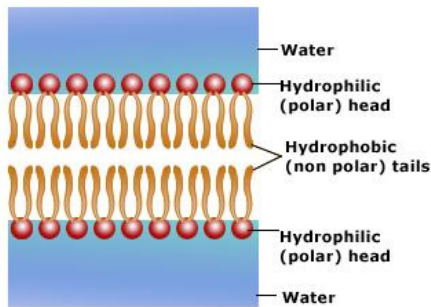


Review for STAR/CST

CELLS, CELLULAR RESPIRATION & PHOTOSYNTHESIS, BACTERIA & VIRUSES



SEMIPERMEABLE (OR SELECTIVELY PERMEABLE) MEMBRANE

- This means it selects what it lets through the membrane.
- Cell membrane is a phospholipid bilayer. It only allows some things to go in and out!
- Phospholipid bilayer = phosphate + fats
- Water can ALWAYS go in and out of the cell membrane via diffusion, where things move from higher concentrations to lower concentrations.
- **Osmosis:** The diffusion of water.

ENZYMES

Proteins that catalyze reactions (this means makes them happen faster or more easily).

- Enzymes are "helpers" and their amount stays the same reaction after reactions!
- How well enzymes work depends on temperature (warmer = work more quickly), pH, and ionic concentrations.
- Enzymes are important in our cell processes, when we digest our food, etc.

TYPES OF CELLS

Prokaryote (bacteria)

- Simple cells.
- Don't have a nucleus
- Have a cell wall outside the cell membrane.

Eukaryotes (plant cells, animal cells, fungi)

- More complicated cells.
- Have a nucleus.
- Major organelles include: nucleus, ER, Golgi, mitochondri
- ANIMAL CELLS** (a type of eukaryotic cell)
- Cell membrane, but no cell wall
- PLANT CELLS** (a one type of eukaryotic cell)
- Have a cell wall in addition to the cell membrane. Plant cells have the normal organelles + they also have chloroplasts, which help them capture sunlight energy to make food (photosynthesis!).

VIRUSES

- *Not really a cell. because they are not living*
- They are surrounded by a capsid (similar to a cell wall), and have DNA/RNA floating inside of them
- No nucleus.
- Not alive because they need a host to reproduce (need someone like you to reproduce).
- *Antibiotics ONLY work against bacteria----they do NOT work against viruses! If you use them too much the bacteria evolve to be stronger!

CELL ORGANELLES (PARTS OF THE CELL)

ENDOPLASMIC RETICULUM (ER): The ER is where many chemical reactions happen and where the ribosomes package some of the proteins. The package then goes to the Golgi apparatus.

- **Rough ER** has ribosomes

• **Smooth ER** does not have ribosomes.

GOLGI APPARATUS: Receives the protein or other substances and modifies it as needed. It then sends it off to where it needs to go in the cell.

NUCLEUS: Controls the cell. Contains DNA.

MITOCHONDRIA: Creates energy from food; where cellular respiration occurs.

CHLOROPLASTS: Only in plant cells and some prokaryotes. They capture sunlight energy and make glucose during photosynthesis.

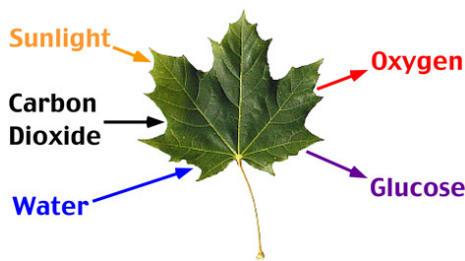
VACUOLE: Storage (mainly found in plants)

CYTOSKELETON: Gives structure to the cell

CILIA/FLAGELLA: Found in prokaryotes; like tails or hair that allow unicellular (one-celled) organisms to move

RIBOSOME: Where protein synthesis (translation) occurs (where protein takes place).

PHOTOSYNTHESIS

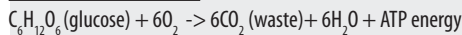


Plants take in water, carbon dioxide, and sunlight energy to create glucose, which they use as food. Oxygen is then a waste product.

PHOTOSYNTHESIS



CELLULAR RESPIRATION



Photosynthesis and cellular respiration are opposite of each other.

CELLULAR RESPIRATION

Occurs in the mitochondria. Cells can't use energy when it is in the form of glucose sugar. The cell uses the glucose to make ATP.

- Think ATP = ENERGY
- The OPPOSITE of photosynthesis. You breathe in oxygen and get glucose from your food, then your mitochondria create ATP and make water and carbon dioxide as waste products.

MACROMOLECULES

All living things are made of cells (or at least 1 cell). Cells are made of **macromolecules** (biological molecules).

4 MACROMOLECULES:

- **Protein**
- **Lipid (fat)**
- **Carbohydrate (sugar)**
- **Nucleic acids (DNA and RNA).**

All the macromolecules are made from simple elements like carbon, oxygen, and hydrogen.

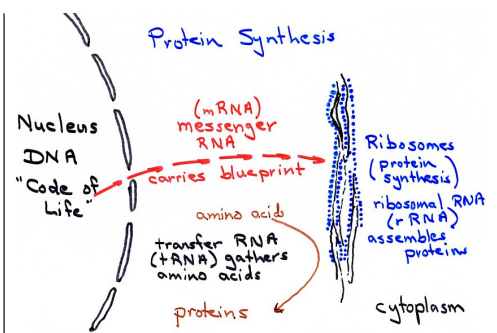
DNA -> PROTEIN, BIOTECHNOLOGY

DNA -> (transcription) -> RNA (translation) -> PROTEIN

Proteins do everything in your body, and are the molecules of life!

Steps of protein synthesis

- **Transcription** the DNA unzips and a copy of messenger RNA is made (mRNA).
- mRNA leaves the nucleus and goes to the ribosomes, where the message is **translated** into an amino acid chain. This happens because the ribosomal RNA (rRNA) helps organize



the right order for the amino acids, and then the transfer RNA (tRNA) goes to get the correct amino acids and puts them into a chain!

- **Proteins** = a bunch of amino acids put together. Also called "polypeptides."
- **Amino acids** are held together by peptide bonds.
- Different proteins have different numbers of amino acids or put them in different orders. This makes them have different shapes/functions.

Base pairing rules for DNA and RNA

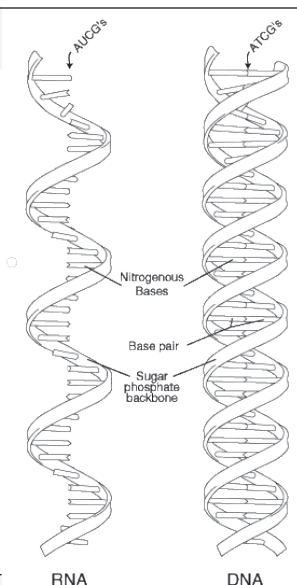
• Use an mRNA codon chart to determine which amino acid is coded for by a codon (3 letters) of mRNA!

• DNA BASES:

Adenine, Thymine, Cytosine, Guanine.
> A pairs with T
> G pairs with C.

• RNA BASES:

Adenine, Uracil, Cytosine, Guanine.
> A pairs with U
> G pairs with C.



DNA and RNA

Nucleotide: a nitrogenous base + sugar + phosphate.

Sugar-phosphate backbone: DNA and RNA both have a sugar-phosphate backbone (DNA = deoxyribose sugar; RNA = ribose sugar).

- DNA replication is **semi-conservative**. Each copy should end up with 1/2 old DNA and 1/2 new DNA and be exactly the same as all other copies!
- **Mutations** often happen during DNA replication. Sometimes mutations have no effect; sometimes they can be very bad or deadly. (Remember the Rice Krispy lab). Mutations lead to genetic variation. They happen constantly, but we only see them sometimes.
- **Gene:** pieces of DNA that code for a protein
- **Chromosome:** DNA coiled inside the nucleus
- *Different genes* code for different traits (for example, you have 8 genes that code for eye color).
- **97% of our DNA is "junk"** it's not part of genes, so it codes for nothing as far as we know.
- Genes are instructions for how to make a certain protein. • Genes are made of DNA.
- You have the same DNA (so the same genes) inside all of your cells, but your cells do different things. Genes for eye color will only be expressed (translated and made into protein) in your eye cells. Genes for strength will only be expressed in your

Review for STAR/CST

muscle cells.

BIOTECHNOLOGY

- Using technology in biology
- Putting exogenous DNA (from a different organism) into something else (makes a transgenic organism).
- Cloning, using DNA to solve crimes (DNA fingerprinting), making new products/organisms (mice that glow!)

MENDELIAN GENETICS

Mutation and sexual reproduction lead to genetic variation in a population.

a. **Meiosis** occurs when when gametes (**sex cells** like sperm and egg cells) are

formed before sexual reproduction. 1 diploid reproductive cell divides twice to form **FOUR haploid** gamete cells.

- **Diploid**: 2 copies of chromosomes (1 from mom, 1 from dad).

- **Haploid**: 1 copy of chromosome

(like in gametes from just one parent)

- **Only reproductive cells** (like ovary cells and teste cells) undergo meiosis!

- ALL cells undergo mitosis, which is just making more cells.

- **Mendel's Laws** show us that *meiosis is random*—1 gamete gets a random combination of chromosomes!

- You have 23 chromosomes from your mom and 23 from your dad. Your gametes will get some combination of those

- Traits that are on different chromosomes don't go together. For example, being tall doesn't affect your eye color.

Crossing over mixes up DNA even more.

- **Fertilization**: 2 gametes combine to form a zygote (a baby baby!)

> **XX = girl**

XY = boy

> You have a **50% chance** of having a boy or a girl because the dad has a 50% chance of giving the X or Y chromosome!

- Each parent gives 1 allele

(form of a gene) for each

trait. For example, a parent with Aa could give "A" or "a" to a gamete. A "aa" parent could only give "b."

- Punnett squares can help you figure out what possible offspring genotypes are.

- **Phenotype** (what you see) depends on genotype (the alleles you have).

Some traits are inherited differently than others

- Simple recessive/dominance (B dominant to b)

- **Sex-linked traits**: gene is located on the sex chromosome (usually the X chromosome)

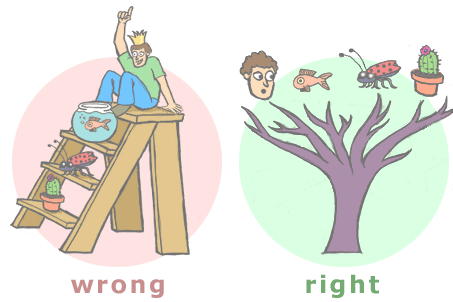
- Pedigrees can help you track a trait through a family.

EVOLUTION

Evolution happens to populations, NOT individuals! It never happens because the organism tried or wanted it to happen!

- **Evolution**: change in allele frequencies over time

- **Natural selection** acts on the PHENOTYPE, not the genotype,



because phenotype is what actually shows.

- A **lethal allele** could stay in a population forever because it might be carried in the heterozygous (Ff) form. (Example: Sickle-cell anemia can be hidden in the population because people who are heterozygous for are less likely to contract malaria)

- **New mutations** happen constantly within populations and can lead to variation. Variation is GOOD because it increases the likelihood that at least some members of a species will survive under changed environmental conditions.

- **Evolution** is the result of genetic changes that occur in constantly changing environments.

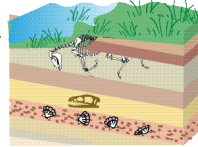
> The more advantageous (better) phenotype is selected for. Organisms with the advantageous trait live longer and produce more offspring with the trait.

> **Variation/diversity** in different species increases the chance that at least some organisms survive major changes in the environment (dinosaurs died, but other life went on!).

> **Genetic drift** is RANDOM chance that leads to some alleles becoming less common (which can decrease variation). (Think of the Amish, who separated from the population)

> **Geographic or reproductive isolation** leads to speciation, because different selection occurs in the different populations.

> Fossils show us what is older (law of superposition = stuff on bottom is the oldest!), when there were lots of diverse species, when things went extinct, etc.



ECOLOGY

Organisms -> Population -> Community (different species) -> Ecosystem (biotic + abiotic) -> Biome (desert, mountains, etc.) -> Biosphere (Earth)

Ecosystems have to stay in balance in order to function.

- **Biotic**: living or used to be living (organisms, dead leaves, etc.)

- **Abiotic**: nonliving (rocks, water, air)

- **Biodiversity** = different kind of organisms can be found somewhere

- **Changes** in climate, pollution, new species, population size, etc., can drastically affect the ecosystem directly or indirectly.

- **Populations** change size depending on birth rate, death rate, immigration (coming IN to a population) or emigration (leaving a population).

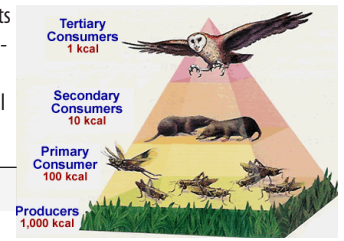
- Water, carbon, and nitrogen cycle between abiotic resources and organic matter (living things and other biotic stuff) in the ecosystem.

- **Producers** make food (plants!); also called autotrophs. Very important because they are the base of all ecosystems!

- Decomposers get rid of waste (bacteria, fungi, etc.—get food from dead organisms!). Very important because they clean everything up and keep it balanced!

f. At every link in the food web LOTS of energy is lost as heat. Grass has 100% energy; grasshoppers gets 10% of grass's

energy; voles gets 10% of deer's energy (or only 1% of grass's original energy).



PHYSIOLOGY

We need all systems in our body to be in balance.

Homeostasis: keeping things the same; keeping body in balance.

- Respiratory and circulatory system help circulate your oxygen in your blood and removes wastes such as CO₂.

- **Respiratory**: Lungs, trachea -> help you breathe

- **Circulatory**: heart, veins, arteries -> help pumps oxygen and carbon dioxide

- **Nervous system** lets body communicate and respond to the outside world.

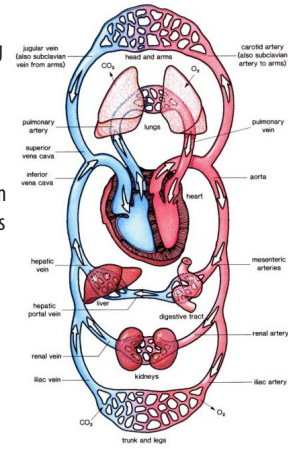
- Feedback loops help maintain homeostasis (when your stomach is full, your brain gets signals that it feels full so you stop eating).

- **Nervous system** lets different body parts communicate by sending electrochemical signals.

- **Sensory neurons** sense things from the environment, like pain, or light (vision).

- **Interneurons** carry the message between sensory and motor.

- **Motor neurons** respond to the signal (make your muscle move, etc.)



IMMUNITY

Our immune system helps us fight disease!

- Skin provides **nonspecific defense** by keeping everything out of our bodies.

- **Antibodies** fight against specific **pathogens** (bacteria, viruses, or anything else bad). You remember how to make antibodies once you've gotten a certain disease once, so that if you get it again you'll be ready to fight!

- **Vaccination** lets you build up good antibodies without having to get sick first.

- **Antibiotic** medication ONLY works on bacteria – NOT ON VIRUSES.

- **AIDS** attacks your **immune system**, so you can't fight off normal diseases like the cold and flu.

INVESTIGATION & EXPERIMENTATION

- **Hypothesis**: educated statement of what you think will happen based on your prior evidence and observations.

- **Experiment**: Helps you prove or disprove your hypothesis.

- **Theory**: In science, a "theory" is like a fact! Scientists create theories to explain what they see based on LOTS of evidence over a long period of time.

Law: "law of gravity" a natural law is a scientific fact.

X-axis: independent variable—the thing that YOU control (time, temperature)

Y-axis: dependent variable—"depends" on the independent variable; such as how temperature affects sweating abilities.