Intro to Biology Notes / Characteristics of Life

- Biology combines general science skills, chemistry, physics, statistics, and math.
- Properties of life:
  - Organization: contains cell(s)
  - Metabolism: Total of biochemical reactions
    - Anabolism - making complex molecules from simple ones
    - Catabolism - making simple molecules from more complex ones
  - Homeostasis: Maintenance of a stable internal environment
  - Growth: Growth and multiplication of cells
  - Reproduction: ∴
  - Response: to stimuli or changes in environment
  - Evolution: Changes in the genetic makeup of a species over time

However, these properties are not fool-proof

- Viruses are structures that meet most but not all of these requirements

Scientific Method:

1. Observation
2. Ask a question - why?
3. Testable hypothesis
4. Prediction
5. Test
6. Refine / iterate

What is the most important part of an experiment?

The CONTROL

5,9

9-20-16 Biology Energy Flow

Ecology

The study of the relationships between living organisms and between organisms and their environment

Population

A group of the same species living in the same area at the same time

Ecosystem

A community and its abiotic environment

Community

An area in which a group of populations interact with each other

Habitat

The environment in which a species normally lives (the location)

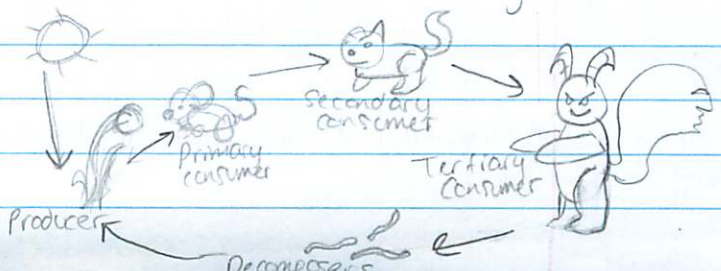
Species

A group of organisms that can interbreed to produce fertile offspring

niche - the role an organism plays in its environment

assimilation - the process by which an organism takes the properties of another organism (ex. I drink milk to gain calcium)

- Producers
- Consumers
- Decomposers



CHOPKINS CaFe MgCu NaCl

Mnemonic for the major elements in an organism

Biomass- energy derived from organisms (living or dead)

9-26-16 • Phosphate Cycle

Law of Limiting Factors: In an ecosystem, what lives there, or what interacts, is determined by the limiting factor- the rarest element (component)

Symbiosis: interaction between two different organisms

- Predation - big guy eats the little guy
- Parasitism - little guy lives at the expense of the big guy
- Commensalism - one guy benefits, host is unaffected
- Mutualism - both dudes benefit from relationship

Biomes: large, naturally occurring community of flora and fauna occupying a major habitat

Succession: Change, → shifting back to equilibrium

→ Aquatic, forest, Desert, tundra, Grassland

Basic Chemistry for Understanding Biology

10-5-16

Vasu Sajgure
Pd. 8

Element: A substance that cannot be broken down any further

- Atom: All things are made of atoms!

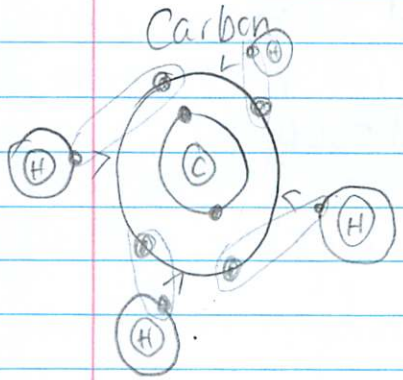
20/20

Particle	Charge	Mass
Proton	+1	1 amu
Neutron	0	1 amu
Electron	-1	1/1834 amu

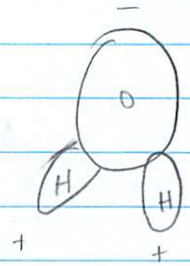
Every atom wants to have the electron configuration of an inert gas.

super strong
weakling

Ionic: Bonding through transfer of electrons - compounds
Covalent: Bonding through sharing ♡ of electrons - molecules



Wow... that carbon kid is pretty popular!



Polarity - having different charges on different sides of the molecule

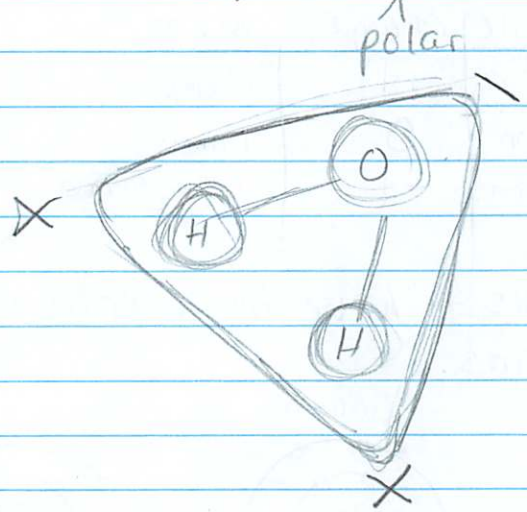
Vanderwaal Forces: the force that lets geckos climb walls (polarity)

Property of water

Adhesion: sticking to something else

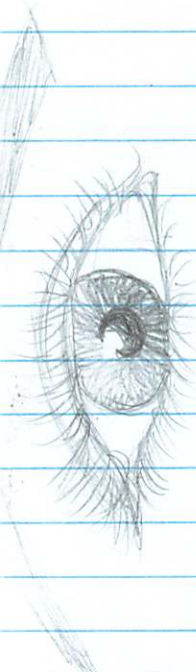
Cohesion: sticking together

- Water is a covalent molecule



- Water is unique in that it expands when it freezes.

Mixture: 2 or more different kinds of atoms that are blended together without any chemical reaction or bonding



Solution: Something dissolved into something else
- *Solvent: Substance that other things can dissolve in
- *Solute: Something that dissolves

Suspension: (components (particles) are different sizes and are not equally/evenly distributed)

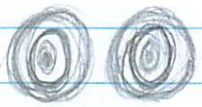
Dissociation: Water can release hydrogen and hydroxide ions and then come back toge

$H_2O \rightleftarrows H^+ + OH^-$

Basic Chem for Bio (cont.)

Sodium hydroxide is a strong base.

SOUR things are pretty acidic.



pH can measure acidity

Buffers lessen the severity of an acid or a base

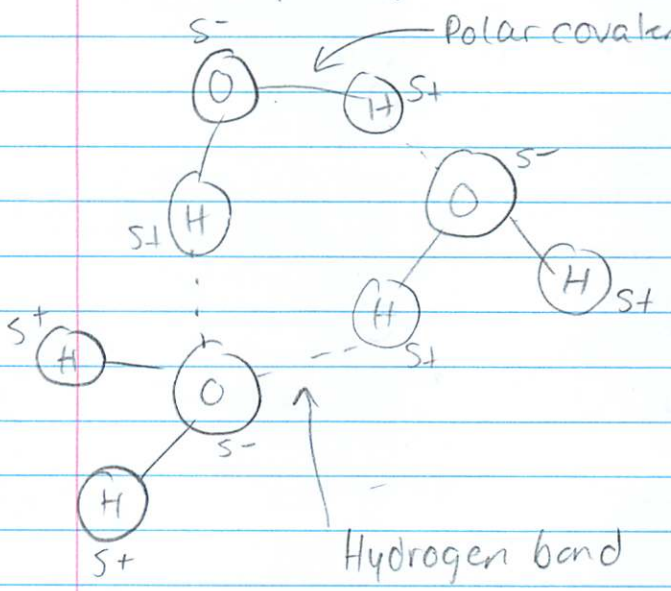
Khan Academy Basic Chem Notes

10-7-16

Properties that affect hydrogen bonds in water

Due to polarity of molecules:

- Solvent properties of water - water is called the "universal solvent"
- Cohesion + adhesion
- Specific heat (one calorie! :))
- Heat of vaporization - 100°C
- Density 1 g/mL



* Hydrophilic substances interact w/ and dissolve in water
* Hydrophobic substances repel water (ex. oil)

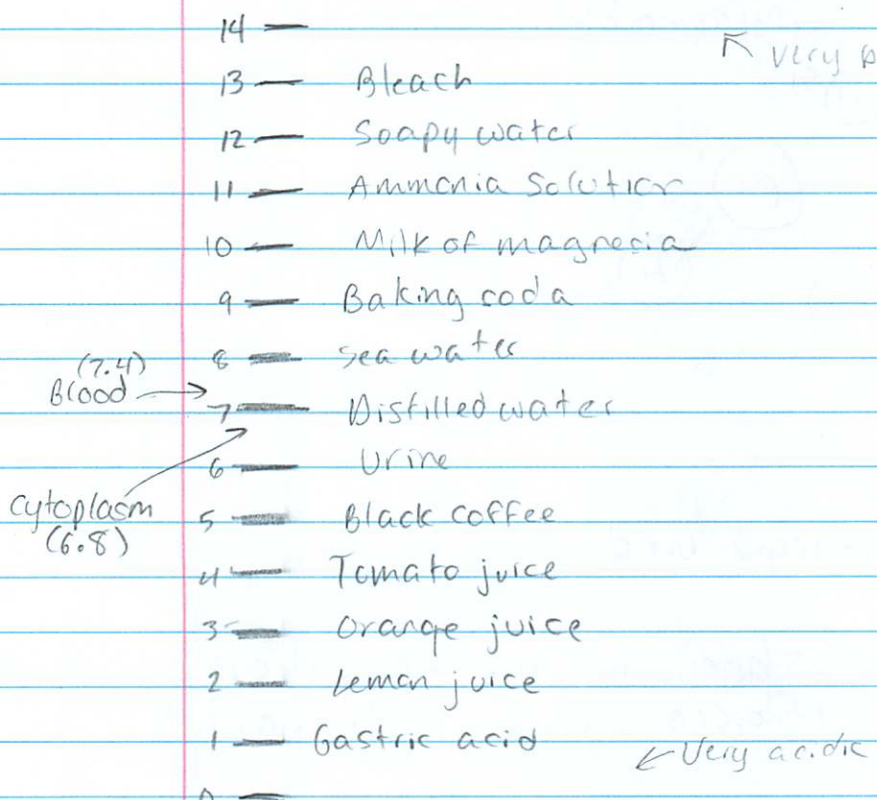
Water reacts differently w/ polar substances than w/ nonpolar substances

---

- An acidic solution has a higher concentration of H^+ ions than pure water. ($> 1 \times 10^{-7} M$)
- A basic solution has a lower concentration of H^+ ions than pure water ($< 1 \times 10^{-7} M$) (aka alkaline)

- Hydrogen ions are spontaneously generated in pure water by the dissociation (ionization) of a small percentage of water molecules - a process called autoionization

- The pH scale is used to determine the acidity of a solution (used in water quality tests)



* Buffers are solutions that can withstand changes in pH
  - Key to maintaining stable pH levels in an ecosystem

Properties of Carbon

- Organic molecules (macromolecules) - contain carbon atoms
- Bonding properties
  - Carbon-carbon bonds are unusually strong
  - Capacity for covalent bonding - can bond w/ up to 4 other atoms
- Hydrocarbons
  - Organic molecules consisting entirely of carbon + hydrogen
  - Make good fuels bc they store a lot of energy
  - Carbon + 4 hydrogen (CH_4) is a tetrahedron

Macromolecules

- Four major types - carbohydrates (sugars), lipids (fats), proteins, nucleic acids (DNA & RNA)
  - These large molecules make up the majority of the dry weight of a cell
  - Wide range of jobs in a cell
- Monomers and polymers
  - Polymers: Long chains of repeating molecular subunits called monomers
    - Carbs, nucleic acids, and proteins usually form polymers, but lipids usually don't
  - Dehydration synthesis: The process by which a polymer forms from monomers - monomers form covalent bonds, and release a water molecule in the process
  - Lots of room for variety of shape and composition of polymers
  - Hydrolysis: The process by which polymers turn back into monomers - bonds broken by addition of water molecule

Carbohydrates

- Biological molecules made of carbon, hydrogen, and oxygen, roughly in the ratio of roughly one carbon atom to one water molecule

- Monosaccharides - simple sugars
  - Formula: $(CH_2O)_n$
  - Typically contain 3 to 7 carbon atoms
  - Glucose ($C_6H_{12}O_6$)
    - Fructose and galactose have the same formula, but differ in organization of atoms → isomers
- Disaccharides
  - Form when two monosaccharides join via a dehydration reaction
  - ex. lactose, maltose, sucrose
- Polysaccharides - long chains of monosaccharides
  - Storage polysaccharides
    - Starch: stored form of sugar in plants
    - Glycogen: stored form of glucose in humans - liver + muscle cells
  - Structural polysaccharides
    - Cellulose - major component of plant cell walls

Lipids

- Hydrophobic, nonpolar, made up of mostly hydrocarbon chains
- Fats and Oils
  - Fats - glycerol backbone + 3 fatty acid tails
    - small organic molecule w/ 3 hydroxyls
    - long hydrocarbon + carboxyl
- Saturated and Unsaturated Fatty Acids
  - Saturated: Only single bonds between neighboring carbons on a hydrocarbon chains (more hydrogen ions)
  - Unsaturated: Hydrocarbon chain has a double bond
- Trans fats: unsaturated fatty acids w/ trans double bonds in fatty acid tails
- Omega fatty acids - essential fatty acids
- Waxes - hydrophobic, found on leaves, some feathers
- Phospholipids - major components of the plasma membrane
- Steroids - hydrophobic, insoluble in water, have four linked carbon rings (most common - cholesterol)

Nucleic Acids

- Key macromolecules for continuation of life
- Roles of DNA and RNA in cells
  - DNA - genetic material of living organisms
  - RNA - genetic material of some viruses; messenger
- DNA in cells
  - Found in nucleus, broken up into chromosomes
- Nucleotides - building blocks (monomers) of DNA + RNA

Proteins

- Intro to Proteins + Amino Acids
  - Every protein has a unique function
    - Enzymes - catalysts in biochemical reactions
    - Hormones - long-distance chemical signals released by endocrine cells
  - Amino acids - monomers that make up proteins
  - Peptide bonds - covalent bonds between amino acids
- Orders of Protein Structure
  - Primary structure: sequence of amino acids in a polypeptide chain
  - Secondary structure: local folded structures that form within a polypeptide due to interactions between atoms of the backbone
  - Tertiary structure: Overall 3D structure
  - Quaternary structure: multiple subunits coming together

Overview of Metabolism

- Metabolism: Network of interactions, consisting of all the chemical reactions in a cell
- Cellular respiration
- Photosynthesis

Activation Energy

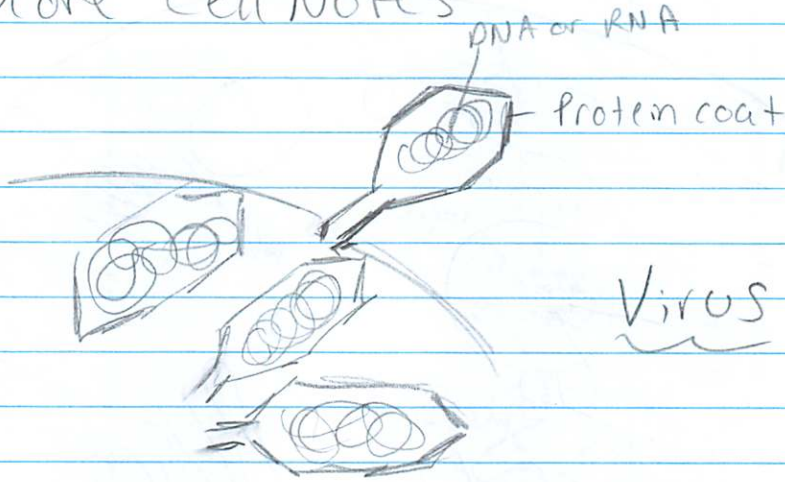
- Initial energy input of a chemical reaction
  - Source is typically heat

Energy and Enzymes

- Catalyst: a substance that speeds up a chemical reaction
  - → Enzymes lower a reaction's activation energy
    - Affected by temperature, pH, inhibitors, activators, and cofactors.

More Cell Notes

11-15-16

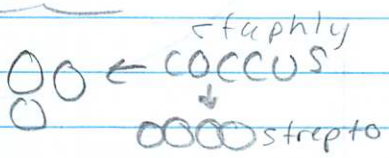


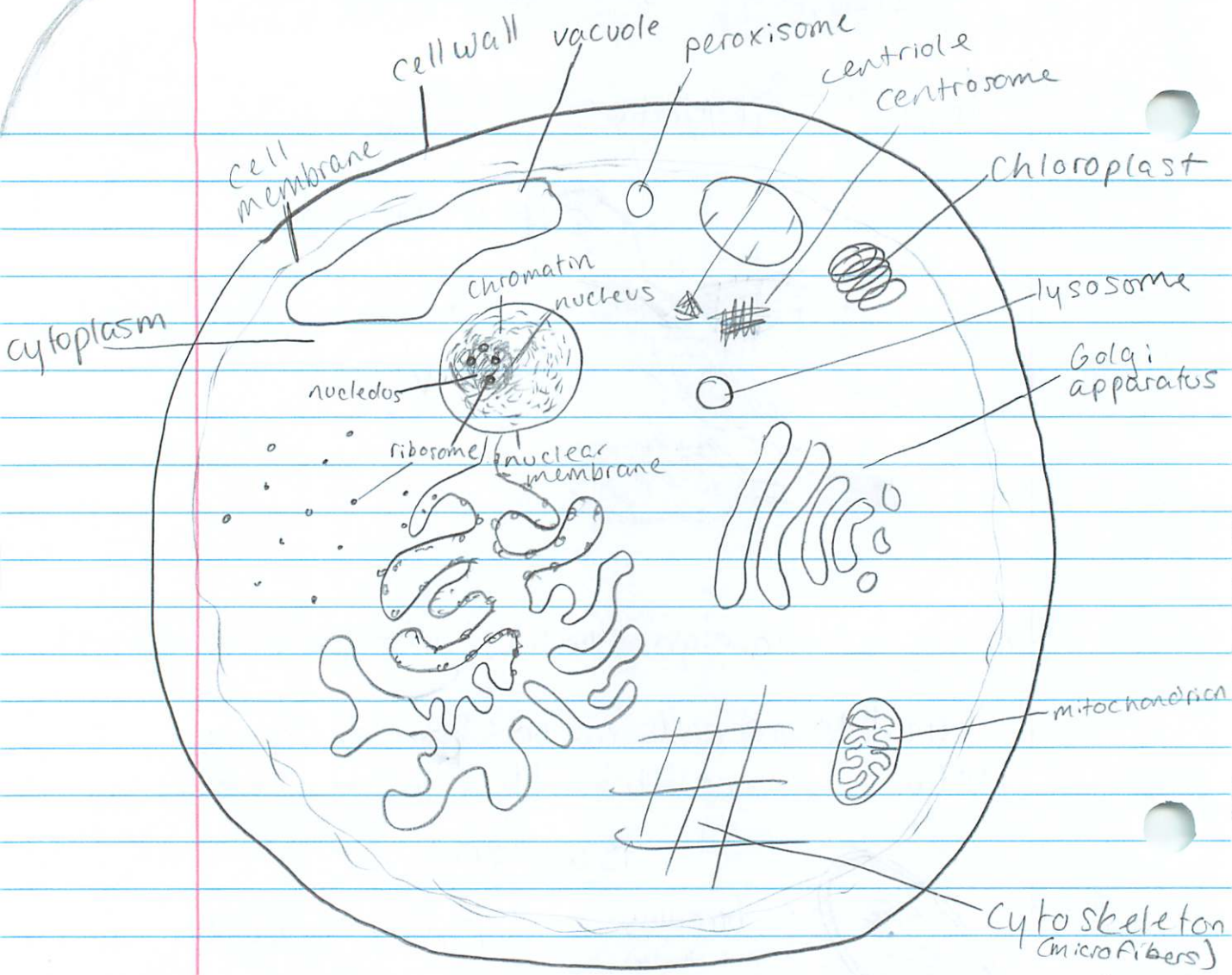
Antigens - foreign things that go into a cell

- White blood cells go to fight antigens

Antibodies fight things that can kill you

Bacteria





cell membrane – semi-permeable; acts as border control; made of 2 layers of phospholipids

cell wall – gives shape and support

nucleus – directs cell activity; contains genetic material

chromatin – protein coating around nucleus

nuclear membrane – border control for nucleus

nucleolus – site of ribosome synthesis

ribosome – site of protein synthesis

cytoplasm – cell jelly

endoplasmic reticulum – canals in jelly (rough – has ribosomes in walls, smooth does not)

Golgi apparatus – puts finishing touches on the package

Mitochondrion – power house; breaks down sugar to make ATP

Discovery of Cells

10-27-16

Anton von Leeuwenhoek (1632-1723)
- Made his own microscopes, and used them to discover single-celled organisms (ex. bacteria)

Robert Hooke (1635-1703)
- Polymath, did experiments w/ microscopes, and came up with the term "cell"

Matthias Schleiden and Theodor Schwann
- Schleiden proposed idea that all plants are composed of cells
- Schwann proposed idea that all animals are composed of cells

Rudolf Virchow (1821-1902)
- Built on work of Schwann, came up w/ cell theory
- "Omnis cellula e cellula" - every cell comes from another cell

Lynn Margulis (1938-2011)
- Serial endosymbiotic theory of eukaryotic cell development → new ideas regarding start of life on earth → eukaryotic cells evolved from bacteria

Cells

10-27-16

1) What do cells look like?
2) What are cells made of?
3) What do cells do?

Prokaryotes - cells that do not have a membrane around their nucleus
- Bacteria, etc.

Eukaryotes - cells that do have a membrane around their nucleus
- Protists, plants, animals

Prokaryotic Cell

Khan Academy Notes: Organic Chemistry, Carbon Compounds, Macromolecules

- Carbons and hydrocarbons
  - Organic molecules contain carbon atoms (exceptions: carbon dioxide, carbon monoxide)
  - Bonding Properties of Carbon
    - Carbon-carbon bonds are super strong
    - Carbon atoms can bond w/ 4 other atoms
  - Hydrocarbons
    - Organic molecules consisting entirely of carbon and hydrogen
    - Good fuels bc covalent bonds store a bunch of energy (released when molecules are burned)
    - Most macromolecules are not hydrocarbons, but carbon chains w/ attached hydrogens are key structural component of most macromolecules

Khan Academy Notes - Cells

23

11-2-16

- Introduction to cells
  - Cells have many different shapes, sizes, and functions, but share fundamental characteristics
  - Must use a microscope to see cells
  - Cell theory
    - All living things are composed of one or more cells
    - The cell is the basic unit of life
    - New cells arise from pre-existing cells
- Microscopy
  - Microscopes help see tiny structures such as cells
    - In complex compound microscopes, the image often appears upside-down
  - Basic microscopes v. Powerful lab machines
    - Magnification
    - Resolution
  - Light microscopes - most student microscopes
  - Electron microscopes - to view something very tiny at very high resolutions
    - Produce images using a beam of electrons rather than a beam of light
    - Two types - scanning electron microscopy + transmission electron microscopy

- Prokaryotic Cells
  - Human body consists of both prokaryotic + eukaryotic cells
  - Components of all cells
    - Plasma membrane - separates interior from environment
    - Cytoplasm - jelly-like cytosol
    - DNA - genetic material
    - Ribosomes - synthesize proteins

- Ex. bacteria - very diverse in form
  - Some have specialized structures on surface
    ex. Flagella act as rotary motors to help them move
- Most prokaryotic cells range from .1 to 5.0 mcm
  - Cells must be small in order to function properly due to surface-area-to-volumer ratio

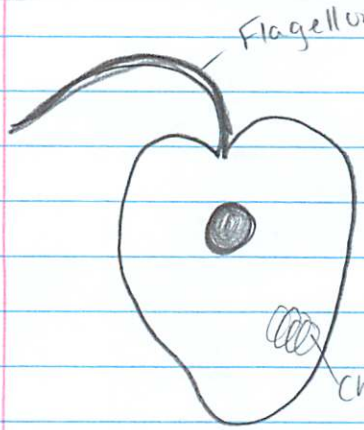
• Eukaryotic Cells
- Contain a variety of different compartments w/ specialized functions, separated by layers of membrane
  → can be much larger than prokaryotic cells
- Eukaryotic cells have...
  - A membrane-bound nucleus
  - A number of membrane-bound organelles
  - Multiple linear chromosomes
- Much more complex than prokaryotic cells
  - Subcellular structures - energy balance, metabolism, gene expression

• Plasma membrane and cytoplasm
- Plasma membrane is outer boundary of cells
- Cytoplasm is goo
- Plasma membrane
  - two-layered structure of lipids + proteins - largely phospholipids
  - controls what enters + exits cell - sugars, amino acids, etc.
  - different types of lipids affect fluidity
  - surface area limits exchange of materials between cell & environment
    ex. some cells have microvilli to increase area
- cytoplasm
  - eukaryotes - everything between plasma membrane and nuclear envelope
  - prokaryotes - everything inside plasma membrane
  - major component - cytosol - water-based solution

- Nucleus and ribosomes
  - Eukaryotic cells store genetic material in nucleus
    - DNA never leaves nucleus – copied onto RNA molecules, which associate w/ ribosomes, which direct the synthesis of proteins
  - Nucleus
    - Houses DNA, synthesis site for ribosomes
      - Chromatin stored in nucleoplasm
      - Nuclear pores let substances enter + exit
      - Nuclear envelope around nucleoplasm
        - two layers of membrane
      - Nucleolus – site in which new ribosomes are assembled
        - Ribosomal RNA combines w/ proteins to form subunits of ribosome
  - Chromosomes and DNA
    - Prokaryotes have looped single chromosomes, eukaryotes have multiple linear chromosomes
    - Chromosomes
      - Only visible during cell division
      - DNA strands bound to structural proteins – histones
        - Called chromatin
  - Ribosomes
    - Consists of 2 separate RNA-protein complexes
    - Eukaryotes get orders for synthesis from nucleus

lysosome - garbage disposal; death star
peroxisome -
vacuole - big bag of water
chloroplast - site of photosynthesis

What do carotinoids and xanthophyls do?



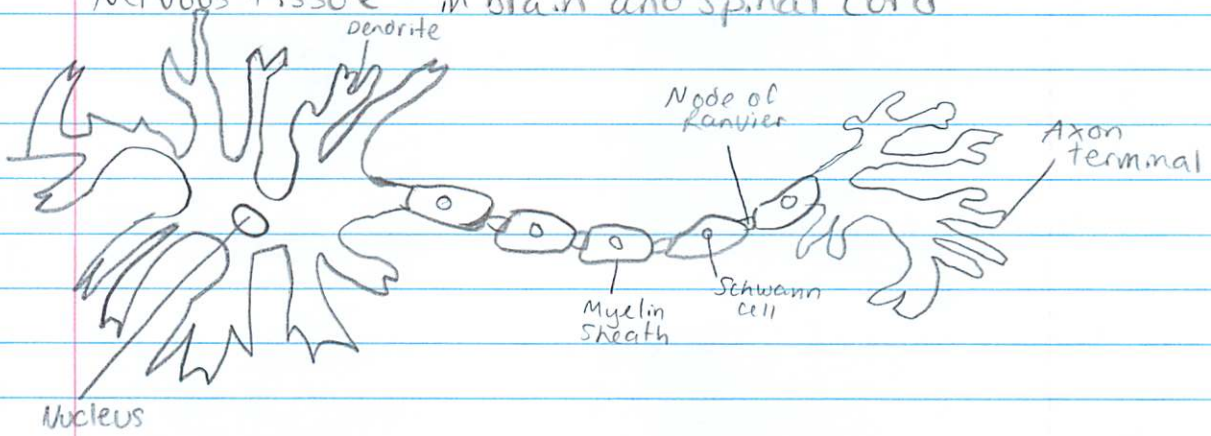
Euglena
(protist)

Paramecium

Amoeba

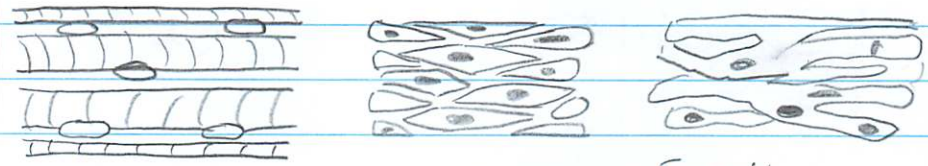
Types of Tissue

Nervous tissue - in brain and spinal cord



Smooth muscle tissue - in organs like lungs and stomach

Muscular Tissue - makes muscles



- Skin
- Blood
- Muscle
- Bone
- Connective
- Pancreas
- Epidermis
- Peridermis
- Xylem
- Phloem
- Parenchyma
- Mesophyll
- Meristem

Diffusion + Membrane Passage Notes

11-28-16 I. Membranes and Transport

A. Osmosis and tonicity

1. Intro

a. Turgor pressure – internal pressure that usually supports a plant – when water moves out of cells, the plant wilts

b. Solute – the dissolved substance

c. Solvent – the substance that does the dissolving

d. Concentration – the amount of solute in a solvent

e. Osmosis – net movement of water across a semipermeable membrane from an area of lower solute concentration to an area of higher solute concentration

i. Important to many biological processes

ii. Often occurs the same time solutes diffuse

2. How it works

a. Diffusion – when molecules move from a region of higher concentration to one of lower concentration

b. In osmosis – two compartments separated by membrane containing water molecules

i. Neither compartment contains solute – molecules likely to move in either direction

ii. Solute in one compartment – likelihood of molecules moving between compartments reduced

3. Tonicity – the ability of an extracellular solution to make water move into or out of a cell by osmosis

a. Related to osmolarity – total concentration of all solutes in the solution

b. Terms used to compare osmolarity of cell to osmolarity of extracellular fluid

i. Hypotonic – extra. fluid < fluid inside cell
→ net flow of water into cell
ii. Hypertonic – extra. fluid > fluid inside cell
→ water moves out of cell to higher solute concentration
iii. Isotonic – extra. fluid = cell
→ no net movement of water

4. Tonicity in living systems
a. A cell will shrink if placed in a hypertonic solution
b. A cell will swell in a hypotonic solution
c. A cell stays the same in an isotonic solution
i. Ex. red blood cells have ideal isotonic conditions – homeostasis keeps them constant
– Hypotonic solution ideal for plant cells – cell won't burst bc of rigid cell wall)
d. Maintaining balance of water and solutes is very important to health of plant
i. No watering a plant → hypertonic or isotonic conditions → wilting (loss of turgor pressure)
• Hypertonic → plasmolysis – cell membrane detaches from wall; constricts cytoplasm

II. Passive transport
A. Diffusion and passive transport
1. Intro
a. Cell membranes – selectively permeable – essential to ability to obtain nutrients, eliminate wastes, maintain homeostasis
b. Passive transport – doesn't require cell to expend energy – involves a substance diffusing down its concentration gradient across a membrane
2. Facilitated diffusion – when molecules diffuse across the plasma membrane w/ assistance from membrane proteins

III. Active transport

A. Active transport

1. Intro

a. When sugar glucose is more concentrated inside a cell, then the cell must bring in more glucose molecules thru active transport - when the cell actually expends energy to move a substance against its concentration gradient

i. Concentration gradient - when a substance is found in different concentrations over a region of space or on opposite sides of a membrane

2. Endocytosis - the process of taking materials into the cell by means of infoldings, or pockets, of the cell membrane

a. Phagocytosis - when extensions of cytoplasm surround a particle and package it within a food vacuole

b. Pinocytosis - when tiny pockets form along the cell membrane, fill with liquid, and pinch off to form vacuoles within the cell

3. Exocytosis - when the membrane of the vacuole surrounding the material fuses with the cell membrane, forcing the contents out of the cell (secretion)

IV. Extracellular Structures - create a complex meshwork of proteins and carbohydrates

A. Collagen - found in animal cells

a. Major component of extracellular matrix

i. Major component of extracellular matrix
- animal contact through the stretch of plasma membrane

ii. type of proteins
iii. modified with carbohydrates
iv. once they're released from the cell, they assemble into long fibers called collagen fibris

☆ gives tissues strength, structural integrity

B. Cellulose - in plant cells
1. Major organic molecule of a plant cell wall
2. polysaccharide composed of glucose

V. Other cell-to-cell junction
A. Plasmodesmata
1. Places where a hole is punched into the cell wall, to allow direct cytoplasmic exchange - plant cells
B. Gap junctions - provide cytoplasmic channels between animal cells

Textbook

Chapter 8: Photosynthesis pg. 201-214

1-4-17

- Energy is the ability to do work - how do organisms actually get it?

- Autotrophs and Heterotrophs
  - Plants are autotrophs - able to make their own food.
  - Animals are heterotrophs - obtain energy from foods they consume
- Chemical Energy and ATP
  - Adenosine triphosphate (ATP) - chemical compound used by cells to store and release energy
  - ADP has 2 phosphate groups to help store energy
  - Energy in ATP is released by breaking the bond between the 2nd and 3rd phosphates.
- Using Biochemical Energy
  - Cells use ATP for active transport and other actions

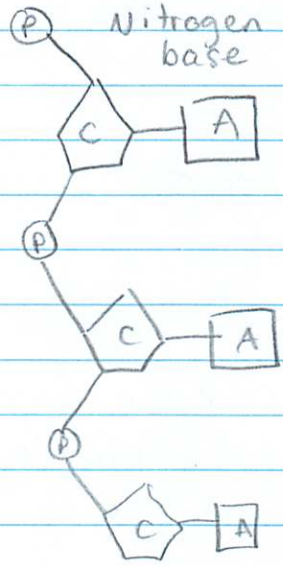
- The Photosynthesis Equation

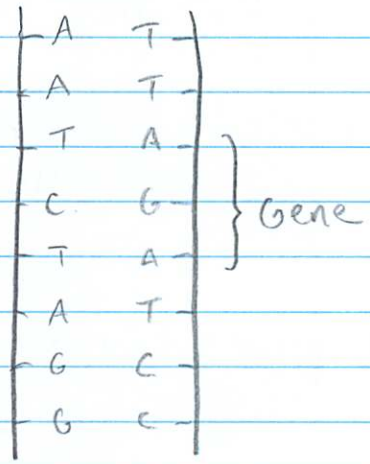
$$6CO_2 + 6H_2O \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2$$

- Light and Pigments
  - Photosynthesis requires light and chlorophyll

- Inside a Chloroplast

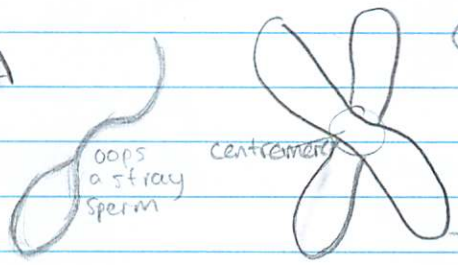
CRISPR - a method of gene-editing, used to remove bad genes and add new ones





Double-helix structure of DNA

- Pops open and peels apart to duplicate itself



Chromosome

- Holds DNA
- Tightly wrapped

homologous - chromosomes that have the same type of gene in the same place

22 out of 23 chromosomes are somatic.
The last one determines sex

Cell division

Mitosis - starts w/ one cell, ends w/ two daughter cells that are identical to the parent cell

Meiosis - associated w/ sexual reproduction; produces sex cells (gametes)

Diploid: two sets (of chromosomes, 1 from mom + 1 from dad)

Haploid: one set

The Human Genome

14-1: Human Heredity

A. Human Chromosomes

1. Karyotype - picture of chromosomes, created from microscope images
2. Typical human cell has 46 chromosomes
   a. Two are known as sex chromosomes
      i. Determine individual's sex
   b. Remaining 44 are autosomes
   c. All cells carry at least one X chromosome
      i. Females: pair is XX
      ii. Males: pair is XY

B. Human Traits

1. To apply Mendelian genetics, biologists need to identify single genes responsible for a certain trait
2. Pedigree chart - shows relationships in a family and can be used to track a specific trait throughout the family
3. Most obvious human traits are usually controlled by numerous genes
   a. Some traits are also controlled by other factors, like environment and nutrition

C. Human Genes

1. Human genome contains ≈ 25,000 genes
2. Blood Group Genes
   a. Rh blood group - two alleles (+ and −)
      i. + allele is dominant
   b. ABO blood group - 3 alleles (I^A, I^B, i)
      i. I^A and I^B are codominant
         • Produce antigens on surface of blood cells
      ii. i allele is recessive
   c. Both groups usually mentioned together
      i. Ex. AB - negative

3. Recessive alleles
   a. Most genetic disorders are caused by a recessive allele
4. Dominant alleles
   a. Some disorders are dominant, but still rare
5. Codominant alleles
   a. ex. Sickle cell disease

D. From Gene to Molecule
1. A small change in the DNA of a single gene affects the structure of a protein
→ serious genetic disorders
   a. Cystic fibrosis
      i. Caused by recessive allele on Chromosome 7
      → Digestive + respiratory problems
      → Messes w/ one protein
   b. Sickle Cell Disease
      i. Characterized by twisted shape of red blood cells
      → Damage in brain, heart, spleen
      ii. Caused by recessive sickle cell allele

14-2: Human Chromosomes
A. Human diploid cells contain > 6 mill. DNA base pairs
B. Human Genes and Chromosomes
1. A chromosome doesn't consist entirely of genes
2. Genes located close together on the same chromosome are linked
C. Sex-Linked Genes - genes located on the X or Y chromosomes
1. Most are found on X chromosome (Y is small)
2. Color blindness - 3 human genes for color vision located on X chromosome

★. Males have only one X chromosome, so all X-linked alleles are expressed in males, even if they are recessive
4. Hemophilia
5. Duchenne Muscular Dystrophy

D. X-Chromosome Inactivation
1. In female cells, one X-chromosome randomly turns off → forms dense region in nucleus (Barr body)
a. Same deal for other mammals

E. Chromosomal Disorders
1. Sometimes, errors occur during meiosis
a. Nondisjunction - when homologous chromosomes fail to separate → abnormal #s of chromosomes can get into gametes → disorder of chromosome #s
b. Down Syndrome
i. 3 copies of a chromosome (21) → mental retardation
ii. 1/800 babies in US have it
iii. Characterized by ↑ susceptibility to diseases
c. Sex Chromosome Disorders
i. In females, nondisjunction of sex chromosomes can lead to Turner's syndrome → sterile, sex organs don't develop at puberty
ii. Males can get Klinefelter's syndrome
• Extra X-chrom. → inability to reproduce

14-3: Human Molecular Genetics
A. Human DNA Analysis
1. Testing for Alleles
a. Prospective parents can be tested for GDs, since their alleles have slightly

different DNA sequences, which can be detected thru a variety of genetic tests, which can help to effectively treat the GDs

2. DNA Fingerprinting
   a. Complexity of human genome – no individual is exactly like another
   b. → DNA fingerprinting can be used to identify a person
      i. Has been used since late 1980s
      ii. Extremely reliable

B. The Human Genome Project
   1. Scientists began to map out the human genome in 1990 - Human Genome Project
      a. Also completed genomes of other organisms
         i. Yeast, fruit fly (Drosophila melanogaster)
      b. Completed project in 2000 (pretty much)
   2. Rapid Sequencing
      a. Method
         i. First determined sequence of bases in separated regions of DNA to serve as markers
         ii. Then used "shotgun sequencing" - cutting DNA into random fragments to determine their sequences
            • Computers reconnected them
   3. Searching for Genes
      a. Only a small part of human DNA molecule contains genes - as few as 35,000
      b. Methods
         i. First searching for promoters (binding sites for DNA polymerase) - indicates start of gene

4. A Breakthrough for Everyone
   a. Genome research is very available to the public

C. Gene Therapy
   1. Info about human genome can be used to cure genetic disorders thru gene therapy: when an absent or faulty gene is replaced by a normal, working gene → eliminates cause of disorder
      a. Highly experimental (not thoroughly studied) treatment
      b. Typically practiced on viruses

D. Ethical Issues in Human Genetics
   1. If genetics can be used to cure disease, should they be used to design human bodies? Or clone people?

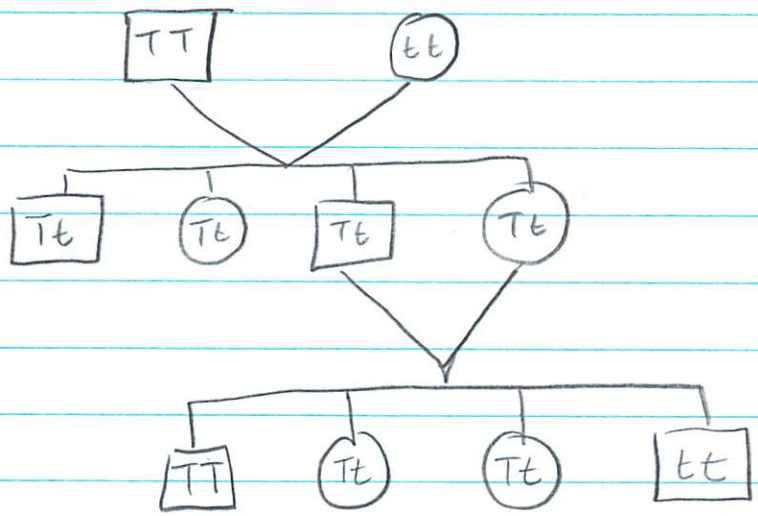
homozygous (same, zygote) – pure; pedigree, same gene from both parents

heterozygous (different, zygote) – a different gene from each parent for a single trait

Gregor Mendel played with pea plants and figured out a whole bunch about genes!

Genotype – actual genetic makeup

phenotype – the trait that appear (ex. height, hair color)

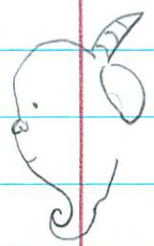


	T	t
T	TT	Tt
t	Tt	tt

T is the dominant allele. Whenever it appears in the genotype, that trait will appear.
t is the recessive allele. Its trait only appears when both alleles are recessive.

Complete dominance – two genes are present, but one completely masks the other

Codominance – both traits are dominant, so when both alleles are present, the corresponding traits appear mixed



	R	R
r	Rr	Rr
r	Rr	Rr

	R	r
R	RR	Rr
r	Rr	rr

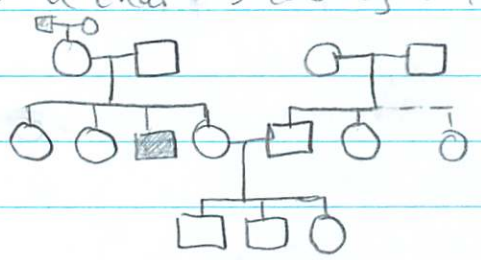
	R	r
r	Rr	rr
r	Rr	rr

i^A i^B i } 3 alleles for blood type (*multiple alleles)

Type A: $i^A i^A$ or $i^A i$
Type B: $i^B i^B$ or $i^B i$
Type AB: i^{AB} – universal receiver
Type O: ii – universal donor

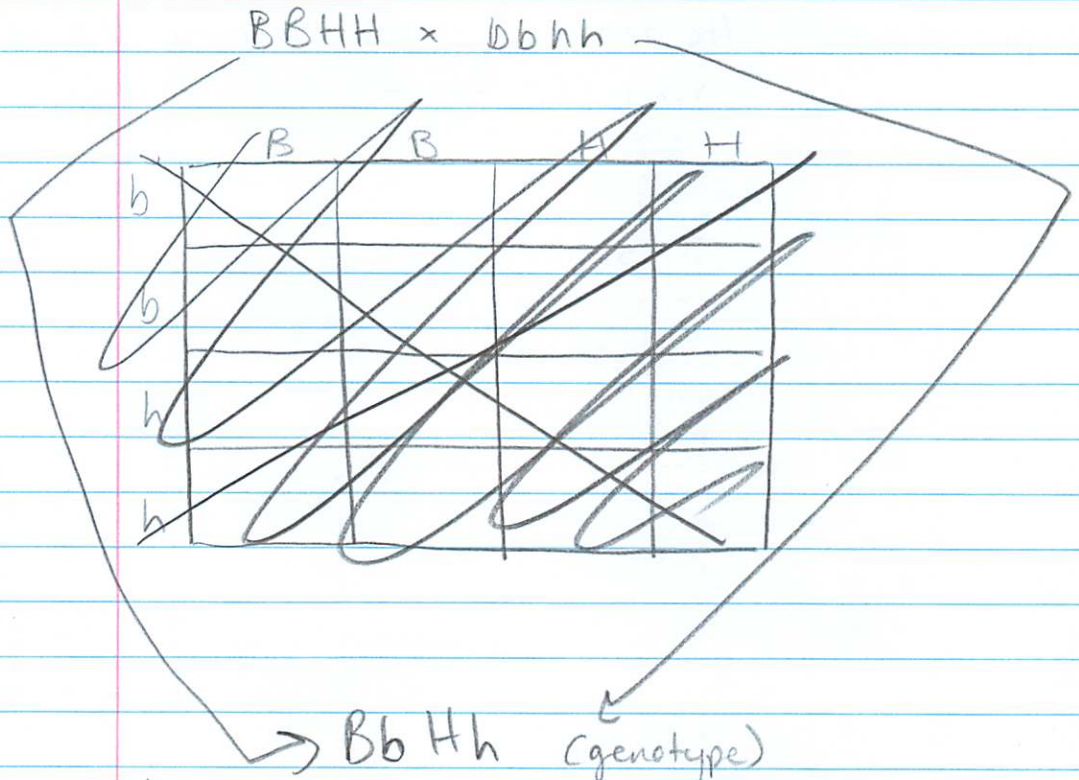
O has no antigens!

Pedigree – a chart showing a trait for a family line



B - Brown eyes H - Curly hair
b - Blue eyes h - Straight hair

BBHH × bbhh



→ BbHh (genotype)

(phenotype) ↳ still has brown eyes, curly hair, but is now heterozygous

BbHh × BbHh

	BH	bH	Bh	bh
BH	BBHH	BbHH	BBHh	BbHh
bH	BbHH	bbHH	BbHh	bbHh
Bh	BBHh	BbHh	BBhh	Bbhh
bh	BbHh	bbHh	Bbhh	bbhh

all possible genotypes

Blue eyes, straight hair - 1
Brown eyes, straight hair - 3
Blue eyes, curly hair - 3
Brown eyes, curly hair - 9

penetrance - how much the environment allows a trait to exist

expressitivity - the degree to which you have a particular trait

3-24-17

60

Khan Academy - Evolution Outline

I. Darwin, evolution, & natural selection
  A. Charles Darwin
    1. British naturalist who proposed the theory of biological evolution by natural selection
    2. Defined evolution as "descent with modification"
      a. Species change over time
      b. Species give rise to new species
      c. Species share a common ancestor
    3. Natural selection
      a. Bc resources are limited in nature, organisms w/ heritable traits that favor survival + reproduction tend to leave more offspring than peers → traits ↑ in frequency over generations
      b. → populations become adapted to their environments over time
      c. depends on environment; requires existing heritable variation in a group
    4. Wrote "On the Origin of Species"
      a. Set forth Darwin's ideas
      b. Based on observation from travels around the globe
        i. Studied + catalogued local organisms at every stop

II. Evidence for evolution
  A. Anatomy
    1. Homologous structures
      a. Species share similar physical features due to common ancestor

B. Molecular biology
1. DNA/genetic code reflect shared ancestry
2. DNA comparisons show relations

C. Biogeography
1. Global distribution of organisms
a. Reflects evolution + geological change

D. Fossils
1. Relation of past to present

E. Direct observation
1. Small-scale evolution

III. Allele frequency & the gene pool
A. Microevolution
1. Change in genes over relatively short period of time

B. Population genetics
1. Studies allele frequencies in populations over time

C. Allele frequency
1. How common an allele is in a population
a. Freq. of allele A = $\frac{\text{\# of copies of A in pop.}}{\text{Total \# of copies of genes in pop.}}$

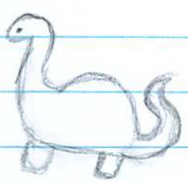
D. Gene pool
1. All copies of all genes in a population

IV. Natural selection in populations
A. Natural selection can cause microevolution
B. Fitness
1. Measure of reproductive success

61

3-24-17

- Polypeptide - chain of amino acids ponded together
  - Makes up proteins (enzymes!)
- Peptide bond - bond between 2 amino acids
  - Takes up (gives off ammonium
- Fossil - any remains of an ancient organisms



- Macroevolution - a big group of changes within a population over a long period of time.
- Microevolution - a changes in a few genes over a short period of time

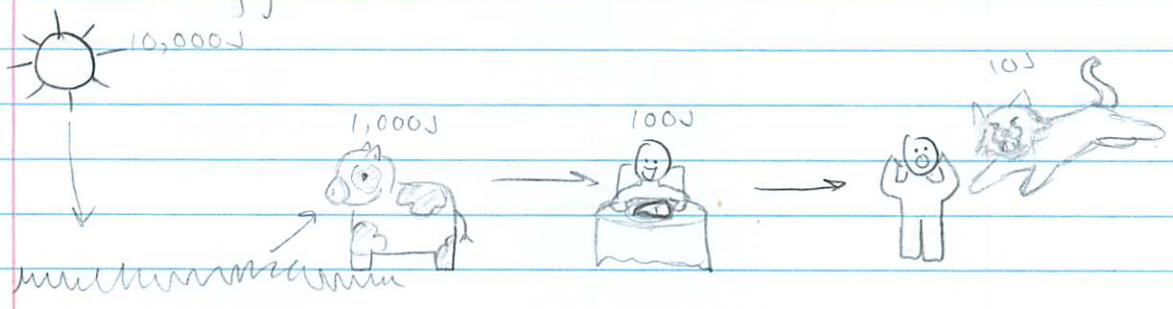
Energy Chains and Webs

Energy chain: A sort of food chain, beginning with the sun, that shows the transfer of energy through a system

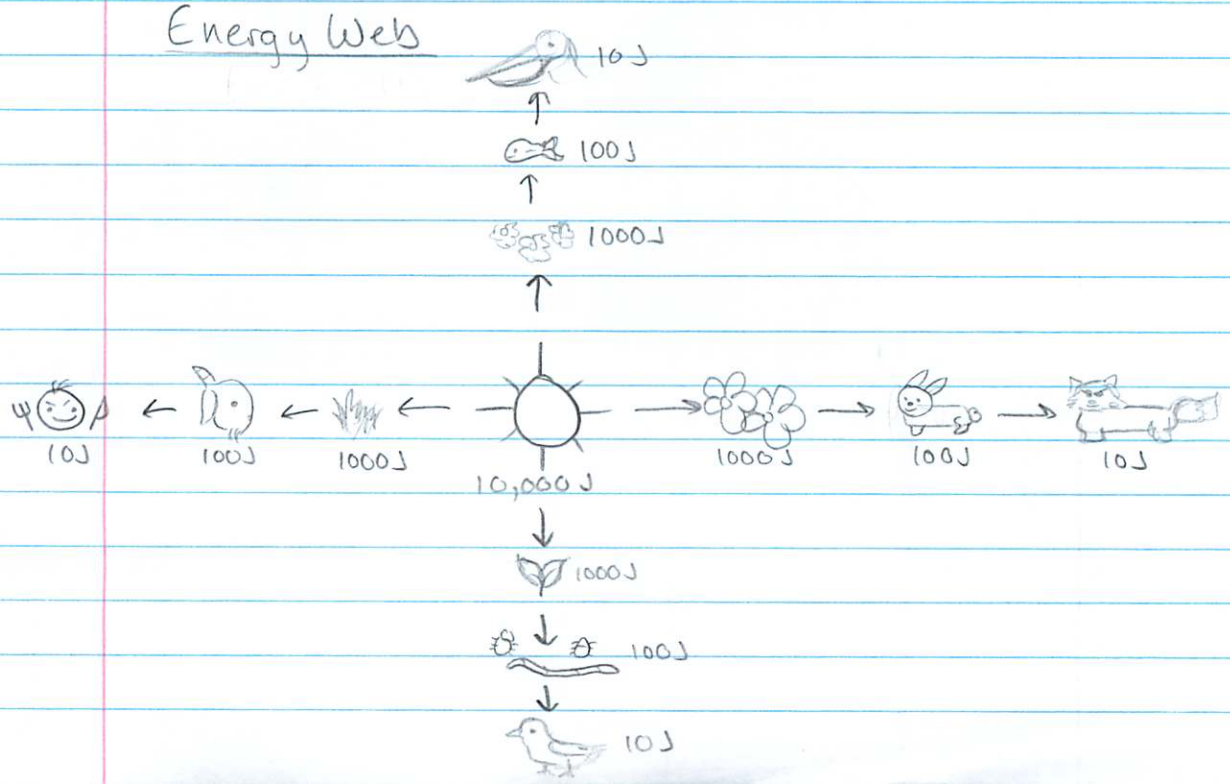
Energy web: Similar to an energy chain, but a web begins with the sun in the center and shows multiple individual energy chains in one diagram.

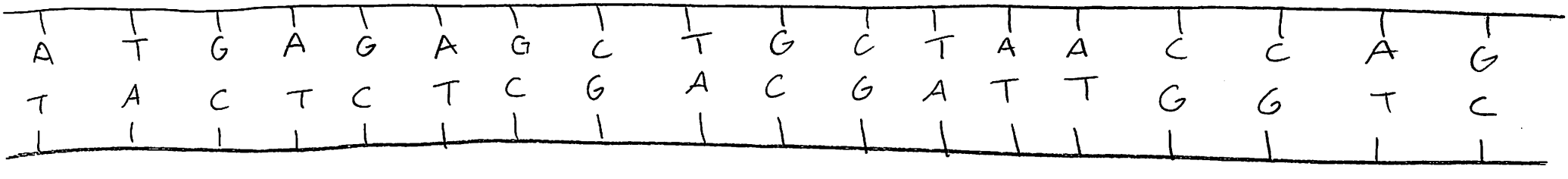
10% rule: Each successive level receives only 10% of the energy from the previous level

Energy Chain



Energy Web





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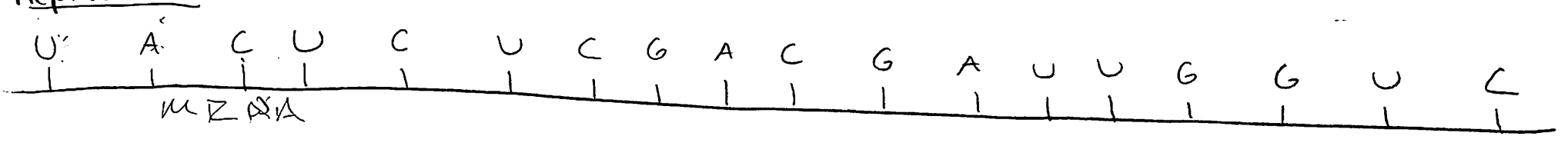
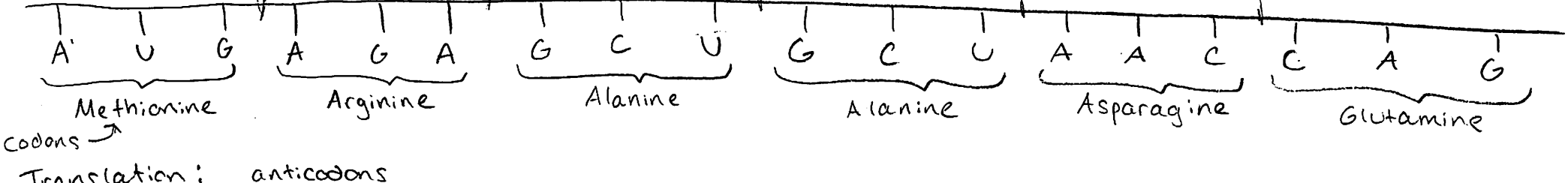
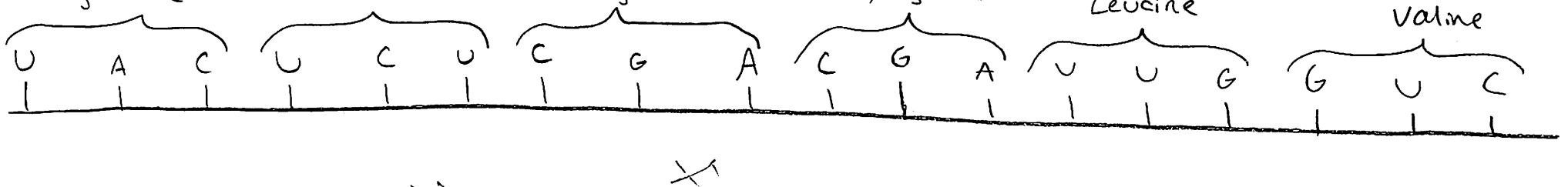
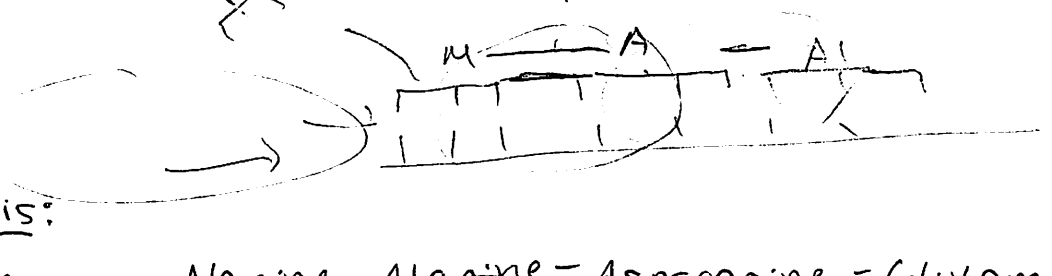


Transcription:



Translation: anticodons





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Protein Synthesis:

Methionine - Arginine - Alanine - Alanine - Asparagine - Glutamine

Vasu Jayanthi: Pd. 8