Jonathan Lam
Mrs. McTague
H Bio. per. 3
12 / 12 / 14

Buffering Abilities of Biological and Abiotic Solutions after Addition of Acids and Bases

Lab Partners
Cole Straughn, Mahad Ulhaq, Lindsay Neumann

Purpose
To determine the degree to which the pH of various homogenates derived from living organisms (milk, egg white, potato, and gelatin) changes with the addition of first an acid (0.1M HCl) and then a base (0.1M NaOH), as compared to tap water (a control) and a pH 7 buffer solution (a second control).
Copied from lab assignment sheet.

Independent Variable: solution - biological (milk, egg white, gelatin, potato), artificial buffer, water
Dependent Variable: change of pH when acids and bases added

Hypothesis
If we add 30 drops of an acid (0.1M HCl) and a base (0.1M NaOH) to a biological solution (milk, egg white, and gelatin), tap water, and a pH 7 buffer solution, *then* the buffer solution will resist the changes in pH the most, then the water because it is so essential to life, and then all of the biological solutions, with milk having the least buffering ability because it is not very important to life.

Materials
- 50mL beaker
- 1 glass stirring rod
- 1 forcep
- 70* wide range pH paper
- 25mL jar of acid (0.1M HCl: hydrochloric acid) and dropper*
- 25mL jar of base (0.1M NaOH: sodium hydroxide) and dropper*
- 50mL pH 7 buffer solution
- 50mL tap water
- 50mL milk
- 50mL potato (blended)*
- 50mL egg white
- 50mL gelatin suspension

Copied from lab assignment sheet. (* = modified)

Safety Considerations
Wearing goggles, wearing an apron, and tying back long hair is recommended during this experiment. Note that 0.1M HCl and 0.1M NaOH are both mild irritant. Avoid skin/eye contact; do not ingest. If contact occurs, flush affected area with water for 15 minutes, rinse mouth with water, and call your teacher. After the experiment, wash down lab bench and wash hands to ensure no harmful acid or base remains.
Copied from lab assignment sheet.

Procedure
1. Pour 25mL of tap water into a 50mL beaker.

2. Find the initial pH of the water using the pH paper: Use the forceps to dip the small strip of pH paper into the water and compare the color change to the standard color chart. Hold the pH paper in the water for three seconds, and then wait for three seconds before comparing the colors.*
3. Record the indicated pH onto the data table.*
4. Add hydrochloric acid to the water one drop at a time. Use the glass stirring rod to stir the contents of the beaker each time a drop has been added. Determine and record the pH after 5 drops has been added.
5. Repeat the procedure (step 5), measuring and recording the pH after every 5 drops, until 30 drops in total has been added to the tap water.
6. Empty the content of the beaker in the sink. Rinse the beaker thoroughly.
7. Pour into the beaker the remaining 25mL of tap water. Repeat steps 1-5 with the sodium hydroxide (base) instead of the hydrochloric acid.
8. Test and record data for each of the biological materials listed (milk, egg white, potato, gelatin) and the buffer solution (instead of tap water) by repeating steps 1-6.
9. Collect data from other groups (within and outside of current class if necessary). Compare them- look for any major differences, and general similarities.*

Copied from lab assignment sheet. (* = modified)

Data (attached, next page)

1. **Full Results Data Table**
   This is the data collected by our group and a few other groups from other classes.

2. **Averages Data Table**
   This is the averages of all the data to easier see which solutions were better buffered the change in pH. Because the changes in the pH after the addition of both acids and bases in each solution were pretty similar (relative to the difference between the solutions), I decided to average the changes of the solution after the addition both acids and bases and report the changes in an average of change of pH per drop of acid or base added.

3. **Ordered Averages Data Table**
   This is the averages of all the data, but is ordered from least to greatest buffering capability and better shows the how all of the biological solutions have a higher buffering capability than water

4. **Sources of Data**
   This shows the sources of our data.

5. **Chart**
   This is a chart of the averages of all of the data, to visually show the results.

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Analysis (Results)

According to the averages of multiple groups' results, the buffer solution resisted pH changes the best, averaging a change of only 0.018 pH units after a drop of acid or base; second was the milk with an average change of 0.063; third was the egg white, with an average change of 0.081; fourth was the potato, with an average change of 0.112; fifth was the gelatin, with an average change of 0.14; the solution to buffer the changes in pH the least was the tap water, with an average change of 0.158. The artificial buffer buffered the best as expected; the biological solutions (milk, egg white, potato, and gelatin) were close behind in their buffering ability; the tap water allowed for the greatest changes, almost nine times that of the artificial buffer and over 1.5 times the average of the biological solutions.

Conclusion

Based on the results, I can confidently conclude that the biological solutions that we tested, besides water, are buffers- that they resist changes in acidity such as our additions of acids or bases to the solutions. Our experiment showed that the tap water's pH changed the most, with a total increase of 3 on the pH scale when we added 30 drops of sodium hydroxide, and a total decrease of 4 on the pH scale when we added 30 drops of hydrochloric acid. On the other hand, the pH of the milk, gelatin, potato, and egg white increased by 1, 4, 2.5, and 3, respectively, when we added the base and decreased by 2, 2, 2.5, and 3.5 when we added the base; all of these values save the addition of a base to the gelatin solution were less than water- this shows that they change less after the addition of acids and bases, showing a better buffering capability. The results from the other groups had very similar data to ours, providing more evidence for my conclusion. Actually, many of the other groups had found a similar amount of change of the biological substances but an even larger amount of change in the water- this better shows that water is not a buffer but the other substances created by organisms are.

My conclusion did not support my hypothesis that the tap water would best resist changes in pH (besides the buffer solution), and that the milk would change the most. I had thought this because water makes up so much of all of our cells (approximately 70%), so any change of acidity in the water of our cells would be buffered; and I had thought that the milk was not very essential to life, much less than water, so I assumed that it would contain buffers. Instead, the results showed that milk resisted the change in pH the most (besides the buffer solution), followed by the gelatin, the egg white, and lastly the water. This is the opposite of what I had hypothesized.

This conclusion makes sense, because the biological substances are all common in the body and should keep their acidities constant so that their proteins would keep their functional shape, so they have various buffers; we learned from class that the shape of proteins is critical, and an abnormal pH could affect it. We also learned in class that water cannot be a buffer, because it is not (chemically) made up of an acid or base; finally, we learned that the water of cells usually contain natural buffers, such as the amino acids of proteins- this validates our conclusion.

Reflection (Comments)

In our experiment, there were few possible sources of error, but we were still confident with the validity of our results and conclusion. We followed all of the directions, although we may have rushed a little bit during the experiment, and our group finished first. Although our data doesn't show too much difference from the other groups', there are some minor changes (that do not affect our conclusion): our tap water changed the least of all the groups. After averaging out our groups' data with some other data, my conclusion is more valid because there is a larger gap between the change in pH of the tap water and the change in pH of the biological solutions- the extra evidence creates a stronger claim that the buffering capabilities of the biological solutions are greater than the water.

To enhance this experiment, we should use biological solutions that are more essential to life, such as blood, or gastric fluids, or tree sap. Without these solutions having a regulated acidity, some organisms could not exist, or will have disorders (as opposed to the liquids we tested) - this would further validate my conclusion that *essential*-to-life fluids will have buffers. If we conduct a similar experiment again, testing these liquids will provide additional evidence to show that important biological substances need to have buffers for organisms to survive.

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Basic Chemistry Study Guide

1. What are the three fundamental subatomic particles within the atom?
    a. proton
    b. neutron
    c. electron
2. Where are these particles located in the atom?
    a. protons, neutrons exist in the nucleus
    b. electron exist in orbitals of sublevels of different energy levels
3. What is the charge of each of these particles?
    a. protons = +1 ($2 * (\frac{2}{3}) + 2 * (-\frac{1}{3})$)
    b. neutron = 0 ($2 * (-\frac{1}{3}) + 2 * (\frac{2}{3})$)
    c. electron = -1
4. How do these particles compare in mass and charge?
    a. mass:
        i. $p^+ \approx n^0 \approx 2000 * e^-$ (protons and neutrons are much greater in mass than electrons)
    b. charge
        i. $p^+ > n^0 > e^-$
        ii. p^+ has opposite charge of e^- (despite large differences in mass)
5. What do these particles determine about an atom?
    a. the number of protons determines the atomic number of the element
    b. the number of neutrons determines the isotope (and therefore atomic mass, mass number)
    c. the number of electrons determines the charge (and therefore the ion)
6. Can any of the three fundamental subatomic particles of an atom be broken down into smaller sub-subatomic particles? If so, which ones?
    a. protons are made of two up quarks (+⅔) and one down quark (-⅓)
    b. neutrons are made of two down quarks (-⅓) and one up quark (+⅔)
    c. electrons are a fundamental particle of matter, and cannot be broken down
7. What is a radioisotope? What does it mean if an atom decays? Why does an atom decay? During decay, how does an atom change? Is there any way to determine if an isotope will be radioactive? How?
    a. also known as a radioactive isotope, a radioactive nuclide, or a radionuclide, a radioisotope is an unstable isotope of an element that goes through radioactive decay (see below). An atom is unstable when its nucleus's neutron/proton ratio is far from the stable neutron/proton ratio (that begins at 1:1 but gradually increases), and the "strong nuclear force" cannot keep the neutrons and protons together in the nucleus. There are many more radioisotopes than stable isotopes
    b. radioactive decay is when an atom spits off particles and energy from its nucleus to become more stable. There are multiple types of radioactive decay that differ in the ways that the atoms change. The major ones are:
        i. α (alpha) decay
            1. an alpha particle (${}^4_2He^{+2}$) particle is spit out by the nucleus
            2. mass number decreases by four, atomic number decreases by two
        ii. β^- (beta-minus) decay
            1. $n^0 \rightarrow p^+ + e^- + \bar{\nu}_e$ and sometimes gamma rays
            2. mass number stays the same, atomic number increases by one
        iii. β^+ (beta-plus) decay
            1. $p^+ \rightarrow n^0 + e^+ + \nu_e$ and sometimes gamma rays
            2. mass number stays the same, atomic number decreases by one

   c. you can predict if an atom is radioactive if its ratio of neutrons to protons is too high or low
8. If you look at the decay chain of U-238, what is happening? What does the decay chain show us?
   a. it goes through a series of fourteen decays (both α and β decays) until it becomes stable as lead
   b. it shows how a single decay of an atom will not always make it stable- atoms may need to go through a long decay chain like this to become stable
9. Why can radioisotopes be dangerous to people? How can they also be helpful? What are some specific example of positive uses of radioisotopes? (Provide examples of your own)
   a. radioisotopes can be dangerous to people because both the particles and energy emitted by the decay (α and β particles, as well as gamma rays) can harm large molecules essential to life, especially DNA, by increasing the chance of irregular and broken bonds, potentially leading to cancer and other disorders
   b. radioisotopes can be helpful because they behave like stable isotopes but give off particles that can be used as scientific "tracers" to show cancer in PET scans. They can also be used to kill cells, especially the fastest growing ones (cancer cells), which is used in chemotherapy
10. What are some key differences between a nuclear reaction and a chemical reaction? What happens in a nuclear reaction? What happens in a chemical reaction? Are mass and energy conserved in both types of reactions?
   a. a nuclear reaction involves the nucleus and radioactive decay, for an element to become stable. An atom may become a totally different element in an atomic reaction. They can give off much more energy and be much more dangerous than chemical reactions
   b. a chemical reaction involves the valence electrons and the bonding or breaking of bonds between elements. An atom cannot become a different element, but its properties can change when bonded
   c. only in a chemical reaction is energy and mass conserved (law of mass and conservation). However, in nuclear reactions, energy may be converted to mass and vice versa (special relativity: $E = mc^2$)
11. How is atomic number different from mass number?
   a. atomic number is constant for all the isotopes of an element, and it is the number of protons in that elements' atoms
   b. mass number is the number of protons plus the number of neutrons in a specific isotope of an element
   c. they both are always whole numbers. $MN \geq AN$, $MN \approx 2AN$
12. How is the atomic mass of an isotope similar yet different from its mass number?
   a. atomic mass is similar to the mass number in value
   b. atomic mass is a decimal (except C-12), measured in amu
   c. mass number is a natural number ($MN\%1 = 0, MN > 0$)
13. Why is the atomic mass of an isotope close in value to the mass number, but not exactly equal to the mass number?
   a. because the protons and the neutrons each equal about 1amu, and the electrons are close to 0amu, $AM = mass\ p^+ + mass\ n^0 + mass\ e^- \approx 1p^+ + 1n^0 + 0e^- = \#p^+ + \#n^0 = MN$
14. How is the relative atomic mass of an element different than the atomic mass of an isotope?
   a. relative atomic mass is an average of the atomic masses of all the isotopes of an element, taking into account their relative abundance
   b. atomic mass is the mass of one isotope of an element
15. How does one calculate the relative atomic mass for an element?
   a. given a list of the masses and relative abundances (percentages) of the isotopes of an element, you have to add the masses multiplied by their percentages
   b. example:

i. given:

Relative Abundance	**Atomic Mass**
50%	10amu
25%	8amu
20%	5amu
5%	20amu

ii. solve: $RAM = 0.5 * 10 + 0.25 * 8 + 0.2 * 5 + 0.05 * 20 = 5 + 2 + 1 + 1 = 9amu$

16. What is an electron configuration? What does it tell you on a very basic/general level? What do the coefficients tell us? What do the letters stand for? What do the superscripts tell us? Could you figure out how many valence electrons are in an atom of an element by looking at the electron configuration? If given an electron configuration, could you figure out which element it was for?
    a. an electron configuration tells us how many electrons are in an atom, where they are located (which sublevel), and the order in which they fill up the sublevels. The largest element's electron configuration is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6$ or [Rn] $4f^{14} 5d^{10} 6p^6$
    b. the coefficients tell us the energy level of the sublevel (because an sublevel exists in multiple energy levels)
    c. the letters stand for different sublevels (in this order: s^2, p^6, d^{10}, f^{14})
    d. the superscripts tell us how many electrons are in the sublevel
    e. yes- you add up the superscripts (the electrons) of the sublevels of the highest electron level
    f. yes- you add up all the superscripts to find the number of electrons; because the atom is neutral ($\#p^+ = \#e^-$, look for the element with that atomic number
17. What are valence electrons? Why are they important?
    a. valence electrons are the electrons in the outermost energy level
    b. they determine an element's chemical properties (therefore, a the periodic table is grouped by families and periods)
18. How many valence electrons do atoms have when they are the most stable? Are there any exceptions to this that you know? If so, what are they? Why do these exceptions make sense?
    a. eight electrons makes a stable shell (the octet rule)
    b. He is the only exception
    c. He has a full valence shell - its valence shell (the first energy level) can only hold two electrons, unlike all the other energy levels
19. How can you determine the number of valence electrons a neutral atom of an element has?
    a. the easiest way is to look on the periodic table. All elements in period 1 have 1 valence electron, 2 have 2, 13 - 3, 14 - 4, 15 - 5, 16 - 6, 17 - 7, 18 - 8 (exception: He).
20. How does the number of valence electrons relate to the charge that atoms of an element will have, if they become ions?
    a. the charge is the number of missing or extra electrons. For example, a $^{+2}$ charge would indicate two missing electrons, and vice versa
21. How can the number of valence electrons help you to predict how many bonds an element will form with other atoms, if they will form covalent bonds?
    a. an atom will usually covalently bond as many times to make its outer shell full (with either eight or two valence electrons). For example, a carbon atom with four valence electrons will usually bond four times to become stable with eight valence electrons

22. How can you predict if atoms of an element will form ionic or covalent bonds with atoms of another element? What is electronegativity, and what is its connection here?
    a. you can predict atoms' bonds by the differences in electronegativities between the atoms. If the difference in electronegativities is greater than 1.7, than it is generally ionic, and a difference less than 1.7 would usually be a covalent bond
    b. electronegativity is the tendency of an atom to attract electrons of other atoms' electrons
        i. the higher the electronegativity, the stronger the pull
        ii. the highest and lowest electronegativities are the most chemically reactive, because they are close to having a full or empty shell and are either very willing to take an electron or lose one
        iii. scale 0-4 (Pauling scale)
            1. two most unstable elements:
                a. fluorine is the highest (4)
                b. francium is the lowest (~0.7)
        iv. dependent on number of protons and number of electrons levels
            1. the more the protons (for the same # of energy levels), the stronger the electronegativity, because the higher number of electrons and protons will create a stronger pull and the atom will become slightly smaller, which allows the nucleus to become a little bit closer to the outside of the atom, which will allow it to exert more of a positive charge
            2. the larger the atom, the farther away the nucleus is from the edge of the atom. Therefore, the more the energy levels, the less the electronegativity
        v. electronegativity differences can create polar molecules, which have special properties
23. If covalent bonds are formed between atoms, how can you tell if the *bonds* are polar or not? If the bonds are polar, how can you tell if the *molecules* are polar or not?
    a. if the electronegativities between the two atoms are between 0.4 to 1.7, then the bond is generally considered polar, because one is strong enough to have a negative charge
    b. you will need to know the structure of the molecule to know whether or not it is polar. Even if three weaker atoms are to be connected to a strong atom such as fluorine, the molecule will not need to be polar, because the three weaker atoms could be spread out equally around the fluorine and exert an equal, neutral charge
24. Contrast what is happening with the valence electrons of the atoms that are being held together by ionic bonds with those that are being held together by covalent bonds.
    a. in an ionic bond, the electron of the less electronegative atom(s) is completely removed from the electron shell of that atom and placed into the electron shell of the stronger atom(s), and one atom becomes negative with a full shell and the other positive with an empty shell
    b. in a molecular bond, the valence electrons are "shared" by both atoms- the valence electrons are in both atoms' valence shell and the atoms have to stay together to do so. They are not given up nor "stolen" from other atoms
25. Why don't we have molecules of ionic compounds? If we don't have molecules of ionic compounds, then what does the formula for an ionic compound tell us?
    a. in an ionic compound, because one atom completely "steals" an electron away from the other atom, the two atoms do not have to stay together, and therefore the two atoms are attracted to each other, but they do not have to stay "together"- right next to each other- in a molecule
    b. the formula of an ionic compound tells us the ratio that the elements exist in, because the elements will have to have a fixed ratio to remain stable and neutral
26. We do have molecules of molecular compounds. What does the formula for a molecular compound tell us?

a. it tells us how many atoms are in the molecule, because the numbers of atoms remain in a fixed ratio (like in ionic compounds) for the molecule to remain neutral

27. What is the difference between intramolecular bonds and intermolecular bonds? Of the two, which are stronger?
    a. intramolecular bonds are covalent bonds, and they keep a molecule together- intermolecular bonds exist between the molecules, including hydrogen bonds
    b. intramolecular bonds are always stronger than intermolecular bonds
28. Why is water such a good solvent? What types of substances (polar, nonpolar, or ionic) does it dissolve well? Why?
    a. water is a good solvent because it is strongly polar
        i. it attaches to the negative and positive parts of ions and polar molecules and pulls on it
        ii. if the positive or negative pull of the water molecule is stronger than the pull that keeps the ionic or polar covalent compound together, it dissolves (dissociates) that solution
        iii. water is the "universal solvent" - very good at dissolving (dissociation)
    b. it dissolves ionic and polar substances, because they have a positive or negative side that the water can attach to and pull on
29. What are hydrogen bonds? What do they form between? What is their significance when it comes to water? What are some other important characteristics of water that relates to the hydrogen bonding?
    a. hydrogen bonds are weak intermolecular bonds often used to hold atoms in their functional shape
    b. hydrogen bonds exist between hydrogen and another atom
    c. because water is strongly polar (and the hydrogen atoms are strongly positive), hydrogen bonds form in water and give it unique properties
        i. cohesion and adhesion
        ii. density
        iii. specific heat
        iv. they release energy to form and vice versa
30. How does hydrogen bonding affect the density of liquid and solid water? How does the uniqueness of ice's density benefit life?
    a. in liquid water, the bonds between the water molecules are loose and constantly form and reform between the molecules as they move past each other, allowing water to flow. Because they are not stable, they are packed together and weak, and liquid water is dense
    b. in solid water (ice), the bonds between the water molecules are rigid and spread out into crystals. This allows ice to be less dense than water, and it can float on top of water (only element to do so)
    c. the ability of ice to float on water is important to insulate bodies of water in times of extreme cold- they freeze from the top down, trapping heat
31. What is cohesion? What is adhesion? What are some applications of these? How are these properties of water beneficial?
    a. cohesion is the tendency of like molecules to stick together
    b. adhesion is the tendency of unlike molecules to stick together
    c. cohesion allows for:
        i. surface tension:
            1. water striders
            2. droplets of water
    d. cohesion and adhesion allows for:
        i. capillary action:
            1. many plants depend on capillary action to bring water all the way up to their leaves
            2. adhesion allows the water to stick to the little tubes in the tree and be pulled up

3. cohesion pulls up more water molecules to cycle through the tree and eventually evaporate, which allows water to constantly cycle through the plant

32. What is specific heat? Does water have a high or low specific heat? Why does that matter and benefit life? What are some examples?
    a. specific heat is the amount of energy (in calories) required to raise one gram of a substance by one degree Celsius
    b. water has an extremely high specific heat of one calorie
        i. unit of calorie based off of water
        ii. this is because of hydrogen bonds absorb (heat energy) when they break, which slows down heating, and vice versa (the hydrogen bonds store energy, and the energy of creating or breaking hydrogen bonds when cooling or heating needs to be overcome in addition to actually heating the water molecules)
    c. this property allows for the regulation of temperatures, especially in the sea, but also on coastal land and sea breezes
        i. water temperature changes by much fewer degrees during the day than land or air, therefore allowing for a more constant temperature for more stable life
36. What is the primary difference between atoms and molecules?
    a. atoms are smaller than molecules
    b. molecules (molecular compounds) are made up of multiple atoms kept together by covalent bonds
37. What are the primary differences with elements and compounds, as well as with mixtures? How would you define them?
    a. element = pure substance that cannot be broken down into other substances by normal means
        i. made up of only one type of atom
        ii. can exist as a single atom or diatomic or triatomic molecules
    b. compound = substance formed when two or more elements are chemically bonded together in ionic or covalent bonds, and exist in fixed ratios
        i. always made up of multiple atoms, and of different atoms
    c. mixture = aggregate (whole formed by combining separate pieces) formed of two or more elements not chemically bonded together, in which the elements do not exist in fixed proportions
38. Why is the periodic table named the *periodic* table?
    a. it is organized into rows and columns, known as *periods* and families. The organization and patterns of the periods are important to its organization
39. Why are the rows called periods? Provide some specific examples of quantitative aspects of the elements within the rows that rise or fall consistently from left to right in every row.
    a. the rows are called periods because certain characteristics consistently increase or decrease, and there is a pattern of characteristics that is the same for every row, because each family has similar characteristics
    b. characteristics that increase regularly:
        i. electronegativity
        ii. size
            1. number of protons (atomic number)
            2. relative atomic mass
            3. mass numbers
40. Why are the columns called families? How are they similar?
    a. they are similar in terms of chemical properties because they all have the same number of valence electrons
41. Why are metals located on the periodic table? What do they have in common?
    a. they are located on the left of the periodic table, mostly from families 1 to 12

   b. common characteristics
      i. low electronegativities
         1. tend to become positive ions when bonding with nonmetals
      ii. conductivity
      iii. ductility
      iv. malleability
      v. shiny
      vi. high melting point
      vii. high density
      viii. hard
      ix. mostly solids

42. Where are the nonmetals located on the periodic table? What do they have in common?
   a. they are located on the right of the periodic table, from families 14 to 18
   b. common characteristics:
      i. opposite of metals (see above)
43. What are the metalloids (a.k.a. semimetals)? Where are they found on the periodic table? Why does this make sense?
   a. they are elements with some properties of metals, some properties of nonmetals, and some intermediate characteristics, such as semiconductivity
   b. they are located straddling the zig-zag between the metals and the nonmetals. This makes sense because the elements are intermediates between metals and nonmetals
44. What are the most common elements (by mass) in the human body?
   a. oxygen
   b. carbon
   c. hydrogen
   d. nitrogen
45. What are trace elements? What are some examples of trace elements? Are trace elements important? Why? What happens if you don't have trace elements in your body? What are specific examples?
   a. trace elements are elements that are needed in small quantities in your body
   b. they are necessary
   c. examples are iron and iodine
   d. deficiencies can cause health problems:
      i. iron deficiency can cause anemia
      ii. iodine deficiency can cause goiters

Jonathan Lam
Mrs. McTague
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Review Packet: Macromolecules

Introduction

1. **What are the four macromolecules essential to life?**
    - carbohydrates
    - proteins
    - lipids
    - nucleic acids

2. **What four elements make up these macromolecules?**
    - oxygen
    - hydrogen
    - carbon
    - nitrogen

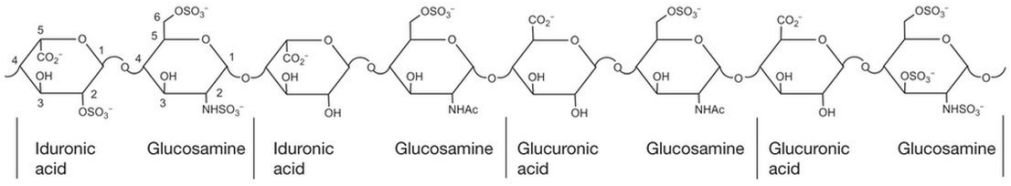
3. **What is a macromolecule?**
    - a molecule essential to life, usually long chains of monomers

Carbohydrates

4. **What are the five carbohydrate monomers?**
    - starch (amylose)
    - cellulose
    - glycogen
    - chitin
    - pectin

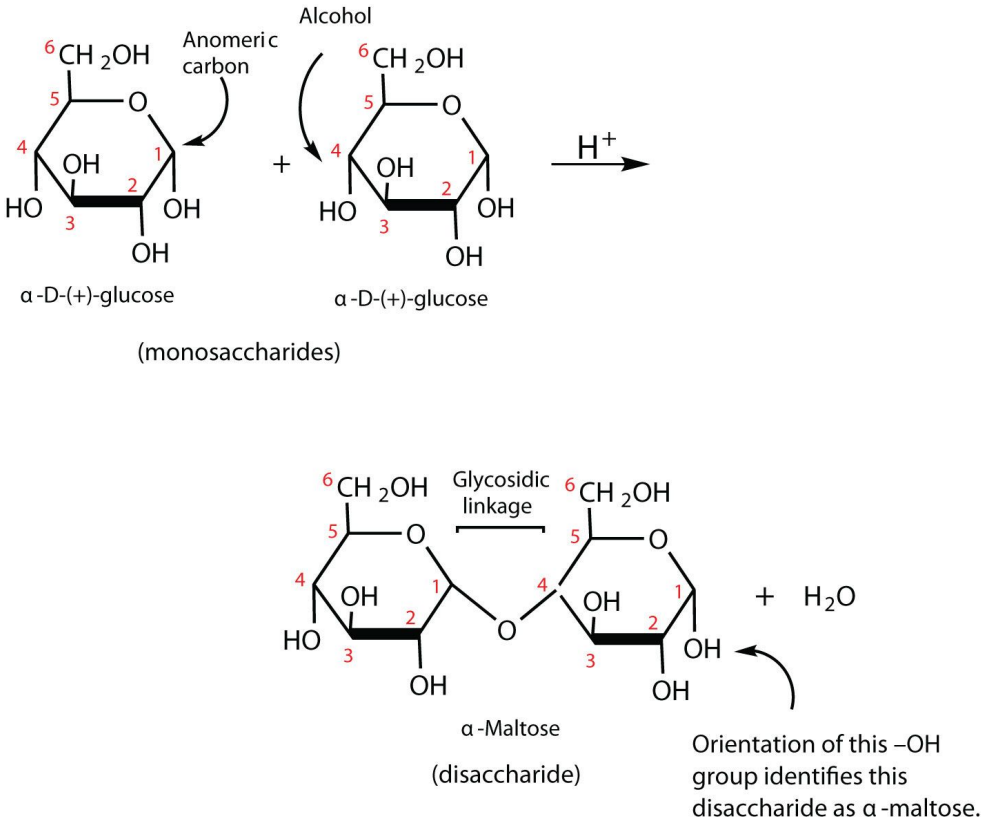
5. **How is a polysaccharide different from a monosaccharide?**
    - a polysaccharide is specifically a carbohydrate macromolecule

6. **How is a polysaccharide different from a disaccharide?**
    - a polysaccharide is a long chain of carbohydrate monomers
    - a disaccharide is made up of only two carbohydrate monomers- they are formed before a whole polysaccharide is created
    - image: a polysaccharide is made up of disaccharides



7. **How is a disaccharide different from a monosaccharide?**
    - a disaccharide is made up of two monosaccharide

- Image: disaccharide is made of two monosaccharides



8. What are the three monosaccharides?

- glucose
- fructose
- galactose

9. What is the chemical formula for all three of these monosaccharides?

- $C_6H_{12}O_6$

10. How are these three monosaccharide different from each other?

- They have different structures/shapes.

11. What are the three (most common) disaccharides?

- maltose
- sucrose
- lactose

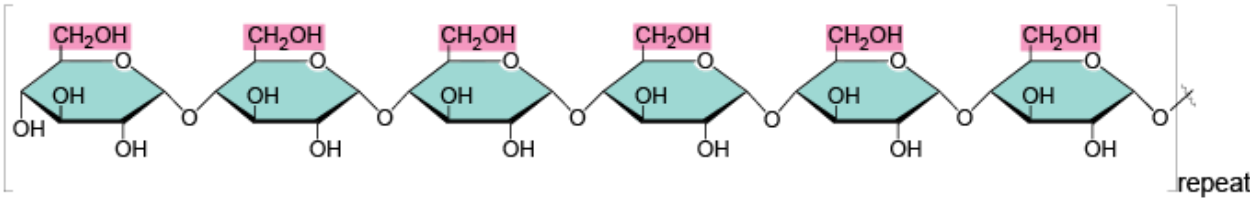
12. How are these three disaccharides structurally different from each other? Be specific.

- maltose is comprised of two glucoses
- sucrose is comprised of a fructose and a glucose
- lactose is comprised of a galactose and a glucose

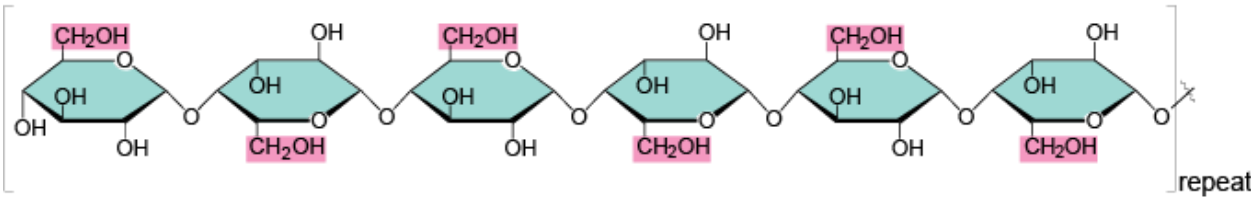
13. Starch, cellulose, and glycogen are all long chains of which monosaccharide?

- glucose

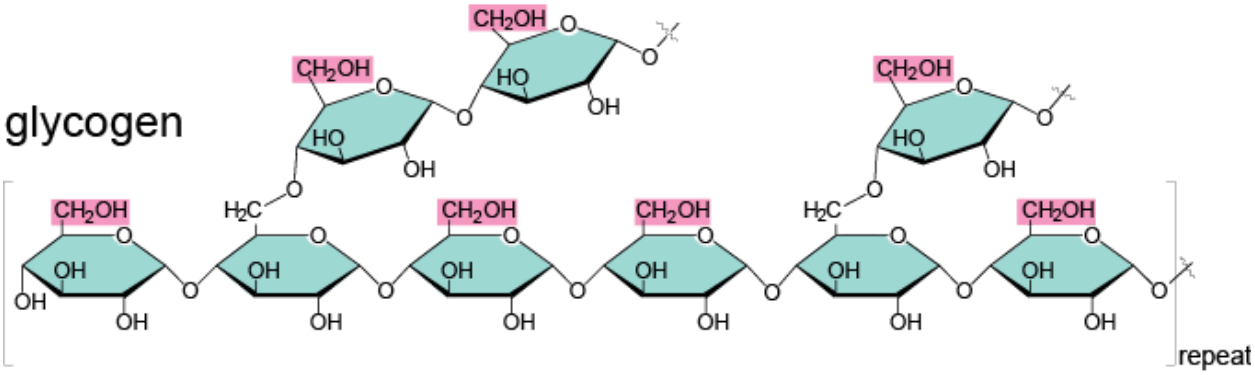
starch



cellulose



glycogen



14. **How are starch and cellulose structurally different from each other, if they are both made of chains of the same monosaccharide?**
    - starch is wavy, but doesn't branch, because all of its "stems" are facing the same direction
    - cellulose is flat and straight, because its top section alternating up and down, allowing it to form hydrogen bonds with another cellulose polymer, making it flat and rigid and strong

15. **Why does the body break down (digest) starch and disaccharides? (What does the body need, and why?)**
    - we need the carbohydrates in the larger molecules to fuel our bodies, but we cannot get the larger molecules into our bodies (they can't physically fit), and because our body burns the individual monosaccharides, not the whole molecule at a time

16. **How does the body break down starch and disaccharides?**
    - hydrolysis: adding water molecules to separate the individual monomers, usually sped up with an enzyme (a catalyst)

17. **Why can the human body break down starch, but not cellulose?**
    - we have enzymes that can hydrolyze the glycosidic bonds in the starch, so that we can break it down quickly enough to absorb it

- we don't have cellulase (enzyme) to quickly hydrolyze the glycosidic bonds in the cellulose

18. **Nearly all humans can digest sucrose and maltose for their entire lives, but there are many humans who lose their ability to digest lactose. What do their bodies cease to make that makes consuming lactose problematic?**
    - the lactase enzyme
19. **Which disaccharide is also known as "malt sugar"?**
    - maltose
20. **Which disaccharide is table sugar?**
    - sucrose
21. **Which disaccharide is also known as "milk sugar"?**
    - lactose
22. **Which disaccharide is found flowing in plants?**
    - sucrose
23. **Which polysaccharide is found in the cell walls of plants?**
    - cellulose
24. **Which polysaccharide is found in the cell walls of fungi?**
    - chitin
25. **Which polysaccharide is found in the cell walls of bacteria?**
    - peptidoglycans
26. **Which polysaccharide is the storage form of glucose in plants?**
    - starch
27. **Which polysaccharide is the storage form of glucose in animals?**
    - glycogen
28. **What is "synthesis by dehydration" ("dehydration synthesis")?**
    - the process of creating a macromolecule, linking together two monomers, by removing a water molecule from each of the molecules to force them to bond. An OH^- and an H^+ leaves from the molecules, one from each, which bond to form water. This bond is known as a glycosidic bond in carbohydrates and a peptide bond in proteins. It can be sped up by enzymes
29. **Could synthesis by dehydration be used to form fructose? Explain.**
    - no. Fructose is a monomer, and synthesis by dehydration can only be used to link monomers together to form larger molecules- not the other way around
30. **Could synthesis by dehydration be used to form starch? Explain.**
    - yes. Starch is a polysaccharide, formed by many monosaccharides joined through dehydration synthesis as glycosidic bonds

Proteins

31. **What is a protein macromolecule called?**

- polypeptide

32. **A protein macromolecule is a long strand of what type of smaller molecules (monomers)?**
    - amino acids
33. **How many different amino acids are there?**
    - 23 in total
        - 20 are common and can be produced in the human body
        - 3 are essential and can only be attained through consumption
34. **If only two amino acids are bonded together, what do you have?**
    - dipeptide
35. **What type of bond holds two amino acids together?**
    - peptide bond
36. **What is needed to break the bond between two amino acids?**
    - hydrolysis (addition of H_2O)
37. **Why does the human body break down polypeptides and peptides? (What does the body need, and why?)**
    - to be able to digest it (a polypeptide may be too large to absorb, or too large to fit into a cell)
    - to be able to get individual amino acids to build with again
38. **Does the human body ever put amino acids together to make polypeptides? If it does, for what purposes does it do so?**
    - yes, for all of the uses of proteins:
        - enzymes
        - protection in the immune system
        - movement (contractile proteins)
        - transportation
        - hormones (signal proteins)
        - storage
        - receiving signals (receptor proteins)
        - structure
39. **Does the human body use synthesis by dehydration to bond amino acids together to make dipeptides and polypeptides?**
    - yes
40. **What is produced when you bond two amino acids together?**
    - H_2O

Lipids

41. **What is a lipid macromolecule called?**
    - triglyceride (fat)
    - phospholipid
    - steroid

42. A lipid macromolecule is made up of what other smaller molecules?

- glycerol
- fatty acids

43. Exactly how many of each type of the above smaller molecules are needed to make one lipid macromolecule?

- triglyceride: 1 glycerol, 3 fatty acids
- phospholipid: 1 glycerol, 2 fatty acids
- steroid: ?

44. Are all glycerol molecules the same?

- yes (chemical formula: C3H8O3)

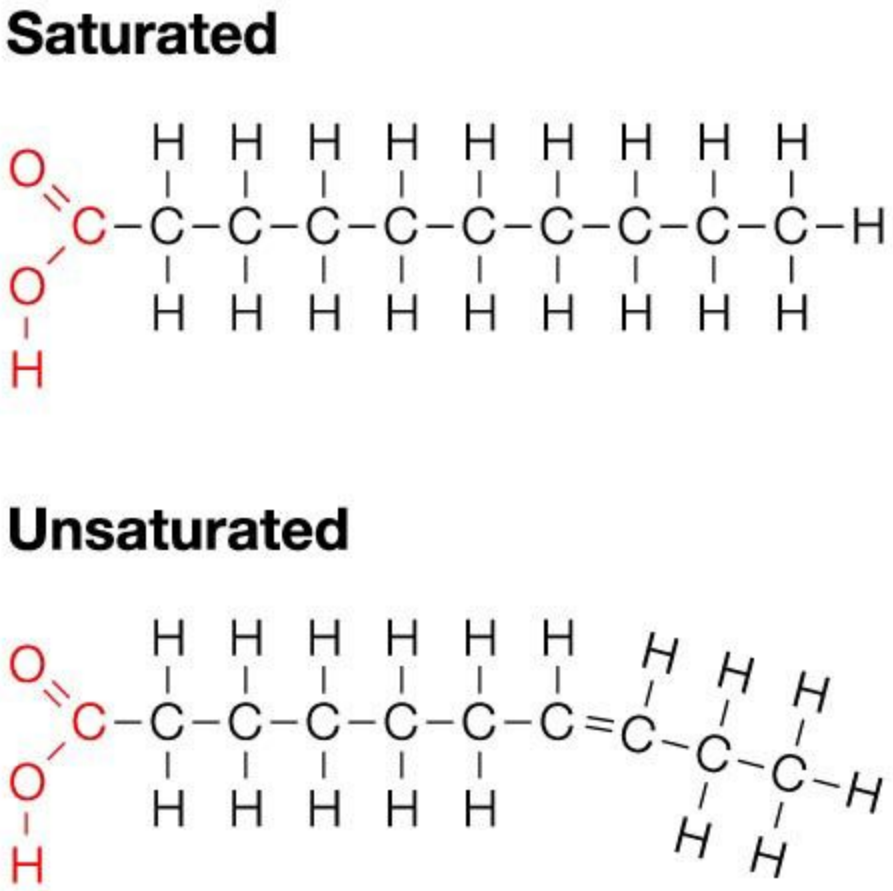
45. Are all fatty acid molecules the same?

- no: the differ in
  - length
  - saturation of hydrogen molecules and number of double bonds

46. Explain the difference between a saturated and monounsaturated fatty acid molecule.

- a saturated fatty acid has no double bonds, and all of its carbons except for the ones on its end are attached to two hydrogen atoms- it is totally saturated with hydrogen, not able to accept any more; this evenness allows for the saturated fat to stay flat, so it is easily stackable; when it is stacked, it forms hydrogen bonds easily, which makes it rigid and solid at room temperature
- a monounsaturated fatty acid has exactly one double bond, and two hydrogens are missing (on the same side), which forms a “kink”, or bend, in the shape of the fatty acid; this does not allow them

to stay flat, so it does not become rigid and solid at room temperature

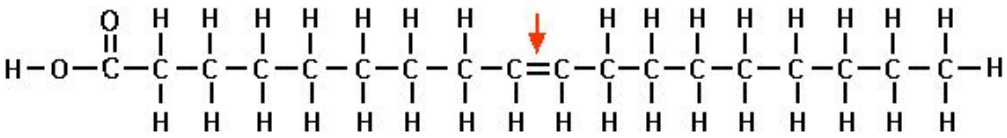


47. Explain the difference between a monounsaturated and polyunsaturated fatty acid molecule.

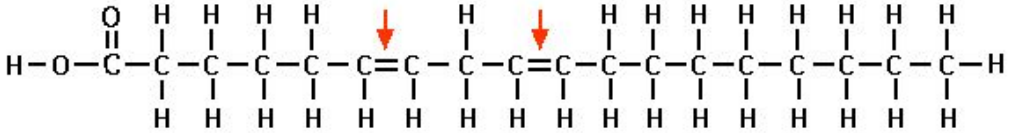
- monounsaturated explained above
- polyunsaturated fatty acids have at least two “kinks” in their backbone, formed by at least two double bonds, and at least four hydrogen bonds; they are even more bent than monounsaturated

fats

Oleic Acid- Monounsaturated Fatty Acid



Linoleic Acid- Polyunsaturated Fatty Acid



48. Which are worse for you: saturated or unsaturated fatty acids? Why?

- saturated fats are worse: because they are flat and rigid, they tend to build up- when they build up in arteries, they can be deadly
- unsaturated fats do not build up because their kinks prevent them from sticking together, and are healthier

49. What types of foods contain saturated fats?

- meat or byproducts (not fish)
  - beef
  - dairy
  - eggs
- tropical plants
  - coconut

50. What types of foods contain unsaturated fats?

- plants (not tropical) and nuts
  - beans
- fish

51. Which type of fat (saturated or unsaturated) tends to be solid at room temperature? Why?

- saturated- because it tends to be flat, they can stack very closely together, allowing for hydrogen bonds to form between them, causing them to become rigid

52. Why does the human body break down triglycerides? (What does the body need, and why?)

- we need the fatty acids, to build other lipids

53. How does the human body break down triglycerides?

- hydrolysis, usually with enzymes (lipase)

54. Does the human body ever put glycerol and fatty acid molecules together to form lipid macromolecules? If it does, for what purposes does it do so? What is the function of lipids in the human body?

- yes, for all the reasons of lipids:
  - long-term energy storage

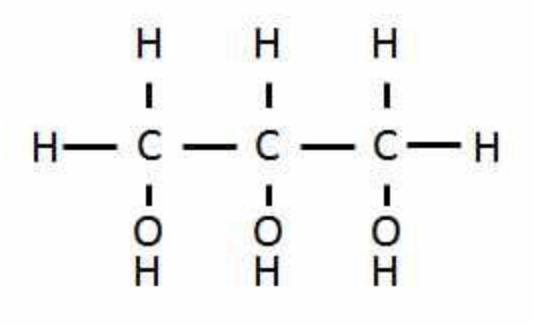
- waterproofing
- cell and organelle membranes
- insulation
- cushioning

55. Does the human body use synthesis by dehydration to bond glycerol and fatty acid molecules together to make lipid macromolecules?

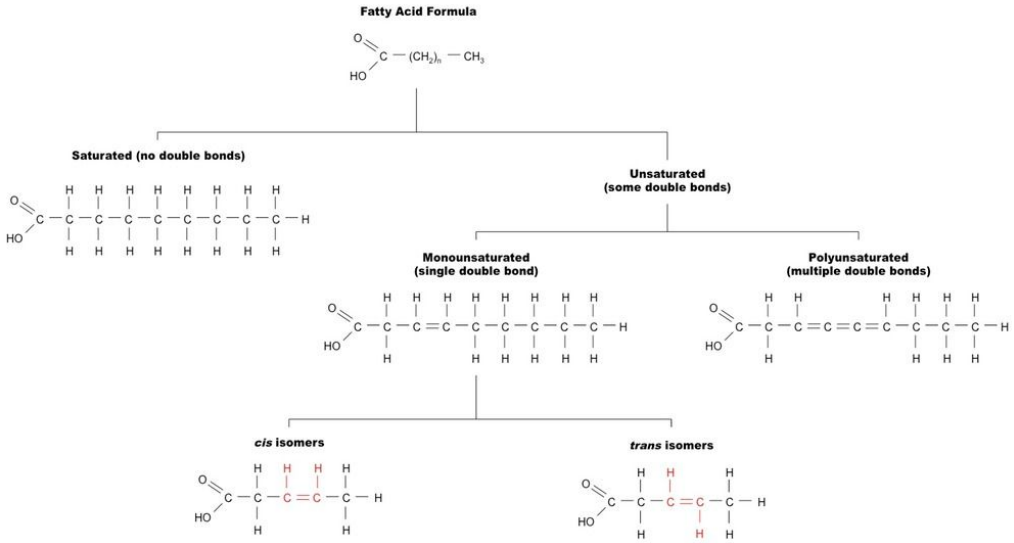
- yes

56. Draw the molecular structure of a glycerol molecule and three fatty acid molecules.

- glycerol:

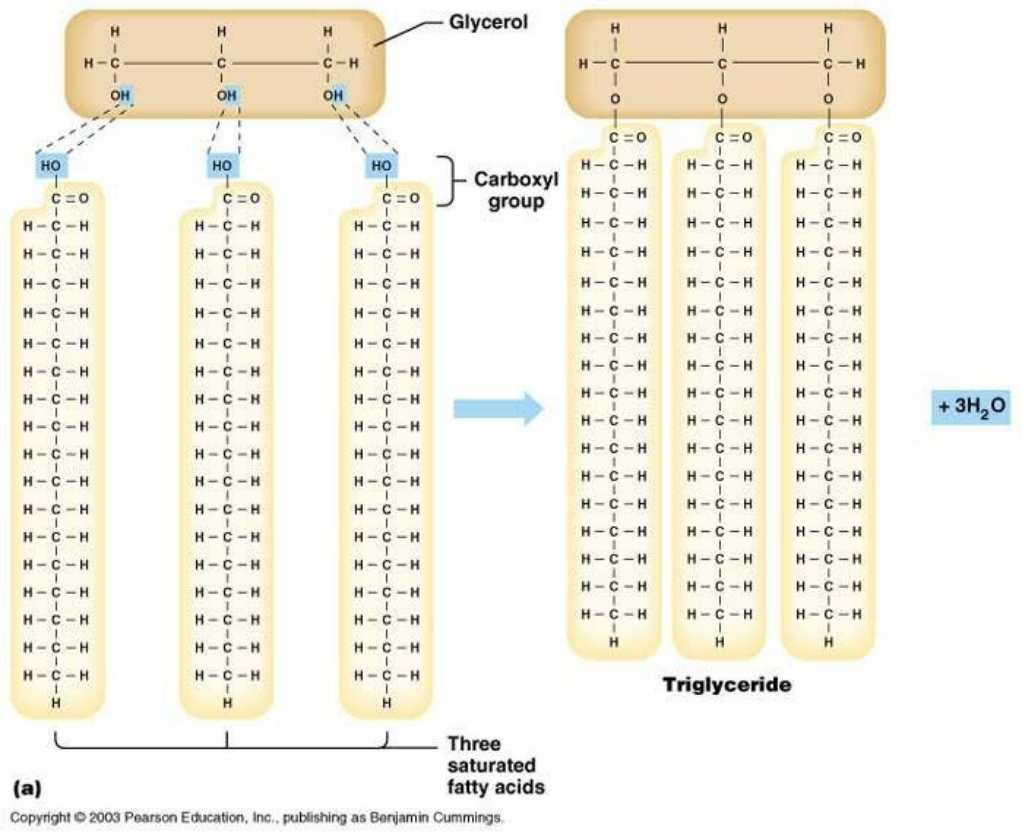


- types of fatty acids:



57. Bond three fatty acid molecules to a glycerol molecule. What is produced when you bond the three fatty acids to the glycerol molecule?

- a triglyceride (fat) molecule and three water (H_2O) molecules are created



Review Sheet: Biochemistry

Food Sources

Carbohydrates

Monosaccharides

- glucose
  - most sugars
- fructose
  - fruits
- galactose
  - milk

Disaccharides

- sucrose
  - fruits
  - table sugar
- lactose
  - milk
- maltose
  - beer
  - seeds
  - malt candy

Polysaccharides
- starch
    - plants, especially
        - potato
        - grains (wheat, rice, barley, sorghum)
- glycogen
    - animals
- cellulose
    - plants (most abundant organic molecule on Earth)

Proteins
All Amino Acids
- animal products
    - red meats (beef, pork)
    - eggs
    - dairy
- beans
- nuts

Essential Amino Acids
- soy

Fats
Essential Fatty Acids
- omega-3
    - flax seeds
    - walnuts
    - vegetable oils
    - fish (unstable omega-3s)
- omega-6
    - leafy vegetables
    - nuts
    - seeds
    - grain
    - vegetable oils

Saturated Fatty Acids
- tropical vegetables
- animals (not fish)

Unsaturated Fatty Acids
- vegetables (not tropical)
- fish

Structure

Carbohydrates
Monosaccharides
- glucose, fructose, and galactose are the only monomers
- all have same chemical formula and number of atoms, different arrangements (different isomers of $C_6H_{12}O_6$)

- shaped differently

Disaccharides

- all contain only two monomers of sugar
- most have glucose, but not all- combinations are unique
- major ones are sucrose, lactose, and maltose

Polysaccharides

- all are long chains of sugars
- starch, glycogen, cellulose, pectin, and chitin are the major ones (all chains of glucose)
- differ in orientation / arrangement of monosaccharides
    - in glycogen, the “antennas” are all facing the same way, is branched
    - in starch, the “antennas” are facing the same way, no branches
    - in cellulose, the “antennas” alternate directions, no branches

Proteins

Amino Acids

- all contain the same “head” but a different “R”-group (side chain). Head contains:
    - alpha carbon in the center, connected to:
        - hydrogen
            - H
        - amino group
            - NH_2
        - carboxyl group
            - makes the amino acid an acid
            - COOH
        - side chain
- side chain determines their properties, especially those relating to acidity and polarity:
    - side chains with mostly C, H, and S are usually nonpolar and hydrophobic and neutral
    - side chains with O and N are often hydrophilic and polar or acidic

Polypeptides

- all contain multiple amino acids in a chain, but in a certain shape
- primary structure
    - chains of amino acids, with a unique sequence
- secondary structure
    - unique shape of amino acid
    - only made up of alpha helices or beta pleated-sheets
    - determined by hydrogen bonds forming at regular intervals down the backbone (not R-groups)
- tertiary structure
    - unique, functional shape
    - determined by R-groups
        - hydrophobic proteins gather in the center and the hydrophilic are on the outside
        - hydrogen bonds form between polar side groups
        - disulfide bridges form
- quaternary structure
    - fully functional shape for some proteins

Lipids

Fatty Acids

- all hydrocarbons (carbon backbone with hydrogens surrounding it)

- all have carboxyl group on one end (COOH)
- differ in length
- differ in saturation of hydrogen atoms

Triglycerides vs. phospholipids?

- triglycerides are a glycerol bonded to three amino acids with the three hydroxyl groups
- phospholipids are a glycerol bonded to two amino acids with the third hydroxyl group bonding with a charged phosphate group, which is hydrophilic

Steroids

- all are made of four fused rings
- different chemical groups attached to the rings yield different properties

Nucleic Acids

DNA vs. RNA

- made of nucleotides
    - each nucleotide is made of:
        - a phosphate group
        - a pentose sugar, one of the following:
            - deoxyribose for DNA
            - ribose for RNA
        - a nitrogenous base, one of the following:
            - adenine (A)
            - guanine (G)
            - thymine (T, U)
            - cytosine ©

Function

Carbohydrates

- main source of energy
    - starch
    - monosaccharides
- short-term energy storage
    - glycogen
- structure
    - cellulose
    - chitin
    - pectin
- taste, attracting animals with fruits for reproduction
    - sucrose
    - fructose

Proteins

- catalyst (enzyme)
    - catalase (breaks down hydrogen peroxide)
- structure
    - ligaments, tendons
- movement (contractile)
    - muscles

- defense
    - antibodies
- signal (signal and receptor)
    - hormones
- transport
    - hemoglobin
    - transporting sugar
- storage
    - milk for babies
    - ovalbumin for eggs
    - seeds for plant embryos

Lipids

- long-term energy storage
    - triglycerides
- protection
    - cushioning
    - insulation
- cell membranes
    - phospholipids
    - cholesterol
- grow muscle
    - steroids (hormones)

Nucleic Acids

- cell functions
- creation of proteins

Dehydration Synthesis and Hydrolysis

Dehydration Synthesis

- method used to link monomers together to form a medium-sized molecule or macromolecule
- removal of hydroxide group from one molecule and hydrogen from the other, which bond to form water, which leaves the two monomers
- the two monomers are left chemically unstable, one missing an electron from the removal of an OH^- molecule and the other with an extra from the removal of a H^+ molecule (they become ions), so they bond together with a covalent, intramolecular bond, sharing the electrons
- happens in cells, with proteins being built in the lysosomes
- happens in cells, with enzymes speeding up reactions to create carbohydrates, fats, and nucleic acids
- when we need to build functional or storage macromolecules that have a different or more advanced function than the individual monomers

Hydrolysis

- method used to break down macromolecules or medium-sized molecules into monomers
- addition of a water molecule allows an H^+ ion to bond with one monomer and an OH^- to bond with the other, breaking them apart by making each one chemically stable without the other
- happens often in digestion to allow individual monomers to be absorbed for body to use and build new macromolecules with

- also allows for individual monomers to be physically small enough to fit through cell walls and be absorbed
- body can't use all of the polymers that we ingest- sometimes we need to change them a little bit
- sometimes a storage form needs to be broken down to be functional- we cannot use a monomer

Conclusion

Functions of Macromolecules

Carbohydrates

- primary source of energy
- structure

Proteins

- enzymes
- defense
- signals/hormones/receptor
- transport
- storage
- movement
- structure

Lipids

- secondary source of energy, long term energy storage
- protection
    - insulation
    - cushioning
- cell and organelle membranes

Nucleic Acids

- instructions for making proteins to carry out functions in the cell and body

Why are these the essential macromolecules of living organisms?
Why are these molecules so critical for life on Earth?
What do they provide for living organisms?

The combination of these four different types of macromolecule allow for every kind of life to survive because they have the capability to carry out essential tasks of an organism. This process of "carrying out tasks" requires multiple parts: the instructions, the application of the instructions, the sources of energy necessary to carry out the task, and the protection and storage to allow tasks to happen. The DNA holds the instructions for all cellular tasks, such as reproduction. The mRNA holds a specific instruction, and a protein is created. The protein does the task, such as catalyzing a chemical reaction or moving a muscle or defending the cell by becoming an antibody. The carbohydrates provide the immediate energy that the cells use to carry out the task. Lastly, the fats store extra energy and cushion the cell from the outside, as well as making up the cellular membranes so that the cell stays together. These molecules, with the addition of water, allow every living task to happen.

Jonathan Lam
Mrs. McTague
H. Bio. per. 3
5 / 30 / 15

The Cell Cycle and Mitosis Study Guide

Steps (overview)

Mitosis

1. interphase
    a. Cell does regular activity (G1)
    b. DNA replicates (S stage)
    c. centrioles replicates (G_2)
2. prophase
    a. DNA (as chromatin) winds around histone proteins, forming chromosomes
        i. nucleolus disappears
    b. centrioles move to opposite poles of cell
        i. mitotic spindle is formed between them
3. prometaphase
    a. nuclear membrane separates into membrane vesicles
    b. chromosomes disperse
    c. kinetochores form, connecting chromosomes to spindle fibers (only one per fiber)
4. metaphase
    a. chromosomes (sister chromatid pairs) line up in the center of the cell
5. anaphase
    a. centromeres dissolve
    b. sister chromatids are pulled apart (one to each pole) by the spindles
        i. motor proteins pull kinetochores towards a pole
6. telophase
    a. nuclear membranes form (around each nucleus)
    b. mitotic spindle disintegrates
    c. DNA unwinds back into chromatin
        i. nucleolus reforms
    d. cytokinesis (cytoplasm division (membrane and organelles also divide as well))
        i. in animals cells, cleavage furrow forms between cells as motor proteins form a ring and close the membranes
        ii. in plant cells (which are not pliable), cell wall vesicles line up, and form the cell wall in between them

Meiosis

Meiosis I

1. interphase
    a. like normal interphase
2. prophase
    a. chromosomes arrange themselves in tetrads (homologous chromosomes (a pair of sister chromtids) pair up), and both chromosomes are on one spindle (vs. only one in mitotic prophase)
    b. crossing over takes place
        i. genes from the two adjacent chromatids can switch (but not outer ones), so that those two chromosomes are different from the parent chromosomes and from each other

3. metaphase
    a. same as mitotic metaphase (except with tetrads instead of single chromosomes)
4. anaphase
    a. homologous chromosomes (sister chromatid pairs) get pulled apart (sister chromatids, which are mostly identical, stay together) to opposite cells
5. telophase and cytokinesis
    a. same as mitotic telophase and cytokinesis, except that DNA usually doesn't unwind back into chromatin
    b. now each cell only has one of chromosome (each one is duplicated, with two almost identical (from the crossing-over) strands of DNA)

Meiosis II

1. interphase
    a. same as mitotic interphase, except that chromosomes don't usually have to be wound (see telophase I), and no replication occurs (only 46 chromosomes, or 23 pairs, to divide amongst the cells)
2. prophase:
    a. same as mitotic prophase
3. metaphase:
    a. same as mitotic metaphase
4. anaphase
    a. same as mitotic anaphase
5. telophase and cytokinesis
    a. same as mitotic telophase and cytokinesis
    b. now each cell only has one chromosome from each pair

Questions

1. **What is mitosis?**
    a. the division of a cell's DNA into two identical sets of DNA
    b. (when followed by cytokinesis, which divides the membrane, cytoplasm, and organelles, then cell division occurs)

2. **What are the main purposes for mitosis?**
    a. prokaryotes/unicellular organisms: reproduction
    b. eukaryotes/multicellular organisms: growth, healing

3. **How many daughter cells are made from one mother cell by mitosis?**
    a. 2 (identical DNA)

4. **How do the daughter cells compare in size to the mother cell? How do they compare in number of chromosomes?**
    a. smaller (half the size)
    b. same number of chromosomes (before DNA was duplicated)

5. **What is the name of the phase when the cell is not in mitosis?**
    a. interphase

6. **What three phases make up interphase?**

a. G_1 (gap 1), S (synthesis), G_2 (gap 2)

7. What happens during the G_1 phase?

a. the cell grows and goes through metabolic processes
b. "normal" cell living
c. first checkpoint at end of G_1, signalling beginning of S phase and doesn't (really) stop until cell has divided

8. What happens during the S phase?

a. synthesis (duplication) of DNA
b. now 92 chromosomes (46 pairs)

9. What happens during the G_2 phase?

a. centrioles are duplicated
b. some proteins for mitosis are synthesized
c. when finished, cell passes through second checkpoint at the end of G_2 into mitosis (prophase)

10. What are the four phases of mitosis?

a. prophase (and prometaphase)
b. metaphase
c. anaphase
d. telophase (usually simultaneous with cytokinesis)

11. Explain what happens during each of the four phases of mitosis.

a. prophase (longest of phases)
    i. chromatin wound (around histone proteins) to form chromosomes
        1. nucleolus disappears
    ii. centrioles go to pole to start forming mitotic spindle
    iii. nuclear membrane dissolves (beginning of prometaphase)
    iv. chromosome pairs attach to spindle fibers (only one per fiber)
b. metaphase
    i. chromosome pairs line up on the metaphase plate at the center of the spindle (and cell)
        1. so that chromosomes would split evenly and the two daughter cells' DNA would be identical
c. anaphase
    i. centromeres dissolve
    ii. sister chromatids become unattached, go to opposite poles
d. telophase (shortest of phases)
    i. chromosomes (previously chromatids) clump together at the poles
    ii. mitotic spindle dissolves
    iii. nuclear envelopes form around the two clumps of chromosomes
    iv. the DNA unwinds back into chromatin
    v. Opposite of prophase

12. How does prophase compare to telophase?

a. they are almost the opposite:
    i. prophase dissolves nuclear envelope; telophase creates (2) nuclear envelopes
    ii. prophase creates mitotic spindle; telophase dissolves it

iii. prophase bundles chromatin into chromosomes (and nucleolus disappears); telophase turns chromosomes into chromatin (and nucleolus reappears)
iv. prophase is the longest phase, and telophase is the shortest

13. How is chromatin different from chromosomes?
a. chromatin is unwound, so that its genes can be accessed easily
b. chromosomes are tightly wound around histone proteins, so that genes are hard to access

14. Why is it helpful to the cell to condense the DNA into chromosomes?
a. it will prevent tangling and damage to the DNA

15. Why does the DNA need to replicate?
a. there has to be two sets of identical DNA for the daughter cells
b. DNA controls all cell activities

16. What is the name of the structure that holds two sister chromatids together?
a. centromere

17. Why is it necessary for the nuclear membrane to dissolve?
a. the chromosome pairs have to be split evenly, and it does that with the mitotic spindle (outside the nucleus)
i. only way for chromosomes to get out is by breaking the nucleus

18. What creates the mitotic spindle?
a. centrioles

19. What is the purpose of the mitotic spindle?
a. to evenly divide the chromosomes to each cell, creating 2 identical sets of DNA

20. Why is it extremely important that the chromosomes line up single file? What does this allow for? What does it ensure?
a. it makes sure that for each pair of chromosomes, exactly one goes to each side
b. if they weren't lined up (if two were on the same spindle or if they were off to one side) the chromosomes might have trouble going to the right cell

21. What is a sister chromatid? How does it compare to a chromosome? Are the two sister chromatids within a chromosome identical?
a. a (sister) chromatid is one of two chromosomes attached to another, identical sister chromatid with a centromere
b. the chromatids go to opposite sides, thus giving each side a single copy of an identical chromosome

22. What is cytokinesis?
a. "division of the cytoplasm"
b. last step of cell division
c. not part of mitosis, but happens at starts during anaphase or telophase

23. How does cytokinesis differ in an animal and a plant cell?
a. animal cells:

i. when the cell membrane pinches to separate the cytoplasm and the nuclei (and divide the organelles roughly in half)

b. plant cells:
   i. when vacuoles with the cell wall material line up in the middle of the cell, forming a cell wall plate, and form the cell wall, separating the two cells
   ii. a cell membrane forms from the vesicle membranes

24. How many pairs of chromosomes does a human typically have?

a. 23 (46 total)

25. Why do we have PAIRS of chromosomes?

a. each pair consists of a chromosome from the father and from the mother

26. Are the two chromosomes within a pair identical? Explain.

a. no: the mother and the father have different DNA

Review Questions: Mitosis and Meiosis

1. You need to be familiar with the main differences between mitosis and meiosis. Sample questions:

- **How do mitosis and meiosis differ in purpose?**
  - mitosis is used to create two genetically identical daughter cells from a cell (asexual reproduction)
    - grow
    - Infect
    - heal
    - replace cells lost during infections
    - reproduction (single-celled organisms)
  - meiosis is used to create four genetically different daughter (haploid) cells from a cell for sexual reproduction
    - animals, multicellular organisms
    - to create unique sperm, egg, and pollen cells

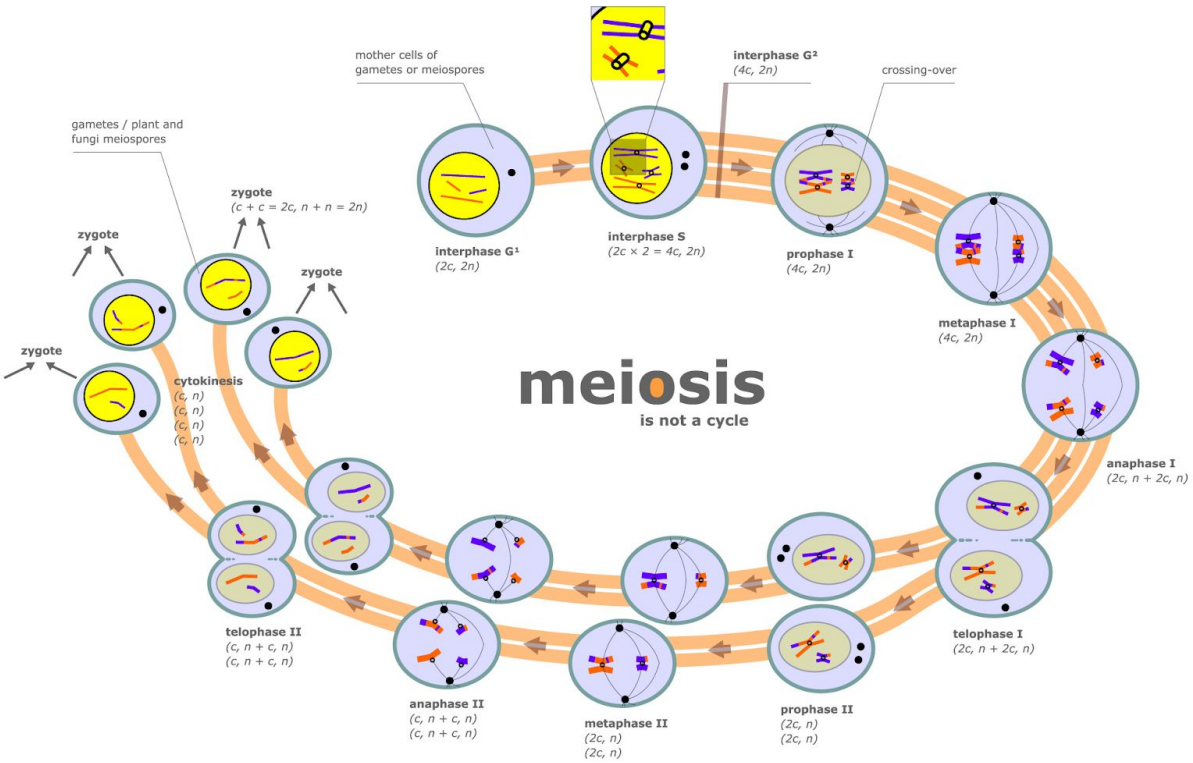
- **Where in the body does mitosis take place? Where in the body does meiosis take place?**
  - Mitosis: Everywhere, for each cell
  - Meiosis: Only for sex cells
    - happens in cells in ovaries and testes
    - happens in ovaries (later plants) and anthems in plants

- **How many times does the cell divide during mitosis? How many times does the cell divide during meiosis?**
  - Mitosis: Once
  - Meiosis: Twice (Theoretically three divisions in total)

- **How many cells are produced from one cell by mitosis? How many cells are produced from one cell by meiosis?**
  - Mitosis: Two
  - Meiosis: Four (Each with half the number of chromosomes)

- **Are the cells produced by mitosis haploid or diploid? Are the cells produced by meiosis haploid or diploid?**
    - Mitosis: Two Diploid (whole: 46 chromosomes)
    - Meiosis: Four Haploid (half: 23 chromosomes)
        - only produces one viable egg, however (all the cytoplasm goes to that one)

2. **You will need to be able to identify diagrams of the cell in various stages of meiosis.**



a.

3. **You will need to be familiar with the stages of both mitosis and meiosis so that you can make comparisons between the two types of cell division. Sample questions:**

- **What is the difference between prophase I of meiosis and prophase of mitosis?**
    - in prophas I two chromosome pairs (a tetrad) are on a spindle
    - there is a "crossing-over"
        - the chromosomes become a little tangled, and genes from any of the four chromatids can be exchanged with another, leading to two of the chromosomes being different from the parent chromosomes

- **What is the difference between prophase I and prophase II of meiosis?**
    - in prophase II, there is no crossing over, and only one pair of chromatids are on a spindle

- **What is the difference between metaphase I and metaphase II of meiosis (and mitosis)?**
    - they are basically the same, except for the changes that were present in prophase

- **What is the difference between anaphase I of meiosis I and anaphase II of meiosis (and mitosis)?**
    - in anaphase I, homologous chromatid pairs separate (a pair for each pole)
    - in anaphase II, sister chromosomes separate (like in mitosis)

- **What is different about the interphase between meiosis I and meiosis II and the interphase before meiosis begins? What is the same?**
    - interphase I is like in mitosis
    - in interphase II, there is no duplication of chromosomes, so that each of its daughter cells will have only one of each chromosome (while somatic cells have chromosome pairs)

4. **Why all of these differences are necessary? Sample questions:**

- **Why is it important that the chromosomes line up "double file"?**
    - So that there is an exchanging of genes when anaphase starts

- **Why is it important that the chromosomes line up next to their homologous partners?**

- so that during the “crossing over” only genes from the same type of chromosome (a homologous chromosome) will be switched

- **Why is it important that the DNA does not replicate in between meiosis I and meiosis II?**
    - So that each daughter cell is a haploid cell so that when the egg and sperm come together a diploid cell is created.

- **Why is it important that the centrioles do replicate?**
    - So that both daughter cells have them. Also so that the mitotic spindle can be created

- **Why is it important that sex cells contain only half the DNA**
    - So that when the zygote is created that their is a mix of genes
        - This is good for a better natural selectivenessity

5. **You will need to be familiar with the vocabulary. You will need to be able to explain the terms and identify the meaning of the terms. You also need to be able to understand questions that use the vocabulary.**

- **Haploid**
    - informally: Having half the number of chromosomes (23)
    - more technically: having only one chromosome per pair (no homologous pairs)
        - having two identical copies of the same chromosome (two sister chromatids of a chromosome), such as the intermediate cell in meiosis, counts as having only one chromosome for that pair

- **Diploid**
    - informally: Having the full number of chromosomes (46)
    - more technically: having homologous pairs of chromosomes (two different chromosomes per pair), the full set, one from the mother and one from the father
    - in somatic cells

- **Crossing over**
  - When genes are mixed between *adjacent* chromatids of the two chromosomes on the mitotic spindle (therefore only two chromatids, not all four are different from the parent ones)

- **Fertilization**
  - When a sperm penetrates an egg

- **Chromatin**
  - The loose (un-spiraled) form of DNA in the Nucleus

- **Chromosomes**
  - Spiraled pieces of DNA

- **Sister chromatids**
  - the pair of identical chromosomes from a duplicated chromosomes
  - bond together with a centromere
  - in mitosis and meiosis II, they are separated during anaphase
  - in meiosis I, they stay together

- **Homologous pair**
  - Pair with the same set of genes
  - in meiosis I, a homologous pair of chromosomes form a tetrad and are separated during anaphase I

- **Centromere**
  - A thingy that holds the chromosomes together

- **Mitotic spindle**
  - structure created by centrioles to equally divide the chromosome pairs to the two poles

- **Centrioles**
  - organelles used to create the mitotic spindle during mitosis and used for basal bodies, and cell microtubule organization
  - part of the centrosome

- **Mother cell**
  - the original cell in mitosis or meiosis
  - gets duplicated (genetically identical copies made; two diploid cells made) in mitosis
  - turns into four different haploid cells in meiosis

- **Daughter cells**
  - the cells that are duplicated versions of their mother cell
    - both sets of daughter cells in meiosis are haploid cells (only have one chromosome, or two identical sister chromatids (one chromosome))

- **Gametes**
  - a mature haploid/germ/sex cell

- **Tetrads**
    - a set of four chromosomes (two sets homologous chromosomes(two sister chromatids))
    - formed during synapsis (prophase I) of meiosis

Review Sheet: Cell Division - Related Topics

Topics related to mitosis

1. **What two classes of genes control the cell cycle? Explain how they do so.**
    - proto-oncogenes
        - speed up/signal the growth of cells
        - allow the cell to grow
    - tumor-suppressor genes:
        - slow down the rapid proliferation of cells
        - at checkpoints make sure cells are ready to prevent error (and tumors)

2. **What are checkpoints? Why are they important?**
    - they are points in the cell cycle in which the cycle does not continue— rather, the cell waits for a signal to continue
    - three (major) checkpoints:
        - end of G_1 (start of mitosis preparation)
        - end of G_2 (start of mitosis)
        - end of metaphase (chromosomes can be separated evenly)

3. **What is cancer?**
    - a tumor with the ability to metastasize (and therefore have a very deadly potential)
    - a malignant tumor

4. **What are several environmental factors that can cause cancer?**
    - Radiation
        - UV rays from sun
        - X-rays
    - Genetics
        - faulty or missing genes
    - age
        - telomeres shorten, start to fall apart and allow DNA fraying
    - free radicals
        - oxygen radicals are high energy molecules that can damage DNA
    - toxins
        - tobacco smoke

5. **How do environmental factors, in general, cause cancer? What do they do to our DNA? Explain the connection between genes and proteins, and what cancer has to do with making too much or too little of certain proteins.**
    - mutate our DNA
    - DNA causes genes, including those that regulate cell division, therefore it can cause cancer

6. **What is a tumor?**
   - a quickly growing mass of cancer cells
   - a mutated cell
     - doesn't follow density-dependent inhibition
     - doesn't need anchorage
     - usually has at least 6 mutated genes related to cell division and regulation

7. **What is the difference between a benign and a malignant tumor?**
   - Benign tumors stay where they are (But still grow and can cause damage)
   - malignant tumors have the ability to metastasize

8. **What does it mean if the cancer cells have metastasized?**
   - to be over a million cells and start to have the ability to send signals to have blood vessels grow towards themselves
   - tumor cells will have source of nutrients, and a way to spread

9. **How are cancer cells able to travel to a new part of the body? What two systems in the body transport the cells? What is the difference between these two systems?**
   - metastasis
   - blood vessels: carry blood cells and plasma
   - lymph nodes: carry white blood cells and plasma

10. **Do all tumors have blood vessels bringing them nutrients? Explain.**
    - no: benign tumors do not have the ability to metastasize

11. **Some cancer drugs (chemotherapy drugs) work by stopping the cell from being able to produce a mitotic spindle. Why would this stop the growth of a tumor?**
    - the mitotic spindle is a necessary part of cell division— if the cell cannot divide and reproduce, no growth can occur

12. **Why can chemotherapy drugs also cause hair loss, nausea, and an immune deficiency?**
    - (chemotherapy is killing or slowing cancer growth with drugs)
    - it doesn't only target cancer cells: it also targets quickly dividing human cells

13. **What are other forms of treatment for cancer?**
    - studying mdm2
    - studying fungus, antifungal medicine can target blood vessels (that allow metastasis)
    - surgery
    - powerful radiation (kill the cells, not mutate them)
    - sometimes cell transplants

14. **How many times do normal cells divide before they die? How many times do cancer cells divide before they die? How is this possible?**
    - normal: 50
    - cancer: infinite:
      - low levels of mdm, high/continued levels of PGAM after cell becomes senile— cell doesn't exit cell cycle
      - sometimes can produce telomerase, allowing telomeres to forever stay long and DNA not to unravel

- increased/mutated proto-oncogenes and decreased/mutated tumor suppressors to speed up cell growth and reproduction

15. How is aging related to mitosis?

- aging happens when mitosis happens too many times
- telomeres get shortened every time there is a cell division
  - when they are too short, the DNA starts to unravel and mutations can occur much easier

16. What are telomeres? What is the function of telomeres?

- telomeres ↔ DNA :: aglets ↔ shoelaces
- at the tip of DNA strands
- long repeating nucleotide sequences
- get shorter every time cell divides
- to prevent the genes from being mutated

17. How are telomeres related to aging? What happens each time a cell replicates and the DNA divides?

- more cell division ⇒ shorter telomeres (except in fetuses) ⇒ more mutations ⇒ more aging

18. What is telomerase? What is its function? Is it present in normal human cells after birth? Theoretically, why could the injection of telomerase into adult human cells cause eternal youth? Why could the injection of telomerase into adult human cells increase the chance of developing cancer?

- telomerase is the protein that extends the telomeres (slow or stop aging)
- in fetuses because there is rapid cell division as the fetus grows (a lot), but want to prevent aging
- theoretically, it can cause eternal life/youth of human cells
  - eventually, in practice, there will always be a buildup of mutations, eventually leading to cancer
  - CANCER IS THE REASON BEHIND NON-ETERNAL LIFE
- it is not present in humans after birth, except maybe in cancer cells
  - if in cancer cells, then cancer cells will never age and can reproduce forever

19. What is progeria? How does it relate to our conversations of mitosis, telomeres, and aging?

- being born with short telomeres
- ages extremely fast, because telomeres run out very quickly
- usually don't live very long (as if they were born senile and lived a life like that)

20. Name several types of cells that have short life spans and divide frequently.

- skeletal, smooth muscle cells
- stomach and intestine lining
- hair follicle, nail, skin cells

21. Name several types of cells that have long life spans and rarely or never divide.

- cardiac muscle cells
- bone cells
- nerve cells

22. What is cell differentiation, also known as cell specialization?

- when stem cells turn into a certain type of cell (become a specialized cell at a specialized task)

23. When does cell specialization occur? Does it occur when you cut yourself? How about when you are sick? How about when you are growing? When is the only time it occurs?

- happens mainly when we are embryos (studies have been done on embryonic stem cells), but also a little bit throughout our growth (adult stem cells, such as basal cells)

24. What are stem cells and how are they different from other cells?

- cells that are non-differentiated/non-specialized — can become specialized
    - can turn into cells that don't regrow, such as neurons
- have all DNA like other cells but it is not a specific type of cell
- mostly in embryos, a little bit in adults
- have telomerase so that they do not grow old after many divisions— they divide a lot (e.g. embryo cells or skin basal cells)

25. Why are scientists interested in stem cells?

- they can be used for healing (can turn into any type of cell based on hormones)
- they have telomerase

26. How are embryonic stem cells different from adult stem cells?

- embryonic stem cells can turn into any type of cell
- adult stem cells are limited to cell types of their tissue of origin

27. What is a blastocyst?

- early development of a mammal (usually five days after fertilization and only a few hundred cells)
- after a zygote
- becomes an embryo, has some stem cells that start to become specialized

28. What types of diseases are scientists most hopeful of treating through the use of stem cells?

- since it can be used to create cells (even in adults) that cannot normally be regrown, it can be used for
    - diabetes, to create insulin-creating cells
    - Alzheimer's, to repair and recreate neurons
    - heart attack, to repair and recreate cardiac muscle cells

Topics which are related to meiosis:

29. Describe what a karyotype is and be able to recognize and name a karyotype when you see one.

- an orderly representation of a person's chromosomes
- some chromosomal diseases can be diagnosed by looking at chromosomes

30. Explain the chromosomal characteristics used to match chromosomes when preparing a karyotype.

- to match up correct chromosome pairs (homologous chromosomes):
    - length
    - G-bands

31. Identify the genders and chromosomal syndromes of individuals based on their karyotypes.

- sex chromosomes:
    - 23rd chromosome pair
    - X = longer, y = (much) shorter
    - XX = female
    - XY = male
    - XXY = usually male, sometimes intersex (Klinefelter's syndrome)
    - X = female (turner's syndrome)

32. Use/identify proper chromosomal notation (e.g., 47, XY, +13).

- notation: "num, sex [, ext]" where num = number of chromosomes, sex = sex chromosomes, ext = extra/missing chromosomes

33. Explain what an amniocentesis is, the procedure itself, and why the procedure is performed.

- when some of the amniotic fluid (fluid surrounding a fetus) is taken out and examined to see the DNA
- can be used to determine chromosomal abnormalities or gender before birth

34. You will need to be able to explain nondisjunction. You will need to explain what it is and when it occurs. You will need to explain the result of nondisjunction. You will need to put combinations of eggs and sperm together and explain the possible outcomes.

- when three chromosomes line up on one spindle thread and one on another in meiosis (I or II)
- it will lead to some of the haploid cells having three (trisomy) or one (monosomy) of a chromosome instead of two

35. Aside from nondisjunction, what else can cause a chromosomal abnormality and chromosomal disorder?

- duplications
- deletions
- translocations
- inversions

36. What are the two types of chromosomal deletions? How are they similar? How are they different?

- terminal: one break happens and the end piece is lost
- interstitial: two breaks happen, and the first and third piece rejoin— chromosome loses some middle material

37. What are the two types of chromosomal translocations? How are they similar? How are they different?

- reciprocal: when two corresponding parts of two homologous chromosomes switch
    - can cause abnormalities
    - sometimes doesn't because same genes just switch
- Robertsonian: when two q sections of homologous chromosomes switch, resulting in the loss of the p sections
    - usually doesn't cause abnormalities (only smaller sections lost)

38. How do chromosomal deletions and translocations cause chromosomal disorders?

- they can cause rearrangements in regular DNA

39. Are chromosomal disorders inherited? Explain why or why not. Try going through the three categories of chromosomal disorders (EXTRA/MISSING CHROMOSOMES, DELETIONS, TRANSLOCATIONS) and consider whether or not individuals typically have these disorders because their parents had them.

- assuming that the parent survives to reproduction age (which can often happen with these disorders)
    - extra/missing: can be carried on, because if missing or extra chromosome is passed on to haploid cell (½ chance) then child could have it
    - deletions and translocations could also be carried on if they are in the haploid cells

Jonathan Lam
Mrs. McTague
H. Bio. per. 3
5 / 30 / 15

Vocabulary:

- **Autosomes**
  - first 22 pairs of chromosomes
  - the “regular” chromosomes
  - come in pairs
- **Sex chromosomes**
  - last two chromosomes
  - “sex chromosomes”
  - X and Y (XX for female, XY for male)
- **Zygotes**
  - fertilized egg cell (has sperm DNA)
- **G bands**
  - darkened area with a high concentration of A and T nitrogenous bases, caused by the dying of a chromosome with Giemsa dye
- **Giemsa dye**
  - dye used to color chromosomes, used to create G bands and identify genes
- **P and Q arms**
  - “p” for petite, used to refer to the smaller end of a chromosome (divided by a centromere)
  - “q” because it is the next letter of the alphabet, the larger end of the chromosome
- **Down Syndrome**
  - trisomy 21: third 21st chromosome (47, XY, +21)
- **Turner Syndrome**
  - monosomy X: only 1 X chromosome (47, X)
  - sexual growth problems, webbed neck
- **Klinefelter’s Syndrome**
  - XXY (47[+], X[+])
  - sexual growth problems, usually a man or intersex
- **Chromosomal notation**
  - a method to show the amount of chromosomes in a karyotype in a single statement
- **Cri du chat**
  - “cry of the cat”: child makes sound like crying cat
  - deletion in chromosome 5p (46, XY, del(5p))
- **Williams Syndrome**
  - deletion in chromosome 7q (46, XY, del(7q))
  - developmental delays, circulatory system problems,
- **Philadelphia chromosomes**

- reciprocal translocation of 9 and 22 (46, XY, T(9; 22))
- leukemia

- **CDC**
  - see “cri-du-chat”

- **CDK**
  - gene that is needed for brain developme)nt (46, XY, del(22p))
  - seizure and intellectual ability may occur

- **Carcinogens, carcinogenic**
  - cancer-causing
  - examples: see above

- **Palpable**
  - easily, noticable (can be felt, seen)

- **Proliferation**
  - rapid spread of cells (i.e. rapid reproduction)

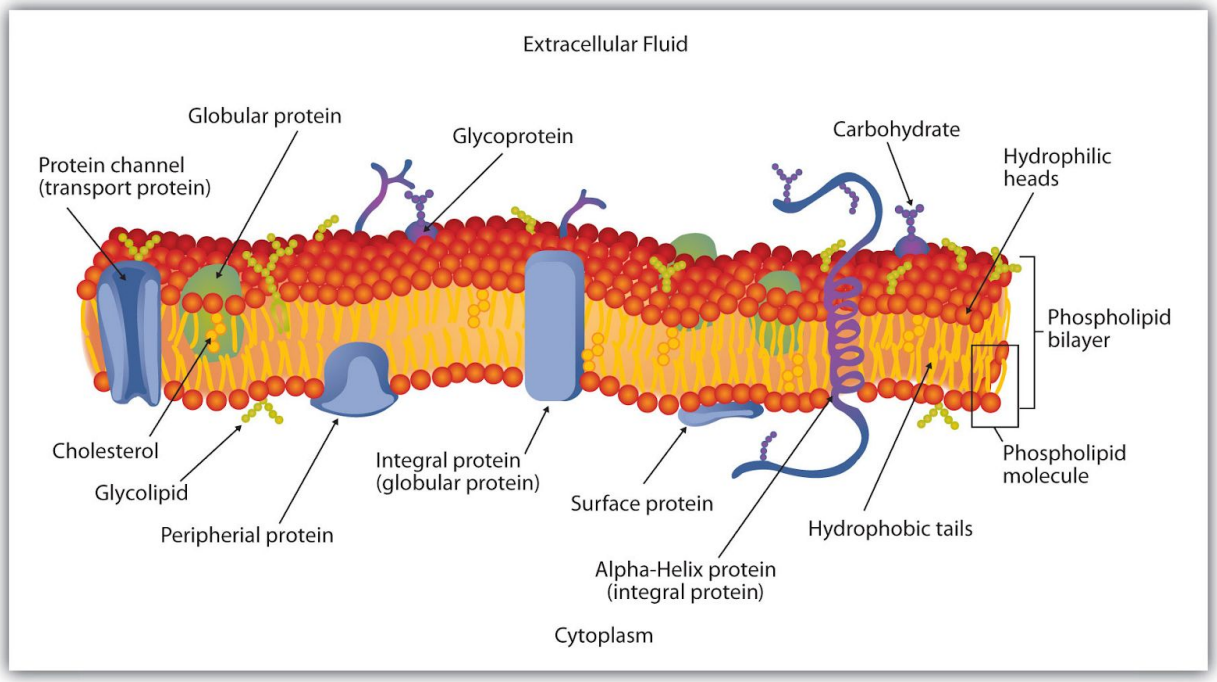
- **Senescence**
  - state of cell when it is still metabolically active but no longer able to reproduce
  - cancer cells do not go through this stage

- **Density dependent inhibition**
  - non-cancerous cells cannot divide if there is too much pressure from the outside from other cells— if there are too many cells, then it cannot divide and reproduce
  - cancer cells do have density dependent inhibition, and therefore can form hard masses of many cells

Jonathan Lam
Mrs. McTague
H Bio. per. 3
4 / 6 / 15

Study Guide: Membrane Structure and Transport

1. **Identify the main parts of cell membrane as shown in a diagram.**



2. **Explain the function of each of the parts of the cell membrane.**
    a. phospholipids?
        i. main part of membrane
        ii. allow for fluidity of cell membrane
        iii. (see below for more importance)
    b. cholesterol?
        i. is in between some phospholipids, helps regulate stability
            1. keeps fluid when cold
            2. keeps stable when warm
    c. carbohydrate chains?
        i. antigens to help other cells recognize as domestic (or foreign)
    d. three roles of proteins related to membrane transport?
        i. transport proteins
            1. protein channels
                a. allowing small polar molecules to pass through
                b. facilitated diffusion (passive transport)
            2. protein carriers
                a. allow larger molecules to bind and pass through
                b. facilitated diffusion
            3. protein pumps
                a. active transport
                b. use ATP to move solutes against concentration gradient
        ii. endocytosis

1. receptor proteins
    a. allow for specific recognition of solutes to enter the cell

3. Explain why phospholipids make a good barrier between the cytoplasm and the extracellular fluid.

a. they have hydrophilic heads and hydrophobic tails
b. they automatically form bilayers that prevent water for readily flowing in and out, allowing for two different environments in and out of the cell or bubble

4. Explain why the phospholipids are arranged in their bilayer.

a. the hydrophilic heads point out because they are attracted to the water in the cytoplasm and extracellular fluid
b. the hydrophobic tails stay in because they are repelled by the water — they try to stay far away from the water

5. Explain why the carbohydrate chains are found only on the outside.

a. they are used as surface markers for other cells (not itself) — it has no purpose inside the cell

6. Compare and contrast the modes of transport.

a. passive transport:
    i. sometimes a protein
    ii. facilitated or simple diffusion
        1. facilitated: through proteins, for larger or charged particles
            a. protein channels
                i. allow small charged molecules (ions) to pass through freely
                ii. osmosis through aquaporins
            b. protein carriers
                i. when certain solutes bind to it it morphs and allows the solute in
        2. simple: for small, nonpolar molecules
    iii. happens by diffusion
    iv. with only kinetic energy of the molecules and none from the cell
    v. with solutes traveling down their concentration gradient
b. active transport
    i. requires a protein (protein pump)
    ii. uses energy from the cell (ATP)
    iii. to move solutes against their concentration gradient
c. bulk transport
    i. endocytosis
        1. bulk transport into the cell
        2. vesicle forms around item, comes into cell
        3. phagocytosis: cellular eating
        4. pinocytosis: cellular drinking
        5. receptor-mediated endocytosis: specific endocytosis of certain molecules that bind to surface receptor proteins
    ii. exocytosis
        1. bulk transport out of the cell
        2. secretory vesicle binds with cell membrane, opens up and releases items out

7. State examples of transport different substances use to enter and leave cells.

a. oxygen, carbon dioxide: simple diffusion
b. glucose: facilitated diffusion (protein carriers)
c. sodium, chlorine, potassium ions: facilitated diffusion (protein channels)
d. water: facilitated diffusion (protein channels (aquaporins)), simple diffusion (occasionally)
e. food: phagocytosis
f. cholesterol: receptor-mediated endocytosis
g. liquids and dissolved solutes: pinocytosis

8. Tonicity:

a. isotonic
    i. when concentration of solutes inside and outside a cell are equal
    ii. in plant cells, this causes the cells to go limp— is not preferred
    iii. is preferred in animal cells
b. hypotonic
    i. when concentration of solutes outside cell is less than inside cell
    ii. is preferred in plant cells — makes them turgid
    iii. may make animal cells expand or lyse
c. hypertonic
    i. when concentration of solutes outside cell is higher than inside cell
    ii. causes plant cells to
d. solute
    i. a substance that is dissolved in a another substance
e. solvent
    i. the liquid in which a solute is dissolved
f. solution
    i. a liquid with a solute dissolved evenly throughout a solvent
g. equilibrium
    i. a balance

9. Explain lysing.

a. the bursting of a cell
b. usually happens in cells that don't have cell walls
    i. (mostly in animal and protist cells — plant, fungi, bacteria, amoeba all have them)
c. usually when a cell is placed in a hypotonic solution, or when virus invades
d. opposite is cell shrinkage or plasmolysis in cells that have a cell wall

10. Explain plasmolysis.

a. the peeling away of a cell membrane from a cell wall (only in cells with cell walls)
b. usually happens when cell is placed in a hypertonic solution
    i. cell wall is rigid, doesn't shrink, but the membrane does
c. usually leads to cell death
d. opposite is lysing

11. Explain applications of membrane transport:

a. alveoli and bloodstream (simple diffusion)
b. villi and bloodstream (facilitated diffusion)
c. kidneys and bloodstream (osmosis)
d. bloodstream and all cells

e. engulfment of germs by white blood cells (endocytosis and phagocytosis)
f. secretion of neurotransmitters from neutrons (exocytosis)
g. solute pumping and ion channels in neurons and muscle cells (facilitated diffusion and solute pumping)

12. Explain different blood types.

a. antigens on blood cells
b. genetic
c. body recognizes and attacks any foreign antigens (but not missing ones)
d. ABO
    i. carbohydrate chains (genetic because created by protein enzymes)
    ii. A and B antigens on cells
    iii. can have A, B, and o (no antigen) genes
        1. o is recessive
        2. A, B are equally dominant (can have both genes and both antigens)
    iv. not too important during pregnancy
e. RhD factor
    i. protein chain
    ii. can have Rh protein or not (+ or -)
    iii. more important important during pregnancy

13. Explain problems with blood types.

a. if foreign antigen is given to somebody, their body will reject it
    i. during blood infusions, if the A, B, and/or RhD antigen is given to somebody who doesn't have that/those antigen(s), then they will fight it off, causing anemia and/or death
    ii. during pregnancy, if Rh+ father and Rh- mother have a child, there is possibility that child can be Rh+. When mother gives birth, blood may mix, and the mother could make antigens for the RhD protein. In later pregnancies, as antibodies go into baby the antibodies would mark future RhD+ babies

Jonathan Lam
Mrs. McTague
H. Bio. per. 3
5 / 15 / 15

Cell Respiration Steps

- cellular respiration: the creation of usable energy to do cellular work from stored chemical energy (breaking down of glucose and creating of ATP (adenosine triphosphate, the high-energy molecule that our body can use directly as energy)), which occurs in three stages (sometimes only one takes place)
    - anaerobic respiration: glycolysis
        - does not require oxygen to happen, but still creates a little energy (but not enough for larger organisms, such as us)
        - happens in all cells (only stage that does)
            - only step in cells in non-oxygen environments (e.g. anaerobic bacteria)
            - only step in cells without a mitochondria (e.g. protists); happens in cytoplasm
            - in cells with mitochondria, used to provide NADH for oxidative phosphorylation
        - glucose + 2 ADP + 2 P_i → 4 ATP (+ pyruvate + 2 H_2O)
    - aerobic respiration: Krebs cycle and oxidative phosphorylation
        - take place in mitochondrial matrix and on mitochondrial inner membrane (on cristae: folds) require oxygen as final electron acceptor so that electrons can pass through
        - cells in eukaryotic cells with a mitochondrial (mostly plant and animal cells)
        - Krebs, like glycolysis, to provide high-energy electrons for oxidative phosphorylation
        - happens more in more active cells, such as muscle cells, liver and intestinal and nerve cells (secretions = bulk transport = ATP)
        - glucose + 30-32 ADP + 30-32 P_i → 30-32 ATP (+ 6 CO_2 + 14 H_2O)
            - only stores 34% of glucose's potential energy (but still more efficient than gasoline or other artificial fuels)
- cellular work: any process in a cell that requires the cell to expend energy in the form of ATP
    - membrane transport
    - cellular division
    - enzymes (chemical reactions)
    - contractile/motor proteins
    - change shape of cell (changing cytoskeleton)
    - making proteins
    - flagella, cilia
- calorimetry: the science of the amount of energy stored in a substance
    - can use a (soda-can) calorimeter and burn the substance (combustion reaction to release heat and light energy from chemical energy reacting with oxygen) to see how much it heats up the liquid in the can— the more the heat increase, the more the calories
    - 1 calorie = amount of energy needed to heat up 1 gram of water by 1 degree Celsius
    - 1 Calorie = 1 kilocalorie
- "-ate" molecules: salt/ionized form of "-ic acid"
    - pyruvate → ionized pyruvic acid
    - citrate → ionized citric acid
    - oxaloacetate → ionized oxaloacetic acid
- intermediate (molecule): molecule that is formed between the reactant and the product of a metabolic pathway (a chain of chemical reactions that turns the reactant into intermediates to arrive at the product)
    - glycolysis:
        - glucose 6-phosphate
        - glucose 1,6-phosphate
        - fructose 1,6-phosphate
        - glyceraldehyde 3-phosphate

        - dihydroxyacetone phosphate
        - 1,3-bisphosphoglycerate
        - 3-phosphoglycerate
        - phosphoenol-pyruvate
    - Krebs:
        - oxaloacetate
        - citrate
        - alpha-ketoglutarate
        - succinate
        - malate
    - oxidative phosphorylation:
        - (none— not a metabolic pathway)
- poisons: substances that bind to and block the ETC in oxidative phosphorylation, stopping the creation of ATP and killing the cell within minutes
    - rotenone blocks first protein complex
    - cyanide, carbon monoxide block third protein complex
    - oligomycin blocks ATP synthetase
    - DNP is an uncoupling agent (see thermogenin under brown fat)
- brown fat: fat tissue that has a high capillary and mitochondrial content that creates less ATP but creates more heat
    - used during hibernation— need to stay warm but don't need to create much ATP
    - high concentration in newborns to stay warm— lose it as we get older
    - uncoupling protein thermogenin in the inner mitochondrial membrane that causes protons to fall back into the matrix before they form ATP, creating heat instead of ATP
- end of reactants:
    - glucose → 6 CO_2 + 12 H_2O (from NADPH)
    - oxygen → 12 H_2O
- fermentation: glycolysis without oxygen (must have method of recycling NADH)
    - lactic acid fermentation:
        - pyruvate is turned into lactic acid and NADH is oxidized to NAD^+
        - in bacteria
        - in our muscle cells
            - lactic acid flows into our bloodstream, is turned back into pyruvate in the liver and the rest of cellular respiration takes place
    - alcohol fermentation
        - pyruvate is turned into CO_2 and ethanol, and NADH is oxidized to NAD^+
        - in yeast and certain bacteria
        - used in winemaking
- types of organisms (based on oxygen)
    - aerobe can only survive in oxygen environments
    - facultative anaerobe can survive by either fermentation (no-oxygen) or oxidative phosphorylation (with oxygen), but prefers oxygen
    - obligate anaerobe is poisoned by oxygen, must live in non-oxygen environment
- glucose not the starting material
    - carbohydrates can all be broken down (polymers) or turned into (monomers) glucose to start cell respiration

- fats can be broken down into glycerol and fatty acids, which can both be used in cell respiration (turned into G3P and acetyl CoA, respectively) and produce 9/4 times the energy of glucose (has many hydrogens and high-energy electrons)
- proteins can be broken down into amino acids (turned to various intermediates) and amino groups (which are waste products and disposed of in the urine)

- biosynthesis
  - glycolysis and Krebs cycle also create intermediates that can be used to form new macromolecules

Molecule / Step	**Description**
glucose	
1. Glycolysis	takes place in cell cytoplasm happens in all cells (can happen without oxygen, is the only step in anaerobic or prokaryotic cells) $2\ ATP + 2\ P_i + 2\ NAD^+ + glucose \rightarrow 4\ ATP + 2\ NADH + 2\ pyruvate$
$+P_i$	ATP phosphorylates it (1 phosphate group is fixed, ADP leaves into cytoplasm)
glucose 6-phosphate	
$+P_i$	ATP phosphorylates it (1 phosphate group is fixed, ADP leaves into cytoplasm)
glucose 1,6-phosphate	
fructose 1,6-phosphate	
hydrolysis	fructose 1,6-phosphate is unstable, causes breakdown into two two-carbon sugars
glyceraldehyde 3-phosphate (G3P) + dihydroxyacetone phosphate	high-energy sugar, also found as product of Calvin Cycle in photosynthesis + secondary, three carbon sugar
2 glyceraldehyde 3-phosphate	dihydroxyacetone phosphate is turned into a G3P molecule
	All following steps (including in other stages of cellular respiration) will be halved for convenience. Each reaction following takes place on *each* G3P.
$-2e^- -H^+$	reduces NAD^+ electron carrier ($NAD^+ \rightarrow NADH$); NADH carries high-energy electrons to mitochondrial membrane, and drops it off to protein carriers; from there, it may be dropped off either into FAD or NAD^+, so that will cause the differences in the amounts of ATP produced
$+P_i$	ATP phosphorylates it because it is now positive after removing electrons (1 phosphate group is fixed, ADP leaves into cytoplasm); can be used immediately

1,3-bisphosphoglycerate	
-P_i	substrate-level phosphorylation: ATP is synthesized by phosphorylating ADP with P_i from substrate molecule (substrate is molecule bonded to enzyme; as opposed to oxidative phosphorylation, when electrons power phosphorylation); can be used immediately; in organisms in anaerobic environments or ones without mitochondria, this is all the ATP they will have to work (very little)
3-phosphoglycerate (3PGA)	low-energy 3-carbon sugar
-H_2O	
phosphoenol-pyruvate	
-P_i	substrate-level phosphorylation: ATP is synthesized by phosphorylating ADP with P_i from substrate molecule (as opposed to oxidative phosphorylation)
pyruvate	final product of glycolysis; carried across mitochondrial membrane by protein carrier into the matrix of the mitochondria
2a. Pre-Krebs	takes place in mitochondrial matrix this and all following steps only happen in mitochondria, with O_2 present $2\ NAD^+ + 2$ pyruvate + CoA → $2\ NADH + 2$ acetyl CoA + $2\ CO_2$
-CO_2	a waste product— diffuses out membranes and out of cell; opposite of photosynthesis, when 6 CO_2 are fixed into RuBP to make a glucose (in contrast, five more will be removed from the pyruvate)
-$2e^-$ -$2H^+$	comes off with CO_2, reduces NAD^+ electron carrier ($NAD^+ \rightarrow NADH + H^+$)
+coenzyme A (CoA)	enzyme similar to Rubisco which later catalyzes the carbon fixation in the Krebs cycle
acetyl CoA	final product of the pre-krebs, to be used in the Krebs cycle
2b. Krebs Cycle	takes place in mitochondrial matrix $6\ NAD^+ + 2$ FAD + 2 ADP + $2\ P_i$ + 2 coA → $6\ NADH + 2\ FADH_2 + 2$ ATP + $4\ CO_2$
+oxaloacetate (OAA)	OAA is the starting and finishing material for the Krebs cycle— it is always replenished and used; it is also found in C4 and CAM plants for carbon fixation
-CoA	CoA was used to help the carbon fixation of the acetate to the OAA, and breaks off for bonding again in the pre-Krebs cycle
citrate (citric acid)	six-carbon sugar; where the common name “citric acid cycle” comes from
-CO_2	a waste product— diffuses out membranes and out of cell; same two steps as in the pre-Krebs cycle, and will happen again with the alpha-ketoglutarate
-$2e^-$ -$2H^+$	reduces NAD^+ electron carrier ($NAD^+ \rightarrow NADH + H^+$)
alpha-ketoglutarate	five-carbon sugar

-CO_2	a waste product— diffuses out membranes and out of cell
-$2e^-$ -$2H^+$	reduces NAD^+ electron carrier ($NAD^+ \rightarrow NADH + H^+$)
—	energy from oxidative reaction powers ADP + $P_i \rightarrow$ ATP; substrate-level phosphorylation; can be used right away
succinate	four-carbon sugar
-$2e^-$ -$2H^+$	reduces FAD electron carrier ($FAD \rightarrow FADH_2$)
malate	four-carbon sugar
-$2e^-$ -$2H^+$	reduces NAD^+ electron carrier ($NAD^+ \rightarrow NADH + H^+$)
oxaloacetate	(go back to first step of Krebs cycle)
	Last step is separate— OAA is not the reactant. Also, now proteins are involved (not a metabolic pathway, but an electron transport chain, so steps will be written differently.
Oxidative Phosphorylation	happens in mitochondrial matrix 8-10 NADH + 2-4 $FADH_2$ (total of 12 high-energy electron pairs) + 26-28 (ADP + P_i) $\rightarrow$ 12 H_2O + 26-28 ATP (depending on amounts of NADH and $FADH_2$)
NADH -H^+ -$2e^-$	oxidation of the NADH to protein complex 1, the main energy source for powering ATP, hence the name "oxidative phosphorylation"; NAD^+ returns to the mitochondrial membrane or the matrix for more high-energy electrons from glycolysis or the Krebs cycle; the "electron transport chain" (ETC) begins here as electrons start to move in a series of "redox" reactions (each molecule is "reduced" and energized by the electrons, and then "oxidized" when it leaves)
pumping of two H^+	two protons are pumped by a pair of the high-energy electrons in the protein complex 1 from the intermembrane space to the matrix; rotenone (pesticide) poison bonds here and blocks the ETC
$FADH_2$ -H^+ -$2e^-$	oxidation of the $FADH_2$ to protein complex 2 (because protein complex one does not have the correct shape to accept $FADH_2$); these electrons do not pass through protein complex 1, and therefore provide less energy than the NADH (each pair passing through only 2 pumps, only pumping 4 H^+, and only creating 2 ATP instead of NADH with 3, 6, and 3, respectively)
carrying of electrons to protein complex 3	lower-energy electrons from protein complex 1 (NADH electrons) and 2 ($FADH_2$ electrons) are carried over by electron carriers to protein complex 3; usually a cytochrome acts as the electron carrier, because it helps catalyze redox reactions; also the reducing and oxidation are done by cytochromes in the protein complexes
pumping of two H^+	two protons are pumped by a pair of electrons; same as in protein complex 1
carrying of proteins to protein complex 4	same as carrying to complex 3

pumping of two H^+	final pump (third one for NADH electrons, second for $FADH_2$ electrons); same as in other complexes; cyanide and carbon monoxide blocks ETC here
$\frac{1}{2}O_2 + 2H^+ + 2e^-$	an oxygen atom and two hydrogen ions pick up the two depleted electrons from the end of the ETS to form H_2O; this is why oxygen is necessary for the Krebs cycle and oxidative phosphorylation to work: oxygen is the final electron acceptor, and without it the ETC would clog up and the mitochondria could not work; also helps keep concentration of protons inside the matrix low by using them up into water
H^+ passing through ATP synthase	protons travel from outside the matrix to inside through ATP synthase protein complexes: with three pumps and the depletion of H^+ by the creation of H_2O, the concentration of the protons outside the matrix are much higher than inside (unless with leaky membranes as with DNP or valinomycin— which can also be useful because it creates excessive heat and minimal ATP, such as during hibernation), and therefore they flow down their concentration gradient (chemiosmosis: facilitated diffusion of ions besides water); kinetic energy of two protons (one pair of electrons) passing through powers the phosphorylation of 1ADP + P_i to ATP; creates 32-34 ATP, which can be used immediately in the cell; DCCD and oligomycin are used to block ATP synthase

Jonathan Lam
Mrs. McTague
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Study Guide: Cells

1. **Explain the key <u>structural</u> differences between prokaryotic and eukaryotic cells.**
    a. The bacteria cell has a nucleoid— an area in which DNA is located, but not defined within a nucleus like eukaryotic cells.
    b. A prokaryotic cell is smaller.
    c. A prokaryotic cell does not have membrane-bound organelles.
    d. A prokaryotic cell can have a capsule, an additional hard protein shell that encases it similar to a plant cell wall, but is used for virility.
    e. Prokaryotes have plasmids and rings of DNA, while eukaryotic cells have chromosomes.
    f. Flagella are simpler in prokaryotes — not made of microtubules

2. **Average Sizes:**
    a. prokaryotic cell: 1-10 microns
    b. eukaryotic cell: 10-100 microns

3. **Explain why all cells contain DNA and ribosomes.**
    a. DNA and ribosomes are both at the core of creating proteins. Proteins are essential to carrying out almost every function in a cell, including building and breaking down molecules, making up tough structures, or transporting materials. DNA is the instructions for making all these essential molecules of protein, and ribosomes are the organelles that create the proteins

4. **Explain the function of every part of a bacteria cell.**
    a. capsule
        i. encases a virulent bacteria, so that it can avoid engulfment by white blood cells
    b. cell wall
        i. made of peptidoglycan, provide support for the cell
    c. cell membrane
        i. regulates what comes in and out of the cell
    d. ribosomes
        i. synthesizes proteins, which are essential to the cell
    e. pili
        i. help the cell grab onto things
    f. flagella
        i. move the cell (spiralling)
    g. nucleoid
        i. contain DNA (no true nucleus)
    h. cytoplasm
        i. store all the cellular organelles

5. **Shapes of bacteria cells.**
    a. cocci (spherical)
    b. spirilla (spiral)
    c. bacilli (rod)

6. **Arrangements of bacteria cells**
    a. di- (pairs)
    b. strepto- (strips, chains)

c. staphylo- (bundles)

7. Differences between archaea and bacteria.

a. eubacteria live in less harsh environments
b. eubacteria are much more common
c. eubacteria are virulent
d. eubacteria are larger than archaebacteria
e. eubacteria's cell walls contain peptidoglycan

8. Classifications:

a. bacteria:
    i. heterotrophic: consume other organisms, need outside food source
    ii. autotrophic: provide energy for themselves
b. bacteria:
    i. aerobic: need and thrive in oxygen
    ii. anaerobic: cannot live in oxygen
    iii. facultative anaerobic: prefer oxygen but don't have to live in it

9. Uses of bacteria:

a. cause disease by killing other cells and releasing toxins
b. can be used to clean up oil spills
c. can be used to create flavors in foods
d. decompose
e. change nitrogen
f. can be used to make insulin

10. Antibiotics work by:

a. interfering with ribosomes (different from eukaryotic ones) to affect protein synthesis
b. interfering with DNA to interfere with protein synthesis and reproduction
c. interfering with the synthesis of the cell wall so that the cell would burst

11. Examples of bacterial diseases:

a. salmonella and E. coli
b. H. pylori (stomach ulcers)
c. staphylococcus

12. Examples of viral diseases:

a. influenza
b. cold
c. ebola
d. hepatitis

13. Size of viruses:

a. 10-300 nm (much smaller)

14. Uses of viruses:

a. viruses are mostly virulent and not really beneficial
b. used a little bit in genetic engineering

15. Prevention:

a. bacteria:
    i. vaccines
    ii. antibiotics
b. viruses:
    i. vaccines

16. Vaccines give an immunity by:

a. giving the person a weakened pathogen or antigen that will not overwhelm their immune system
b. the person gets an immune response
    i. white blood cells create antibodies
    ii. memory cells store idea of antibodies
c. whenever someone gets pathogen again antigens quickly take it out

17. Vaccines are "safe" because:

a. weakened
    i. attenuated or weakened actual pathogen
        1. chemicals
        2. old age
    ii. a similar pathogen
        1. not as powerful
b. non-virulent
    i. toxoid
        1. weakened toxin
    ii. subunit
        1. uses a particle that will trigger an immune response
    iii. killed or inactivated
    iv. accelular

18. Vaccine is not only way to become immune— if you get the actual pathogen you will become immune as well.

19. A person has to have had the immune response to be immune, either by getting it themselves or through a vaccine. They will not be immune without having the illness.

20. Treatment of viral infections:

a. anti-viral medicines: slow down regeneration of viral particles so that they take longer
b. sleep and let immune system take care of it
c. antibiotics cannot be used— they target living organisms, specifically parts of bacteria

21. Lytic and lysogenic cycles:

a. both in DNA viruses
b. lytic the DNA forms its own ring
    i. ring is read and proteins are created for capsule and for DNA
    ii. viruses reproduce immediately
c. lysogenic viruses don't reproduce immediately
    i. DNA becomes a prophage, part or organism's (probably bacteria's) DNA
    ii. when environmental stimuli comes then it switches over to lytic cycle

22. Retroviruses are different because:

a. they are RNA viruses whose RNA translates to DNA which becomes a prophage and goes through a cycle very similar to the lysogenic cycle

23. Viruses are given at different frequencies because:

a. some are "stronger" — they stimulate a strong immune response because they infected more of you

24. They are considered living or non-living because:

a. living:
    i. can reproduce (with help)
    ii. have genetic material
        1. can evolve
b. non-living
    i. do not have all the essential properties of life

25. Theory of endosymbiosis:

a. eukaryotic cells were formed when larger prokaryotes engulfed smaller prokaryotes, and they formed a symbiotic relationship
    i. the larger cell engulfed the smaller one
    ii. the smaller cell started to produce energy or some other beneficial function to the larger prokaryote
    iii. the smaller cell stayed in the larger cell, and reproduced by itself
    iv. after many generations, the smaller cell lost the function to live by itself, can only live in the larger cell as an organelle
b. evidence:
    i. mitochondria and chloroplasts
    ii. double membranes
    iii. independent reproduction
    iv. have their own DNA and ribosomes
    v. similar in size to some bacteria

26. Explain the process of the creation of proteins in a cell.

a. a gene from DNA is read into mRNA
b. tRNA carries mRNA to a ribosome (rRNA)
c. ribosome reads mRNA in pairs of three by sliding it through its subunits
    i. finds start codon AUG
    ii. reads pairs of three to determine correct amino acid sequence
d. primary structure protein either
    i. goes out into the cytoplasm to be assembled there (if free floating)
    ii. goes to the rough ER (if attached to it)
e. in rough ER
    i. assembled into secondary and tertiary structures
    ii. some substances added to it
    iii. packages it in a transport protein to the cis side of a Golgi
f. in Golgi apparatus
    i. travels through membrane sacs
    ii. each membrane sac has different enzymes that add some finalizing touch to the protein
    iii. some membrane sacs add more proteins to the proteins (quaternary structure)

iv. packages it in:
    1. secretory vesicle: to transport out of the cell
    2. lysosomes: for storage of hydrolytic enzymes within the cell
    3. vacuoles: for storage of non-hydrolytic enzymes and other substances inside the cell

27. Differences between animal and plant cells:

a. plant cells:
    i. have cell walls (cellulose)
    ii. are more polygonal
    iii. have a central vacuole and decentralized nucleus
    iv. cells are right next to each other, cell walls attached to each other, cytoplasm flowing between cells through plasmodesmata
    v. have plastids
b. animal cells:
    i. are circular
    ii. have a central nucleus
    iii. have centrioles and flagella and cilia

28. Explain the importance of cellular organelles:

a. mitochondrial disease:
    i. cells do not get energy and can die
    ii. if there is no energy, there can be no functions done, and the organism dies
b. lysosomal disease:
    i. enzyme (Hurler) or enzymes (I-cell) missing from a cell
    ii. a molecule cannot be broken down
        1. causes buildup in the cell that impairs it
        2. can lead to a lack of the building blocks of the molecule
    iii. can cause an organism to die if enough of its cells do not function correctly

29. Predict what would happen in cells, and to the human body overall, if a given organelle was not present or not able to function properly.

a. nucleus: reproduction
b. nucleus, ribosomes, rough ER, Golgi: protein synthesis
c. lysosome: waste buildup or lack of certain molecules.
d. cytoskeleton, cell wall: structure of cell would fail, collapse
e. cilia, flagella: no movement (wouldn't affect much in humans)

30. Explain the cell as the fundamental building block of life.

31.

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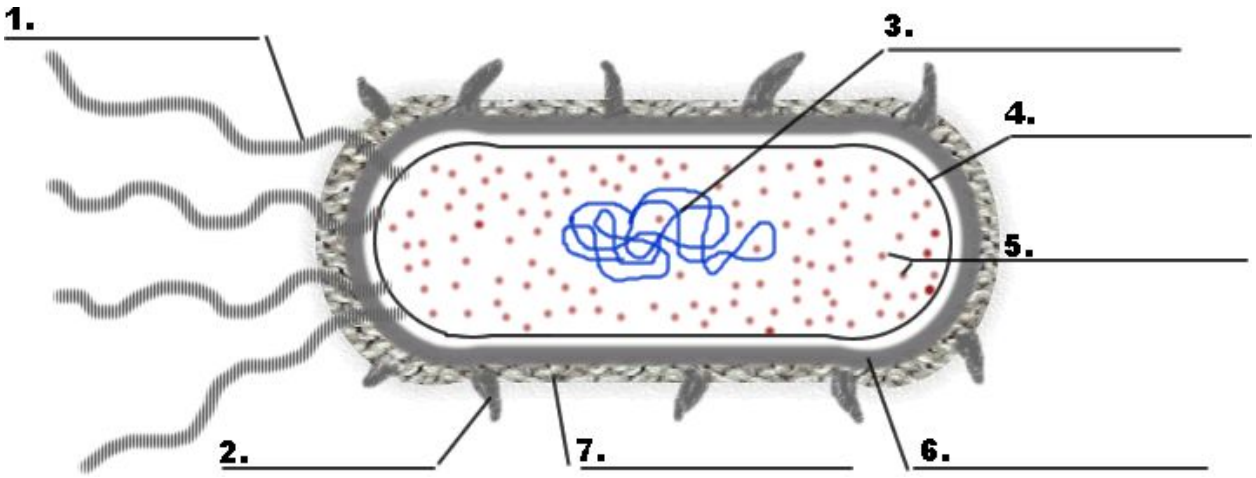

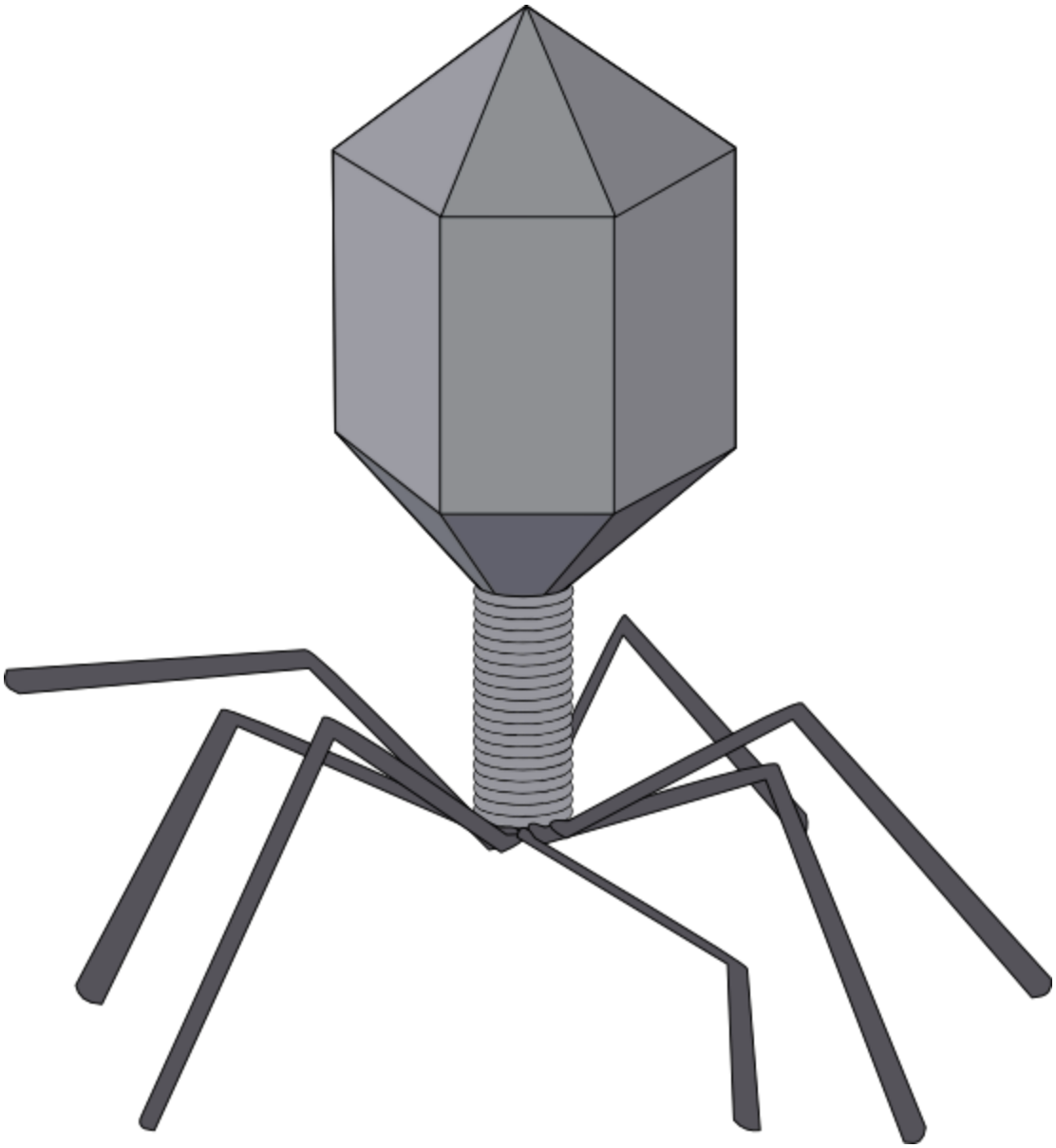

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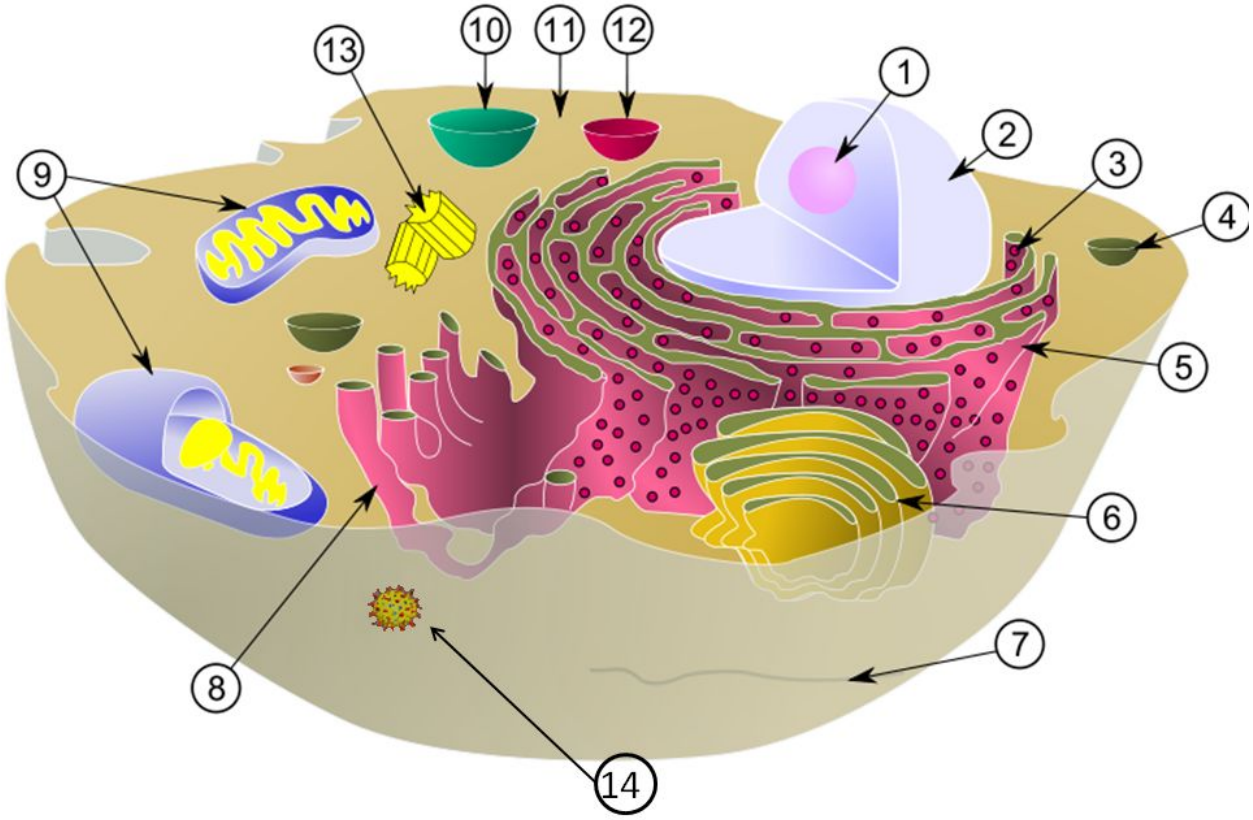

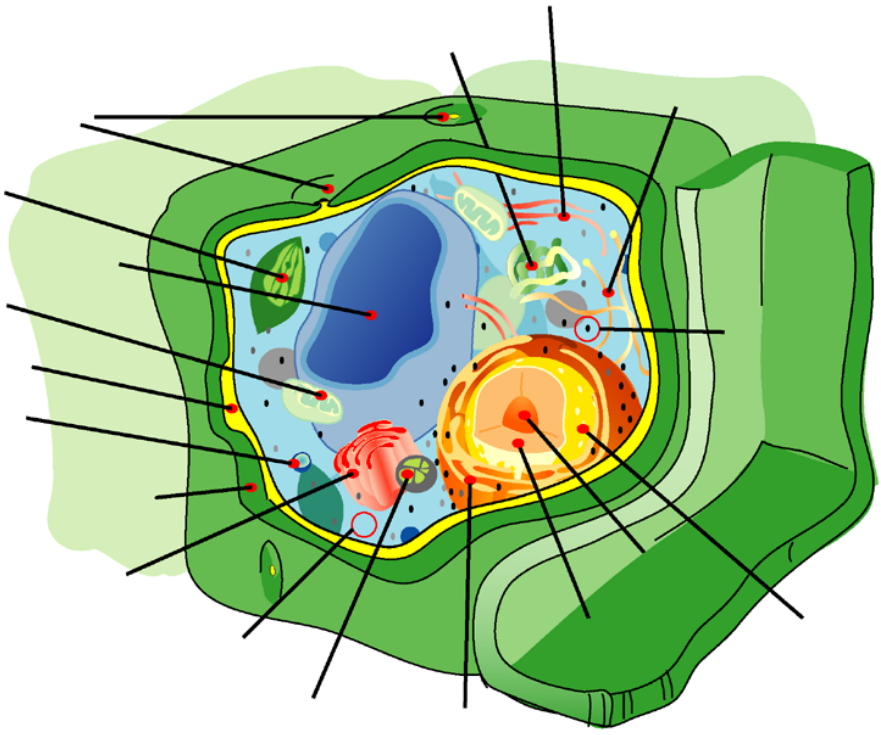

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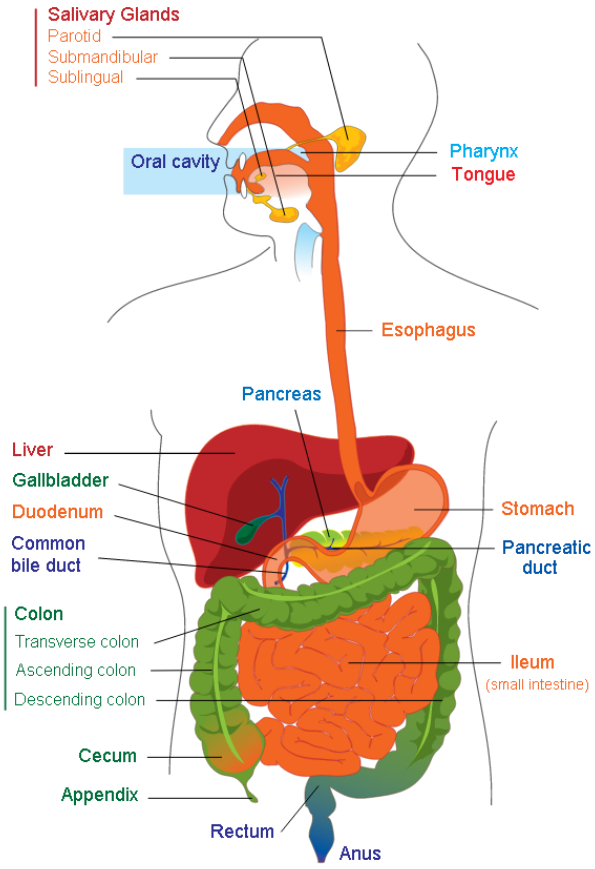
Review Sheet: Enzymes, the Digestive System, and Nutrition

Be able to label a diagram of the digestive system.



You need to know the function(s) of each part of the digestive system and its accessory organs (salivary glands, pancreas, liver, gall bladder). Since structure fits function, also consider and be able to describe how the structure of these organs allows them to perform their functions well.

Part	Function	Form/Structure	Other
mouth (oral cavity)	ingestion		first part of digestive system
- teeth	mechanical breakdown	strong incisors for holding on molars for grinding food canines for tearing food	depends on food
- tongue	physical digestion moving the bolus	4 intrinsic and 4 extrinsic muscles to change shape and move	some consider it the strongest muscle
- salivary glands	release saliva		three pairs begins secreting upon

			sensing food parotid, sublingual, and submandible glands
- saliva	digestion moistening	amylase: breaking down starch lysozyme: kill bacteria glycoproteins: lubricate foods buffers: neutralize acids in the foods, prevent cavities	first chemical digestion
pharynx (throat)	food passes through here		leads into mouth, nose, eyes, ears, esophagus, and trachea
- larynx (voicebox)	moves up when swallowing, triggers epiglottis		
- epiglottis	moves down to prevent food from going down the trachea	a flap at the back of the throat	
esophagus	carries food from mouth to stomach	mucus: lubricate food circular smooth muscles move food by peristalsis long, skinny elastic: to allow food to pass muscular: to push food by peristalsis	25 centimeters long first area with peristalsis
stomach	store food mix food kill bacteria break down proteins	pepsin: breaks down proteins HCl: activate pepsinogen to pepsin, kill bacteria, break down foods mucus: protect stomach lining muscular sac	food called chyme now does most of the mechanical break down two sphincters are called cardiac and pyloric sphincters
intestines	chemically break down and absorb food		three sections: duodenum, ileum, and jejunum
small intestine	break down and absorb food	2.5cm wide 6m long	99% of digestion happens here (digestion and absorption- and some in the large intestine and the stomach and mouth as well)
duodenum	do most of the chemical breakdown of foods	enzymes, bases from pancreas bile from liver and	short

		gallbladder enzymes from lining (disaccharide enzymes: maltase, sucrase, lactase)	
liver	produce bile regulate blood nutrients after being absorbed	bile: emulsify fats	in a “strategic position” between the intestines and the heart - so it can supply enzymes and bile to the duodenum and absorb nutrients from the ileum, jejunum, and large intestine has over 500 functions in the human body (digestion is just a little bit) largest gland in the body, with multiple lobes that function differently
gallbladder	store bile concentrate bile secrete bile (along with liver)		connected to liver and duodenum (with bile duct)
pancreas	produce digestive enzymes produce bases produce hormones to regulate blood sugar	most enzymes- to break down all four basic macromolecules (amylase, trypsin, ghinotrypsin, peptidases, nucleases, lipase) sodium bicarbonate: neutralize stomach acid glucagon and insulin: regulate blood sugar (glucagon to increase blood sugar, insulin to store blood sugar (deficiency is called diabetes))	
ileum and jejunum	absorb most nutrients to the body	covered in waves, covered in villi, covered in microvilli, and has many capillaries and lymph vessels inside it	absorbs all molecules small enough; the liver detoxifies and filters out unneeded / harmful molecules absorption happens often through diffusion, but sometimes transport proteins (“pumps” to force nutrients in when the concentration inside is higher than outside)

villi	absorb nutrients (in ileum and jejunum)	have microvilli have capillaries have lacteals	cells in villi reassemble lipids before moving them away
microvilli	absorb nutrients (on villi)	the nutrients actually land in here wavy so that nutrients can get trapped	where the absorption happens absorbed nutrients move by diffusion
capillary	carry nutrients away		most macromolecules and absorbed materials go into here (e.g. amino acids, monosaccharides, nucleic acids) eventually empty into venuoles -> hepatic portal vein -> liver -> heart -> body
lacteal	carry lipids away		only lipids go into here (too large when assembled to fit in the capillaries) eventually empty into the hepatic portal vein
large intestine (colon)	absorb water create nutrients		much wider than small intestine
cecum	houses digestive bacteria		short in humans long in vegetarians food is called feces by now separated into the ascending, transverse, and descending colon
- appendix	houses digestive bacteria (in cecum)	E. coli: break down cellulose, create vitamin K (more prominent in herbivores; eat probiotics to help; antibiotics kill it and can cause diarrhea; need these to live in baby when it is newborn) white blood cells: part of our immune system, contribute to immunity	a vestigial structure in humans now prone to infection from food getting stuck in it
rectum	stores feces		
anus	expel waste (feces)	has a sphincter	the only sphincter we can control

You need to know the vocabulary of the digestive process (e.g., bolus, chyme, peristalsis, sphincters, mechanical/physical digestion, chemical digestion, ducts, villi, microvilli, lacteals, capillaries, ingestion, digestion, elimination, alkaline, gastrin, chief cells, parietal cells, etc).

Term	**Definition**
herbivore	an organism that can eat plants and plant products only
carnivore	an organisms that can eat animals and products only
omnivore	an organism that can eat both categories of food (meat and vegetables)
alimentary canal	a digestive tract with two openings, an anus and a mouth
crop	pouch-like organ that stores and softens food
stomach	a muscular sac that churns and grinds food
gizzard	a specialized stomach that uses the help of abrasive materials, especially rocks and dirt
accessory organ	an organ that aids in the digestion of food , but does not have food pass through it, typically by secreting enzymes or other digestive fluids
bolus	food after it leaves the mouth (mixed with saliva, chewed up)
chyme	food after it leaves the stomach (proteins broken down, mixed more)
feces	waste products without nutrients (food after it leaves the large intestine)
peristalsis	a wavelike, involuntary contraction of smooth muscle to move food through the digestive tract
sphincter	a circular ring of muscle that contracts most of the time but opens for short amounts of time to let food pass; a weak sphincter may cause problems such as acid reflux
mechanical digestion	the physical breakdown of food into smaller particles, but not changing the type of molecule
chemical digestion	the chemical breakdown of food into smaller molecules, changing the molecule and having a chemical reaction; usually happens through hydrolysis
duct	a tube that carries a fluid (typically a certain secretion, such as bile) from one bodily part/organ to another
villi	a projection inside the ileum and jejunum that absorbs nutrients to capillaries and lacteals

microvilli	smaller projections on the surface of the cells of villi that are the actual absorptive surface; nutrients move in here by diffusion
lacteal	a lymph vessel that absorbs lipids
capillary	a blood vessel that absorbs nutrients in the digestive system, leading to venuoles and the hepatic portal vein
ingestion	the first step of digestion; the act of eating, or moving food into the body
digestion	the second step of digestion; the act of breaking down food into pieces small enough for absorption
absorption	the third step of digestion; the act of transferring essential nutrients from the food into the body
elimination	the last step of digestion; the act of removing feces (unabsorbed and nutrient-poor waste from the food) from the body
alkaline	synonym of basic; pancreatic juice includes an alkaline substance, sodium bicarbonate, that helps neutralize stomach acid
gastrin	a hormone that is created when sensing food (either by the senses or in the stomach), and is sent out in the bloodstream to stimulate the creation of gastric juices; is stopped by a negative-feedback loop when the pH is below 3 in the stomach
gastric juice	the secretion of the lining of the stomach; includes mucus from the mucous cells, pepsinogen from the chief cells, and H^+ and Cl^- ions from the parietal cells
chief cells	secrete (inactive) pepsinogen into gastric lumen; will activate in the lumen
parietal cells	secrete H^+ and Cl^- ions into the gastric lumen; will combine in the lumen
mucous cells	secrete mucus into the gastric lumen
lumen	the cavity, or open space, of a certain body part (e.g. a stomach, blood vessel, small intestine)

Other Vocab

Term	**Definition**
artery	a blood vessel that carries blood away from the heart (usually oxygenated)
arteriole	a smaller branch of an artery

vein	a blood vessel that carries blood back from the heart (usually deoxygenated)
venuole	a smaller branch of a vein
hepatic portal vein	the vein that carries all the blood from the intestines straight to the liver (before the heart) so that it can be filtered and regulated first
capillary	a tiny blood vessel where the exchange of oxygen for waste materials takes place, and where nutrients are picked up in the intestines
extracellular / interstitial fluid	the fluid between cells - nutrients sometimes flow in here so that cells in a certain area (not always adjacent to the capillary) can exchange nutrients

Be able to describe common problems with our digestive systems (GERD, ulcers, diarrhea, constipation), what causes them, and treatments.

GERD (chronic acid reflux)

- caused by a weak cardiac sphincter
- stop smoking and drinking (weaken body as a whole)
- lose weight, eat small meals (less volume in stomach, so less likely to go up to esophagus)
- don't sleep after eating, sleep with head up (so gravity pulls stomach acid away from esophagus)
- medications to reduce stomach acidity
- medicines to impede acid production
- surgery to strengthen cardiac sphincter

(stomach) ulcers

- originally thought to be stress, aspirin, smoking, alcohol, coffee
- caused by H. pylori, which burrows into the stomach lining and affects the mucous cells
- cured with antibiotics and bismuth

diarrhea

- when food moves too quickly through the large intestine, because the body wants to get it out (usually because of infection), and not enough water is absorbed

constipation

- when water moves too slowly through the large intestine because peristalsis doesn't move it fast enough (not enough fiber in diet)

(extra) hemorrhoids

- swollen veins in the anal canal
- caused by excessive strain
- prevented with enough fiber
- can be removed by surgery

(extra) diverticulitis

- when bulging sacs in the large intestine (or anywhere in the digestive system) get swollen and infected

Be able to describe why organisms need to eat. What does food provide? Describe the three nutritional needs of all organisms.

food provides:

- energy
- building blocks
- other nutrients:

nutritional needs:

- macromolecules, organic molecules
- vitamins
- minerals

Be able to describe the four classes of essential nutrients. Distinguish between vitamins and minerals. Describe coenzymes as a link between vitamins and enzymes.

- essential fatty acids
    - fatty acids that we cannot create by ourselves but are still essential to our living
- essential amino acids
    - amino acids that we cannot create by ourselves but are still essential to our living
    - typically, single vegetables are "incomplete" - that is, not having all the essential amino acids. But sometimes a group of two vegetables (e.g. corn and beans) will have all of them (including histamine for infants)
- vitamins
    - organic, essential molecules that are essential to our health in very minute quantities
    - B vitamins function as coenzymes
    - B, C vitamins are water-soluble
    - A, D, E, K vitamins are fat-soluble
- minerals
    - inorganic elements necessary in our body in minute amounts

Describe the obesity epidemic in the United States. Explain how diet and exercise can influence the risks of cardiovascular disease and cancer. Include an explanation of the differences between HDL and LDL cholesterol.

More and more people are getting obese, meaning that they accumulate too much fat, in the U.S.A. and other developed countries. This can lead to many serious health problems and a lower standard of living. It has doubled to over 30% in the U.S. in the last two decades. There are a few causes for it: genetics; leptin deficiencies; and evolutionary adaptations to survive. Included in this epidemic are cholesterol. LDL cholesterol blocks arteries, increases the risk for cardiovascular disease, and increase blood pressure. People are eating too much trans and saturated fat, not exercising enough, and smoking too much, which cause the increase in LDL and lower HDL.

Be able to accurately and in detail answer all of the "You Should Now Be Able To" statements at the end of the Digestion and Nutrition PowerPoint.

Other

evolutionary adaptations of the digestive system

- size of stomach
    - carnivores have large, expandable stomachs - may not get to eat for days, must spend long time digesting the same food
    - herbivores have steady source of food, not large stomachs
- length of digestive tract
    - herbivores need to digest tough cellulose, have a much longer digestive tract than carnivores
    - meat is relatively easy to digest, and carnivores have shorter digestive tracts
- size of cecum
    - carnivores have small cecums, because they do not really need it - it stores food so that bacteria can digest the cellulose in it
- ruminants

    - some herbivores who eat a lot of tough plants, such as cows and grass, have multiple stomachs, and are called ruminants, which allow them to digest food multiple times, including digestion of the cellulose by the bacteria in their gut

feeders

- substrate
    - eat through their food
    - worms
    - maggots
- fluid
    - only drink nutritional rich substances
    - mosquitoes
    - hummingbirds
- bulk
    - eating large chunks at a time
    - humans
    - most animals
- suspension
    - strain a substance, usually water, for food
    - baleen whales

Heimlich maneuver

- use fist and press up into diaphragm
- will increase pressure into lungs and force air into the trachea, hopefully popping food out

feedback loops

- positive
    - continue a reaction indefinitely
    - end product stimulates the production of more end product, starting cycle over and over and over forevermore
    - pepsinogen turns into pepsin with the help of pepsin, which continues to activate pepsin proteins
- negative
    - stops the reaction
    - makes the reaction have a specific stopping point, once the reaction is finished, to achieve homeostasis- so that there is not too much of the reaction
    - gastrin is created to stimulate the stomach juice; when the acidity is too strong, the gastrin is affected by the acidity, and stops to function

Don Boone

- man who had his intestines sucked out by a change in pressure
- survived, but with nutrition problems
- 5 year-old girl had similar ordeal

another form of digestion

- within a cell, a food vacuole attaches to lysosome with enzymes that digest it
- happens in single-celled protists

functions of macromolecules

- fats help absorb fat-soluble vitamins (A, D, E, K)
- fats help regulate cells
- pectin is a form of starch, but is branched
- dietary fiber is the food (usually carbohydrates) that body cannot digest
    - (water-)soluble fibers
        - turn into a gel
        - let absorption take longer, slows it down

        - makes you feel full longer
        - oats, fruits
    - (water-)insoluble fibers
        - adds bulk to waste
        - allows food to move more easily throughout
        - grains, vegetables

Jonathan Lam
Mrs. McTague
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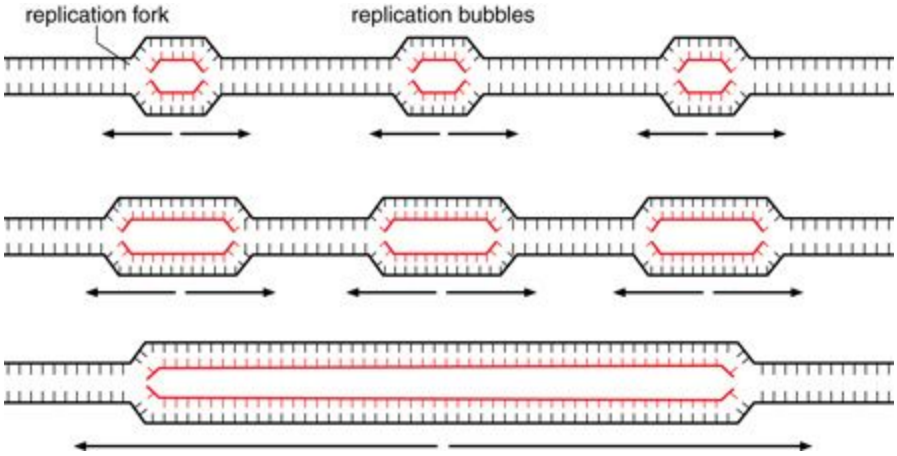
DNA Replication and Protein Synthesis Steps

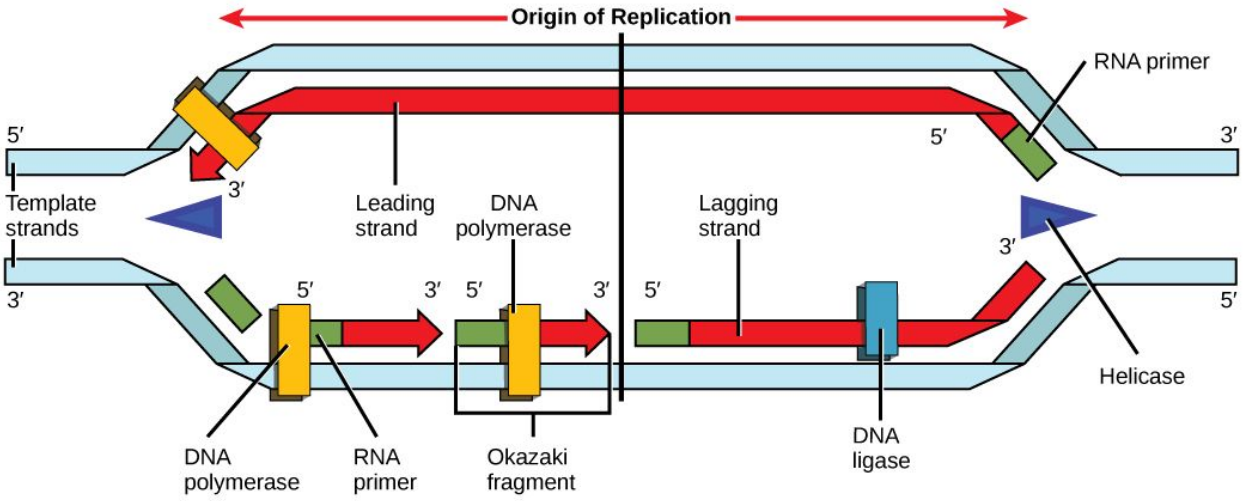
DNA Replication

1. DNA is uncoiled as chromatin in the nucleus during the S stage of interphase.
2. At certain "replication origins," DNA helicase can attach to the DNA strand and start unwinding (breaking the H-bonds) and opening it up (in both directions). This creates a "bubble" with two "replication forks" on each end.



3. When the fork is large enough (for a protein to get in), a DNA polymerase III enzyme attaches to the DNA strand that is growing from the 3' to 5' end. It starts using base pairing the original strand (the "template") to match the nucleotides and attach them to the growing strand backbone (using dehydration synthesis), creating the second polynucleotide strand from 5' to 3' (antiparallel to original strand) (red in above diagram), thus forming a complete DNA strand. On this strand, the "leading strand," the polymerase works continuously, because it can continuously attach new nucleotides to the 3' end of the growing strand.
4. On the "lagging strand", the DNA replication happens slower and is more interrupted. Because the lagging strand is opening up from 5' to 3', the growing strand opens up 3' to 5', in the direction that the polymerase cannot work. Therefore, there has to be a RNA primase, which creates a short (~10 nucleotide) piece of RNA that attaches to a piece of DNA close to the fork of replication, from which the 3' end is exposed. Then, the DNA polymerase III can come in and start base pairing and synthesizing DNA because it has a 3' end anchor. When it reaches the next RNA primer, DNA polymerase III leaves and DNA polymerase I enters, and it replaces the old RNA primer (used as an anchor and not needed anymore) with DNA nucleotides. These fragments, called Okazaki fragments, are still not bonded by their backbone, however,

and DNA ligase has to come in and bond the two Okazaki fragments together. This happens repeatedly.



5. Each of these bubbles opens up wider and wider until they run into each other, diverging and becoming two separate strands of DNA (see first diagram).

Notes:

- DNA replication is "semi-conservative," meaning that some of the some (half) of the new DNA is from the old DNA.
- After the base pairing by DNA polymerase, nuclease can recognize errors in the replication. DNA polymerase and ligase can redo the base pairing and mending to fix it. This process is called "excision repair."

Protein Synthesis

1. This can happen any time during interphase. It starts in the nucleus.

Transcription (putting a gene from DNA into mRNA)

2. Initiation
    a. At a "promoter" region in DNA (usually a TATA box), RNA polymerase attaches to the DNA.
    b. RNA polymerase starts unwinding and unzipping (breaking H-bonds in) DNA.
3. Elongation
    a. At the end of the promoter region, the polymerase starts to transcribe the nucleotide sequence into RNA nucleotides— it uses a template strand of DNA (the other strand is unused) to base-pair-match the RNA nucleotides, forming a complementary strand to the template strand.
        i. Like in DNA replication, the addition of a nucleotide comes from a nucleoside trophosphate, which releases a pyrophosphate, which gives off energy.
    b. The growing mRNA strand breaks off as it grows, and the DNA re-zips and rewinds itself, from the energy created from the release of the pyrophosphate.
4. Termination
    a. The RNA polymerase reaches a stop sequence, which causes it to break off, as well as the RNA, from the DNA.
    b. The DNA fully re-zips and rewinds itself back into its regular, double-helix shape.

mRNA preparation

5. Still in the nucleus, the mRNA has to be prepared so that it is ready to enter the ribosome.
6. On the end that is going to feed into the ribosome, there is a single guanine added (the 5' cap). On the other end there is a repetition of 50-250 adenosines (the (3') poly-A tail). This is to have the mRNA feed the right way into the ribosome, and so that it is not attacked by enzymes in the cytoplasm.
7. Introns (non-coding nucleotide sequences) are removed from the mRNA, so that only the exons are left.
8. The mRNA now floats out into the cytoplasm, and to a ribosome.

Translation (turning an mRNA gene into a amino acid sequence (protein primary structure))

9. Initiation
    a. The 5' end of mRNA attaches to a smaller subunit of a ribosome (made of rRNA and made in the nucleolus). Then, a larger ribosomal subunit attaches.
    b. In the P site of the larger subunit, there is a initiator tRNA molecule carrying methionine, whose anticodon matches with the AUG start codon on the mRNA, from which the mRNA starts being read. Because the only start codon is AUG, all protein primary structures begin with a methionine amino acid (which may be trimmed off later).
10. Elongation
    a. Another tRNA molecule with the matching anticodon for the next codon (three nucleotide bases on the RNA, which codes for a specific amino acid; in DNA, the groups of three are called "triplets") comes into the A site (adjacent to the P site). It carries with it an enzyme and an amino acid.
    b. The amino acid chain from the tRNA in the P site bonds to the amino acid in the tRNA in the A site (with a peptide bond).
    c. The ribosome shifts down one codon, so that the tRNA in the P site moves to the E site, and the one from the A site (with the polypeptide chain) moves to the P site. The one in the E site exits the ribosome to pick up more amino acids, and the A site is now empty.
    d. Elongation repeats.
11. Termination
    a. When one of several stop codons is reached, then the tRNA, rRNA, mRNA, and polypeptide chain will all dissociate. The protein can now continue to form further structures (i.e. secondary structure, tertiary structure, potentially quaternary structure).
        i. If the ribosome was connected to an ER, then the protein goes straight into the ER.
        ii. If the ribosome was free-floating, the protein would go into the cytoplasm to get assembled.

Mutations

- classifications:
    - DNA structure mutations
        - point mutations: when a single nucleotide is incorrect, inserted, or deleted, causing an amino acid to be different
        - frame-shift mutations: when there exists an extra or missing nucleotide, causing an amino acid and all the ones downstream (all the nucleotides down in the 5' → 3' direction) to be different
            - usually more serious than point mutations, because it affects multiple amino acids
    - protein structure mutations
        - nonsense mutations: a point mutation that causes a codon to become a stop codon
            - can greatly shorten proteins, therefore having an enormous effect on the protein
        - missense mutations: a point mutation that changes an amino acid from one to another

        - silent mutations: mutations that don't actually change the amino acid (some amino acids are coded by multiple codons)
        - conservative mutations: mutations that change amino acid to another of same type
            - less serious than non-conservative, worse than silent
        - non-conservative mutations: mutations that change amino acid to another of a different type
- mutations originate from DNA but show on proteins
- mutations can be classified by their effects on DNA or protein
- "mutagenesis" is production of mutations, and is caused by
    - DNA replication and recombination (aging)
    - mutagens
        - radiation
        - chemicals

Notes:

- process called "central dogma of molecular biology," and discovered by Francis Crick, Nobel Prize winner who found out the structure of DNA
- "mRNA" = "messenger RNA"
- "tRNA" = "transfer RNA"
- "rRNA" = "ribosomal RNA"

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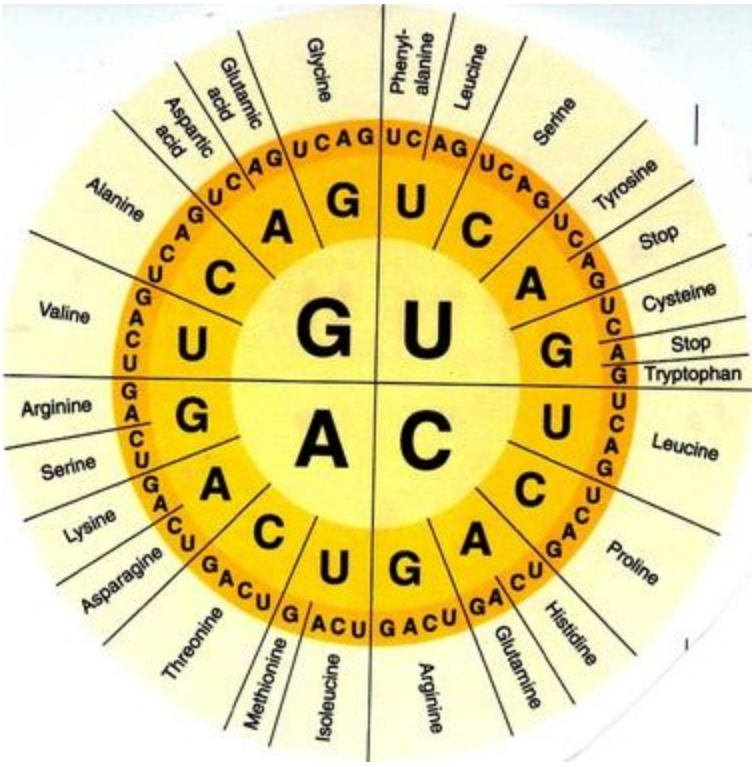
- codons can be found out (by a human) with a chart



	U	C	A	G
U	UUU = phe UUC = phe UUA = leu UUG = leu	UCU = ser UCC = ser UCA = ser UCG = ser	UAU = tyr UAC = tyr UAA = stop UAG = stop	UGU = cys UGC = cys UGA = stop UGG = trp
C	CUU = leu CUC = leu CUA = leu CUG = leu	CCU = pro CCC = pro CCA = pro CCG = pro	CAU = his CAC = his CAA = gln CAG = gln	CGU = arg CGC = arg CGA = arg CGG = arg
A	AUU = ile AUC = ile AUA = ile AUG = met	ACU = thr ACC = thr ACA = thr ACG = thr	AAU = asn AAC = asn AAA = lys AAG = lys	AGU = ser AGC = ser AGA = arg AGG = arg
G	GUU = val GUC = val GUA = val GUG = val	GCU = ala GCC = ala GCA = ala GCG = ala	GAU = asp GAC = asp GAA = glu GAG = glu	GGU = gly GGC = gly GGA = gly GGG = gly

Jonathan Lam
Mrs. McTague
H. Bio. per. 3
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Elodea, Onion, Potato Lab Comparison and Analysis

Comparison Chart

	elodea	**onion (stained with iodine)**	**potato (stained with iodine)**
shape	rectangular	rectangular	pentangular
dimensions	25x50 microns	75x250 microns	150x150 microns
color of cytosol	clear	clear	clear
other colors present	green (chloroplasts)	none	purple (iodine and starch)
has chloroplasts	yes	no	no
has leucoplasts	no	no	yes
has chromoplasts	no	no	no
nucleus visible	no	yes	no
central vacuole visible	no	no	no

Purpose of Lab

The purpose of this lab was to how the diversity and unity in plant cells— that some structures exist in all plant cells, and some do not exist or are not as important in some plant cells but are in others. In other words, if you only looked at the Elodea cell, then you might infer that all other plant cells look very similar to it, but vastly different potato and onion cells can show that this is not the case. For example, while elodea and onion cells are long and rectangular, potato cells are pentangular, and larger. The color of all their cytosols are clear, but there are some other pigments in the cell that differ: for example, the elodea cells are mostly green because of their chloroplasts, and potato cells are purple due to their staining of iodine. They also have different combinations of plastids, sometimes having many or none of one type. Another point of comparison was that only the onion cells had their nucleus visible, and none of the cells had a visible central vacuole, even if it was the largest organelle of a cell. These were all interesting and informational aspects that sometimes differed and sometimes were constant amongst these three types of cells.

Jonathan Lam
Mrs. McTague
H Bio. per. 3
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(Revised) Enzyme Lab Analysis and Conclusion Responses

Suppose you had dipped a filter paper disk in a 30% potato extract solution. Using the graph, predict how long it would take this disk to rise to the top of a beaker of H_2O_2.

If we had dipped the filter paper disk in 30% potato extract, I predict that it would have risen in about 42 seconds, according to our trend line (about ⅛ of the way between the 25% and the 50%).

How does the concentration of the enzyme affect the rate of the breakdown of hydrogen peroxide? Use the results of this experiment to justify your answer.

We noticed that the higher the concentration of the enzyme catalase of potato extract, the faster the hydrogen peroxide breaks down, and the faster the byproduct O_2 bubbles form and push the disk up faster. The graph shows this very clearly, with each increase in concentration leading to a decrease in time of the bubbles to raise the paper disk. With no catalase, the paper disk didn't rise (in a ten-minute time-frame), the 25% potato solution took 57 seconds, followed by the 50% of 21 seconds, the 75% of 14 ⅔ seconds, and the 100% with 12 ⅔ seconds. In other words, the disk dipped in 25% potato solution took 4 ½ times as long as the 100% potato extract, which is a huge difference.

Our data also suggests that the concentration of catalase and breakdown of the H_2O_2 is not a linear relationship. Instead, it looks exponential, with a smaller change between each interval. This means that when a high concentration of enzyme is present, then changing the concentration would be insignificant. This can be seen in our graph, because the change between the 75% and the 100% is only 2 seconds, while the change between the 25% and the 30% is 36 (18 times as much). From this I can conclude that enzymes cannot make a reaction instantaneous, and it can only increase the speed of a reaction to a certain point.

Jonathan Lam
Mrs. McTague
H Bio. per. 3
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Study Guide: Evolution

1. **Explain what science is. How does it try to explain natural phenomena?** Science is "the search for truth" through the scientific method. The word itself comes from a latin root meaning "to know" - It is a way of knowing - an approach to understand the natural world. It uses observations and facts to explain our natural world. It uses well-tested laws, and theories to explain natural phenomena, but not religion or unsupported ideas. It compares its theories objectively with the natural world.
2. **Explain the difference between inductive and deductive reasoning.** Inductive reasoning is a method of logic to come to *broad*, *general* conclusions based on specific observations. Deductive reasoning is a method of logic to come to a *specific* conclusion based on lots of general past knowledge or solid facts, usually formed through inductive reasoning. Deductive reasoning usually leads to hypotheses for experiments, and often many deducted conclusions can be formed from a single broad idea. It is also usually used to test the broad idea, because it is based off ofth
    a. example of inductive reasoning: Wallace formed the idea of biogeography (theory, broad idea) after studying the similarities of closely placed species (specific evidence).
    b. example of deductive reasoning: I know that mammals have no feathers (general statement); cows are mammals; therefore, cows do not have feathers (specific conclusion)
3. **Explain the difference between a hypothesis and a theory.** A hypothesis is a testable reasonable explanation of natural phenomena based on observations and research, that is not necessarily well-tested. A theory is a broad idea that is well-tested, supported by many well-tested laws, and can be proven wrong by new evidence. Hypotheses can *become* theories with enough supporting evidence. Theories are usually much broader, and can explain new observations and is general enough to generate new underlying hypotheses.
4. **Explain the difference between an observation and an inference.** An observation is an objective noting of a fact or occurrence. An inference is a logical conclusion based on observations.
5. **Explain the purpose of experimentation and the role of observation.** Experimentation is used in science to provide more evidence to support (not prove: see 9) or disprove hypotheses, laws, and theories. Observation is used to collect evidence from the natural world and from experimentation, as the basis of the inferences and support for hypotheses, laws, and theories. Observation and the inferences that can be inducted are crucial to science and are fundamental to understanding nature.
6. **Explain how the scientific meaning of the term theory differs from the way it is used in everyday life.** Literally, a theory is a guess, that does not have to be supported nor proven. In science, it is a widely-supported idea, with many well-supported laws to back it up. They explain a natural phenomenon by making sense of multiple laws, and they are very probable but falsifiable still.
7. **Explain the difference between a theory and a law. Be able to use the example in class of atomic theory versus the law of conservation of mass, as well as use at least one new detailed example, as part of your explanation.** A theory is a broad idea that makes sense of multiple laws and *explains* a phenomenon. A law is a more specific idea that *describes* a phenomenon, but only one part of it. Because theories are made up of many well-supported laws, observations, and well-tested hypotheses, they are well-supported as well, but are falsifiable and modifiable.
    a. example: Dalton's atomic theory was at first based off of three laws: the law of conservation of mass, the law of definite proportions, and the law of multiple proportions. The theory actually made the laws make sense - before they were just statements that were true, but now they were statements that had meaning. His original theory was modified after new evidence and laws appeared.
    b. example: The theory of General Relativity by Albert Einstein is a large theory that explains gravitation. It is based off of many ideas, including the theory of Special Relativity and (a generalized) Newton's law of Universal Gravitation. Newton's law is specific - it only states that all matter attracts all other matter with a force directly proportional to its mass.

8. **Explain whether or not evolution is just a guess and probably not correct because it is just a theory.** Evolution is a theory, but that does not mean it is just a guess and probably incorrect. It is based off of much evidence, such as the theory of natural selection and observations of fossils, DNA, and structures of living things.
9. **Explain whether or not anything in science is ever proven.** Nothing in science is ever proven. Everything in science is falsifiable, because new evidence can always prove it wrong. For example, the widespread ideas about the Sun and the Moon revolving around the Earth was a theory that was superseded by Copernicus's (correct) idea through observation that the Earth revolves around the sun, and the Moon revolves around the Earth.
    a. "Proofs only exist in mathematics and logic, not in science"
10. **State and explain characteristics that made Darwin well suited for science.** Darwin had an open mind, and was very curious even as a boy. He was a naturalist, so he observed nature, and collected evidence for himself, free of bias. He also had the means to travel all over the world, so he collected a lot of evidence. He also had the courage to publish his idea, which was so revolutionary at the time, to the world.
11. **State and explain why evolution is such an important theme in biology. Explain why it has been described as the single best scientific idea to date.** Evolution is so important because it explains and makes sense of life as we know it, with so much diversity and unity. It explains why we are all related but different at the same time. It explains how we became this way, which has been a huge mystery before it. It provides details, unlike creationism, and it makes sense. It has so much evidence to back it up. This is also why it has been described as the best scientific idea.
12. **Explain natural selection as a theory for how evolution occurs.** Natural selection is a mechanism for evolution. It depends on the genetic variation in a population - individuals in a population will have different DNA due to mutations. Some of these will be harmful, and will kill the organism. But when there are times of disastrous and enormous change, when only the mutated organisms survive, then they will have been naturally selected because of their mutated genes. Because a higher percentage of these better adapted organisms will survive in a species, a higher percentage of the next generation (the offspring) will have inherited these helpful genes.
13. **Be able to apply the parts of the theory of natural selection to a given example to explain the process. For example, in class we applied the parts of the theory to giraffes to explain how they evolved to have long necks. We also looked at bed bugs, furless bunnies, cat whiskers, vultures, finches, peppered moths, etc. Be able to apply the parts of the theory to new examples (This connects to the PBS "list of four").** Necessities for natural selection and examples:
    a. observations and inferences supporting the theory of natural selection:
        i. genetic variation (genetic mutation)
        ii. overproduction of offspring (higher changes of genetic mutation and helpful genes)
        iii. struggle for existence (competition for necessities; survival of the fittest)
        iv. differential survival and reproduction rates (strongest individuals survive and reproduce best)
    b. example: bed bugs
        i. some bed bugs have genes resistant to pyrethrums
        ii. many bed bug offspring created to ensure that some have good genetic mutation (resistance to pyrethrums)
        iii. bed bugs who have resistance survive better (less likely to die when sprayed)
        iv. bed bugs who have resistance have higher chance and rate of survival and reproduction
14. **Explain how Darwin arrived at his theory of natural selection. Who were Lyell and Malthus? How did they influence Darwin? How did Darwin's voyage on the HMS Beagle influence him?** Darwin was a naturalist, and his (unbiased) study of nature led to his discovery of nature. He saw Lamarck's work on evolution, and modified it, coming up with his idea of natural selection. He also saw biogeography as evidence. He also knew about Wallace's (another naturalist with similar ideas) ideas on evolution, which was similar. His trip on the HMS Beagle influenced his work, because he got a chance to go travel far away

and to collect many samples to study. He spent five years noting the characteristics of the animals and staying on the beaches to collect samples. He noticed that the islands all had different species, and that closely located islands had closely related species. This made him seriously doubt the idea that all species were created individually, at the same time. He felt like "a blind man being given sight." Lyell was a geologist who thought about geological time, and created the fossil record that dated back millions of years. This gave enough evidence of evolving species in the past for Darwin's theory to make more sense. Malthus was a mathematician focused on population studies, and noticed that there is an overpopulation of offspring (more than could produce, and more than an ecosystem could sustain) and that there were competitions for resources in a population. These were two of the components for natural selection - but he didn't know about genetic variation and therefore the different rates of reproduction based on the randomly selected advantageous traits, something that Darwin knew from being a farm boy.

15. **Explain how Darwin's theory of evolution differs from Lamarck's. Why did Darwin's theory prevail and Lamarck's did not?** Lamarck had an idea of evolution similar to Darwin's, but his proved obsolete. Lamarck said that individuals in a species evolved *during* their lifetimes, simply by *willing* themselves to survive. Although he was correct that individuals can evolve, both of these assumptions are incorrect. Darwin said that species cannot modify their own genes, but can pass down mutations, and those organisms naturally selected (not willed by themselves) survived the best. He said that organisms only evolved over multiple generations, not during a lifetime.
16. **State, explain, and be able to use and use vocabulary associated with evolution.** Vocabulary:
    a. mutations
        i. when a gene is reproduced with an error in an individual; can be passed down
    b. variation
        i. when a mutation occurs; differences in a population
    c. adaptations
        i. change in species or organism when it becomes better suited to its environment (more fit)
    d. survival of the fittest
        i. better survival for more fit species (see fitness below)
    e. natural selection
        i. a theory that supports evolution and is a major mechanism of evolution (see 12)
    f. descent with modification
        i. as species reproduce and more mutations occur, bad mutations are weeded out and good mutations stay in the gene pool, and modifications stay. This is descent (reproduction) with modification (good mutations)
    g. fitness
        i. the ability of an organism to survive based on its naturally selected traits, better suited to its environment
    h. gene frequency
        i. amount of a gene left in a population; advantageous traits stay in a population with a high gene frequency and vice versa
    i. comparative anatomy
        i. comparing structures of different species; if the structures are similar, suggest evolution from a common ancestor with that structure
    j. analogous structures
        i. structures that are similar in different species that do not have a common ancestor; fit a certain environment; do not suggest evolution
            1. formed from convergent evolution: when two non-related species form similar features to because those features best fit their environment
            2. fins in whales and fish are analogous structures
    k. homologous structures
        i. structures that are similar in different species; suggest evolution

l. vestigial structurous
    i. remnants of structures in a species left over from an ancestor species (shows descent) that are not subject anymore to natural selection and therefore decaying
m. comparative embryology
    i. comparing the structures of embryos to other species to show that a species has evolved from another species; used when similarities only shown in embryos and not adults
n. comparative biochemistry
    i. comparing DNA of different species; usually closely-related species have similar DNA
o. comparative biogeography
    i. to compare the distribution of individuals in a species geographically; usually species are grouped together; shows that species evolve from other existing species in an area

17. **Describe the various pieces of evidence that support Darwin's theory of evolution and how/why the pieces of evidence support the theory.**
    a. Pieces of evidence supporting Darwin's theory of evolution:
        i. fossil record
            1. shows the variety of structures of life
            2. shows organisms with intermediate features
            3. shows that there were changes over time to structures
            4. shows complex species originated from simpler ones
        ii. comparative anatomy
            1. species have similar structures
            2. shows that species originated from common ancestor with that structure
        iii. comparative embryology
            1. same as above (but in embryos, because they are not needed when we develop)
        iv. vestigial structures
            1. shows that we originated from species with those structures
            2. shows that natural selection has weeded those unnecessary structures out
        v. biogeography
            1. shows that communities of plants and animals evolve (in isolation) from common ancestors of the area (and do not just come to be)
        vi. comparative DNA (biochemistry)
            1. shows that all cells have similar molecular structures
            2. shows that closer-related species have more similar DNA
    b. Acronym for the six pieces of evolution: ABVDEF (V, not C):
        i. Anatomy
        ii. Biogeography
        iii. Vestigial structures
        iv. DNA
        v. Embryology
        vi. Fossils
18. **Describe how biology, technology, and society are connected.** New advances in technology related to biology (medicines, surgery) are drastically improving the standard of living and average life span in our modern society. Technology is also allowing us to create many new experiments with biology, such as cloning, which may change our society in the future. Society is changing, which is one environmental factor that may affect our evolution (biology) and our technology. The goal of science is to understand natural phenomena. The goal of technology is to apply scientific knowledge.
19. **Describe how evolution is connected to our everyday life.** Evolution is related to our current lives because it is how our life became this way. Without evolution, we would all be the same, primitive cell. There would be no diversity in life. It shows that we are also always changing in response to our environment, even if that doesn't seem so. We may not be *homo sapiens* in the future, but something else

that has adapted to a more modern world. It also helps us fight disease and lead conservation efforts. Researching genes' purposes has allowed genetically modified crops. DNA can be used to identify individuals. We speed up natural selection and evolution in "bad" (insects, pests, parasites, and bacteria) organisms when we use chemicals against them.

20. **Explain why and how evolution is a core theme of biology.** Evolution is a core theme of biology because it *makes sense of the unity and diversity of all life*. Without the theory of evolution, we would not know why some species are similar to other species, and why some are so very different. We would not understand that everything is changing, because it happens so slowly, and is very hard to notice.

Extra Notes

Section 1.5: Unity of life based on DNA and a common genetic code (explained above)

Section 1.6: The diversity of life can be arranged into three domains

- There are two main "dimensions" in the world of biology:
    - The "vertical" dimension is the size scale that stretches from molecules to the biosphere.
    - The "horizontal" dimension spans across the great diversity of organisms existing now and over the long history of life on Earth. -(Chapter 1 Evolution Powerpoint)
- taxonomy is the branch of biology that names and classifies species, arranges species into a hierarchy of broader and broader groups, from genus, family, order, class ,phylum, kingdom
- life divided into three domains:
    - bacteria
        - most widespread, diverse prokaryotes
    - archaea
        - prokaryotes that live in Earth's extreme environments
    - eukarya
        - have a nucleus and organelles
        - divided into four subdomains
            - protists (prokaryotes)
                - multiple kingdoms
            - plants (eukaryotes)
            - fungi (eukaryotes)
            - animals (eukaryotes)

Section 1.7: Evolution explains the unity and diversity of life (explained above)

Section 1.8: Scientific inquiry is used to ask and answer questions about nature (explained above)

- science is a way of knowing - an approach to understanding the world around us

Section 1.9: Scientists form and test hypotheses and share their results

- controlled experiment is important to compare an experimental group with a control group. Without the control group, researchers cannot rule out other variables.
- science is a social activity
- science seeks scientific, supported causes for natural phenomena
- science is necessarily repetitive

Section 1.10: Biology, technology, and society are connected in important ways (explained above)

- science has become such a powerful aspect of society that every citizen should be scientifically literate

Section 1.11: Evolution is connected to our everyday lives (explained above)

Section 13.1: A sea voyage helped Darwin frame his theory of evolution (explained above)

- Aristotle, who had a major influence on Western thought, believed that species were perfect and permanent
- idea that the Earth is 6,000 years old and all species were individually designed was a common belief

Section 13.2: Darwin proposed natural selection as the mechanism of evolution (explained above)

- first two reasons of natural selection are observations, other two are inferences based on the observations
- individuals do not evolve but species evolve as bad traits get weeded out and the good traits accumulate
- evolution is not chosen - it is random

Section 13.3: Scientists can observe natural selection in action (explained above)

- it is shown that pesticides can kill 99% of insects on first usage, but become less and less effective

Section 13.4: The study of fossils provides strong evidence for evolution (explained above)

- paleontologists dig and find fossils
- some fossils are mineral casts when empty spaces in organisms once were
- trace fossils are footprints, burrows, and other remnants of an ancient organism's behavior
- some fossils retain organic material, when it is covered by a material in which bacteria cannot get to it

Section 13.5: Many types of scientific evidence support the evolutionary tree of life (explained above)

Section 13.6: Homologies indicate patterns of descent that can be shown on an evolutionary tree

- scientists can form an evolutionary tree of life similar to a family tree, with ancestors and descendants
    - tree is usually sideways

Section 13.7: Evolution occurs within populations

- microevolution is when gene frequencies in a population change
- no individual can evolve

Section 13.8: Mutation and sexual reproduction produce the genetic variation that makes evolution possible (explained above)

- new alleles originate by mutation
- a mutation that alters a protein's function will probably be harmful
- mutation rates in animals and plants average about 1 in every 100,000 genes per generation
- in organisms that reproduce sexually, most variation results from unique combinations of inherited alleles

Section 13.12: Natural selection is the only mechanism that consistently leads to adaptive evolution (explained above)

- relative fitness is the contribution an individual makes to the gene pool of the next generation relative to the contributions of other individuals
- fittest individuals produce the largest amount of viable, fertile offspring, and therefore pass the most genes on to the next generation

Section 13.14: Sexual selection may lead to phenotypic differences between males and females

- Darwin first to examine sexual selection, form of natural selection, in which individuals with certain traits are more likely to attract mates, not necessarily survive better
- the distinction in appearance between the sexes is called sexual dimorphism
- sometimes, individuals within the same sex compete with each other, called intrasexual selection
- in intersexual selection, or mate choice, individuals of the other sex choose their mates

Section 13.15: The evolution of antibiotic resistance in bacteria is a serious public health concern (explained above)

Section 13.17: Natural selection cannot fashion perfect organisms (explained above)

- selection acts only on existing variations

- evolution is limited by historical constraints
- adaptations are often compromises
- chance, natural selection, and and the environment interact

Jonathan Lam
Mrs. McTague
H Bio. per. 3
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Ability to Gel of Different Types of Pineapple Lab

Group Members: Kyle C., Cole S., Alex S.

Purpose: Does the type of pineapple (fresh, frozen, or canned) affect whether or not it will gel in a Jello salad?

Independent Variable: type of pineapple (fresh, frozen, or canned)
Dependent Variable: whether or not the pineapple will allow the Jello to gel

Hypothesis: If I try to make a Jello salad with fresh, frozen, and canned pineapple pieces, then only the frozen pineapple will gel over (because the fresh and canned pineapple are too moist to allow the Jello to gel).

Materials:

- 75g fresh pineapple (diced)
- 75g frozen pineapple (diced)
- 75g canned pineapple (diced)
- 3 packages of Knox Original Unflavored Gelatin
- 1 hot plate
- 1 scale (grams)
- 1 measuring cup (¼ cup measurement)
- 3½ cups tap water
- 1 large beaker (1000mL capacity)
- 3 small beakers (600mL capacity)
- 1 spoon (any size, for mixing)

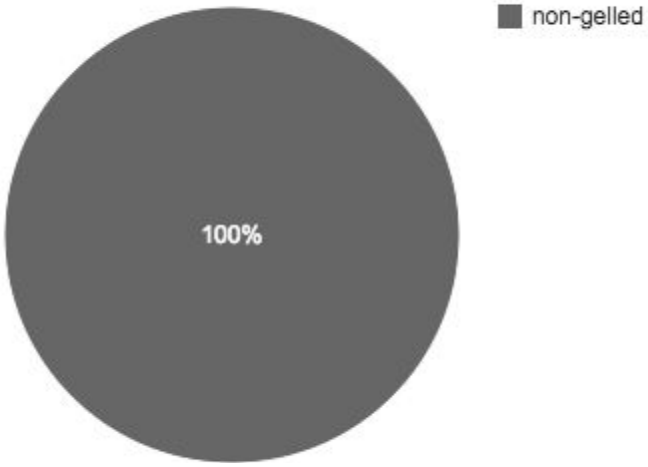
Procedure:

1. Follow instructions on Jello packet to preparing the Jello. Use *water* instead of fruit juice, heat up water in the large beaker (1000mL) on the hot plate, and use only ¼ of the materials. (Step 1 on packet). Do not refrigerate yet.
2. Put the mix and the heated water in a small beaker (600mL).
3. Add fresh pineapple (75g) to mix (in the small beaker).
4. Repeat steps 1-3 with frozen and canned pineapple pieces. Use separate beakers for each one.
5. Refrigerate all three mixes (in the small beakers) for three hours. (If the beaker cannot be taken out after three hours, then leave to refrigerate for *at least* three hours).
6. After the Jello solutions have finished refrigerating, record whether or not each Jello mixture has gelled over. If a Jello is not completely solid but not a liquid either, record observations on the degree at which the Jello has gelled.

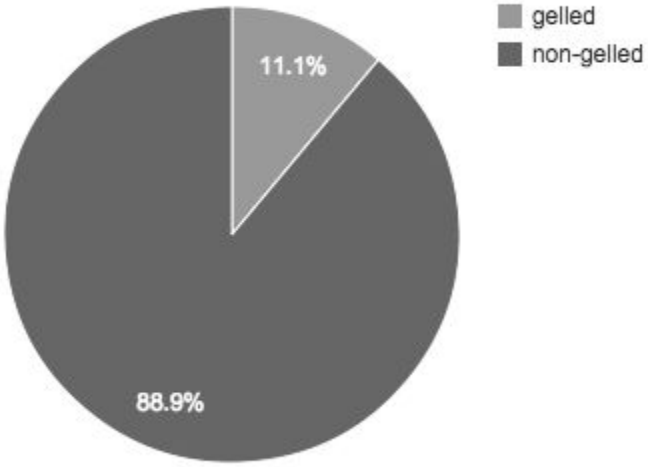
Observations:
Gelling of Pineapple Types (Class Data):

	TYPES OF PINEAPPLE				
Students	**Fresh**	**Frozen**	**Canned**	**Control**	**Notes**
Jon, Cole, Kyle, Alex (our lab)	no	no	**yes**	*none*	
Emily, Bea	no	no	**yes**	**yes**	
Elizabeth, Molly	no	no	**yes**	**yes**	two trials
Mahad, Attie	no	no	**yes**	**yes**	
Lindsay, Gwen	no	no	**yes**	*none*	
Jacob, Owen	no	no	**yes**	**yes**	
Rachel, Samantha	no	**partial**	**partial**	**yes**	froze a little bit; possible error in procedure
Maddie, Jessica, Monicam, Abigail	no	no	**yes**	*none*	
Kennedy, Amanda, Jennifer, Dileka	no	no	no	*none*	possible error in procedure
Total Gelled	0/9 (0%)	1/9 (11%)	8/9 (89%)	5/5 (100%)	

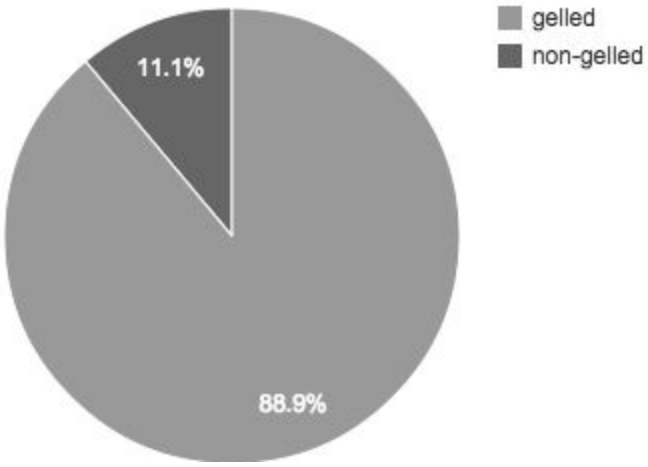
Fresh Pineapple



Frozen Pineapple



Canned Pineapple



Analysis:
The results for all the experiment results are very consistent. All the control trials gelled over, and almost all the canned pineapple trials gelled over; on the other hand, no fresh pineapple trials gelled over and almost no frozen pineapple trials gelled over. The two outliers - Rachel and Samantha's group, and Kennedy, Amanda, Jennifer, and Dileka's group - may have been inaccurate because of an error in their procedure, so their experiments may have agreed with the rest of the class if they were correct. The data shows that 0 out of 9 of the fresh pineapple gelled (0%); 1 out of 9 of the frozen pineapple gelled (11%); 8 out of 9 of the canned pineapple gelled (89%); and that 100% of the controls - the plain gelatins - gelled over. The last statistic, the control, is important so we know that making just the Jello by itself will work.

Conclusion:
Based on the data, I can conclude that adding fresh or frozen pineapple to a Jello salad will not allow it to gel, but adding canned pineapple will. This is because there is a strong trend shown in our experiments: 0 of the fresh pineapple Jello salads gelled and only one of the frozen pineapple gelled. However, all but one of the canned pineapple Jellos gelled. Based on our class discussion, our results, and some research, I strongly believe that our results and conclusion are accurate because pineapple naturally has an enzyme called bromelain that breaks down proteins, such as the collagen in gelatins that causes them to become solid. The reason that canned pineapple will gel in Jello is because during the canned process, it is heated, during which the bromelain deactivates and no longer functions. However, the fresh and frozen pineapple still have active bromelain, which prevents the gelatin to solidify.

This proves that my hypothesis was very wrong, because the frozen pineapple Jello did not gel, but only the canned one did. It shows that my original prediction that the frozen pineapple is less wet than the fresh and canned pineapple is false or irrelevant.

Reflection (Comments):
I am very confident in my conclusion, because we have very consistent. There is also a valid scientific reason - that the bromelain enzyme in the fresh and frozen pineapple does not allow the gelatin to gel - to explain our hypothesis as well. Also, the outliers in our experiments may have been mistakes, so this supports our data as well. Next time, I will have to make sure to include a step to label the beakers so that there is no confusion between which type of pineapple is in which beaker - our group had an issue with this, as we did not label at first and labeled a little carelessly at the end of class because we were starting to run out of time. Because of this, our original results were that the fresh and the canned pineapple Jellos did not gel, but the frozen did; later we had to switch the frozen and canned pineapple results because they were labeled wrong. Also, we should have included more steps to make more measurements for the degree to which each Jello gels over, such as measuring the volume of the liquid before and after and the viscosity of the liquid before and after, because both the frozen and fresh did not gel over - doing so may yield even more accurate and interesting details.

Jonathan Lam
Mrs. McTague
H. Bio. per. 3
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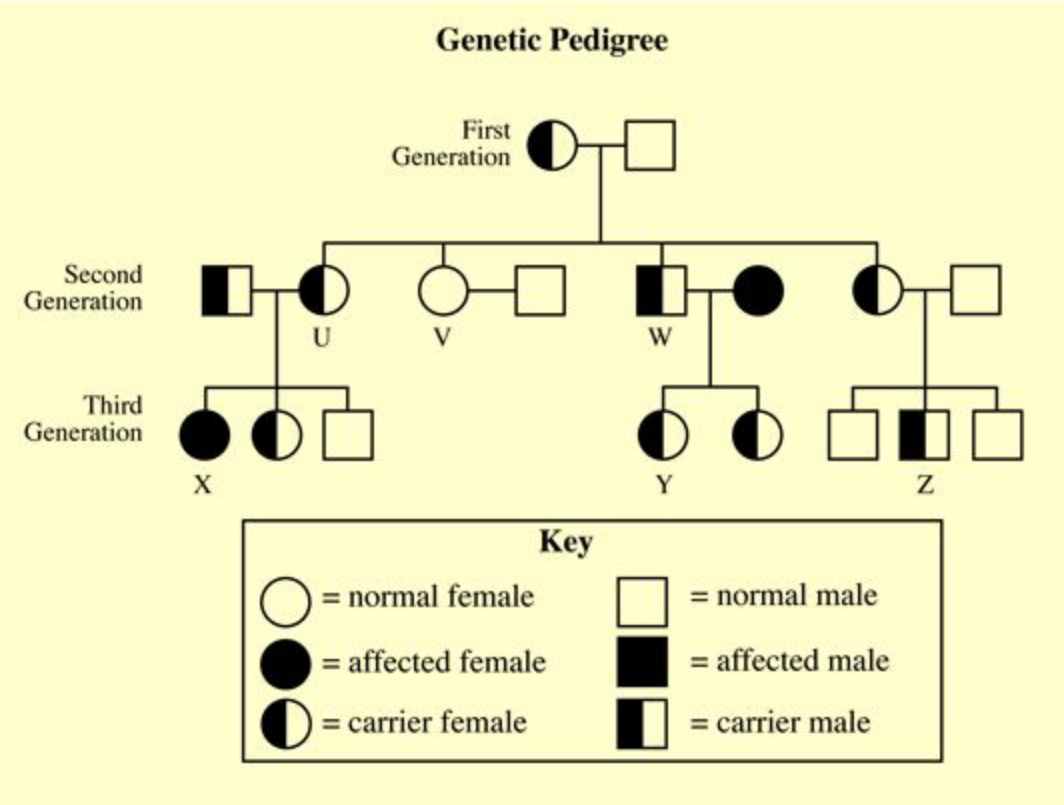
Genetics Study Guide

Vocabulary

- heredity: transmission of traits from one generation to the next
- genetics:scientific study of heredity
- hybrid: offspring of two different varieties
- genetic cross (hybridization): cross-fertilization process
- P generation: parent generation
- F generations: “filial” generations, child generations
- Punnett squares: diagrams used to show possibilities of different gene combination
- phenotype: physical gene expression combinations
- genotype: genetic gene expression combinations
- locus: specific location of gene on chromosome
- allele: sometimes synonymous with gene, a form of a gene that is found in the same place on homologous chromosomes
- gene: “heritable factors” (Mendel)
- character: varying feature
- trait: specific variant of a character
    - can be dominant or recessive
        - some dominant traits:
            - freckles
            - dimples
            - six fingers
            - A and B type blood
            - + Rh factor
        - some recessive traits:
            - no freckles
            - no dimples
            - five fingers
            - o type blood
            - - Rh factor
            - most diseases:
                - tay-sachs
                - cystic fibrosis
                - sickle-cell anemia
                - X chromosome diseases
                    - color-blindness
                    - baldness
- complete dominance: when there is a dominant and recessive gene, and the the dominant totally overrides the recessive gene; Mendel discovered this
- incomplete dominance: when a dominant gene does not totally override the recessive gene, resulting in a mixing
    - petal color (red + white = pink)
- codominance: when an organism has two dominant genes in which both are expressed
    - blood type (A + B = AB)
- polygenic inheritance: when a gene is controlled by multiple genes

    - eye color (two genes)
    - skin color (three genes)
- epistasis: when a gene is controlled by another gene (modifier gene)
    - labrador coat colors
- lyonization: if multiple X chromosome, then all but one become dense Barr bodies
    - calico, tortoiseshell cats
- pedigree: family tree diagram indicating gene inheritance with shaded boxes
    -



Gregor Mendel

- "father of modern genetics"
- German monk
- 1800s, only few years after Darwin's publication *On the Origin of Species*
- bred peas because it reproduces quickly. has many different varieties, is readily available, and its reproduction could easily be controlled
    - chose seven characters with "true-breeding varieties"
- genetic discoveries:
    - complete dominance:
        - for each characteristic, there are multiple alleles, alternate versions of the genes
        - organisms inherit two alleles from each parent
            - different alleles are "heterozygous"
            - same alleles are "homozygous"
    - law (#1) of segregation: all gametes have exactly one allele for each characteristic, because alleles separate during production of gametes

- law (#2) of independent assortment: all genes are separated and having/inheriting one gene is not always correlated with having/inheriting another

Jonathan Lam
Mrs. McTague
H Bio. per. 3
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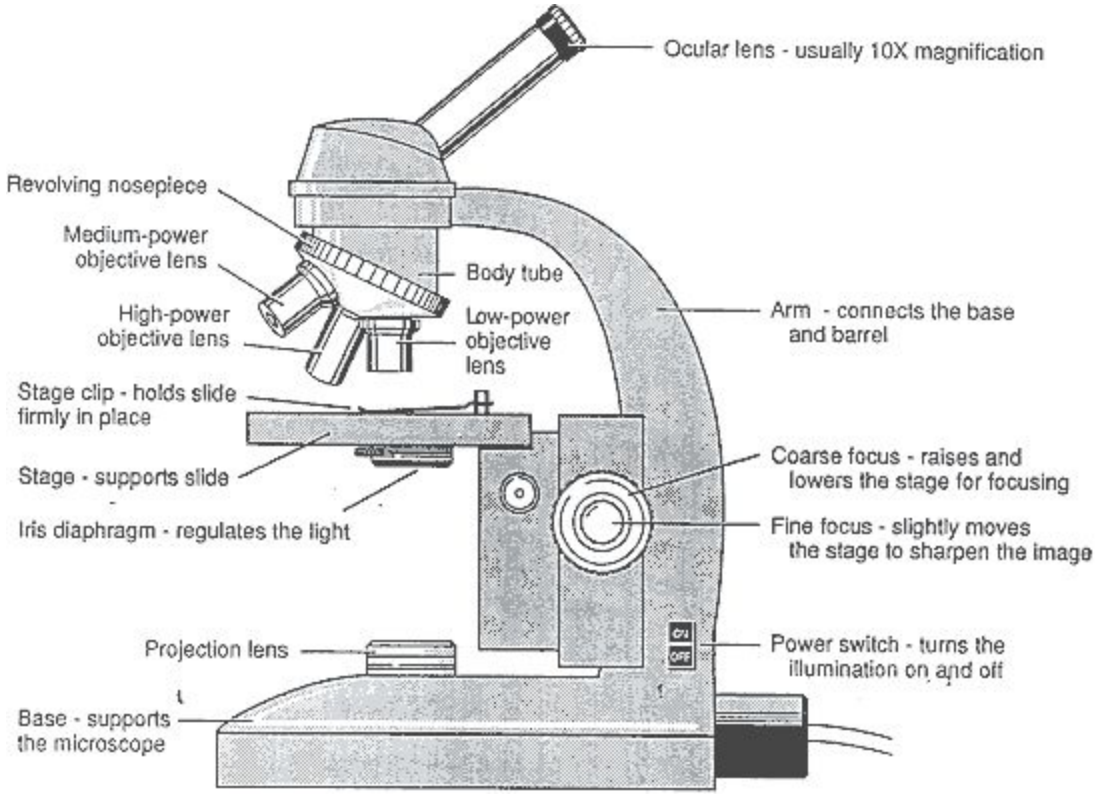
Microscopes Quiz Study Guide

1. **Label a diagram of the compound light microscope.**



2. **State the function(s) for each part of the compound light microscope.**
    a. ocular lens (10x): magnify a little bit
    b. arm: connect barrel, adjustment knobs, and the base, hold here
    c. objective lenses: add much more magnification
        i. scanning objective lens (4x): lowest power, find object, scan most of stage; mostly use coarse adjustment knob
        ii. low power objective lens (10x): medium power, for medium uses; can use both knobs (after using scanning)
        iii. high power objective lens (40x): very high power, to see very small items; only use fine adjustment knob (after using low power)
    d. rotating nosepiece: switch between different objective lens
    e. stage: a moving flat surface that supports the slide and is controlled by the focus knobs
    f. stage clips: used to stabilize the slide
    g. diaphragm: control the amount of light that goes through the slide, so that the image is the most in focus
    h. adjustment knobs: control the movement of the stage
        i. fine adjustment knob: adjust the stage very slowly, especially for the high power lens, and a little bit of the low power lens
        ii. course adjustment knob: adjust the stage quickly, especially for the scanning lens, and a little bit of the low power lens
    i. light/mirror: allow the specimen to be illuminated

j. base: supports the microscope and keeps it steady

3. Explain the proper use and care of the compound light microscope.

a. Use both hands to carry a microscope.
b. Make sure a microscope will not fall by placing it far from the edge of the table and watching the power cord.
c. Start with stage rolled down, and scanning objective lens down, and then place the slide on the stage.
d. Roll the stage as far up as it can go (carefully and slowly, and watch it).
e. Look through the ocular and bring the object into focus with the coarse adjustment knob.
    i. If low-power is needed, (leave the stage position and) switch the lens and use the fine-adjustment knob only. If high-power is needed, start with low-power and do the same steps. Only use the fine adjustment.
f. To clean up:
    i. Put the scanning lens down and the stage down.
    ii. Clean the lens with lens paper.
    iii. Wrap the cord (securely).
    iv. Cover the microscope with the plastic cover.

4. Calculate the total magnification when given the magnification of the ocular lens and an objective lens.

a. Multiply:

	Ocular (10x)
Scanning Objective (4x)	40x
Low-power Objective (10x)	100x
High-power Objective (40x)	400x

5. Calculate the diameter of a field of view in both mm and µm (for example at 40X or 400X) when provided with the diameter of the field of view at a different magnification (for example at 100X).

a. Field of view and magnification are inversely proportional. Just multiply and divide:

Power	FOV (mm)	FOV (µm)
40x	5	5000
100x	2	2000
400x	0.5	500

6. Determine the size of an object based on the determined diameter of a field of view.

a. Divide the diameter of the FOV by the number of times an object can fit in that diameter.

7. Describe and draw how the orientation of an object changes when viewed under a compound light microscope.

a. Objects are rotated 180º. This also applies to movement of the slide: all movements seemed reversed (flipped both laterally and longitudinally).

8. **Describe and draw how the field of view changes from magnification to magnification.**
    a. The FOV decreases as magnification increases, and is inversely proportional. For example, the FOV of a 40x can be 5mm, and the FOV of 400x can be 0.5mm (10^1 higher magnification = 10^{-1} FOV).

9. **Describe and illustrate how the depth of field changes as the magnification increases.**
    a. Depth of field gets smaller, similar to FOV, as magnification increases. Being more specific, the increased magnification can only focus on a smaller area, in all three dimensions. Therefore, an object that seems in focus in scanning mode may not be in focus or even in view in the low power or high power lenses, while any object in focus in the high or low power lenses will be in focus with the scanning objective.

10. **Explain how to adjust the stage to bring the different layers of a specimen into focus at high magnifications.**
    a. If you want to bring a lower object into focus, you must move the stage up, so that the longer distance between the lens and the object will shorten to become the focal distance, and vice versa.

11. **Compare and contrast the compound light microscope, stereoscope, and electron microscope. Discuss their magnifications, the objects they are used to view, how they work, and their advantages and disadvantages.**
    a. Stereoscope
        i. has two views of the same object with different perspectives, creating parallax and a sense of depth
    b. Compound Light Microscope
        i. focuses beams of light
        ii. commonly used, not too expensive
        iii. acceptable magnification
        iv. does not kill a specimen
        v. in color
        vi. only can see a layer (in high resolution; at lower magnifications, can see the outside)
    c. Electron Microscope
        i. focuses, reflects, and returns beams of electrons
        ii. very expensive, not very common (needs a powerful computer and much equipment)
        iii. much higher magnification
        iv. kills a specimen
        v. in black and white
        vi. can see the surface of an object, or a layer (both in high resolution)
        vii. two types: SEM (surface) and TEM (one layer)

Jonathan Lam, Cole Straughn, Alex
Mrs. McTague
H. Bio. per. 3
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“Absorption of Milk by Oreos” Lab

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1. **Purpose (Question/Statement):** Will Oreos with extra stuffing absorb more milk than regular Oreos?
2. **Hypothesis:** If we dunk a Mega-Stuf, a Double-Stuf, and a regular Oreo into milk for a certain amount of time, then the Mega-Stuf Oreo will absorb the most amount of milk.
3. **Materials:**
    1. 3 Mega-Stuf Oreos
    2. 3 Double-Stuf Oreos
    3. 3 regular Oreos
    4. 4 cartons of milk (250mL)
    5. 1 beaker
    6. 1 graduated cylinder
    7. 1 spoon
    8. 1 timer
4. **Procedure:**
    1. Obtain lab materials.
    2. Measure 100mL of milk in graduated cylinder.
    3. Pour milk into beaker.
    4. Drop regular Oreo into milk.
    5. Wait 10 seconds.
    6. Pick up Oreo with a spoon (don’t scoop up milk) and put aside.
    7. Pour milk into graduated cylinder.
    8. Record change in amount of milk (amount of milk absorbed by the Oreo).
    9. Pour out milk.
    10. Repeat steps 2-9 with two more regular Oreos.
    11. Repeat steps 2-10 with Double-Stuf and Mega-Stuf Oreos.
    12. Clean up lab materials.
5. **Observations:** (Amount of milk absorbed)

	Regular	**Double-Stuf**	**Mega-Stuf**
Trial 1	3.5mL	2mL	4mL
Trial 2	4mL	2mL	4mL
Trial 3	7mL	0.5mL	2mL
Average	4.8mL	1.5mL	3mL

6. **Analysis:**

In all the Oreo trials, the Oreos absorbed similar amounts of milk. The average for the regular Oreos is 5mL, 1.5 mL for the Double-Stuf; and 3mL for the Mega-Stuf. There was no obvious correlation between the amount of stuffing and the amount of milk absorbed - the Double-Stuf held less than the regular Oreos, and the Mega-Stuf held more than the Double Stuf.

7. **Conclusion:**

Our hypothesis that the Mega-Stuf Oreos would absorb the most milk was proved false. There was no correlation in our data between the amount of stuffing and amount of milk absorbed.

8. **Reflection:**

We learned that the cream of an Oreo is not very absorptive, and that Mega-Stuf and Double-Stuf Oreos, despite having more "stuf," are not better than regular Oreos in absorbing milk.

Next time we do this experiment, we will try to have less source of error, by making sure we have enough time. We had to rush our experiment, and as a result spilled some milk and may have thrown off our results and gotten our conclusion wrong. Next time, we can also measure the absorption of the cookie and the cream of the Oreos separately to see easier whether or not the cream or the cookie does more of the absorbing.

Jonathan Lam
Mrs. McTague
H. Bio. per. 3
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Photosynthesis Study Guide

- **State and explain the two things that all living organisms need (from food).**
    a. energy
    b. basic building blocks (monomers and macromolecules)

- **Explain the key differences between producers (autotrophs) and consumers (heterotrophs).**
    a. producers create their own food, mostly from photosynthesis (some from chemosynthesis)
        i. Create food for all the organisms
        ii. Can convert light energy to usable chemical energy
        iii. Can create organic molecules from inorganic molecules
        iv. Chemo- and photo- autotrophs
            1. Chemoautotrophs get energy from oxidizing minerals--- for bacteria deep in ocean, ground, or extreme environments
            2. Photoautotrophs are like the ones we talked about, using light energy to create chemical energy
    b. consumers are dependent on producers and other producers for food
        i. Cannot live or exist without autotrophs

- **Explain the difference between photoautotrophs and chemoautotrophs. Provide examples of organisms that are photoautotrophs and chemoautotrophs, and compare the diversity of these two groups.**
    a. Photoautotrophs: do photosynthesis from water and CO2. Gain energy from light
        i. Plants, Algae, Protists and some Bacteria
    b. Chemoautotrophs: Oxidize mineral substances then use the energy made with CO2 and water to make sugars
        i. Archae Bacteria
    c. Explain: Differ in how they obtain the energy to make sugars energy. Chemoautotrophs use minerals. Photoautotrophs use light.
    d. Explain: More diverse and large amount of photoautotrophs.

- **State and explain the mathematical relationships between the wavelength, frequency, and energy of electromagnetic radiation. (The electromagnetic spectrum ranges from radiowaves to cosmic waves and includes light.)**
    a. Low to high energy:
        i. Radio waves (extremely low power, huge wavelengths, no damage)
        ii. Microwaves
        iii. Infrared waves
        iv. Visible light
            1. Red to violet (note red next to infra**red** and violet next to ultra**violet**)
        v. Ultraviolet rays
        vi. X-rays
        vii. Gamma rays (extremely harmful, will disintegrate, from nuclear bombs and supernovas)
    b. The higher the frequency, the higher the energy, and the shorter the wavelength

- **State and explain what a photon is.**
    a. It is a bundle of energy- the higher the energy of a light wave, the more the energy in the photon

Jonathan Lam
Mrs. McTague
H. Bio. per. 3
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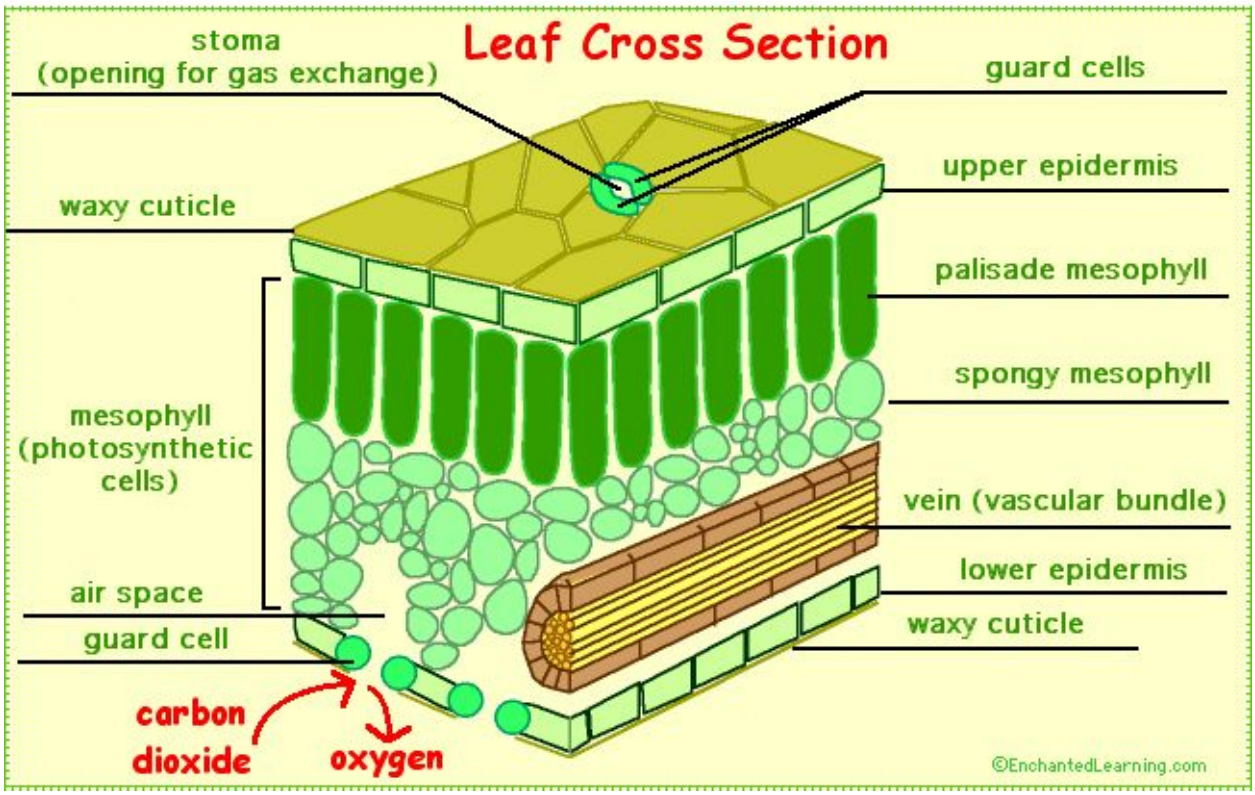
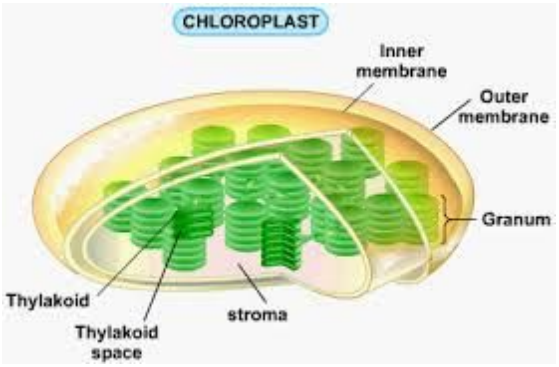
- **Label a diagram of a cross-section of a leaf**
- 

- **State and explain the differences in location, structure, and function between the epidermal and mesophyll layers of cells in a leaf.**
    a. Epidermal cells secrete a cuticle (have many Golgi?) and have no chloroplasts
    b. Mesophyll layers have chloroplasts
        i. Palisades cells
            1. Close together
            2. Long and towards top of cell
            3. Many chloroplasts
        ii. Spongy cells
            1. Loosely packed (air spaces)
            2. Irregularly shaped
            3. Fewer chloroplasts (but still some nonetheless- do little photosynthesis from leftover light from top and reflected light from bottom)

- **Explain the structure and function of guard cells and stomata. Explain how the guard cells function by explaining about how water balance and osmosis causes the guard cells to open and close the stomata.**
    a. Guard cells are two long cells around the stomata
    b. They open by filling up with water, making them bulkier and rounder, creating a space into the spongy layer
    c. Let carbon dioxide in and oxygen out
    d. Sometimes close to conserve water- can cause photorespiration in C3 plants

e. Stimulated by blue light at dawn- complex chain reactions involving ions and pumps to get water in

- **Label a diagram of a chloroplast.**
- 

- **State and explain the structure of a chloroplast. What are thylakoid sacs, thylakoid membranes, thylakoid spaces (lumen), stroma, etc?**
    a. Outer membrane: originally a vacuole membrane
    b. Inner membrane: originally bacteria membrane
    c. Thylakoids: sac
        i. Thylakoids membrane: where light reactions take place
        ii. Thylakoids lumen: space inside thylakoids where protons build up
    d. Grana: stack of thylakoids
    e. Interlamella: extension of thylakoids connecting grana
    f. Stroma: fluid in chloroplast in which Calvin cycle takes place

- **Label a detailed diagram of the thylakoid membrane with its embedded photosystems, electron transport chains, solute pumps for H+, ATP synthase, etc.**

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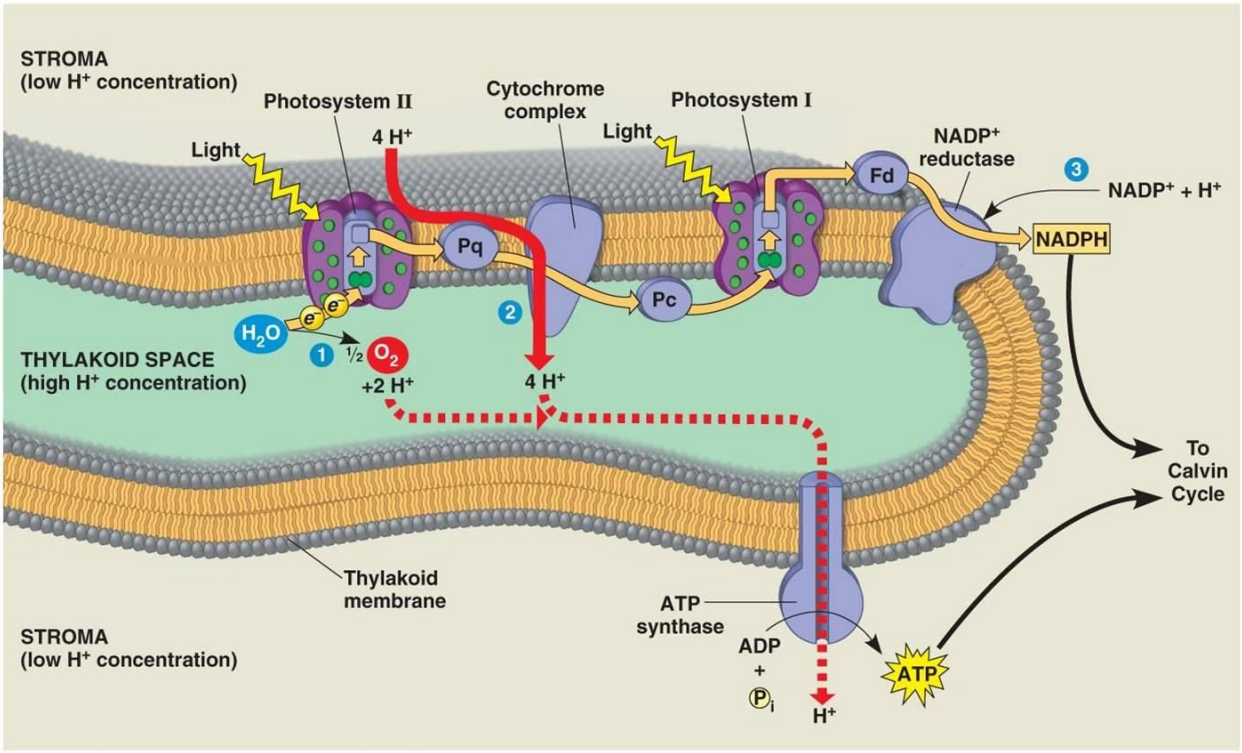

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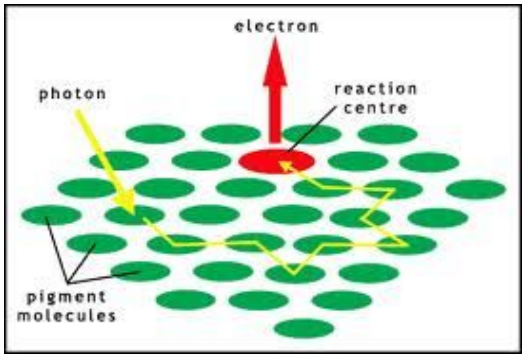
- **Label a diagram of a photosystem.**
- 

- **Label and explain a diagram of an overview of photosynthesis.**

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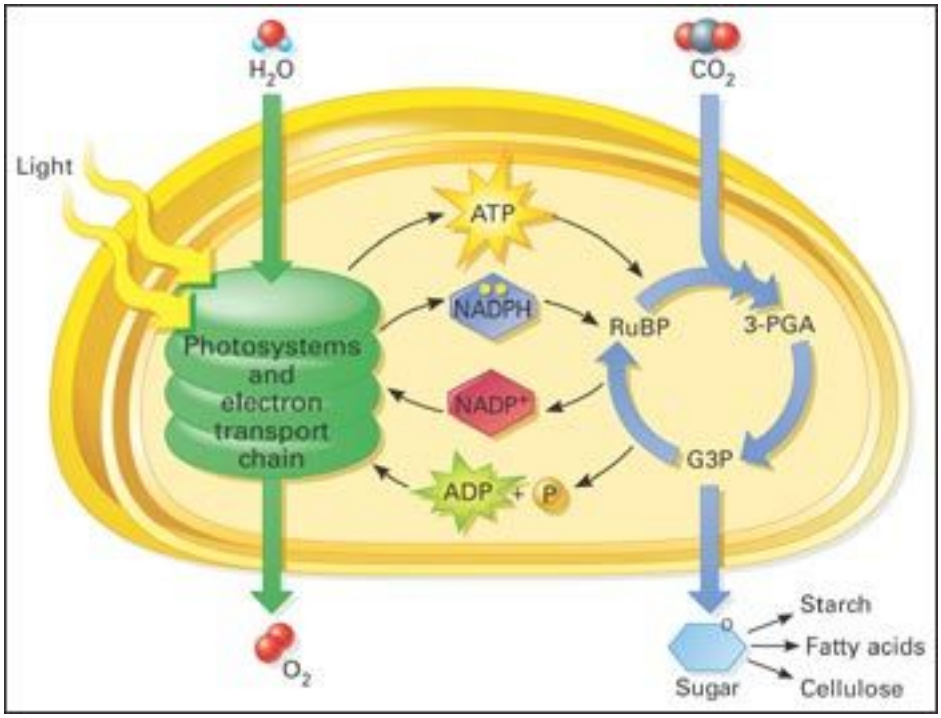
- 

- **Label and explain a diagram showing the steps of the light reactions.**

- **Label and explain a diagram showing the steps of the Calvin cycle.**
- Look at thylakoid membrane

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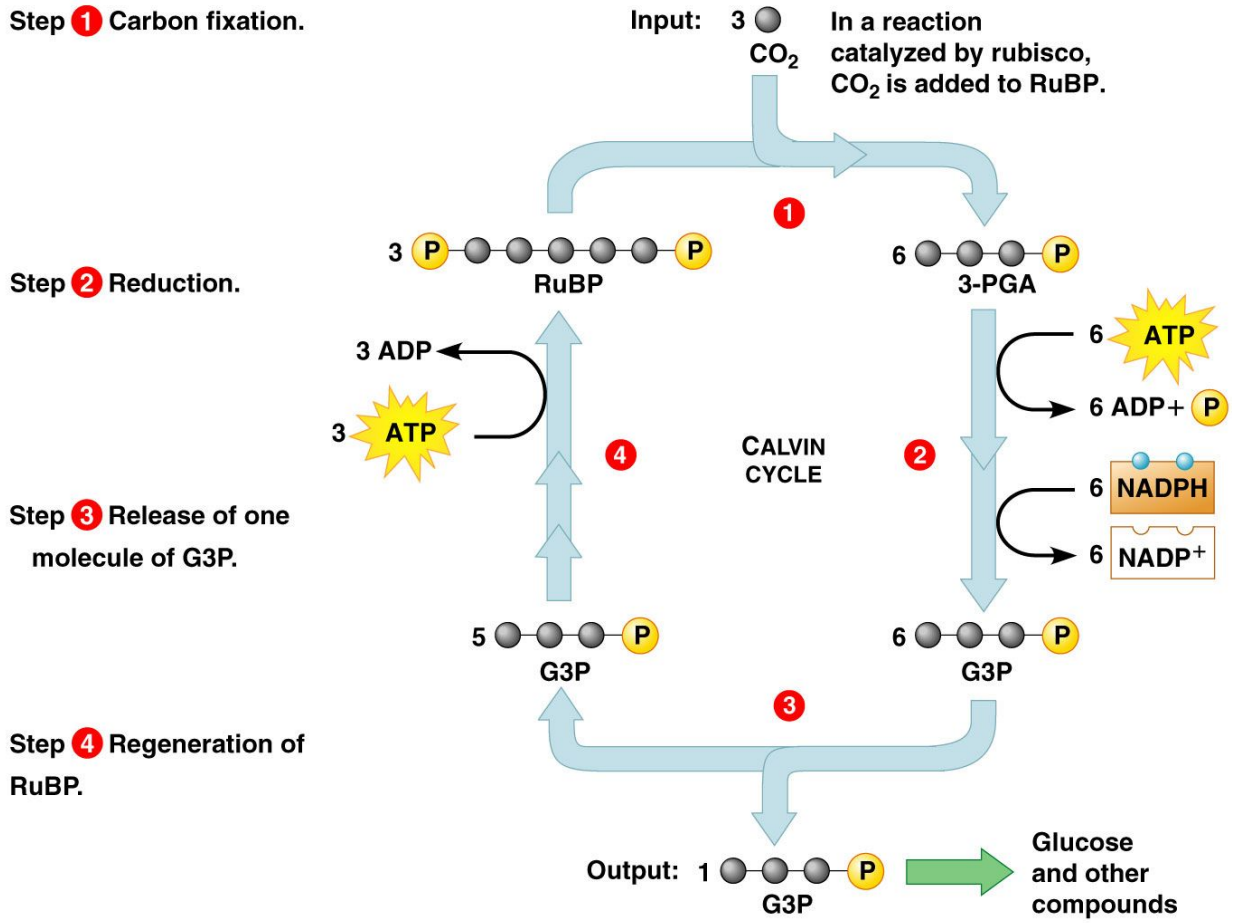

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- **Explain the entire process of photosynthesis at both the overview and extremely detailed levels and use appropriate terminology in doing so.**
  a. In a leaf cell (or other photosynthesizing plant cell), in the chloroplast, in the thylakoids membrane, a photon of light strikes the pigments (chlorophyll and carotene) in the photosystem 2.
  b. The pigmented carry the energy to a pair of chlorophyll a molecules in the center of the photosystems.
  c. An electron from the chlorophyll pairs is excited and jumps up to a primary electron acceptor.
  d. A water molecule from the lumen is split by an enzyme into 1/2 O2 and 2 H+ ions, and two electrons. The electrons are taken by the chlorophyll pair, and the O combines with another to become diatomic and diffuses out of the cell (or photorespiration, if stomata are closed too long in C3 plants)
  e. The primary electron acceptor carries the excited electron to the proton pump, which pumps H+ ions inside the lumen. The energy of the electron is depleted
  f. … not done yet

- **Explain the difference between oxidation and reduction reactions. Identify reactions as either oxidation or reduction reactions.**
  a. oxidation = lose electrons
  b. reduction = gain electrons

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- **Explain the effect of environmental conditions on the rate of photosynthesis.**
    a. photosynthesis uses CO_2 and releases O_2
    b. the more the photosynthesis the less the CO_2, and the less the greenhouse gases and global climate change
    c. photosynthesizers are CO_2 sink

- **Explain, as well as compare and contrast, the C4 and CAM adaptations that help plants handle certain environmental conditions.**
    a. C4 do their light reactions in cell usually near the vein and do there calvin cycle in a mesophyll cell called a “bundle-sheath” cell
    b. CAM plants store CO2 at night and do their light reactions in the day.
    c. both store CO_2 first into PEP, a three carbon sugar that becomes OAA, a four carbon sugar, with carbon fixed

- **Explain global warming and the ozone layer (mostly unrelated).**
    a. ozone used to protect Earth from harmful rays
    b. CFCs chlorine can break down O_3 into ClO^- and O_2, and contribute to global warming

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Red Onion Lab Analysis Questions

1. **Your onion cells, like most plant cells, contain specialized organelles called plastids. Your onion cells have only one of the three different types. What type of plastid appears to be present in the cytoplasm of your onion cells? Explain your choice.**

   The onion cells appear to have chromoplasts. Chromoplasts are responsible for the creation of pigments in a cell, and there are green and pink pigments in the onion cell. As for the other types of plastids it might make sense that there could be leucoplasts in the onion cells, but it is improbable because there is little starch in an onion. It is also improbable that they have chloroplasts, because they do not go through photosynthesis.

2. **Which of the three types of plastids are obviously not present? Explain your choice. Explain why they are not present.**

   Chloroplasts are obviously not in the onion cells, because the onion does not need to go through photosynthesis, because it does not need to make its own energy— the main onion plant can do that and provide the energy.

3. **Compare the onion cells before and after the addition of salt water. What changes took place? What do you think caused these changes to take place?**

   Before the addition of salt water, the cells looked like normal (plant) cells— there were cells pushed up against each other, with their cell walls touching and the cell membrane taking up the entire space of the cell. After the addition of salt water, the cell membrane shrunk, peeling away from the cell wall (but the cell wall kept its shape). All the organelles and cytoplasm became concentrated in a small part of the cell, and the cytoplasm turned a bright pink from all the concentrated chromoplasts and pigments. I think this took place because the salt absorbed the water out of the cells, causing the amount of water in the cell to lower and the membrane to shrink.

4. **Compare the size of the average onion cell before and after the addition of salt water. Did the overall size of the cell change much? If so, did the size of the cell increase or decrease and why does this change make sense? If the overall size did not change much, does this make sense and why?**

   The size of the cell (held by the cell wall) did not change— only the cell membrane shrunk. This makes sense, because the cell wall is built rigid to prevent the bursting or implosion of the cell when there is an abundance or lack of water in the cell. It did its job here by keeping its shape (and size).

5. **The onion cell, like all plant cells, have two barriers that separate the inside of the cell from the outside. What are these two barriers? Explain the differences in their function.**
   a. Cell membrane: This is a flexible, inner barrier that regulates the substances coming in and out of the cell. It has transport and receptor proteins that allow certain substances in and out, and allows for exo- and endocytosis (the importation or exportation of vesicles into and out of the cell).
   b. Cell wall: This is a rigid outer barrier that will withstand osmotic pressure, so that the cell will not burst when there is too much water nor implode when there is too little, such as when we poured salt water on it.

1 Most of all, I would like to discuss Orwell's amazing imagination to write *1984*, with concepts alien to us, especially a government based on excessive control and hypocritical slogans; he invented a way of living with "telescreens" that created a life with no freedom, and a "Thought Police" that noted your every action. I also would like to discuss Winston Smith. Being the main character, he has a very high capacity for complete independent thought that is discouraged in his society. He rebels against Big Brother when most other people happily believe everything the government fills their brains with, and therefore wants a life like we Americans happily live in (and take for granted) every day. I would also like to talk about one major theme in the book: that a life in a strict socialist government is meaningless. It oppresses intelligent people such as Winston and Julia, who believe in freedom and a better life.

2 I find the last chapter (Chapter 6 of Part 3) of the book very confusing. It is clear that Winston has been released from the Ministry of Love after his torturing and "curing" process, but he has not been shot in the head. The last paragraph states, "He was walking down the white-tiled corridor with the feeling of walking in sunlight, and an armed guard at his back. The long hoped-for bullet was entering his brain ... But it was all right, everything was all right, the struggle was finished. He had won the victory over himself. He loved Big Brother" (300). It seems that he resigns to Big Brother. When he mentioned (metaphorically) that the "bullet was entering his brain," he probably means that the old, freedom-seeking Winston was dead, not that he was physically dead - that he had become like everybody else, like the government wanted: a person who was incapable of independent thought, who worked and lived for Big Brother.

3 I would rate my enjoyment level of reading *1984* an eight out of ten. As I mentioned earlier, the ideas Orwell put into the book are too evil for us to imagine, which is interesting. The description is very elaborate, and the narration includes all of Winston's thoughts. It's very easy to see why Winston feels injustice and pain. However, the book did seem a little boring and confusing in some parts, with difficult vocabulary and a little bit of "Newspeak" - the abridged version of English. This was especially obvious in "the book" by Goldstein: "Even after enormous upheavals and seemingly irrevocable changes, the same pattern has always reasserted itself, just as a gyroscope will always return to equilibrium, however far it is pushed one way of the other" (202). It continues in this monotone for many more pages, and brings my rating down.

4 *1984* easily presents to all its readers that a nation with extreme control will be meaningless. No individual thoughts can be thought of, including and especially those involving creativity and ideals of liberty - this would be considered "thoughtcrime" in the world of *1984*. This means that a world described by this book would be very different from the modern-day, free life we live in the U.S.A., which has proven to work very well. Therefore, *1984* warns against socialist governments. This is the most meaningful idea I have gotten out of this book: that we should appreciate our life as it is, without having to fight for our privacy and freedom.

Jonathan Lam
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A Reason

"Careful!" warned John from the passenger seat. “Watch that ice patch.”

Vincent was already driving intently, and replied coolly, "Don't worry— I can handle this." He carefully maneuvered around the hazard.

Meanwhile, Kyle began to get impatient in the backseat. He looked past the comfortable interior of the luxury car with the heat turned high and into the unencouraging torrents of snow; he then plopped back down again, depressed. If it had been a sunny day, he soon be in the city, glad as could be. *That was not to be. Not with this weather,* he concluded.

A heavy snowstorm stood between them and the great New York City, causing accidents left and right. Major roadways were closed, and detours had to be taken. When they began late, they knew it was a mistake: their trip would take much longer than they thought it would.

The road conditions were becoming dangerous, and news stations throughout the tri-state region advised extreme caution and warned against driving unless absolutely necessary.

It was, however, essential for the teens to face the danger. They were auditioning for an important soccer all-star state team in New York City. This was a team that could change their life and springboard their future careers. There was little debate as to whether or not they should go.

"Surely we're almost there now? You said it'll take an hour and a half, but we're already two hours in. We're almost late!" whined Kyle, although he foresaw the answer.

"No such luck," replied John. "With the road conditions the worst they've been in years, we won't be able to drive over thirty miles per hour. I'm sorry, but we're going to be late."

"But... at this rate, we'll be an hour and a half late— they told us to be there by ten o'clock *sharp*. We can't be late!"

"Serves you right for eating breakfast for an hour this morning," Vincent mumbled.

"Hey, that wasn't—" Kyle blurted out.

John, the oldest and the pacifier for the three, interrupted quickly. "You two, stop! Vincent needs to focus. Don't worry, Kyle. It's all going to work out."

The amicable atmosphere shattered, and the next few minutes passed in a painful silence.

Still indignant, Kyle broke the quiet. "It isn’t fair! The *one* time I have a chance to shine, it's taken by a snowstorm! Why didn't you listen to the weather forecast? We’re going to lose our chance."

Then, he naively threw a tantrum with strings of curses for the next few minutes, while John and Vincent remained quiet. Suddenly, the yelling stopped as Kyle pulled himself together.

"On second thought, we can get there. We're in Greenwich now, and we have another two hours until registration ends— we can get there on time," Kyle thought out loud. "Vincent, drive faster. You're a speed-demon; show it! We don't have to go at ninety miles-per-hour like we do sometimes, but sixty will do— plus, it's within in the speed limit. Let's not be late. I know you can do it. Please?"

John, with a constant phobia of the breaking the law, quickly exclaimed, "Vincent, don't listen to him! He's implacable and puerile: he doesn't know the danger of speeding. You know they issued a thirty mile-per-hour speed limit in most of Connecticut- there's a reason behind any law. If we don't get there on time, I think they can cut us a little slack, given our situation."

The car suddenly accelerated and then stops to an abrupt halt. Vincent said, "The road is getting dryer- I can feel it. I think my *superior* driving skills can handle some more speed."

John gave him a look and said, "I don't think you should do this, Vincent. I have no respect for those who break the law. Plus, not all of the road is the same— and who knows—"

Kyle interrupted: "Majority rules! Vincent and I say we can go a little faster. Let's go!"

"Kyle, stop being so autocratic! In the name of the law and safety's sake, I really feel—"

Vincent started driving, and John's last attempt to change their mind failed. He turned to an apathetic standpoint of the subject.

"Listen, you two. You always want to speak, never to listen. Suit yourself. I don't agree, but I'm going to get some rest now. You guys tire me out," he said, and dozed off.

Kyle smiled and sat back in his seat. He didn't exactly despise John, but there was a mild sense of antipathy between the two, more of a dislike and uneasiness, a clash between two strong-minded people. Therefore it wasn't often that he won an argument against John, and every time his success excited him. He spent the next half an hour in bliss.

Soon, they were moving at sixty miles-per-hour on the deserted Merritt Parkway.

"When exactly will we arrive? My calculations weren't off, were they?" inquired Kyle.

Vincent glanced at the screen in the dashboard. "Well, the GPS says we'll be there in just over an hour and fifteen minutes. That means we'll be on time, arriving at approximately—" He looked down at his watch, briefly calculating. "—nine forty-five. Pretty good timing, don't you think? It'll be WHOA"

The car swerved, and Kyle grabbed onto his seat. John woke up, eyes wide open.

In the next moment, time slowed down. There was a metallic crunch, then a few smaller booms. Vincent and John's heads were punched back by airbags, and they groaned simultaneously and fell unconscious. The car rammed into the railing, stopped unexpectedly, and the hood began smoking, a giant wooden block upon it. Kyle was groggy and disoriented, but the situation soon dawned on him. There was a tree trunk, enormous in diameter, lodged onto the top of their hood. He immediately pulled out his phone and dialed 911.

For a moment, as the dial tone rung, Kyle looked outside at the snowdrifts and leisurely, drifting snow, he contemplated the real situation, and began to empathize with John. *Nature is powerful. Could we really have avoided it? The law knew best- was I wrong?*

"Hello? ... I'm reporting a car accident on the Merritt Parkway, between exits fifteen and sixteen ... I'm in the car, and my friends are in the front. They're both unconscious. What should I do? ... Okay ... Yeah, we were speeding a little bit, because we were already late to an audition ... Yeah, I realize we're not going to be there on time now. It's my fault in part ... Okay, thanks a ton." He sighed and reported the situation to his family.

I should have listened to John. He was so right: the law and safety— what could be a better incentive than that? An audition doesn't matter compared to this. It's all my fault! A strong feeling of pathos for his innocent friends began to arise in Kyle.

He went on to check on Vincent and John like the policeman had told him to. Luckily, they were alive and breathing; their breaths were slow and irregular, and he could tell that they were in pain.

Why did I do this? Why am I so impulsive? Why does my day have to be ruined... in so many ways? I engendered this entire, terrible situation. I'm a terrible person. John was right.

The sound of sirens came and blared in his ear. Firefighters inspected the engine for possible danger, and deemed it safe. A policeman and nurses walked up to the car. Kyle was interrogated fiercely but briefly, and the two other boys were moved into the ambulance.

The policeman informed Kyle that his friends' legs were badly broken in multiple spots, and they wouldn't be able to play soccer or even stand for a long time.

Kyle broke down, sobbing, in front of the emergency crew.

"It was all my fault! Between my arrogance and the wisdom of time-tested law, I'll take all the blame! I didn't realize how inimical I was— the law is broken all the time! How was I supposed to know that the speed limit, being a law, was there for a reason?"

Jonathan Lam
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Reflection

In my short story I decided to base my ideas on the themes of obedience to the law, as well as arrogance. I combined the two (and used two quotes from the book), so that my main character was arrogant and broke the law, with consequences: Kyle was supposed to be an allusion to both Antigone and Creon. He was stubborn and he had influence in some ways (like Creon), but he also broke the law and ended up paying for it (like Antigone). Because he has some of the characteristics of both of them, he illustrates the arrogance and the law-inobedience that makes him make a mistake to become the tragic hero, and he is misfortunate, similar to both Creon and Antigone. Also, to make this story a little more similar to *Antigone*, I tried to use dialogue extensively in this story. I came up with this storyline because we had been driving to New York City just a few days ago, on a day when the roads were incredibly icy, and I had an important concert that I had to play at. The difference is that we went slow and didn't miss anything. This is an example of a situation that may have happened had we not slowed down for safety and ignored the time-tested and rational law (of a speed limit). And lastly, the names in the story were not totally random; they were the names of the others at my table when I began my story.

The underlined text in the short story is either key words (including extra Latin ones) or quotes.

A Tragedy of Human Nature

In Shakespeare's tragedy *Romeo and Juliet*, the two lovers Romeo and Juliet are wild in their passion for each other despite the problems with their relationship. However, their strong feelings led to many negative decisions that in turn led to their downfall: following their initial choice to love each other and defy their families' mutual hatred, they ended up making a series of dangerous decisions for each other that worsened their own situation and led to the infamous tragedy of the lovers. With choices made that are "too rash, too unadvised, too sudden" (2. 2. 123-125)— as Juliet herself had said about loving Romeo— a dramatic tragedy ensues. Decisions made by a person out of strong emotions will lead to a vicious cycle of hasty negative decisions and potentially even to the person's demise.

No matter a person's regular personality, sudden emotions will engender impulsive, rash decisions. Romeo, for example, is normally a gentle and well-behaved gentleman— even Lord Capulet had acknowledged him positively, finding him "a portly gentleman, and, to say truth, Verona brags of him to be a virtuous and well-governed youth" (1. 5. 75-77). Before Mercutio's death, Romeo had not any plans of violence towards Tybalt or any of the Capulets, but the tsunami of sadness and anger from his friend's untimely and sudden slaughter had invoked a strong urge for revenge, overriding all of his logic and previous intentions for peace. Just prior to Tybalt and Mercutio's fight, he had said, "Gentlemen, for shame forbear this outrage! Tybalt! Mercutio! The Prince expressly hath forbid this bandying in Verona streets" (3. 1. 87-90)— however, when Benvolio attempts to convince Romeo of the same following Mercutio's death, Romeo could not help but fight Tybalt just as Mercutio had done moments before. Ignoring Benvolio, Romeo impulsively assumed Mercutio's provocative personality and said to Tybalt, "Either [you] or I, or both, must [die]" (3. 1. 130-134). If he had just used the slightest bit of sense, he would not have forgotten what he had tried to reason into Mercutio: that a fight like this would be dangerous or deadly, both physically by the sword and by the penalization by the prince. Even Juliet had understood this concept when she said in the balcony scene to Romeo, "Well, do not swear [thy love to me]. Although I joy in thee, I have no joy in this contract tonight. It is too rash, too unadvised, too sudden" (2. 2. 123-125). She understood the potential

consequences of their love, passionate but sudden, that would require either extensive planning or an extreme reform between their families to forget their grudges and start unbiased. However, they decided to love and marry each other in the presence of their rival kin, and they stepped right into a marriage of hiding, lies, and a bleak future. Their initial love and hurried marriage, the hidden and secretive plans, Tybalt's death, and Romeo's suicide are all examples of both Romeo and Juliet making reckless decisions throughout the course of the story, amongst many other, smaller choices that they could have improved. Indeed, reckless decisions only lead to nasty conclusions— without the help of logic, outcomes of decisions are subject to catastrophe.

Another essential point that Shakespeare is trying to convey is that hasty, emotional decisions tend to induce more hasty, emotional decisions— a vicious cycle that persists until the person is calm enough to reflect and reform or until the person's downfall. For example, the ultimate downfall of both Romeo and Juliet is part of a larger chain of events, all linked by bad choices made. It starts when Juliet goes to Friar Lawrence for advice when her father suddenly changed his mind to arrange a soon marriage (within days) to County Paris— she threatens to stab herself to show the depth of her devotion to Romeo. By doing this, she forces Friar Lawrence to make a quick, rash plan to "save" her from Paris and join her with Romeo, one prone to failing. She says to the Friar, "I long to die if what thou speakest speak not of remedy" (4. 1. 67-68), and that "if in thy wisdom thou canst give no help, do thou best call my resolution wise, and with this knife I'll help it presently" (4. 1. 53-55). Her desperation is exactly the kind of attitude to avoid, as it evoked a deadly plan. When Friar John, the messenger to Romeo, returned without delivering the message, the Friar knew that Romeo and Juliet could be doomed: "Unhappy fortune! By my brotherhood, the letter was not nice but full of charge of dear import, and the neglecting it may do much damage" (5. 3. 17-20). Then, Romeo, devastated without knowing the Friar's scheme, foolhardily decided to kill himself for Juliet, saying to his messenger Balthasar, "Get me ink and paper, and have post-horses. I will hence tonight" (5. 1. 25-27). Balthasar advised him, "I do beseech you, sir, have patience. Your looks are pale and wild" (5. 1. 28-30), but Romeo ignores him, to his own loss. In this short sequence of events shortly prior to the deaths, it is clear that desperation and hastiness were major influences to the decisions, which went from Juliet's threatening of Friar Lawrence to a double suicide by Romeo

and Juliet, quickly escalating from an unintelligent decision to loss of life. This course of events was without careful, reflective, and logical thinking on the part of the main characters. By stopping to think, much of tragical aftermath may have been prevented. Simple, reasonable thinking may have solved their problems with ease: if Juliet had not been so desperate and threatened to stab herself, then Friar Lawrence could have come up with a better, more reasonable and foolproof plan, and if Romeo had not immediately thought about dying with Juliet but instead moved on or talked to the Friar, then they would certainly have survived and maybe even ran away to live happily. This is similar to Romeo's "love at first sight" for Juliet and marriage the following day. This was a mistake that encouraged their dangerous relationship that caused trouble throughout the plot. With a little bit of logical and creative thinking, Romeo and Juliet could have moved past their drastic and frantic resolutions— instead, they made their decision to love and set off a disastrous, unstoppable chain reaction.

Shakespeare is trying to teach his readers about an aspect of human nature: the power of strong emotions. Love, hate, and anger— all of which were present in *Romeo and Juliet*— can all have disastrous results, because people will become careless and illogical upon encountering them. Both Romeo and Juliet illustrated this, being imperfect, average people that gave in to their emotions and died for each other. Shakespeare artfully used the knowledge of this correlation of emotion and failure to create a fascinating love story and tragedy, a story with many lessons. Thus, the cause of the tragedy of Shakespeare's *Romeo and Juliet* was not only the main conflict of familial hatred, but also human nature.

Jonathan Lam
Mrs. Staron
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Romeo and Juliet **Balcony Scene** Critique

Video: Frank Zeffirelli's 1968 *Romeo and Juliet* with Olivia Hussey and Leonard Whiting

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Although the "balcony scene"— Act 2, Scene 2— of the 1968 version of *Romeo and Juliet* was performed almost word-for-word from the original play, the performance conveyed much more than the plain text did. Unlike our read-alouds in class, the producers of the movie considered many aspects that would add to the effect of the dramatic story: many aspects to improve the appearance and tone of the actors so that the plot would be more interesting. Many aspects of the film, especially the music, the scenery, and the acting of the protagonists, led to the successful rendering of the well-known scene from the famous play.

The music in the movie was well-matched to the mood of the characters. Near the beginning of the scene, when Romeo first approaches and notices Juliet up on the balcony— as he said when Juliet entered, "But soft, what light through yonder window breaks? It is the East, and Juliet is the sun" (2. 2. 2-3)— gentle, slow, and quiet flute music played a romantic tune in the background. Visually, we can tell how much Romeo is attracted to Juliet, but the music creates a mood of romance that the audience is inclined to absorb— this way, Romeo's sense of love towards Juliet can be transmitted to the viewers of the film, making the film more convincing. During most of the scene, as Romeo and Juliet converse, there is no music playing, as their feelings are not somewhat ambiguous as they go back and forth about their love and loyalty. When they decide that they would get married, their excitement was carried out to the reader by their expressions and tone, but also by the new music that appeared— still a flute and violin song, but this time upbeat and happy. This happened when Juliet told Romeo, "If that thy

bent of love be honorable, Thy purpose marriage, send me word tomorrow" (2. 2. 150-151). The addition of music into the scene played a crucial role in allowing the audience to feel like Romeo and Juliet, effectively pulling them into the story and making them more involved.

Another powerful and purposeful aspect of the movie was the scenery and appearance of the scenery and overall appearance of the video. A few of the details were from the book, but a few small details were altered to produce a more exact effect. According to the book, the balcony scene occurred at night, and Romeo had scaled a high wall to see beautiful Juliet on the balcony— however, without the full moon shining on their faces, the ivy covering the stone walls of the castle, and the old-fashioned clothing of the lovers, there is no way to imagine in full the romance and symbolism from the plot. There would be no way to visualize the backyard of an old castle at night, rustic and majestic at the same time. The full moon, which is often associated with love and uncertainty, and a castle, a somewhat mysterious place, were both important features that the movie helped the reader understand much better. It was also much easier to see that the Juliet on the balcony was like a trophy on a tall pedestal— a precious item, hard to get, that would sound an alarm when taken. The balcony separated them, and was another important piece of symbolism. Lastly, the costumes, which were colorful and made to the style of centuries ago, were matching and helped add to the reality of the scene— there was no mention of them in the book. Overall, the visual aspects that Zeffirelli changed had a huge impact on the story.

A play wouldn't be a play without skilled actors and meaningful dialogue, and Hussey and Whiting fulfilled their roles as dramatic, interesting characters in the film. First of all, they spoke directly from the book, clearly and with the correct punctuation and emphasis on words,

which alone adds meaning to a text and makes it easier to understand. What they really emphasized, however, were the tones and speed of their speech. At times, they spoke slowly, uncertain, of vows and identity; while at other times, they spoke excitedly and hopefully of marriage. One of the most notable was Juliet's well-known line: "O Romeo, Romeo, wherefore art thou, Romeo?" (2. 2. 36). It was pronounced slowly and sadly; Juliet was staring off into the distance, sighing. Another instance was when Romeo had shown himself to Juliet. In the book, the only indicator that he had spoken out to Juliet was that there was no "[aside]" next to his dialogue; however, in the movie, he shouted out his line to her (as opposed to whispering to himself earlier). Following his exclamation, Juliet's line was, "What man art thou that, thus bescreened in night, So stumblest upon my counsel?" (2. 2. 56-57). Her line did not indicate fear or surprise, but seemed rather calm; in the movie, however, Hussey appeared very frightened, convincing our class much better than the book that she was startled by Romeo's intrusion. The acting was very convincing, and it greatly improved the effectiveness of the scene.

Zeffirelli deliberately had many details of the film perfected in order to preserve the splendor and feeling within the balcony scene. Between the music in the background, the scenery and the acting, the movie had a much larger effect than the book. Zeffirelli's producing, along with Hussey and Whiting's acting, performed the play in the most effective manner to the audience.

Jonathan Lam
Mrs. Staron
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Cerebration

He stood there, on the smooth wooden platform. His back was turned to the audience. Next to his name on the screen above his head, eleven "X"s stood silently, patiently waiting for their twelfth, unknown companion. The crowd was silent. Tall and thin, he stood unwavering, sweat forming on his forehead. He shifted his stance slightly, his blond hair ruffling, and started his final move.

Two hours earlier, Lenny Lee had walked into the Nutmeg Bowl of Fairfield, Connecticut for the final week of the CIBL high school bowling league. His friend and doubles partner for the day, Dennis, greeted him on his way in and yelled at him to hurry up because practice had already started.

"Don't worry, I'm coming!" There was still plenty of time before the first games began, and Lenny showed no urgency in his movements. In a little while, the matches were underway. Besides being the final week in the league and a doubles tournament, the ambiance did not suggest anything new. Pins flew; parents cheered. Shots missed; smiles disappeared. The air became saturated with the mixture of emotions. It lent ones at random to the players, causing both the misfortune and luck abundant throughout the bowling alley.

Meanwhile, Lenny easily kept up a 200 average, trailing closely behind Dennis. No other team had them in sight as each of the first four games led them farther and farther ahead.

*** * * SOME FACTS TO CONSIDER * * ***
Lenny and Dennis were seniors.
They both were well-behaved, determined learners, especially in bowling.
They were fourth and first highest averaging bowlers, respectively.
The second highest averaging bowler was absent.
They were going to win, guaranteed.
These were the last games in their high school league and bowling career.
This would be the best, and perhaps final, time to set a new record.

Before long, the last game, the fifth game, approached. There were strikes, one after another. Nobody noticed until the first five frames were filled with little crosses, "X"s. A sixth one followed, and people clapped. The seventh, eighth, and ninth flew by in the same manner. Before long, the tenth frame loomed in Lenny's way to his first perfect game.

By now, all of the surrounding bowlers had stopped bowling, watching in awe. The breaths of the best bowlers stopped in their chests as the final shots flew. Throughout the season, there had been a few games above a 290, and they wondered as a group: could Lenny keep up?

"Are you nervous?" Dennis asked him, with the most innocent face. Having bowled multiple 300 games, he was well aware, of course, of the anxiety dominating Lenny's face.

Lenny replied yes. “Well, don’t be. Just relax,” was his only advice. Lenny was left struggling to figure out how to do so. Anxiety is not an easy foe to conquer.

Despite his angst, the tenth and eleventh throws were also a success. With the fall of every last pin came a massive reaction in the still-gathering audience, quickly swallowed each time by the silent throat of anticipation for the next shot.

Eleven “X”s on the screen. One “X” more. Ten pins in a triangle. Ten pins to knock down. A lane sixty feet by forty boards. A single board off target to a ruined game. All these Lenny knew, but his mind taunted him. Would these numbers fail him? Would his years of hard work and practice lead to a successful shot or a failure?

There was no choice but to start. The swing began, and the crowd stared. Moods flew, replacing each other in fractions of a second. Uncertainty. Jubilation. Dread.

The swing went left, only slightly, but enough. The ball followed. The hook came early. The ball hit high. The pins flew. The ten pin shivered but refused to fall.

There was the strongest uncertainty in the air. To get a perfect game or to miss a few frames and get a decent game would have certain, simpler reactions. But to score a 299, to be just away from perfect, was not something to prepare for. Nonetheless, the crowd reacted.

“Congratulations, Lenny!” Dennis shouted, and people rushed in to shake his hand. Some bowlers seemed disappointed and reluctant to make a remark, but the parents were relentless in their admiration. However, he quietly held in his own dismay.

Only returning to his house later that day did Lenny dampen his disappointment, with some logic and cerebration. There was no reason to be angry with himself, he realized— no harm had come out of the experience. Then, he smiled and continued his journey home.

*** * * A REALIZATION * * ***

People are not meant to be perfect.
A single perfect game does not indicate perfection.
(Consistent 300 games would be perfect, but it has not been achieved.)
Perfection does not exist, and improvement matters.
There’s always time to bowl a 300 when bowling for fun in the future.
A 299 game is still a success.

Jonathan Lam
Mrs. Staron
English per. 8
12 / 19 / 14

Fate: Life's Greatest Mentor

In Homer's *The Odyssey*, fate plays a critical role in the form of prophecies and gods meddling with humans. The various prophecies throughout *The Odyssey* are all predetermined to happen; however, although even the gods cannot change the end result of fate after it is decided, it is vague and people have some degree of power over the small details of their lives. Much of a person's destiny is fixed, but there is room for choices and mistakes to be made; those few decisions that a person can make can show their personality; Homer is trying to teach us that fate is a mentor to us. It is used to teach lessons and to test a someone's character. Fate is a general, fixed structure for people's lives, that teaches lessons and character.

An important function of fate is to instill discipline. For instance, after Odysseus's return to Ithaca, Poseidon becomes furious at the Phaeacians' attempt to help Odysseus and turns their returning ship to stone. King Alcinous of Phaeacia takes this as an omen, because he remembered his father's prophecy, saying to his people, "If we gave safe conveyance to all passengers, we should Poseidon's wrath, he said, whereby one day a fair ship, manned by the Phaiakians would come to grief by the god's hands … so my old father forecast" (235). Alcinous took this as a warning to them and a lesson to all that they should never help strangers that appear if they want to keep the peace with the gods. Although the message that the islanders received was taken literally and the meaning was a little bit altered - Poseidon only wanted to stop Odysseus and anybody else who offended him - the main message of not offending the gods got across to the Phaeacians, and the forecast may have prevented a mountain built around their city. Similarly, Halitherses warned the suitors with a prophecy, "Let us think how to stop [the deaths of the suitors]; let the suitors drop their suit; they had better, without delay" (24). His advice could have prevented the deaths of the suitors, but they arrogantly refused to listen to him. They knew that they had done wrong in the face of the gods and fate, so they had no reason to try to redeem themselves when Odysseus came home and attacked them. The prophecy, like all the other prophecies in the book, was a lesson to all of the people to prevent future mistakes.

Because someone's future is fixed, it tests the character of people, especially those who know their future. Odyssey's future is already fated and known by the gods or through prophecies such as Tiresias's. Therefore, it seems like there would be little meaning to the story:

Tiresias's prophecy tells Odysseus that he will reach home for sure; Odysseus knew he return to live contently. However, Homer does put meaning behind this, because Odysseus does not stop and relax in the Underworld when he hears his fortunate future: he still intends to do his best to return home quickly and safely. Odysseus's perseverance is tested with the knowledge of his own destiny, because he still tries his best to do his best, even knowing the end result. Somebody else of a less heroic character might give up after hearing the prophecy that "a seaborne death soft as this hand of mist will come upon you when you are wearied out with rich and old age, our country folk in blessed peace around you" (189). Another example of this is when Odysseus tells his men not to kill the cattle of Helios: "Let this whole company swear me a great oath: Any herd of cattle or flock of sheep here found shall go unharmed; no one shall slaughter out of wantonness ram or heifer … They fell at once to swearing as I ordered" (219). His men knew that killing the cattle would be a fatal decision, but they decided to make an excuse to take the impossible risk and take their lives by aggravating the gods- exactly what Odysseus had told them not to do. They decided to give up to the worse of two fated options because of lack of discipline and perseverance- they failed the test of perseverance that the prophecies put forth to them. The foreshadowing that prophecies provide is an excellent test of patience and endurance.

Because fate can be used as a lesson, to warn people of mistakes in times to come, it cannot change. In Halitherses's forecast, he said that Odysseus was going to come home, and that "I see this all fulfilled" (24); similarly, Tiresias ends his prophecy with "And all this shall be just as I foretell" (188). Both of these statements show that they are certain the Odysseus will come home, no matter what - Odysseus's fate cannot be changed. Indeed, Odysseus returns home, fulfilling the prophecies. This makes sense because the prophecies were to be used as future lessons, therefore an uncertain destiny would be useless. Since Odysseus could not change his fate, then there is no way to avoid the lessons he learned: he returned home to slaughter the wrongdoing suitors after his nineteen years of punishment at sea; there was no way for him to return home early so that Penelope and Telemachus's loyalty would not be tested; Poseidon was avenged for Polyphemus and Odysseus learned to be humble to the gods; and the suitors became firm to take over Ithaca. A person's destiny has to be fixed, so that all lessons will end up learnt by the humans, and no shortcuts in life are taken.

Anybody can change some aspects of their future, but not their fate. Fate is fixed, but it does not include all the details of someone's future. For example, in Tiresias's prophecy to Odysseus, he did not lay out Odysseus's future for him exactly how it would unfold; instead, he made Odysseus's future very vague, and he left some choices for Odysseus to take. Odysseus orders his men, "Avoid those kine, hold fast to your intent, and hard seafaring brings you all to Ithaka. But if you raid the beeves, I see destruction for ship and crew" (188). This goes to show that Odysseus actually had a chance to return home without being captured on Calypso's island for seven years, if not for his men. Therefore, even the best prophets cannot know everything that is to happen, because fate leaves some opportunities open for people to decide what to do. Similarly, Halitherses prophesied, "Odysseus will not be absent from his family long: he is already near, carrying in him a bloody doom for for all these men … My forecast was that after nineteen years, many blows weathered, all his shipmates lost, himself unrecognized by anyone, he would come home" (24). He only forecasts about the end result and a little description of what had happened- he did not go into the details about what was to happen. Nobody was sure exactly how Odysseus was to return, because his future was not entirely decided. He still had to make his own decisions about the way he was to return to Ithaca. These little holes in the rigid structure of fate, these opportunities, allow fate to test people's character, because those little decisions show important characteristics of a person, especially perseverance.

Fate is not totally decided, nor is it totally left open to for a person's decisions; instead, it is a mixture of both. Homer's *The Odyssey* included fate as a major entity, of predicted futures, to teach us that fate is meant to be this way. All of the prophecies in the book were proven true in the end, no matter what, which shows that much of our destinies are set- but they were left open to interpretation and change as to exactly what happened. Fate acts like a teacher in people's lives: it teaches and tests our character in difficult times. Fate is designed to be both ambiguous and definite to teach and test people, and it is a major guide to peoples' lives.

Jonathan Lam
Mrs. Staron
English per. 8
2 / 12 / 15

Found Poems

Poem 1

Words (from envelope)**:**

- spirit
- power
- knowledge
- brilliant
- oasis
- guru
- surge
- steaming
- halo
- exist
- watchdog
- flinch
- lose
- dark

Poem: A Guru Watchdog

Having a great oasis of knowledge
Is a brilliant, wonderful power.
Your mind is an invisible halo
Quietly steaming over your body.

Knowledge, hidden in the form of reason
Always protects you, a guru watchdog:
It surges through you, stealthily hidden,
Fighting your dark and villainous devils.

Reason can destroy your worst nemeses
Of fear and doubt- who attack your spirit-
Without even one tremor or flinch;
It does this constantly, subconsciously.

It does exist, so you don't want to lose
Your powerful, precious, and prepared mind.

Literary Devices

metaphor	"your mind is an invisible halo"
metaphor	"reason … is a guru watchdog"
personification	"[Reason] *fights*"
personification	"[Reason destroys your worst nemeses] without even *flinching*."
alliteration	"powerful, precious, prepared"

Jonathan Lam
Mrs. Staron
English per. 8
2 / 12 / 15

Poem 2

Words (from another poem)**:**

- divine
- supernova
- nurturing
- eat
- driving
- flying
- super

Poem: “When I was a Superhero”

Last night,
I was a superhero,
Divine, deathless, debonair.

I was a machine of sorts:
No need to eat,
No need for nurturing.

I could drive-
Or fly, if I wanted-
As fast and far as I wished.

I was like a supernova,
Shining brighter than the brightest star;
Doing everything in the most “super” way.

I was a superhero,
Solving the world’s problems
In last night’s dreams.

Literary Devices:

alliteration	“divine, deathless, and debonair”
simile	“I was like a supernova”
metaphor	“I was a machine”

Jonathan Lam
Mrs. Staron
English per. 8
11 / 26 / 14

My Death Wish

Every day since the end of August, I've been running as fast as my legs could carry me, far away from school and into the quiet forest roads many miles away. Since August, even high school has hardly seemed a challenge. Today, for my incredible effort, I've given myself a death wish- a day of torture for my body and perhaps the ruin of my reputation among my siblings and peers.

A race official announces that the boys high school cross country race begins in two minutes. No longer was my team practicing for our races. Today, the results of our weeks of training will be revealed in my first race. I unwillingly head down to the starting line with hundreds of competitors. The five-kilometer high school cross country race at New Fairfield is my death wish

This race will matter to me. It's my first competition of my first sport of my first year in high school, and my performance this race may not only be used as a baseline reference to Coach, but also an opportunity to be judged negatively by my teammates, family, and friends.

But I'm not ready. My legs are cold. There's some soreness in my foot from a tiring workout some days ago. I didn't drink nearly enough water yesterday. And worst of all, I am wearing my uniform's uber-short shorts in front of hundreds of strangers. I'm also not well trained. I'm set up for a terrible day- the day I signed up for cross country I set myself up for a day like this.

For the last month, since the first day of school, cross country has been the most physically grueling experience of my life. Our running practices have taught us the skill of running and the sense of peer pressure that whispers in you, "Keep running until your legs feel 'dead,' and then run some more!" Being a freshman on the team with the fastest sophomores in decades has been a shameful experience, so much so that I complained for hours on end after the first day of school to my parents to allow my resignation from the team if my legs didn't stop hurting by the end of the week. They denied my request.

That recent feeling was nothing compared to my current mental state-of-being. On the starting line, I imagine horrible scenes of my own demise: falling behind and returning home with a last place medal; and even dying, which seemed not too unlikely in a human stampede. I

also imagine myself miraculously full of energy, sprinting the whole way without being tired. Although common sense reminds me that either extreme was very unlikely I nonetheless actually become a little depressed, seconds before the gun sounds. The “Good Luck!” I receive from my teammates doesn’t help, but I strive to stay optimistic, and enjoy the last few moments of physical relaxation.

Once the race officials scan the starting line, one of them yells, “Runners, to your marks! … Set …” BAM! The gunshot booms throughout the sky, and the hundreds of runners surge forward the way a rip current rushes out to sea. We start out spread over a starting line a hundred feet wide, and are soon funneled into a small pathway only twenty feet wide, and I get shoved in every direction by aggressive competitors. Within moments, I am left far behind our front-runners, indecisive about how to pace myself. As we pass the stadium where Coach and many of the spectators are situated, my high adrenaline and fear set in, causing a drowning panic. As Coach points at a runner passing me and yells to me to “Run as a team! Keep up with him! Run!” I race forwards to match strides with him.

At that moment, I secure my death wish. I have no reasonable excuse- no injury or problem with my running. If not, then my sister would jeer at me for not beating her race times, and Coach would think badly of me. So I race. I pick up my legs and run despite the terrible pain and fatigue building up.

Now I attempt to distract myself from running a little bit. One of our senior runners had told me that once I recognized that “Running was pain,” and when I could distract myself from the pain, running would become much easier. I try to think about programming- of logical code that makes sense and doesn’t require any physical effort- however, I trip on a rock and my mind floats back to running.

I then reminisce about bowling, another one of my hobbies, though I remember the frustration I experience so often when bowling, which disturbs my worried soul even more.

Then, I turn to school, which comforts me as I recall this year’s successes and remarkable improvements from middle school. I think of the support of my friends, my teachers, and my family. It takes my mind off running, my body subconsciously taking over. Oh, what a different

experience running is now! I hardly notice the increasing exhaustion that was so painful earlier in the race.

By now, I've reached past the third kilometer mark, so I have less than halfway to go. Feeling pretty good about myself, I attempt to speed up, and the pain increases exponentially. Nevertheless, I bump up my speed, and manage to rush past a runner for the first time. I don't slow down as I tire, whereas I instead speed up, and I pass a second runner, a third, a fourth. I start to notice others slowing down, and I use this to my advantage and continue gaining places. They're sweaty and muddy and unwilling to run any more, just as I am. Now I realise that I'm not the only one who feels this terrible; that others can empathize with me. By the looks on their faces, they're using even more effort to push themselves than I am; I realise now that I have a greater potential, so I order my legs to push their limit..

The weariness of my legs and my shortness of breath are indescribable, yet somehow I make my way to the last kilometer at a fast run. My legs are becoming so tired that I start to trip over my own feet and barely catch myself from falling, and I look ahead to see the last kilometer of the race to be on a steep hill, and my heart drops. The dull pains in my legs return. I fall behind a few runners, dreading the next few minutes. I can't do this! I almost stop, but I think back to cross country practice.

I tell myself, *We've run faster and longer than this before. You've run harder than this. This is easy, and you can do this*. I remember the pain of practice and reassure myself that I'm not going to die. I barely manage to prevent myself from walking or completely stopping.

There's only half a kilometer left in the race. Mind tricks are all I have to keep myself from giving up. *It's only half a kilometer left to go. Only one and a half laps around a field.* Along with Coach's yelling on the sideline, I encourage my body to move faster, until I'm achieving a full-out sprint.

There's a hundred meters left. I urge my body to go faster, and it almost cries back to me, "Jon, you're going to die! You can't do this anymore!" The urge to stop is so great, I almost cry on the finishing stretch. In no time, there's only fifty meters left; twenty-five meters; ten meters, and I finish!

Jonathan Lam
Mrs. Staron
English per. 8
11 / 26 / 14

I can't believe it! I survived the race, and I've beat my sister's times. I can't wait to boast my scores at home. Coach and the fastest of my fellow teammates congratulate me for a great first race as a freshman, and I've made varsity as a top runner in the race. I'm astounded and so tired so that it takes a great effort for me to return to our tent and gulp down some water, relax, and think about my race.

I never want to race again, although I know I'll have many more like this over the next few years in high school. I know running has felt like a death wish I put upon myself, though I also know that the way I am running will not kill me, and the harder I run, the better I'll do, and the more satisfied I'll be about myself. Although it's painful, effort is nevertheless worth it- the more diligent you are, the better the reward. As Dad always says, "No pain, no gain."

I realise that my life from a toddler to a young adult will be that last uphill kilometer, full of pain and struggle and tests of moral character disguised as self-imposed death wishes- but, one day, if I have the strength to persevere, there's hope that I'll be able to fly through that finish line at the top of the hill.

It's time I ought to try harder.

Jonathan Lam
Mrs. Staron
English per. 8
2 / 10 / 15

Peace Metaphor Poem

Peace
is a blade of glass
calm and a fresh green;
that never argues with the wind,
but lets it pass by;
that, yet trampled year after year,
grows back without a single complaint.

Peace
is the night sky,
dull black with twinkles of light;
that is cold, quiet, still,
but calming and friendly;
that cools down the fiery tempers
of millions of hot stars.

Peace
is the infant’s mind,
a rainbow of ideas and learning;
that thinks only of fun and games,
but not of violence;
that grows so fast,
not noticing the harsh world outside.

Jonathan Lam
Mrs. Staron
English per. 8
4 / 24 / 15

Personification of Death

1. **Which "Death" is closest to what you would have expected (assuming you have some sort of expectation of Death in your mind)? Which is farthest? How so? How did seeing a version of Death very different from what you might have expected affect you?**
    a. I imagine Death much like Sample A, from Harry Potter. It shows Death as a scary, vulture-like being, with crows and a dead tree in a graveyard. I'm very afraid of Death and not willing to let go of the world yet (but this may change as I age), and I imagine it as a spooky being.
    b. I imagine Death least like Sample F, "The Appointment in Samarra." It portrays Death as a sort of normal person, scary but reserved, acting just like a human being. He had an appointment with the merchant's servant just like any businessman might have, and it shows that you cannot escape your fate. It makes Death seem more humane, like a normal person who schedules "appointments" with people.

2. **Is there much overlap? In other words, do you see many consistencies or similarities between texts? Where? And why might that be?**
    a. Yes. There are a few main themes:
        i. Scary, skeletal figure:
            1. In the first and second images, Death is portrayed as an evil, scary vulture of evil and a hooded skeletal figure. This is the main stereotype of Death that I have—that it is a scary place and figure that is unknown and evil.
        ii. Loving character:
            1. In the third image, Death is shown as a caring person for fallen souls, similar to God watching over living humans. He has many faces (souls of the fallen) in his cloak, and he has a kind face looking down at all of them.
        iii. Sly, humanoid person:
            1. In the three texts, Death is heavily personified as a normal person that makes regular encounters with humans (as they die). The appointments seems like normal, routine encounters that are not scary or exciting, but like business deals.
    b. This is because some, but not all, people think of Death the same way, similar to other unknown, shadowy, and mysterious concepts.

3. **It's incredibly easy to find personifications of Death if you're looking for them. But why might that be? What are the implications of personifying Death? Why is this appealing (as an artist or as an audience)? What are the benefits? The consequences?**
    a. I think finding a personification of Death is easy because everybody faces death, and it is an inevitable concept. To attempt to recreate Death is a difficult task, being such a mysterious and unknown idea, so people try to turn it into something that we *can* understand: a person. Therefore, it is probably to allow people to express their concept of Death into something that others can also understand.
    b. This is appealing because there can be so many different ways to interpret Death, and adding humanoid personalities and properties can be very interesting, especially with different perspectives.
    c. As mentioned earlier, this makes Death easier to understand and relate to. However, it may not be able to capture entirely an idea so complex as Death, just like it would be difficult to explain in one text or image how life is.

Jonathan Lam
Mrs. Staron
English per. 8
9 / 22 / 14

Dear School Board of JBHS,

I believe that all students at our high school, Joel Barlow, should be allowed a *free* breakfast in the cafeteria during the 30 minute break to encourage it. Because of the insufficient amount of sleep that many students receive, few students actually have time to eat, and many head off to school with an empty stomach and begin their school day hungry until lunch. Many professionals and reputable websites, such as WebMD and Health.com, agree that eating breakfast is one of the healthiest and easiest choices you can make any day that more of us need

Not eating breakfast can cause many negative side effects besides being hungry, many of which will affect a student's schoolwork. Without breakfast, students can easily become tired and distracted during classes, so that it will be more difficult to listen to lectures, participate in class, and finish assessments to their best capability - and, through the course of an entire four years of a high school career, can negatively affect their learning technique and capability for the rest of their lives. Plus, most people who eat in the morning tend to be significantly happier and healthier than those who do not.

We have a 30 minute break in the morning. Breakfast only takes ten to fifteen minutes. Taking a few minutes off from studying will do no harm. I know that there is already breakfast served at Barlow in the mornings, but a *free* breakfast will greatly increase the number of students who eat breakfast. Plus, because of the positive effects of eating breakfast, a sufficient breakfast a day may pay off in the future, if the students do better in school now and better in the future, which will only have a positive effect on the school's reputation.

Sincerely,
Jonathan Lam

1 There are many things I would like to discuss about *The Da Vinci Code*. First of all, I would like to discuss the way this book was written: it was narrated by multiple people, both protagonists and antagonists, for the reader to tell how one felt about the other and how they justified their unruly and sometimes extreme actions (especially the antagonists). This also made this book very interesting for the reader. There were also a few twists in the book that I was not expecting. For example, Teabing's traitorous role as "the Teacher" shocked me when he revealed himself late in the book. Similarly, I was surprised when Teabing and Langdon informed Sophie that the Holy Grail was a woman, not a traditional chalice, contrary to popular belief.

2 Because this book is a fast-paced mystery novel, the puzzles, clues, and solutions all flew by. This made the entire book a little confusing, especially because the puzzles were combined with a different culture - the French - and was about a subject that I have little knowledge about: the Holy Grail and its theories. Similarly, I know little about many important objects, including the painting *The Last Supper* by Leonardo da Vinci, which was referenced a few times in the book: "On it hung an eight-foot-long print of The Last Supper … Uncertain, Sophie made her way closer to the painting, scanning the thirteen figures - Jesus Christ in the middle, six disciples on His left, and six on His right. 'They're all men,' she confirmed" (204). I only know what this painting looks like based on the descriptions in the book, but if I had prior knowledge of it, I probably can understand the book much better.

3 I would rate my level of enjoyment reading this book a ten out of ten. I liked how realistic this mystery feels, with many true facts backing it. The theory about the famous Holy Grail mystery that Dan Brown presents through Robert and Sophie's adventure is very interesting, and literally ends up where they started - even after hundreds of miles traveled chasing the answer - which is unique. Also, because the book was set in France and Great Britain, this book is very different from most books I read. Overall, I liked this book very much.

4 I think the most powerful and emphasized theme in this book is that women are powerful, but often suppressed. Mary Magdalene, the Holy Grail, was a woman - however, the Church wanted to suppress her because her marriage to Jesus Christ made him seem less godly. Also, Sophie helped Robert many times, especially to escape arrest and solve the mystery: she helped him escape from the Louvre Museum at the beginning, and knew many of the answers to the puzzles that her grandfather left behind.

Jonathan Lam & Hanna Trojanowski
Mrs. Staron
English per. 8
9 / 11 / 14

The False Friendship

Once upon a time, there was a Wolf. He an old, slow Wolf, but he was also very mean. One day he was hunting and he came across a little bright clearing in the middle of the forest. As he entered the clearing he saw a Bird with an injured wing. She was digging for worms and not paying attention to her surroundings.

The Wolf thought to himself, *Well, won't this be the easiest catch*. He was just about to snatch the unsuspecting Bird when as of a sudden he saw a Fox. The Fox was making his way towards the Bird. Instead of grabbing the Bird, the hung back to watch the approaching Fox.

Watching the Fox close in towards the Bird, he realized that he wouldn't be able to reach the Bird faster than the quick, quiet Fox. So he hung back and watched from a distance, to see if the Bird survived for him to eat.

Meanwhile, the Fox went to talk with the Bird.

"Why, hello little Bird," said the Fox. "How do you do?"

Startled out of her uneventful worm-picking, the Bird was frightened. She replied timidly, "I'm okay… why are you talking to me? You should have eaten me already."

"Dearie, I would never, *ever*, want to harm you. I just want to be your friend. Anyways, don't you need help escaping that Wolf?"

Not realizing that there was a Wolf, she was frightened; and being the naive animal she was, she agreed right away.

The two new friends leapt right into creating a plan to escape the old Wolf, for they could not waste a second more. The Fox decided that the best place to trap the Bird would be an old hollowed out oak tree stump.

The Fox was satisfied in where his plan was going. He knew the Bird was too afraid to even think of the Fox as anything other that a friend. *Well*, thought the Fox, *the foolish little Bird is playing right into my trap! I will soon have a wonderful meal.*

The Fox pointed towards the setting sun and whispered to the Bird, "Go that way for about 100 meters, and you should see an old hollowed oak tree stump. Go past it a little bit, so that your scent will go farther than the tree and will throw the Wolf off, but then backtrack and hop into there until I say the Wolf is gone."

By now, the Wolf was agitated and tired of waiting for the Fox to go away. He figured that the interaction between them would not stop him. Deciding to take action he leaped out into the clearing straight at the Bird.

The Fox yelled, "Go *now*!" and the Bird hopped away. He threw himself at the Wolf to buy more time and then fled into the trees after the Bird. The Wolf, who had been knocked on his side, chased after the Bird.

When the Bird came upon the dead oak tree, she immediately flew inside and rested in the little hollow.

"Hey Birdie, come out, come out! You can't hide from me much longer!" said the Wolf, but the Bird dare not say anything. She trusted the Fox in that this hiding spot was safe. And soon she heard the Wolf run by and felt a huge amount of relief and gratefulness to the Fox.

Soon, the Fox came up to the entrance to the tree, but instead of assuring the Bird that the Wolf was gone, he cackled.

"Haha! I got you now!" exclaimed the Fox. "You're trapped and there is no way out!"

"What do you mean? Why would you do that?" asked the Bird, a little nervous. "But I thought you're my friend now."

"I only had to be nice to get you to trust me. And because you trust me, you came right into my trap so that I can eat you, all to myself, without the Wolf watching me."

And the Fox leapt onto the gullible Bird and gobbled her up.

"There is more danger from a pretended friend than from an open enemy."

1) I will like to discuss the most prominent theme: that there is prejudice against anyone different. Matt, the main character, is looked down on throughout the book for being a clone and not a true human being, although there is *no* way to tell them apart. He was insulted and ignored by everyone but his closest friends. I would also like to discuss Matt as an inspiring character. He is truly determined because of the disrespect he tolerated every day, so he tries exceptionally hard to excel: "[Matt] was in a rage to learn. He would excel, and then everyone would love him and forget he was a clone" (91). Before Matt learns of his to-be fate, he makes sure he is indispensable and respected by doing his best, and ends up very talented as a result.

2) Not much of the book is confusing to me except for a few of the Spanish words. Because this book is written about a fictional country, Opium, in between the U.S. and Mexico, the characters speak English and Spanish. The word "eejit" was used commonly throughout the book for the humans or animals with computer chips in their brains so they couldn't think by themselves. I didn't realise until I searched the word that it literally meant "idiot" in Spanish. Also, the word "curandera" was a word that I didn't know; it is a healer that uses herbs.

3) I liked this book, and would rate my enjoyment reading this book a nine out of ten. The language used is simple and clear. There is a lot of action, most of it relating to the theme: especially when Matt was being bullied and ignored, and when Matt was running away the country of Opium to avoid being used for body parts. However, I do wonder why such a large portion of the book about Matt's life in Aztlan is necessary in this book. It does show Matt's character fighting for his new friends, but he could have hid out in Opium until he felt safe and avoided that extra adventure. I feel that is was unnecessary, and this brings my rating down.

4) The most important idea I found from this book was not to judge people based on a prejudice or some bias. Matt was a clone, and he was very biased against in many people's minds because clones are generally thought of as inferior. Instead, he was a very talented, bright child who believed in justice. Even so, was taunted by Tom whenever they saw each other: "[Tom] punched the air near Matt's head. practicing-he said-karate exercises. He whispered insults too low for anyone else to hear. 'You're a clone,' he murmured. 'Know what that is? A kind of *puke*. you were puked up by a cow'" (67). However, clones and humans are no different, except for the way they were created. Maria's mother said declaring clones as inferior was just a way to make body transplants sound humane. "'No one can tell the difference between a clone and a human. That's because there isn't any difference. The idea of clones being inferior is a filthy lie'" (245), says Matt's bodyguard to him, and this shows that bias is wrong: even if a person is a clone, it doesn't mean they have to be an animal, but could be even better than someone "regular." This idea can be applied to many other biases as well.

Jonathan Lam
Mrs. Staron
English per. 8
10 / 23 / 14

The Practical Usage of Scapegoating (Revised)

Scapegoating is often thought of as the easiest way to blame others for someone's own faults and mistakes - to most people it has no other purpose. *Animal Farm* by George Orwell proves otherwise: that it actually can be used for other reasons besides getting someone in trouble; and the book itself is a lesson in the form of a warning against falling into its trap. In the novel, a shadowy character named Snowball takes the blame for any trouble on the farm, for any action as ridiculous as a sheep urinating in the drinking pool; but this does not only take the blame off of the sheep, but has other side effects. Through Napoleon's cunning use of blame, *Animal Farm* teaches its readers that scapegoating does not only place blame on an innocent person or group, but can also be effectively used to unite an audience and promote oneself, only if the audience is uneducated.

Napoleon's lies about Snowball have one great effect: they create a sense of unity among the animals. During the executions of the supposed traitors of Animal Farm, "the three hens who had been the leaders in the attempted rebellion … stated that Snowball had [told them to rebel] … a goose came forward and confessed to have secreted six ears of corn … a sheep confessed to having urinated in the drinking pool - urged to do this, so she said, by Snowball" (Orwell 84). The animals all blame Snowball for troubles that he certainly did not do, making him the unfortunate scapegoat. The animals, however, are fed so much misinformation about him being evil by Napoleon that they really believe that Snowball was the cause of all the terrible actions caused against Animal Farm; even actions done by themselves they believed to be under the influence of Snowball and they blame on him. Orwell exaggerates this blame to warn us against being too gullible - to the reader, the blames are so irrational and so easy to prove wrong that the

reader can easily see how a little bit of rational thinking and education could help the animals. The result of this feeling is that "the animals were thoroughly frightened. It seemed to them as though Snowball were some kind of invisible influence, pervading the air about them and menacing with all kinds of dangers" (Orwell 79). This quote also shows the overall sense of fear and hatred towards Snowball that was created by Napoleon to create one thing that all the animals can relate to. By doing this, he is also creating amongst them a sense of unity and comradeship against a single cause; thus they are *all* strictly anti-Snowball and pro-Napoleon, which would be impossible if Snowball was still on Animal Farm to reason against Napoleon and help them distinguish between right and wrong; if he were there, then the animals can see before their own eyes whether or not Snowball is the actual culprit. However, Snowball is absent, the animals all feel frightened, and they will work harder together. This is what Napoleon wants. This shows that blame can result in a beneficial, but false, sense of togetherness.

The pigs become even worse than the humans had been, but are not antagonized by the animals; instead they are looked up to. The pigs' artful blaming of the humans for all of their troubles take any blame off of, and even promote themselves. Old Major says, "Our lives are short, miserable, and laborious … Man is the only real enemy we have. Remove Man from the scene, and the root cause of hunger and overwork is abolished forever" (Orwell 6). Man is being blamed here, but it is only partially their fault. To live well generally also means to work hard. However, the animals believe that they are living well even after the pigs take most of their foods because they believe that only Man is evil, and that the pigs are *helping* them by ridding them of Man - they do not understand that Man did not cause all of their troubles, because they are not taught to think for themselves. To show this, the book states, "The animals worked like slaves.

But they were happy in their work, … well aware that everything that they did was for the benefit of themselves and those of their kind who would come after them, and not for a pack of idle, thieving human beings" (59). This, along with the fact that the pigs and the dogs did not work nor produce anything, shows that the pigs had become just like the non-producing humans. However, unlike the humans, they had convinced the other animals that *they* had been helping them by showing them the cause of their troubles, and therefore the other animals believe Napoleon and trust him. Again, Orwell is trying to give a lesson here, because obviously more work for less food (as it was under Napoleon's rule) is better in all cases than less work for more food (as it was in Jones' time) - but the animals are so brainwashed into believing otherwise. Therefore, some education for the animals would have helped them in this situation, because then they can distinguish between the obvious right and wrong, even if it is not told to them, and the animals will be able to reason independently; therefore, Orwell is also teaching us that education is the solution to elude propaganda by scapegoating. This also applies to his scapegoating of Snowball, which he uses skillfully to maintain his leadership and support.

The farm and its concept of Animalism would never turn out so tyrannical but unified without the use of falsely blaming others, and without the education of the animals. Animalism would not been created without the hate for the humans, who take all the blame for both their faults and the pigs' faults; the unity and the overall support for Napoleon to lead would not have been without the blame of Snowball. But Orwell also shows that this form of persuasion is only helpful to Napoleon, and warns against it, showing that the lack of education among the animals is a major cause. Orwell's *Animal Farm* is a lesson to us: that scapegoating can have practical and even beneficial uses for the one who blames, at the expense of the scapegoat.

Nick Ferrante

Thinking About Thinking

I hardly have the time;
For while I am writing this,
I've decided to make this poem rhyme.
By now I have concluded
That rhyming will have to do-
Otherwise I wouldn't be erasing,
That would have to be you.
This poem could be regarded as a reflection,
Comprised mostly of my current thoughts
Although my productivity is limited
Rhyming the words is where I get caught;
For while I write this poem
My thoughts can wander.
The quiet time I have
Is my time to ponder.
I realize I'm probably-
No, in fact, most likely-
Dragging this poem on.
But I had to write it,
For my friend Jon.

“A House of My Own” (p. 108)

Based on this vignette, make some inferences about the author, Sandra Cisneros. Explain your inferences.

“A House of My Own” in *The House on Mango Street* is about Esperanza’s house after she leaves Mango Street, the house of her dreams. It shows the pride and satisfactions she gets from having a nice house— a house that shows that she is not just a poor Hispanic girl in a bad neighborhood and house, but a “normal” American with a “normal” house. In essence, it shows how happy she is to be an free, *ordinary* citizen, not below the standard of the norm like she used to be. She wants to fit into society like everyone else, not being held back by poverty or race. Through Esperanza, I can infer that Sandra Cisneros, having wrote this book with Esperanza being the character that represented herself, must have felt the same way when she got her own house; so when I am describing Esperanza, I am making inferences about Cisneros also.

To Esperanza, her new house is “A house all *my* own. With *my* porch and *my* pillow, *my* pretty purple petunias.” It seems that she is very glad to be able to say that she actually owns property for herself, and does not have to depend on others. There is nobody else to depend on, “Nobody to shake a stick at. Nobody’s garbage to pick up after.” She feels independent and excited because like most Americans who can grow up and have their own house, she can too. She was completely happy to leave her old house (while many people would feel sadness doing so) and have her own house, showing that she is a person who enjoys freedom and control over her own life. With this new house comes freedom from family, freedom from being under a landlord (had she bought an apartment instead), freedom from prejudice and freedom from shame of living in such a poor, brick house such as the one on Mango Street— she welcomes all these new liberties into her life.

In addition, the house is “real.” Overall, she is extremely satisfied with her new residence, being what she wants her house to be. It’s the opposite of her house on Mango Street, the one that she was ashamed at. When moving into the house on Mango Street, she thought, “I knew then I had to have a house. A real house. One that I could point to. But this isn’t it” (5). She was extremely unhappy about her house, because it was not the movie-star houses she saw on TV that everybody adored and looked up to. Instead, she was like a rat in a sewer, full of shame and an undesirable place to call home, hated by and stomped on by all the humans. Now, when she had a house, one that she *could* call home and mention to others, she doesn’t complain. The fact that owning her own house means so much to Esperanza means that she didn’t fit in before (which was a major theme throughout the book), and that she strived to belong. Now, when she belongs, she is confident, unashamed, and even boasts about her house, without worrying about living in the ghetto on Mango Street.

Jonathan Lam
Mrs. Staron
English per. 8
1 / 30 / 15

Vignette Modeling

Option 1: *Hands*

We have similar hands, for similar tasks, in our family. Mom's hands are small, with petit fingers and dry, clean skin all the time. They are masters at typing and doing chores. Jessica's hands are long, too long, from playing eloquent songs on the piano. Her fingers are sticks on a branch, too skinny and fragile. My fingers are also long, but much stronger for heavier tasks and bowling. They're fast and large, also great for playing the piano. My little sister has stout hands, still growing, that give her trouble when they type or play some songs on the piano. They're not very adept at many tasks.

But Dad's hands are different. They're huge, like the paws of a tiger. They're rough, strong, and dirty from working in the yard. They're clean and careful when operating the machines in the hospital. They're playful when they pick you up, but scolding when they point at you and accuse you. They raised me, taught me, and loved me all my life. They're like my fairy godmother, or a part of my conscience, emotionally and even physically guiding me through important events; they're a sign of home and welcome, my family and friends, a source of comfort and advice, my hardworking and humble roots. A sense of life and hope.


Salto Ángel
Por Jonathan Lam y James Bebon


¿Dónde se ubica Salto Ángel?
Parque Nacional Canaima, Venezuela
Río Gauja, Auyantepui montañas
Venezuela
Aruba
Kòrsou
Curaçao
St. Vincent and
the Grenadines
Grenada
Coro
Maracaibo
Valledupar
Cabimas
Barquisimeto
Caracas
Valencia
San Juan de
Los Morros
Calabozo
Porlamar
Cumaná
Carúpano
Barcelona
Maturín
Trinidad
and Tobago
Mérida
Ciudad
Guayana
Ciudad
Bolívar
Upata
Cúcuta
San
Cristóbal
Bucaramanga
Yopal
Ayacucho
A

¿Qué tipo de lugar es?

"patrimonio de la humanidad" (UNESCO)

987 metros

¿Qué características geográficas hay?

tepui

jungla

ríos

¿Qué plantas y animales se pueden ver?

monos, jaguares, armadillos, y más

>1,200 especies (aves)

>500 especies (flores)

¿Qué actividades se pueden hacer?

playas

volar, tomar canoa, andar

gente indígena

¿Hay reglamentos?

no acampar

entrar por avión

HIKE VENEZUELA ADVENTURE

¿Otros hechos interesantes?

Jimmie Angel chocar
(1937)

¿Otros hechos interesantes?

películas *Up*, *Dinosaur*, *Arachnophobia*

¿Dónde se puede hospedar?

Campamento Canaima


¿Por qué debemos visitar este lugar?
magnífico


¡Vengan a Salto Ángel!

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(resto de las picturas son de las páginas webs de información)

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Mi Casa Ideal

Jonathan Lam


Es importante que ... tener
Es urgente que ... haber

Es malo que ... haber

Me gusta

Prefiero que ... tener

bolera


Es bueno que … ser hechos de
Es mejor que … ser


Es urgente que ... tener
Es importante que ... comprar


Quero que ... obtener

¡Gracias para mirar!

Es bueno que ... ser

Río de Janeiro

Nuestra Vacación

Juan (Jon) y Pablo (Kyle)

primo … casa grande

día uno

1

el veintidós de junio

bote pequeño


no tranquilo

día quince

15

el seis de julio

Pasteles		*$2.00*
Alitas Fritas/Fried Chicken Wings		*2 for $1.00*
Chicharrones/Fried Pork Skin	*1/2lb $3.50*	*1lbs $7.00*

Ordenes Extras / Side Orders

Arroz y Habichuela / Rice & Beans	***sm*** *$3.50*	***lg*** *$6.50*		
Tostones o Maduro / Fried Green or Sweet Plantains				*$2.00*
Papitas Frita / French Fries				*$2.00*
Yuca con Cebolla (Cassava w/Onions)	***sm*** *$2.00*	***med*** *$3.00*	***Lg*** *$5.50*	
Chuleta Fritas / Fried Pork Chops	*1 for$ 2.50*	*2 for$4.00*		

Mofongo / Mashed Fried Green Plantains

De Chicharrones / with Fried Pork Skin	*$4.50*
De Pollo / with Chicken	*$4.50*
De Camarones / with Shrimp	*$9.50*

Ensaladas / Salads

Lechuga y Tomate (Lettuce & Tomato)	***sm*** *$2.00*	***med*** *$3.75*	***Lg*** *$5.00*	
Lechuga Tomate y Aguacate (Lettuce Tomato & Avocado)	***sm*** *$2.50*	***med*** *$4.00*	***Lg*** *$6.00*	
Ensalda de Papa / Potato	***sm*** *$2.00*	***med*** *$4.0*		
Mollejita / Chicken Gizzard	***sm*** *$3.00*	***med*** *$6.*		
Macarone / Macaroni	***sm*** *$2.00*	***med*** *$3.50*	***Lg*** *$7.00*	

no entender

Bistec Palomilla a Caballo / Grilled Steak w/Egg	*$8.50*
Bistec Encebollado / Steak w/onion	*$7.50*
Bistec Palomilla a la Parrilla con Cebolla y Pimiento (Steak w/onions & Peppers)	*$8.50*
Bistec Empanisado / Breaded Steak	*$7.50*
Espageti con Albondiga / Spaghetti with Meatballs	*$6.50*
Costillas de Res Guisado / Beef Ribs Stew	*$7.75*

Cerdo / Pork

Patitas de Cerdo Guisada / Pig Feet Stew	*$6.50*
Pernil / Roast Pork	*$7.00*
Chuleta Frita / Fried Pork Chops	*$7.00*
Chuleta Guisada / Pork Chops Stew	*$7.00*
Costilla Asada / Roast Pork Ribs	*$7.50*

Pollo / Chicken

Pollo Guisado / Chicken Stew	*$6.50*
Pollo al Horno / Baked Chicken	*$7.00*
Chicharrones de Pollo / Fried Chicken Chunks	*$7.00*
Pechuga a la Parilla / Grilled Chicken Breast	*$8.00*
Pechuga Empanizada / Breaded Chicken Breast	*$8.00*
Pechuga Guisado / Chicken Cutlet Stew	*$7.50*

Marisco / Seafood

Camarones al Ajillo / Shrimp in Garlic Sauce (8)	*$12.00*

WhereYouEat.com


un paseo … robar dinero

tomar taxis


Mateo … gritar

día dieciséis

16

el siete de julio


el “Cristo Redentor”
gente


una gira


un hotel

día diecisiete

17

el ocho de julio

mismo bote

día treinta y uno 31

el veintidós de julio

no buen viaje

Jonathan Lam & Cole Straughn
H. Geometry per. 5
Barna
5 / 12 / 15

Inclinometer Project: Light Pole Contest

Summary

In our project, we compared the heights of two stadium light poles, one from Barlow (during a track practice) and the other from Bunnell (during a track meet), with indirect measurement. We built an inclinometer/clinometer with the help of the videos, and brought a measuring tape and an iPhone 6 to videotape. We measured the distance of ourselves from the poles, the angle at which the top of the poles were from our eye level, and the height of our eye level from the ground. From there, we used the basics of right triangle trigonometry to find the heights of the light poles.

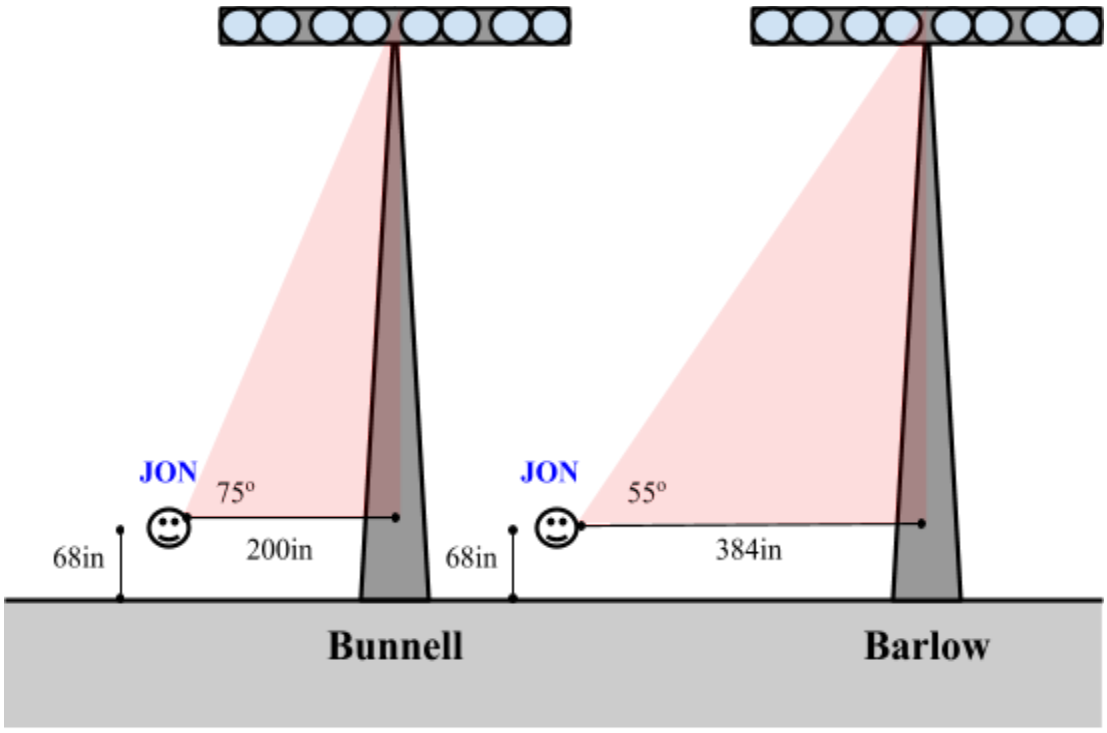
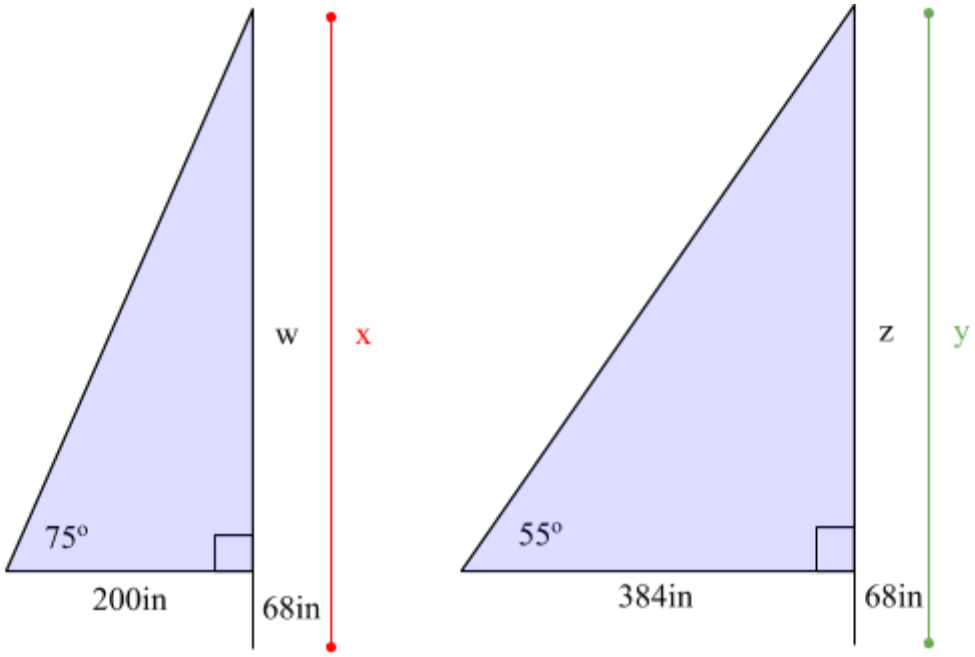


Image not drawn to scale.



Find and compare x and y.

Image not drawn to scale.

Measurements and Conclusion

Calculations:

Bunnell

- $tan\ 75 = \frac{opp}{adj} = \frac{w}{200}$
- $3.732 = \frac{w}{200}$
- $200 * 3.732 = (\frac{w}{200}) * 200$
- $746.4 = w$
- $x = w + 68 = 764.4 + 68 = 814.4in\ /\ 12 = 67.87ft$

Barlow

- $tan\ 55 = \frac{opp}{adj} = \frac{z}{384}$
- $1.428 = \frac{z}{384}$
- $384 * 1.428 = (\frac{z}{384}) * 384$
- $548.4 = z$
- $x = z + 68 = 548.4 + 68 = 616.4in\ /\ 12 = 51.37ft$

Conclusion:

From our measurements, we concluded that the light pole from Bunnell is taller than the one from Barlow by 16.5 feet, being 67.87 feet tall while the Barlow one was 51.37 feet tall. We can conclude that Barlow needs taller lights.

Reflection

From this project, we learned with a real-life example how to use the basics of right-angle trigonometry to indirectly measure lengths. Although our example (comparing the heights of two light poles at high-school stadiums) was not the most practical, it was a simple example that made clear the basics of an application of trigonometry. Unfortunately, it was a very narrow application of trigonometry, only using tangent with right triangles.

What we might do next is to expand our experimentation with a broader range of trigonometric tools: to try to measure with non-right-angle trigonometry (with the Law of Sines and Cosines), as well as some of the other math problems that we saw involving indirect measurement (e.g. the moon crater problem) to further our understanding of the usefulness of trigonometry, but we did not have much time with other schoolwork.

Theorem List

Know how to state, prove, and use the following (unless otherwise indicated):

- ** : don't need to know (we didn't go over in class)
- * : don't need to prove

1. All right angles ≅
2. All straight angles ≅
3. **If a conditional statement is true, then its contrapositive is also true. (given p ⇒ q, ~q ⇒ ~p)
4. SSAC
5. SCAC
6. CSAC
7. CCAC
8. Addition property (segment + ≅ segments)
9. Addition property (angle + ≅ angles)
10. Addition property (≅ segments + ≅ segments)
11. Addition property (≅ angles + ≅ angles)
12. Subtraction property (≅ segments/angles - segment/angle)
13. Subtraction property (≅ segments/angles - ≅ segments/angles)
14. Multiplication property (like multiples of segments/angles)
15. Division property (like divisions of segments/angles)
16. Transitive property (2 segments/angles ≅ *same* segment/angle)
17. Transitive property (2 segments/angles ≅ ≅ segments/angles)
18. VAT
19. All radii of a circle ≅
20. If two sides of a triangle are ≅, the angles opposite the sides are ≅ (and inverse**)
21. If two angles of a triangle ≅, the sides opposite the angles ≅ (and inverse**)
22. Midpoint formula: $M = (\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$ (M = median; x_1, y_1 are coordinates of first point; x_2, y_2 are coordinates of second point)
23. If two angles supplementary and ≅, then they are right angles
24. If 2 points equidistant from the endpoints of a segment, then they determine the perpendicular bisector of that segment
25. If a point is on the perpendicular bisector of a segment, then it is equidistant from the endpoints of that segment
26. If two (non-vertical) lines are parallel, then their slopes are equal
27. If two (non-vertical) lines have the same slope, then they are parallel
28. If two lines are perpendicular (and neither is vertical), then each line's slope is the opposite reciprocal of the other's
29. If a line's slope is the opposite reciprocal of another line's slope, the two lines are perpendicular
30. Remote exterior angle inequality
31. Alternate interior angles ≅ ⇒ || lines
32. Alternate exterior angles ≅ ⇒ || lines
33. Corresponding angles ≅ ⇒ || lines
34. SSIS ⇒ || lines
35. SSES ⇒ || lines
36. If two coplanar lines are perpendicular to a third line, they are ||
37. || lines ⇒ ≅ alternate interior angles

38. || lines cut by transversal ⇒ any pair of angles formed are ≅ or supplementary
39. || lines ⇒ ≅ alternate exterior angles
40. || lines ⇒ ≅ corresponding angles
41. || lines ⇒ SSIS
42. || lines ⇒ SSES
43. In a plane, if a line is perpendicular to one of two parallel lines, it is perpendicular to the other.
44. **Transitive property (parallel lines)
45. **A line and a point not on the line determine a plane
46. **Two intersecting lines determine a plane
47. **Two parallel lines determine a plane
48. **If a plane is perpendicular to two distinct lines that lie in a plane and that pass through its foot, then it is perpendicular to the plane
49. **If a plane intersects two parallel planes, the lines of intersection are parallel
50. Triangle sum
51. Remote exterior angle sum
52. Midline theorem (midline of a triangle is ½ length of and parallel to side it doesn't intersect)
53. No-choice
54. AAS ≅
55. $S_i = 180^o * (n-2)$
56. $S_e = 360^o$
57. $d = (n * (n - 3)) / 2$
58. exterior angle of equiangular polygon $= 360^o / n$
59. MEP
60. MER
61. The ratio of the perimeters of two similar polygons = ratio of any pair of corresponding sides
62. AA
63. SSS ~
64. SAS ~
65. Side-splitter
66. If three or more || lines intersected by two transversals, the || lines divide the transversals proportionally
67. Angle bisector theorem
68. Altitude to hypotenuse
69. Pythagorean theorem
70. $a^2 + b^2 = c^2$ ⇒ right triangle (converse of Pythagorean theorem), with c as the longest side and the angle opposite to c being the right angle
71. distance = $\sqrt{(\Delta x)^2 + (\Delta y)^2}$
72. In a 30º-60º-90º triangle, the sides opposite these angles are x, $x\sqrt{3}$, and 2x, respectively
73. In a 45º-45º-90º triangle, the sides opposite these angles are x, x, and $x\sqrt{2}$, respectively
74. A radius perpendicular to a chord bisects that chord
75. A radius that bisects a chord is perpendicular to that chord
76. The perpendicular bisector of a chord passes through the center of a circle
77. If two chords equidistant from the center, then they are ≅
78. If two chords ≅, then they are equidistant from the center
79. (79-84) ≅ central angles ⇔ ≅ arcs ⇔ ≅ chords
85. Two-tangent theorem (2 tangents to same point are ≅)
86. Inscribed angle = ½ intercepted arc
87. Chord-chord angle = mean of intercepted arcs (½ sum of intercepted arcs)

88. Secant-secant, secant-tangent, tangent-tangent angle = ½ difference of intercepted arcs
89. If two inscribed or tangent-chord angles intercept the same arc, then they are ≅
90. If two inscribed or tangent-chord angles intercept ≅ arcs, then they are ≅
91. An angle inscribed in a semicircle is a right angle
92. **The sum of the measures of a tangent-tangent angle and its minor arc is 180^o
93. If a quadrilateral is inscribed in a circle, its opposite angles are supplementary
94. If a parallelogram is inscribed in a circle, it must be a rectangle
95. Chord-chord power theorem
96. Tangent-secant power theorem
97. Secant-secant power theorem
98. **The length of an arc is (AB being the arc, d being the diameter, and AB measured in degrees): $(\frac{mAB}{360})\pi d$
99. $Area_{square} = s^2$ (s = side length)
100. $Area_{parallelogram} = bh$ (b = base; h = height)
101. $Area_{triangle} = \frac{1}{2}bh$
102. $Area_{trapezoid} = \frac{1}{2}h(b_1 + b_2)$
103. **$Median_{trapezoid} = \frac{1}{2}(b_1 + b_2)$
104. **$Area_{trapezoid} = Mh$ (M = median; this is a combination of theorems 102 and 103)
105. $Area_{kite/rhombus} = \frac{1}{2}d_1d_2$ (d_1 and d_2 = diagonals)
106. $Area_{equilateral\ triangle} = \frac{s^2\sqrt{3}}{4}$
107. $Area_{regular\ polygon} = \frac{1}{2}ap$ (a = apothem; p = perimeter)
108. ** $Area_{sector} = (\frac{mAB}{360})\pi r^2$ (mAB is arc measure in degrees; r = radius)
109. **Similar figures theorem: If two figures are similar, then the ratio of their areas equals the square of the ratio of their corresponding segments: $\frac{A_1}{A_2} = (\frac{S_1}{S_2})^2$ (A_1, A_2 = areas; S_1, S_2 = two corresponding sides)
110. A median of a triangle divides the triangle into two triangles with equal areas.
111. **Hero's formula (skipped)
112. **Brahmagupta's formula (skipped)
113. $LSA_{cylinder} = 2\pi rh$
114. $LSA_{cone} = \pi rl$
115. $V_{rectangular\ box} = Bh$ (B = base area; h = height)
116. $V_{prism} = Bh$
117. $V_{cylinder} = \pi r^2 h$
118. **$V_{prism/cylinder} = Ch$ (C = cross-section (parallel to base) area; same as base)
119. *$V_{pyramid} = \frac{1}{3}Bh$
120. *$V_{cone} = \frac{1}{3}\pi r^2 h$
121. **In a pyramid or a cone, the ratio of the area of a cross section to the area of the base equals the square of the ratio of the figures' respective distances from the vertex.
122. *$V_{sphere} = \frac{4}{3}\pi r^2$

Postulates / Properties

Postulates are "obvious truths" — inferrable

- Two points determine a line/ray/segment
- A line/ray/segment determines two points
- Three points determine a plane
- A plane determines three points

- Two lines intersect at a point
- Two planes intersect at a line
- If a line is on a plane, then all points on the line must be on the plane
- If two things = each same thing, then they equal each other
- Any segment or angle is ≅ to itself (reflexive property)
- SSS ≅
- SAS ≅
- ASA ≅
- HL
- A line segment is the shortest distance between two points
- Parallel postulate
- If a line intersects a plane not containing it, then the intersection is exactly one point
- AAA ~
- Tangent is perpendicular to radius drawn to the point of contact
- If a line is perpendicular to a radius at its outer endpoint (on the circle), then it is tangent to the circle
- $C_{circle} = \pi d$
- $A_{circle} = \pi r^2$
- $A_{sphere} = 4\pi r^2$
- $V_{rectangular\ prism} = lwh$

Properties of Geometry

- Addition, subtraction, multiplication, division properties of algebra
- Addition, subtraction, multiplication, division properties of geometry
- Transitive property
- Substitution property
- Reflexive property
- Properties of quadrilaterals
    - Parallelograms
        - Rectangle
        - Rhombus
            - Square
    - Kites (½ properties of rhombi)
    - Trapezoids
        - Isosceles trapezoids

Definitions

View this Quizlet set (has most of the theorems as well).

Miscellaneous

- All definitions reversible; some theorems are
- Process of proving a theorem (including thought bubbles!)
- Probability
    - combinations and permutations
    - favorable choices vs. total
- Detour proofs

- Constructions
    - Perpendicular bisector
    - ≅ angles
    - ≅ segments
    - || lines
- Slope
- Indirect Proofs
- Transformations
- Geometric mean / mean proportional
- Indirect measurement
- Angle of incidence, reflection
- Right angle trigonometry
- Law of sines/cosines and derivations
- Walk-around problem
- Three cases (three proofs) of theorem 86 (inscribed angle = ½ intercepted arc)
- LSA vs. TSA
    - slant height and altitudes
    - great circle
    - “red rice experiments”
- Proportional analysis (unit conversions)

Jonathan Lam
Coach Swift
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Notecard Review

Cardiovascular Fitness

- heart:
    - blood enters from right atrium
    - blood is pumped to lungs from right ventricle (to pulmonary artery)
    - blood is received in left atrium (from pulmonary vein)
    - blood is pumped out to body from left ventricle (to aorta)
    - size of fist
    - has 5-6L of blood circulating body
    - pumps 30 times its weight each minute
    - arteries go from heart; veins to heart; capillaries are oxygen/nutrients/waste exchange sites and are where arteries and veins meet
    - arteries are pumped by heart; veins are "pumped" by muscles when we move, and have valves (so it is important that we move to get blood flowing)
- benefits of cardiovascular fitness
    - (these benefits only happen if exercising for more than 15 minutes at a time)
    - strengthens heart (more efficient, larger, lower RHR)
    - decrease risk of cardiovascular endurance
    - improved energy
    - improved body composition
    - helps relieve strain associated with stress
- vocabulary:
    - cardiovascular fitness: the ability of the heart, lungs, and circulatory system to deliver enough oxygen and nutrients to the body's cells and muscles
    - aerobic: with oxygen
        - involves slower, longer activities
    - anaerobic: without oxygen
        - shorter, more explosive exercises
    - pulse: caused by pressure of blood on an artery wall that corresponds to a heartbeat
        - easily found on wrist (radial) or neck (carotid)
    - resting heart rate (RHR): heart rate when waking up, without doing any exercise
        - lowers as fitness levels improves (10-20 bpm slower in a more fit person)
    - recovery heart rate period: time it takes for HR to get close to RHR (below 100-120 bpm)
        - usually 5-10 minutes of cooldown after an exercise, but if it is not lowered, continue to cool down
        - the more fit, the less time it takes
        - 15 bpm lower = 570,024,000 beats saved in a lifetime
    - maximum heart rate: heart rate that should not be exceeded during exercise
        - approximately 220-age
    - target HR range (THR): range that should be reached and maintained during cardiovascular exercise to obtain training benefits
    - blood pressure: measure of blood force against walls of arteries
        - top is systolic (contracted)
        - lower is diastolic (relaxed)
        - normal is 120/8

    - hypertension: high BP
        - heart has greater resistance
        - over 50 mil Americans
        - risk factor for stroke and heart attack
        - 140/90 BP
    - FIT (3-5 d/w; 60-90% THR; 15-60 minutes)
- diseases/conditions:
    - cardiovascular disease affects many inactive people
        - #1 cause of death in US
        - risk factors:
            - controllable: smoking, obesity, hypertension, high LDL, stress, inactivity
            - uncontrollable: age, genetics, gender
    - heart attack: when artery supplying heart becomes blocked
    - stroke: when artery supplying brain becomes blocked
    - arteriosclerosis: hardening of the arteries
    - atherosclerosis: narrowing of the arteries

Muscular Fitness

- muscular strength: amount of force a muscle can produce in a single maximum effort (1RM)
- muscular endurance: ability to sustain a given level of muscular tension for a long period of time (i.e. hold or repeat contraction
- FIT (2-6 d/w; ME 30-50% 1RM, MS 60-90% 1RM; 1-3 sets: ME 12-20 reps. MS 5-8 reps)
- only when reaching upper limit of all sets increase intensity
- measuring muscular fitness exercise:
    - repetition: completion of single, full ROM of the body part being used
    - set: a group of repetitions performed one after the other
    - tempo: the speed at which you go through full ROM (4020)
        - 4 seconds concentric
        - 0 seconds hold
        - 2 seconds eccentric
        - 0 seconds hold
- safety:
    - warm up, cool down
    - start with endurance training for first two weeks
    - check weight, seat height, and collars (especially when working with partners; on machines)
    - breathe
    - use correct form (no bouncing)
    - always use a spotter (not on machines)
    - go through full ROM
    - train muscles on both sides (of body and part)
    - train from large muscle groups to small muscle groups
    - put equipment away after use
- types of exercise:
    - isometric: contraction with no change in length (i.e. no movement)
        - disabled people/rehabilitation
    - isotonic: shortening and lengthening of muscle through full ROM with no change in weight
        - most common, like most of the ones we do in class

    - isokinetic: shortening and lengthening of muscle through full ROM *with* change in weight
        - using heavy chains, resistance bands
- muscle fiber types:
    - slow-twitch (red) muscle fibers
        - jogging, swimming
        - contracting for long periods of time
        - most recruited
        - low intensity endurance events
    - fast-twitch (white) muscle fibers:
        - a lot more force/power
        - sprinting
        - poor aerobic endurance
        - short, high intensity events
- atrophy: wasting away or decreasing in size of body part, especially muscle
- hypertrophy: increase in size of muscle fiber, usually stimulated by muscular overload
- myths about muscular training:
    - it does not always give you a muscle-bound physique
    - it is not unfeminine
    - muscle doesn't turn into fat and vice versa
    - strength does not mean size
    - no nutritional supplement will make someone stronger
        - creatine gives you more energy (pulls water into cells), but causes cramping and could cause kidney failure
        - hydroxycut has a lot of caffeine and increases your BP, HR, and causes sweating and dizziness
        - whey protein shake stores muscle glycogen, repairs damage to muscles; helps the most (if you exercise)
        - anabolic steroids
            - physiological effects:
                - abnormal bleeding/blood clotting
                - acne
                - masculinization in females, feminization in males
                - decreased HDL
                - elevated BP
                - increased risk of heart disease, liver cancer
                - worse immunity
                - nosebleeds
                - stunted growth in children
            - physiological effects
                - depression
                - increased aggressiveness
                - personality changes
                - mood swings
- successful weight training:
    - SMART goals
    - needs: injuries and limitations
    - choose right equipment
    - how much time are you able to commit?

    - safety (train both sides of body and part; train large to small muscles)

Nutrition

- the study of nutrients in foods and in the body, and of related behaviors
- nutrients: substances in food that your body needs to function properly to grow, to repair itself, and to supply you with energy
- Calories (kilocalories):
    - fats: 9C/g
    - carbs: 4C/g
    - proteins: 4C/g
    - water, minerals, vitamins: 0 (no energy for body)
- factors influencing diet:
    - stress/emotions
    - nutrition
    - availability/convenience/cost
    - advertising/media
    - culture/religion/family
    - taste/smell/looks
    - celebrations
    - lifestyle/sleep/hunger
    - allergies
- fad diets:diets with no nutritional value and promote weight loss without sound nutritional practices
    - Atkins (high fat; low carbs)
    - tapeworm
    - juice
- GMOs: foods with altered DNA: 70% processed foods have GM ingredient
- (5) aspects of nutritious diet
    - adequacy: enough of each essential nutrient, fiber, and energy
    - balance: no overemphasizing one nutrient/food type at expense of another
    - calorie control: correct amount of energy (no more; no less)
    - moderation: no excess fat, salt, sugar, other
    - variety: differ from day to day
- essential nutrients: nutrients required for normal body functioning that we cannot produce
- carbohydrates: sugars and starches in body; preferred source of energy
    - simple: sugars in fruits, vegetables, sweets, milk
    - complex: starches in grains, seeds, nuts, legumes
        - fibers:no energy
        - bulky (fullness)
        - move waste through system
    - glucose: chief fuel
    - glycogen: starchlike storage form for glucose in liver and muscle
    - glycemic index: classifying carbohydrates (by rate of sugar release)
        - higher is bad, causing quick release and decline in sugar levels (refined grains, sweets)
        - lower is better: slow release and decline (whole wheat)
    - excess carbs, proteins, fats stored as fat
- proteins: nutrients made of amino acids that help build and maintain body tissues
    - builds, repairs body tissue (especially when growing or injured)

    - can provide energy
- fats
    - insulates and cushions
    - major storage form of energy
    - 3 types:
        - trans (hydrogenated): artificial, used to extend shelf life
            - BAD: increase LDL and lower HDL
        - saturated: animal fats that are solid/semisolid at room temp.
            - too much associated with heart disease
        - unsaturated: healthy liquid (vegetable oils)
            - omega-3 found in many kinds of fish, good for heart
    - cholesterol: fat-like substance made in liver of animals; can make yourself
        - for production of hormones
        - for vitamin D synthesis
        - recommended <200 mg/dL
        - increase HDL, lower LDL
        - decrease LDL by increasing fiber, switch to unsaturated fats
        - increase HDL by increased unsaturated fat, exercise, stop smoking
- vitamins: organic compounds that help regulate many vital body processes including digestion, absorption, and metabolism of other nutrients
    - no calories
    - catalyze energy-producing reactions
    - most are essential (cannot be synthesized)
        - Vitamin D: sunshine vitamin: made by skin when exposed to sun
    - water soluble:
        - C, 8-B complex
        - extra urinated, in bloodstream, needs replenishing often
    - fat-soluble:
        - A, D, E, K
        - buildup is toxic
        - stored and transported in fat
- minerals: inorganic compounds that body cannot manufacture but act as catalysts for many vital processes
    - 20 essential minerals
    - most commonly missing for Americans: Mg, Fe, Ca
- water: most important
    - transportation
    - chemical reactions
    - solvent
    - shock-absorption
    - lubrication
    - temperature regulation
    - 60-70% body weight
    - 2.4L water a day
    - mL water for calorie burned
- weight loss
    - 3500 C/lb
    - weight gain/loss by calorie intake/output
    - safe: 1-2 lb/w through cardio and weight training

- body composition: ratio of fat to muscle, bone, other body tissues
    - essential, non-essential fat
    - overweight: body weight above recommended (adjusted height-weight table)
    - obese: excessive accumulation of body fat (over 25% male, 32% female)
    - found with:
        - BMI (least accurate, no regards to density)
        - skin folds
        - underwater weighing (most accurate, gets density)
- eating disorders:
    - anorexia: severe loss of body weight, fear of eating and gaining weight/becoming “fat”
    - bulimia: uncontrollable binge eating, extreme purge (puking, extreme exercise)
- somatotypes
    - endomorph (pear-shaped)
    - mesomorph (muscular)
    - ectomorph (thin)
- Harvard food pyramid
    - daily exercise, weight control at base
    - whole grains, plant oils, vegetables, fruits, at bottom
    - nuts/legumes, then fish/poultry/eggs, then dairy/calcium
    - lastly red meat, butter, white rice/bread, potatoes and pasta, sweets
    - vitamin supplement
    - alcohol in moderation
- know muscular fitness exercises

Jonathan Lam
Coach Swift
Wellness 9 per. 1
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Wellness 9 Midterm Study Guide / Review

Note: This will be transferred to the notecard for the test. The test is open-notes.

Wellness

overall state of well-being or total health encompassing physical, emotional, social, intellectual, spiritual, and environmental needs; dynamic, must be worked towards

Physical

physical fitness

- eating
- nutrition
- exercising
- fitness

Intellectual/Mental

- making good decisions
- staying focused
- thinking critically

Emotional

- happiness level
- stress level
- self-esteem
- emotional eating
- negatives

Social

- good friends
- good family
- good communications

Spiritual

- peaceful
- good beliefs
- good relationship with religion

Environmental

- people around you
- air quality
- lighting
- not getting distracted

Occupational

- being happy with what you do for a living
- participating

Effect

- can have a positive, negative, or both effect on a person

Wellness Continuum
shows that the better your wellness, the better you can develop; the worse it is, the quicker your death and the worse your overall problems

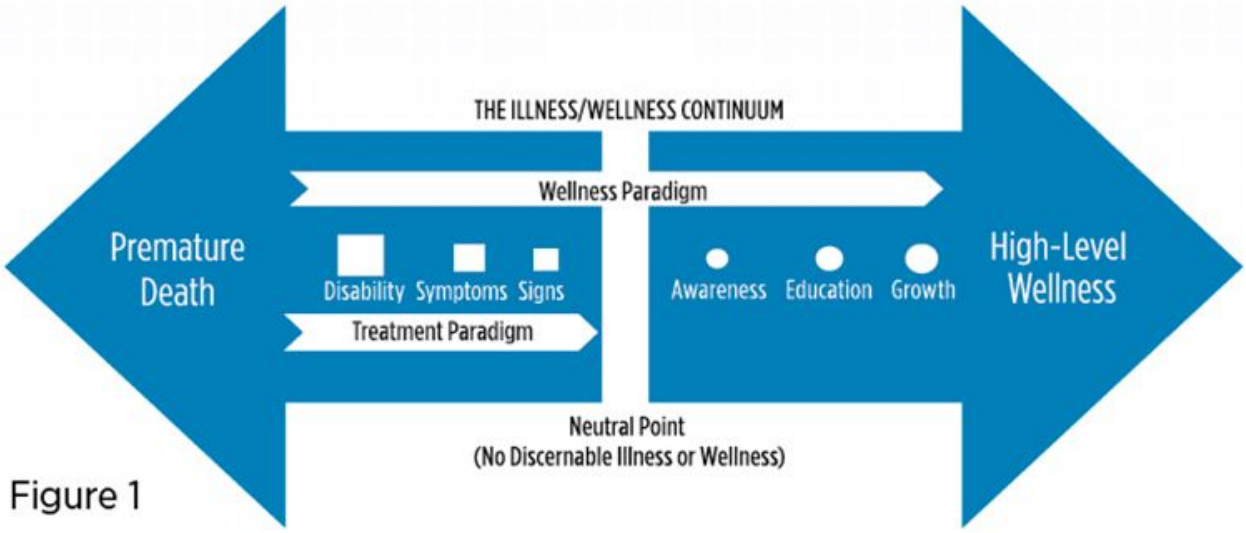

Figure 1

Values
beliefs and ideas that are important to you that guide the way someone lives their life

- integrity
- respect
- trust
- honesty
- community
- health, fitness

can have conflict (need to prioritize)

Support System

a group or network of people relied on for emotional, social, physical, spiritual, and intellectual support. They are used to maintain/attain your wellness; can change as people change, enter into, or disappear from your life

Examples

- family
- internet
- friend
- coach / teacher
- counselor / advisor
- police
- God
- doctor

Personal Fitness

Attitudes / Media Influences
negative attitudes on physical fitness

- lack of time
- lack of knowledge
- lack of athletic ability
- lack of motivation
- media
- past experiences
- lifestyle choices

Health Risks

- **6 Controllable**
    - inactivity
    - obesity
    - smoking
    - hypertension
    - high LDL
    - stress and tension

- **3 Uncontrollable**
    - age
    - gender
    - heredity / genes

Benefits of Exercise
improved body appearance
improved body image
self-control
enjoyment of life
improved health
improved life expectancy
improved physical performance
increased muscular endurance
increased energy level
increased success in school/job
cope with stress
sleep better

Physical Fitness vs. Physical Activity vs. Exercise
physical activity: something you do
physical fitness: something you acquire
exercise: planned and structured with fitness as your goal

Components of Fitness

Health-Related Fitness
components of fitness that contribute to how well the systems of the body operate

- related to overall state of health
- essential toward contribution toward prevention of disease and promotion of health

- **Cardiovascular Endurance**
    - body's ability to sustain prolonged exercise for at least 15 minutes with an appropriate heart rate
    - most important indicator of good health
    - mile run, pacer

- **Muscular Strength**
    - amount of force a muscle can produce with a single maximum effort
    - pull-up, push-up

- **Muscular Endurance**
    - ability to sustain given level of tension for long period of time (hold contraction or repeat)
    - sit-up

- **Flexibility**
    - ability to move joints through full ROM
    - has to be specific
    - sit and reach

- **Body Composition**
    - ratio of fat to muscle and other body tissues
    - BMI
    - ranges:

	12	**13**	**14**	**15**
Girl	14.7-24.2	15.5-25.3	16.2-25.3	16.6-26.5
Boy	14.8-24.1	15.4-24.7	16.1-25.4	16.6-26.4

Skill-Related Fitness
components of fitness that contribute to ability to successfully play sports

- **Agility**
    - ability to change position/direction of body in controlled manner
    - shuttle run

- **Balance**
    - ability to keep upright posture while standing still (static) or moving (dynamic)
    - stork test

- **Coordination**
    - integration of eye, hand, and foot movements
    - tennis-ball wall

- **Power**
    - ability to do strength performances at rapid pace
    - vertical jump

- **Reaction Time**
    - amount of time it takes to get moving once senses signal need to move

    - ruler drop

- **Speed**
    - ability to cover distance in short time
    - 40-yard dash

Goal Setting

SMART

- **Specific**
    - cannot be too general
- **Measurable**
    - has to have a unit, something that can physically be measured
- **Action Plan**
    - has to have some plan, schedule, that allows the goal to happen
- **Realistic**
    - has to be achievable
- **Time Frame**
    - has to give a certain time period to complete the task

Exercise Guidelines

Starting Factors

- medical exam
    - get limitations from existing conditions
- fitness evaluation
    - get baselines
- SMART goals
    - set goals, see improvement

Clothing

comfortable, move freely, cool body
sneakers: most important item for any activity
socks: prevent friction of skin against shoes (blisters)
shirt: synthetic (dry-fit material), wicking effect allows body to stay dry and "breathe"

- not dark at night
- light shirts in hot weather to better reflect sun

shorts: not too tight around thighs

Workout Sequence

1. **Warm-Up**
   5-10 minute exercise before workout to reduce chances of injury
    a. light activity
        i. general

ii. specific

b. stretch (dynamic)

2. Work-out

3. Cool-Down

10-15 minute mild exercise following vigorous exercise that allows body and heart rate and breathing and circulation to normalize, prevents blood from pooling, prevents tight muscles from become sore

a. light activity
b. stretch (static)

Weather/Environmental Considerations

- **Appropriate Clothing**
- **Illnesses**
  - hyperthermia
    - increase in temperature with decrease in body fluids
      - heat cramps
        - muscles involuntarily contracting causing pain
        - not too serious
      - heat exhaustion
        - excessive sweating, dizziness, extreme weakness
        - body is inadequate
        - mildly serious
      - heat stroke
        - dry, clammy skin
        - stopped sweating, body's cooling function stopped, overworked
        - extremely serious, life-threatening
    - wear light-weight, light-colored clothing
    - drink fluids before, during, and after practice (too late when thirsty- already dehydrated)
    - check urine color
    - exercise before 10 and after 4 on hot days
  - hypothermia
    - excessive (>4ºF.) in body temperature
    - hypothalamus begins to lose ability to regulate body temperature
    - frostbite is tissue damage that occurs when circulation to skin decreases so that tissue receives insufficient oxygen and nutrients
    - between 10 and 2
    - warm-up and cool-down
    - darker earlier in day
    - stay clear of icy areas
    - check outside temperature and windchill
    - stay hydrated
    - wear a scarf
    - don't overdress, but layer clothing
      - synthetic shirt, then water/wind shel

Safety Considerations

- don't exercise if ill
- wait to exercise after eating for 2-3 hours
- run/walk against traffic, bike with traffic
- exercise with another person or in a group, carry cell phone
- stay away from remote, unpopulated areas
- wear reflectors wen dark
- sunburns
    - cover skin
    - use 1 oz sunscreen
    - UVA - skin damage
    - UVB - skin burn
    - SPF 30 recommended
- ticks
    - blacklegged tick (deer tick)
    - cannot jump or fly
    - skin rash (bull's eye)
    - fever
    - headache
    - muscle and joint pain
    - swelling of joints
    - paralysis
    - avoid woody areas, perform a tick check
    - use tweezers, pull it out straight

Injury Treatment

muscle soreness

- exercise at right level
- goes away after 1-2 days

blisters

- don't remove skin
- puncture with sterile needle
- apply sterile gauze

shin splints

- exercise at right level
- RICE
    - rest
    - immobilize
    - cold
    - elevate

stitch in side

- apply pressure, stretch to opposite side, breathe deeply

sprained ankle

- don't roll ankle
- RICE

Principles of Training

Principle of Overload

exposing body to more work and stress than normally experienced to increase fitness; dependent on the person

- Milo of Crotona, the "grandfather of overload"
- **FIT Variable Chart**

	Cardiovascular Endurance	**Flexibility**	**Muscular Endurance**	**Muscular Strength**
Frequency	3-5 d/w	3-7 d/w	2-6 d/w (alternate)	2-6 d/w (alternate)
Intensity	60-90% THR	mild tension	30-50% 1RM	60-90% 1RM
Time	15-60 minutes	15-30 seconds 2-3 sets	12-20 reps 3 sets	5-8 reps 3 sets

Principle of Progression
progressively increasing the level of exercise so that improvement in physical fitness will continue; body adapts, so overload must be kept at more than "normal"

Principle of Specificity
specific training effects result from specific type, method, or type of exercise; doing specific exercises to improve specific components of physical fitness in specific body parts; different for every part

Flexibility

Application of the Principles of Training
to improve flexibility must stretch soft tissue farther than accustomed to
gradually increase mild tension point
stretching exercises will only improve flexibility in the joints you stretch

Benefits
increase circulation
prevent injury
reduce chance of low back pain
relieve emotional tension
improve body position for sports
facilitation of strength development

Types of Stretches
static: slowly moving muscle to its stretch point and holding position for 15-30 seconds, safest; best for cooldown
dynamic: moving through full ROM in slow, continuous, controlled manner; best for warm-up
ballistic: bouncy, jerky movements using the body's momentum; only for extreme athletes; not recommended
isostatic: keeping tension throughout the whole stretching exercise (even when muscle relaxed)

Safety Considerations
warm-up before stretching
communicate when doing partner stretches
stretching is individual
go to mild tension (not mild pain)
stretch both sides of joint and body

Stretches

1. modified hurdlers stretch: hamstrings, adductors
2. elevated hamstring stretch: hamstrings
3. partner hamstring stretch: hamstring, gluteus
4. standing quadriceps stretch: quadriceps, hip flexor
5. partner quadriceps stretch: quadriceps, hip flexor
6. lying quadriceps stretch: quadriceps, hip flexor
7. kneeling anterior tibialis stretch: anterior tibialis
8. partner anterior tibialis stretch: anterior tibialis
9. spinal twist/pretzel: spinal erectors, abductors
10. tensor T: spinal erectors
11. angry cat: spinal erectors
12. partner knee to chest: spinal erectors
13. shoulder and chest stretch: deltoids, pectoralis
14. arm across chest: deltoid
15. door/corner stretch: pectoralis, deltoid
16. partner tug of war: deltoid, latissimus dorsi
17. calf wall stretch: gastrocnemius
18. step calf stretch: gastrocnemius
19. triangle calf stretch: gastrocnemius
20. partner calf stretch: gastrocnemius, hamstring
21. latissimus overhead stretch: latissimus dorsi, deltoid
22. standing lateral side bends: lateral trunk
23. mid-back stretch: mid back, lateral trunk
24. press up: rectus abdominis, spinal erectors
25. forearm stretch: forearm
26. tricep stretch: tricep
27. bicep door stretch: bicep
28. neck stretch: trapezius, neck
29. trapezius stretch: trapezius
30. piriformis stretch: piriformis, gluteus
31. butterfly: adductor
32. partner adductor stretch: adductor

Healthy Decisions

STAR Decision-Making Process

Stop

Think

- prevent impulsive decisions

Act

Reflect

- prevent future impulsive decisions

Various Drugs

- **Tobacco**

    - #1 preventable cause of death
    - active ingredient: nicotine
    - thousands of carcinogens
    - stimulant

- **Alcohol**
    - easy to obtain
    - active ingredient: ethanol
    - depressant

- **Marijuana**
    - active ingredient: THC
    - 2 carcinogens, thousands of times stronger than those in tobacco
    - cannabinoid

- **Prescription Drugs**
    - “pharming parties” are when teens go and exchange pharmaceuticals when they meet

- **Drug Facts**
    - Connecticut vs. National Averages
    - Males vs. Females

Healthy vs. Unhealthy Relationships
should not get too physical - would be abuse
Ray Rice was not a healthy relationship
Tiger Woods made bad decisions, not healthy relationships

Bacterial vs. Viral STIs
bacterial:
- chlamydia
- gonorrhea
- syphilis

viral:
- HIV
- HPV
- hepatitis (B)
- herpes

Preventative Techniques
- condoms
- lubricants
- universal precautions

Jonathan Lam
Mrs. Staley
West Civ. per. 7
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Alexander "the Great": A Fitting Title

Being the first person to conquer the Egyptian, Greek, and Persian empires in just over a decade was no walk in the park, and neither was integrating a culture into all of those empires nor attempting to unite them all. Alexander of Macedon was this man: he conquered the greatest empires, spread the Greek influence, and lead in a unique way with his inspiring character that he is famous for. Although he was not the ideal leader such as Plato's idea of a philosopher-king, he was an ethical man who wanted his people content. His well-known title, "Alexander *the Great*," was very appropriate for him: his fine character and social goals, his unique political leadership and strategic conquering, and his economic advances all are examples of his greatness.

Best known for his military genius, courage, and devotion to his followers (Document 2), Alexander had the personality to be a great leader. The famous "The Legend of the Helmet" is a story praising his morals: when his thirsty army was marching in the hot desert, he did not allow himself - he even rejected - the special treatment of a ride and precious water. Therefore, his soldiers were very inspired by his act that showed them that he is equal to them: "this action … was as good as a drink of water for every man in the army" (Document 5), a *great* act that only shows impressive moral character. He was often sculpted or painted on anything from his companions' sarcophaguses to even the clothes of Roman emperor Marcus 540 years later (Documents 4, 8), because all his people admired him for his character. Although some people beg to differ, and that he was very vain, because he was mostly shown as "a beautiful youth, with wonderful locks flowing backward from a broad forehead" (Document 6), it's still likely that the people thought of him this way, having the energy and youth to have fought in so many battles and ruling from when he was a young adult, only 20 years old (Document 2). Another of the great parts of his character was that, while some critics believe that his conquest was only for his personal legend and as achievements (Documents 6, 7), Alexander made it "clear that part of his goal in conquering foreign lands was to spread the influence Greek culture" (Document 2), and therefore he did not only fight and conquer for his personal benefit and fame. As a result of his goal, Greek literature and theater remained a prominent influence in the Middle East for nine centuries, and Greek was the official language of Jordan for a full millennium (Document 8); this

should be recognized as an impressive achievement, because he had impacted those millions of people in the Middle East for so many years (Document 3). Because Macedonia was a part of Greece, Alexander decided not to create a whole new empire, but to expand on an already great one; to spread the greatness of *Greece*, not himself. He is similar to Plato's ideal philosopher-king in this way- he wants good to the people, and does not use his power selfishly, just as he did not accept the water that he could have taken because of his authority in "The Story of the Helmet." It is from Alexander's excellent leadership traits and his cultural goal that much of his greatness and fame rises.

Alexander's military conquests and political campaigns allowed him to rule such a large area of so many people. His homeland Macedonia is very small; however, with the strong military foundations of new weapons and disciplined soldiers laid by his father Philip II, Alexander was able to conquer an area almost as large as the Roman empire in only eleven years, from his homeland of Greece to the far east of India (Documents 1, 8). He was unstoppable in his conquests, and defeated the powerful empires of Greece, Persia, and Egypt without any major setbacks. The main reason Alexander was able to create and sustain such a large empire was because of not only his military might but also his method of rule: "Alexander adapted existing administrative structures rather than imposing new ones" (Document 2). Instead of wiping out existing cultures and government systems, he assimilated Greek methods into a conquered territory, without excessive control. As a result, "Greek cities throughout the realm of Alexander often had some degree of self-control" (Document 2), and this extra freedom was a revolutionary idea that Alexander created. Freedom is an ideal that everyone wants, and usually a dictator would rob its subjects of freedom by being tyrannical and imposing strict laws; Alexander did the opposite, leaving the territories to self-rule if they were still under his power and he still had some control over them - this way, the people would be much more content. This differed from Plato's philosopher-king as well- instead of giving the common, uneducated people no power at all, he instead gave them local power in their governments, but he still controlled the overall power over the conquered lands. This can be considered an even better idea than Plato's, because local governments may need to be adapted to their own people and culture, something that the philosopher-king may not take into account; therefore, this idea of rule also contributed to

Alexander's greatness. Lastly, he tried to create equality in his kingdom, even amongst the Persians, their original enemies. "In 324 B.C., he and approximately 80 of his officers married Persian wives, and 10,000 of his soldiers with native wives were granted gifts. Alexander also planned to bring Persians into the army and into the administration of his empire" (Document 2). Although his idea was mostly unsuccessful, it showed the reasonable ideals of equality that we fought for and enjoy today, and it was a demonstration of his brilliant character and ideas to make a much larger percentage of his people (the Persians) content in his empire. In his lifetime, Alexander created over 70 cities, some of which had an enormous effect on history, especially Alexandria of Egypt. These political influences, which had influenced the lives of all the inhabitants of the Middle East and the rest of his empire, again qualifies as "great," especially because he did not use force to prevent the territories from fighting, but instead kept them content by allowing some self-rule (Document 5). Alexander's unusual method of assimilation and accommodation in the areas that he ruled was no simple idea; it it played a huge part to his greatness as a political ruler.

Although he was not known for making dramatic economic changes to his empire, some of his actions improved the economy through easier trade. Because a huge area of two million square miles (Document 8) was now under one rule and one language, trade became much easier because international trade between different empires and nations were not necessary; instead, trading was more local and simpler because there were no borders to cross. Alexander simplified trade further by establishing a new currency, "a new coinage system" (Document 2), which would standardize prices and clear up confusions of transactions with currency conversions. This would also open up easier trade routes from Europe and Africa to China and India, without crossing over other empires. Also, having conquered Persia, an "enormously rich prize" (Document 7) and many other territories, Macedonia was not poor, which also contributed to the overall wealth of the empire. His political system of some self-rule probably also allowed cities control over their own trade, without as many restrictions as a dictatorship. The other great part of Alexander's economic system was that the rulers were not known for being overly wealthy, and therefore corrupted by money. Alexander was not well-known for being very rich; nor was he known for spending huge amounts of money for useless items for his personal benefit or

enjoyment. The common people could still control their lives and the economy by themselves. This was one major aspect of Plato's ideal government, and it worked very well, in practice, in Alexander's government. Not only did Alexander create a politically-sound system, he also developed an empire with better trade, and therefore more overall wealth.

Alexander of Macedon was a very unique man who achieved many exceptional accomplishments with his empire. He lead with a skillful nature, to conquer and to spread Greek culture; he had excellent ideas to rule his people in a new way; and he improved trade throughout his whole empire by unifying and standardizing currency. Few people in history can claim these accomplishments. According to D. Cruson's description of the quality of greatness, Alexander is great for having "altered history to a substantial degree" (Document 3): creating such a tremendous impact on thousands of people for so long- even if his empire did fall after only a decade, its impact on all the people was enormous and lasted for several centuries; and, he was not a ruthless dictator that caused mass death and destruction. Based on his remarkable social, political, and economic ideas and methods, Alexander undoubtedly deserves the status of greatness and his title of "Alexander the Great."

Jonathan Lam
Mrs. Staley
West Civ. per. 7
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Ancient Greece Study Guide

Essential Questions

How do people use power responsibly?

People use power responsibly when they do not become corrupted by greed or wealth but instead use their power only for the good of all their people under their power, especially rulers. An example of an unjust ruler would be one that is so rich and wealthy that he spends it all on himself and impractical items. An example of a just ruler would be one of Plato's "philosopher-kings," who rule reluctantly, without any wealth or property and raised with only morale stories and ideas. If power is used to help others, or for another just cause, then it is used responsibly.

To what extent do any of the Greek models achieve responsible use of power?

I think few Greek models (in power) will achieve responsible use of power. Most of the people with power were leaders or other politicians, who were probably tempted by the amount of wealth they had access to. We have read about a few leaders and lawmakers, such as Lycurgus and Pericles, who were known as just and created laws that helped most of the citizens of their city-states.

Polis (city-state)

What is a city-state?

A city-state, or polis, is an independent city of Ancient Greece. Although they are all Greek, and have many things in common such as language, religion, and culture; they are independent, and therefore can self-govern, wage war, and have have the same function as regular, larger nations.

Why do you think the ancient Greeks organized their society this way?

I think that they organized their society this way because they had little means of communication and traveling, so new ideas and technologies could not move very quickly. Therefore, the most effective way to live was in a smaller city-state with laws based on their own people, rather than as the whole country of Greece.

What impact did geography have on this organization? Did religion have an impact on it at all?

Geography had a large impact on this organization. Because Greece is mountainous and has many small islands, it would be hard to travel and get ideas across to different areas. This would make governing very difficult, because laws and news would travel very slowly across Greece to be carried out. A smaller form of government was more efficient in ancient times.

What characteristics do all polis' share? (ex. sea trade)

All Greek city-states, like all other governing nations, have to have some sort of power organization in the form of a government. They also have to have trade, mainly from the sea, but also from land. They have to be near water to trade and to have enough water for everyday needs, including washing and drinking. All city-states also have to have some source of food, whether that is from trade or agriculture or hunting. A specialization of workers (jobs) will necessary to function correctly, and usually a form of currency that all people can use. Also, a military, complex institutions (schools and businesses), advanced technology, and record-keeping are all necessary in a polis.

Specifically, the Greek city-states all have citizens that can all speak Greek, and know the Greek religion and culture.

Jonathan Lam
Mrs. Staley
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Vocabulary

1. **Civilization**
    a. an advanced society of self-governing people that have similar culture, religion, and ideas.

2. **Military Oligarchy**
    a. a government system in which the power is placed in a few military generals

3. **Direct Democracy**
    a. a government system in which the people are directly involved in government

4. **Skepticism**
    a. doubt about the truth of something; the theory that certain knowledge is impossible

5. **Socratic Method**
    a. dialectics: a method of philosophy that involves cross-examining (questioning, dialogue)

6. **Timocracy**
    a. a government system in which the power is based on possession of property; where rulers are inspired by ambition or love of honor

7. **Autocracy (Plato and his idea of the Philosopher-King)**
    a. a government system in which one person has absolute power

8. **Philosophy**
    a. the rational investigation of the truths of principles, conduct, and knowledge

9. **Pythagoras**
    a. an Ancient Greek philosopher that studied mathematics and philosophy and tried to link the two together; he associated “cosmos” with the universe for the first time and thought that it could be explained through math; came up with the Pythagorean theorem

10. **The Academy**
    a. the school founded by Plato to train men to become “philosopher-kings” and to teach them the ideas that he created

11. **Oracle of Delphi**
    a. also known as the Pythias; a priestess at the city-state of Delphi, which was considered to be the center of the world and very spiritual/sacred; gave prophecies/pronunciations, or answers to questions or advice that was asked of her (probably under the influence of poisonous gases from a fissure in the Earth) in the form of jumbled phrases and words; sometimes she was misinterpreted

12. **Peloponnesian War**
    a. the 30-year war between Athens and Sparta that resulted in a Spartan victory; fought in three phases; Athens weakened during war and surrendered; Sparta established an oligarchy on Athens (under the rule of the “Thirty Tyrants,” including Plato), that was overthrown after many years; Spartans used the help of the Persians to defeat Athen’s navy

13. **Golden Age**

a. the period of time in Athens between the defeat of a Persian invasion and the Peloponnesian League; Pericles ruled during this time; Greek city-states are united happily

14. Draco

a. a person called upon to make reforms to Athens while it was an oligarchy; said that *all* wealthy people can participate in government; only punishment was death; people felt it was unjust, and overthrew him; "draconian" created after him, because he was so harsh

15. Cleisthenes

a. self-declared ruler who overtook Peisistratos; organized "demes," representative structures based on geography; power was organized more equally than ever before; ostracism was legal; *created* democracy

16. Aristocracy

a. a government system in which a wealthy, privileged class rules

17. Pericles

a. a ruler of Athens at the end of the Golden Age; had the "Funeral Oration"; died during the Peloponnesian War; was a great orator; ruled by himself in a democracy because of his skill, not because he wanted power; *perfected democracy*

18. Funeral Oration

a. a speech given by Pericles after the first year of the Peloponnesian War against Sparta to commemorate (and sugarcoat) the dead, to encourage more people to fight, and to discuss what the people are fighting for (the greatness of Athens, the Athenian democracy. and the Athenian ways)

19. Egalitarianism

a. the idea that all people are equal

20. Lycurgan system

a. the government system of Sparta under the laws of Lycurgus;; Council of Elders watching over two kings (all military generals); military oligarchy; people were equal and were not greedy (they ate the same foods, together; used iron as currency; outlawed unnecessary items); boys were trained to be strong; women educated

21. City state

a. a polis; a self-governing city in Ancient Greece; (see above, at "What is a city-state?")

22. Acropolis

a. the raised part of an Athenian city, usually raised; usually includes temple and other important buildings; most famous Acropolis at Athens, with the Parthenon

23. Agora

a. the center of an Athenian city; a marketplace; a gathering place, assembly; the center of athletic, spiritual, political artistic life of Athenians

24. Idiotes

a. eligible citizens of Athens or Athenian cities that could vote but did not; modern day word "idiot" comes from this word

25. **Allegory of the Cave**
    a. an example situation that Plato describes to explain his idea of the philosopher-king: prisoners who are facing a wall in a cave can only see shadows from people walking in front of a fire behind them, not knowing what real sunlight is like anymore, and when one prisoner escapes and sees outside for the first time and returns with news that the shadows that they are seeing are not caused from real sunlight, the other prisoners laugh; used to show that the philosopher-kings are used to bring enlightenment to the ignorant, common people, and that they will probably face much skepticism

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Spartan Government

Two Kings (Dual Monarchy)

Sparta was ruled by two military general-kings. They were under the watch of the Council of Elders.

Ephorate (Group of five men)

Sparta had five ephorates that were elected annually. They swore to the Spartan state (not to themselves like the two kings), and helped rule with the kings.

Council of Elders

The Council of Elders was a group of 60 experienced military generals that helped the two kings make decisions. They voted on decisions.

Assembly

The assembly was a group of eligible Spartan citizens that helped make decisions in the Spartan government.

Helots

The helots of Ancient Sparta were slaves. They worked the land for their owners, the Spartans.

Material Wealth in Sparta ($)

Since Lycurgus wanted to make sure that people would not become greedy in Ancient Sparta, he changed the currency to iron. Iron was extremely plentiful, heavy, and of low value, unlike gold or silver, so that people would not want it and it would be impractical to steal it.

Spartan Boot Camp

The Spartan training for boys was very tough. They went to start learning at the age of seven, where they started taking roles of leadership, and started to learn preliminary writing and reading. At twelve years old, training increased in difficulty, and their lives were made harder. Leaders started to show, and they were selected to lead.

Role of Women

Women were treated well in Ancient Sparta - more equally than in most of the rest of the world at the time. This was mainly because the Spartans wanted the women to bear strong children. They therefore were trained in academics, as well as athletics.

Lycurgus

Lycurgus was an extremely influential law writer of Ancient Sparta. He wrote the constitution of Sparta. He created many laws (most of them resulting in the above), and he made Spartans strong and equal.

Jonathan Lam
Mrs. Staley
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Athens & Sparta – Characteristics of Civilization

Comparison of government, education, citizenship, military, etc.

Athens	Sparta
direct democracy	military oligarchy
interested in arts, politics	interested in military
capital of Greece for long time	capital of Greece after Peloponnesian war
educated well	educated in basics
not taught to fight	taught to fight
women not equal	women educated, trained
had slaves	had slaves
major Greek city-state	major Greek city-state

Athenian Democracy

Development of Democracy in Athens

1. Dictatorship
2. Aristocracy
3. Draco (see above)
4. Economic Class Crisis
5. Solon's Constitution
6. Rule of Peisistratos
7. Rule of Cleisthenes (see above)
8. Direct Democracy (see above)

Pericles (funeral oration, nationalism, courage and skill)

Pericles was well known for being a great speaker. He was also known for ruling by himself in a democracy, but being supported by the Athenians. He ruled because of skill, not wanting of power. He gave the "Funeral Oration" (explained above and below). His rule was the end of the Athenian "Golden Age."

Athenian Court System

Juries were selected randomly. They voted guilty or innocent, like we do today.

Funeral Oration of Pericles (what funeral?)

What was the speech about? (main ideas)

- Greatness of Athens
    - Athenian democracy being the best, most just form of government
    - Athenians being morally just
    - Athenian empire and monuments are grand
- Why the people are fighting and dying

- to keep Athens
- is a noble cause that they are fighting for
- those men have undone any sin they have committed

Why is it important?

The Funeral Oration was important to boost the morales of and recruit the Athenians, as well as to commemorate the dead that fought in the war. It is also very important to us because it provides the Athenian view of their own government and greatness.

What distinguished Athenians from Spartans?

Athenians are just as prepared as Spartans, without having to go through such difficult situations during training, because they are well-educated. They also have a better government than the Spartans, because all the people got a say in government.

Peloponnesian War 431-404 B.C.E.

Who was involved?

Athens and Sparta were the main opponents in the war. Persia was called on by Sparta for some of the war to help defeat the Athenian navy.

What caused the war?

The Athenians became very powerful, conquering all of Greece but the Peloponnesian League, and worrying Sparta. Also, the Helot revolt of Sparta (during which Sparta rejected 5000 Athenian troops) and the Megara/Corinth conflict (during which Athens helped the Spartan enemies), helped cause the war.

What was the outcome? (downfall of Athenian Golden Age, Thirty Tyrants, Socrates)

Sparta won the war. The downfall of the Athenian Golden Age, in which they had their height of democracy and their empire, resulted. Sparta put the Thirty Tyrants to rule Athens as an oligarchy. Plato served on the Thirty Tyrants for a few years, but left because it was too violent. Socrates also refused to listen to them.

Greek Philosophy

What is philosophy?

Philosophy is the study of the fundamental nature of knowledge, reality, and existence, especially when considered as an academic discipline.

Socrates and Plato

Socrates was one of the earliest and most well-known Ancient Greece philosophers. His work was based on the study of morality and ethics, and he was sentenced to death because he held onto his beliefs. Plato was Socrates's student. Because Socrates had no writings (his method of philosophy was through dialogue), historians only know about Socrates through Plato's writings, such as *The Apology*, and *The Republic*. He focused his work more on the best government, which he formulated through the Socratic Method, because he wanted a government better than the democracy that killed Socrates unjustly. He founded an Academy that lasted for hundreds of years and taught many scholars, including Aristotle (the tutor of Alexander the Great).

Socratic Method

The Socratic Method is a method of philosophy that involves cross-examining (questioning) to find truth about human knowledge, conduct, and morals

Jonathan Lam
Mrs. Staley
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Oracle of Delphi (history & significance of oracles)

The Oracle of Delphi, or the Pythias, was a priestess at Delphi. Delphi was considered to be the center of the world, and had great spiritual importance. At the center of Delphi, there is the Temple of Apollo. Inside, in the deepest chamber, the Pythias would answer questions and give advice to those who asked her - ranging from personal questions to advice to great cities. Her responses would usually be in jumbled sentences or words, which would require an interpreter to translate into comprehensive text. These answers would be very vague, and could be interpreted in many ways, right or wrong.

There would be a ritual to visit the Oracle, because the Greeks believed a lot in them. First, the asker (who may have traveled from far away, all over the globe) would stop at the foot of the road up to Delphi. He would walk up, and purify himself in the Castalian Spring. He would sacrifice a sheep or a goat, and its entrails would be examined for omens (If there was a negative omen, he may be sent back, despite having gone so far and sacrificed a sheep or a goat). He then would pay a small fee, and then have his question or advice taken by a priest. He would wait for an answer, and get one. Then, he would leave.

There is skepticism in the modern day world that the Oracle really has the power to make true prophecies. In the ancient world, when people were very superstitious, there was no doubt that the Oracle was right, and the god of prophecies, Apollo, was speaking indirectly to them through the Oracle. However, in the modern-day world, as scientists attempt to find a scientific reason for everything, researchers have concluded that since Delphi lies on criss-crossing fault lines and since Greece is a very active seismological site, there is a high possibility that the Oracle was under the influence of nauseous gases when making her prophecies. There has been traces of those gases found in Delphi.

Plato's *The Apology* – The Trial of Socrates

Plato's *The Apology*, was about the trial of Socrates. Socrates is defending himself. He describes how the Oracle has said that he was the wisest man in Greece - he tried to prove her wrong, thinking, *How can* I *be the smartest man*? He went around Greece, questioning others to see their wisdom. However, he could not find a man wiser than himself, because all of the men he asked thought that they knew more than they really did - however, he was humble, and he knew that he did not know everything. Then, he explains that his questioning and his students' questioning has lead people to become angry at him, because they think that he is corrupting the youth that has questioned them, and is like the stereotype of philosophers of Ancient Greece - he studies *science*, doesn't believe in gods. and tries to make the worst of everything. However, he explains that this is not true - that he does believe in gods, and only tries to find truth in things and people. He then goes on to say that convict him or not, he will not be affected by their verdict: if they say he is guilty, then he will die in peace, because God will not allow a wise person to die in pain; however, if they decide to free him, he will continue teaching (in the form of asking questions) no matter what.

Plato and *The Republic* (why was it written)

Plato's *The Republic* is another of his most well-known works. It is a dialogue between Socrates and other characters to determine what justice is and why people act justly, as well as the ideal government in which the leader and everyone else is equal and just. Socrates is the character for himself: Plato expresses his own ideas through his character. He discusses why all the major existing governments would not work, as well as what his own government does to prevent the faults of the other governments.

Plato's Philosopher-King

Plato's idea of the ideal ruler in the ideal government is the "philosopher-king." This philosopher-king would be a well-educated ruler that was extremely just. He would be raised without family, possessions, or money, so that he would not be corrupted or distracted. He would also be raised only with stories of good triumphing over evil, of justice and equality. He would not be raised with any music, poetry, or drama, as these can be considered

corrupting. He would be chosen as the best from a group of people training to be rulers. He would rule reluctantly, because he does not want power - he uses it because it is his duty. He is well-educated, better than the common people, so he does not make decisions that may seem good or will only be good for the short-term - therefore, he will not listen to the "mob mentality" that killed Socrates. He will have no money, except for the minimum that he needs for a humble life. He will have only a role in politics, but not economics.

Plato's Ideal Government

Plato's idea of the ideal government in which everyone is just is one with three classes: the rulers, the auxiliaries, and the common people. The rulers include the philosopher-king and the other people who help him rule - however the philosopher-king has absolute power; therefore, Plato's idea of an ideal government is an autocracy. They have no power in economics, but have every power in politics. Then, there are the auxiliaries, the police and the military who enforce the law. Again, they only have power in politics. Together, these two classes make up the Guardians of the state, the political power. Lastly, there are the common people, who make up the vast majority of the society. They are mostly farmers and merchants, and they provide the state with food and other supplies. They control the goods, and therefore the economy. However, because they do deal with money, and are not well-educated, they have no role in government.

There are many positive elements to this idea. One of the most important is that the people in power are trained to not handle money or be unjust in any way. Another is that it will be more effective than a democracy, because there will be no objection to the leader, but will be better than a dictatorship, because the leader is not self-proclaimed through violence and well educated. Also, there will not be the mob mentality of the common people like there is in a democracy, which can lead to unjust and negative decisions.

There are also a major negative element: the people may not want to be ruled by a single ruler. They may feel unhappy that they have no say in government, and revolt. Also, the ruler may make rash decisions, and not listen to the common people even when they're right.

Jonathan Lam
Mrs. Staley
West Civ. per. 7
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The Middle Ages Study Guide

Essential Questions

Apply these to the Crusades. These will be put together in one essay question.

- What lessons can be learned from conflict?
    - conflict is costly and unnecessary
        - as people look back on conflicts and notice how useless or unnecessary an old conflict was, they can try to prevent more of the same conflict; however, this usually doesn't work, as people don't learn from their mistakes, but when it does it could change some people
        - they could learn that all that unnecessary fighting is caused by propaganda, and they can learn the true nature of stereotyping and hate so as to be influenced less by it
- Is conflict inevitable?
    - yes: conflict comes from wanting of power and control; as people get more powerful they will fight for domination over some people or land
    - people will do whatever they can to get rid of people who are "different" from them or are powerful to assert their own power and blame others for problems
        - they use propaganda and stereotypes to do this (see section on stereotypes), which just gets worse and worse— sometimes, it even is unnecessary and extremely immoral, but people listen to it and follow it because it is very convincing
- Can civilization progress without conflict?
    - no: people learn valuable lessons from conflict, and some from conflict alone (see first question)

Byzantium and Islam

1. **Why was the Eastern Roman Empire able to flourish after the fall of Rome in the West? (politics, trade, location)**
    a. originally split by Diocletian as a type of experiment
    b. reunited again by Constantinople, but capital of Constantinople was declared
    c. still thought of themselves as romans, essentially Romans in the East
    d. taken over by Ottoman Turks in 1400s, who named Constantinople Istanbul, made it their capital, and used the Hagia Sophia as a model for mosques
    e. had both religion and law rule, similar to Western Europe, but law and rulers were much more powerful
        i. leader was patriarch of Constantinople, and Pope of sorts— head of church
    f. Constantinople:
        i. central position in empire
        ii. next to water (Bosporus Strait)
            1. good for trade, especially luxuries from Black Sea
            2. could protect trade routes from pirates
            3. good protection (on a peninsula, had a wall on last side)
    g. their legal system was very advanced
        i. Justinian compiled the Corpus Juris Civilis, the "Body of Civil Law"

1. it was a compilation of thousands of books of law from older civilizations, especially Roman and Greek laws
    a. he chose from the best
    b. he modified some so that they were simple and understandable, and did not contradict each other
2. three parts:
    a. codex: the actual laws
    b. digest: a series of jurisdictions
    c. institutions: a student textbook of the law

2. What cultural contributions did they make to the world?

a. architecture
    i. Muslims used this to model their mosques after
b. law
    i. compilation of many different systems of law and makes sense
        1. many of the laws are still in use today (for example, the "Law of Nations" are our Declaration of Independence's "Natural Laws," and their basic ideas of ethics still exists to govern our modern lives)
c. preserved Roman culture past the Dark Ages of Europe and away from the destructive barbarians, including their law and knowledge
d. kept the idea of a modern, civilized life when most of Europe was not so (the feudal system of Western Europe)

3. What was the importance of the Byzantine Empire, especially under Justinian? (the Golden Age)

a. architecture
    i. great architectural projects, especially religious buildings like the Hagia Sophia, were constructed in Byzantium under the rule of Justinian
b. expansion
    i. Justinian conquered huge lands for Byzantium, almost doubling its size
    ii. reconquered Italian peninsula from the barbarians and restored some of the old cities
c. law (see above for legal system and Corpus Juris Civilis)

4. What is the Eastern Orthodox Church? Why was it formed?

a. the branch of Christianity that was created in Byzantium
b. created in the schism (split) between them and the Roman Catholic Church because their views on the ideas on the power of Church and state differed
    i. Pope and Patriarch excommunicated each other
c. head of church is the Patriarch— similar to a Pope
d. emperor chooses the Patriarch, so state is still more powerful than religion— one of the things that Western Europe disagreed with
e. here, clergy could marry (whereas Roman Catholic priests couldn't marry)
f. here, most people were Greek (while most Roman Catholics were Latin)

5. Who was Muhammad?

a. prophet of Islam
b. direct descendent of Abraham (through Ismael)
c. 622 received prophecy through Angel Gabriel
d. orphan in Mecca, got his prophecy there

e. not everyone believed him (others were polytheistic)
f. captured Mecca after fleeing to Medina
g. left no heir
h. first of caliphate

6. What are the main beliefs of Islam and the Five Pillars of Islam?

a. Islam literally means peace and submission
b. over 1 billion followers
c. Muslims are Islam followers, mosque is house of worship
d. have teachings similar to Christianity (based on Christianity)
e. believe in human rights, and not terrorism (as some people think)
f. Sunni and Shi'a Muslims
g. Allah is Islam God
h. believe in other prophets of God, but final prophet was Muhammad
i. five pillars:
    i. pilgrimage (make a journey to Mecca)
    ii. prayer (pray five times a day towards Mecca)
    iii. faith (acknowledge Allah as monotheistic god)
    iv. tax (charity)
    v. fast (during Ramadan)

7. What role did Islam play in the Crusades?

a. Arab Muslims took possession of the Holy Land of Jerusalem in 600s from Byzantium as part of their expansion, taxing Christians but staying mostly friendly towards them— still allowing pilgrimages
b. later, Seljuk Turks took over, and started to stop Christians from completing pilgrimages; also started attacking Byzantium as part of expansion
c. after emperor Alexius of Byzantium called on Pope Urban for help, the Crusades were called against the Muslims for control of the Holy Land
d. the Muslims defended their land in the People's Crusades, but lost the second, more organized part of the First Crusade
e. the Muslims easily defeated the Christians in all the other Crusades, eventually taking over all what the Christians had taken in the First Crusade

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Middle Ages

1. What is feudalism and why was this system established after the fall of Rome?

a. government system of western Europe
b. relationship between lord and vassals
c. the vassal:
    i. pays for him (ransom and ceremonies)
    ii. serves in court and battle
    iii. give knights
d. the lord
    i. gives land and home
    ii. gives protection

e. manorialism is the economic system that works with feudalism, between the lesser lords and the peasants / serfs
    i. manor was self-sufficient
    ii. serfs provide service, tax
    iii. lords offer protection, land
f. feudalism established because there were:
    i. lots of poor people
    ii. power vacuum after fall of central government and all-powerful emperors
        1. small, decentralized governments formed
    iii. people needed food and protection
    iv. provided order, stability, and people knew their place
g. knight
    i. be chivalrous
        1. kind (especially to women)
        2. be honest (fighters)
        3. release knights when ransom is paid
    ii. capture people for ransom
    iii. given to a lord by their vassals
    iv. defend their lord
    v. fight during the Crusades
    vi. fight in tournaments before the Crusades to get out their energy and find the best

Jonathan Lam
Mrs. Staley
West Civ. per. 7
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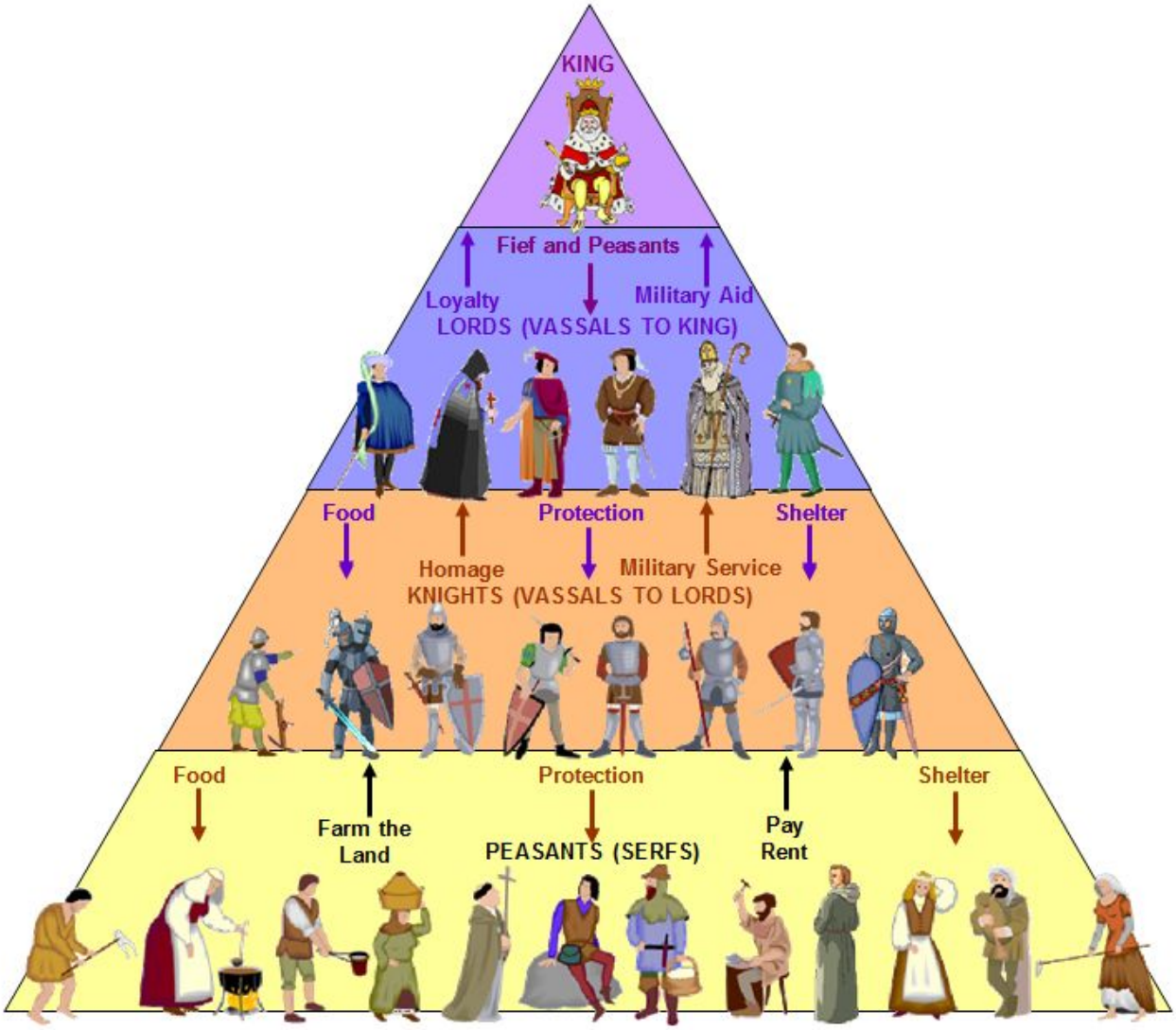

2. What are the key vocabulary words for this unit?

a. fief: land given to a vassal along as part of a contract
b. manor: the house and land of the lord, which was self-sufficient and managed with the manorial system (serfs served their lords)
c. fallow: the state of a field left devoid of crops to allow the land to become fertile again after growing crops on it; fields were rotated to be fallow and grown on (usually ⅔ of the land was grown on at any given time)
d. chivalry: a system of courtesy that knights have to follow
    i. be nice to ladies
    ii. be honest
    iii. be loyal
e. vassal: a lesser lord
    i. has a feudal contract with a higher lord
    ii. owns part of the higher lord's land
    iii. can have his own vassals and serfs to work for him on his manor

f. subinfeudation: the division of a feudal estate by a vassal who in turn becomes a feudal lord over his tenants
g. Pope: the head of the Church, who was meant to ensure that the faith of Christianity did not waiver
h. Patriarch: the head of the Eastern Orthodox Catholic Church and Byzantium, the head of their faith

3. Who was Charlemagne?

a. large and grand, but not disproportional
b. wore normal clothes when he was with the public, but wore fancy when he was with other important officials
c. was temperate in drinking and eating
d. was educated and he educated his children (including daughters) well
e. funded the Church greatly
f. conquered a lot of land for Byzantium, especially in the Italian peninsula
g. first emperor (of Byzantium) to be crowned by Pope and had huge influence and support by the people

4. Describe the daily life of a medieval serf. (Bodo, manor life)

a. work all day
b. one-room home
c. animals inside when it's cold
d. women worked too by weaving and taking care of the house and children
e. pay taxes to lord and Church
f. works at farm
g. gave bribes of small foods
h. pay rent (of chickens)
i. workshops at manor house
j. hated their work
k. women work at their own quarter of the manor house (and gossip)
l. very superstitious
m. had to listen to Church
n. were given Sundays off by the Church
o. had traveling Charles the Great and traveling judges
p. great fair every year in Paris

5. What was monasticism and what role did the monasteries play in the Middle Ages? Who joined the monastery and why? (wealthy)

a. monks lived in monasteries
b. isolated from outside world
c. much safer than outside world
d. under strict Benedictine Rule that promotes obedience and humility
e. very highly respected, one of the fundamental institutions
f. very specific and tough rules and requirements to get in and stay
g. for the wealthy, who could afford to send their children away to get a good education
h. provided as institutions for the poor: inns, hospitals, refuge from war
i. had libraries to copy books
j. monks were missionaries to barbarians

k. bishops, abbots played huge part in feudal system
l. had to pay some of assets to church
m. tool vow of poverty, chastity, and obedience
n. monks filled education roles
o. convents were monasteries for women

6. Stereotypes

a. created and fueled by hate, misunderstanding, fear, and the wanting to get rid of "outsiders" — people that are different
    i. in some ways just a way to establish power and have any possible threats
b. comes from our normal influences and places of learning
c. usually based on fact, but twisted with opinion
    i. makes it powerful and plausible
d. becomes part of peoples' lives, and some people do not know it is wrong nor know how much they can hurt people
e. media has a large role
f. bandwagon prejudice
g. not enough questioning
h. hate is mostly fear
i. the offending-ness depends on the amount of truth in the stereotype
j. usually targeted statements used to antagonize a certain group

7. Crusades (overview)

a. began in 1096
b. Muslims conquered Holy Land during expansion in 7th century
c. in 1071 Seljuk Turks blocked access of Christians to the Holy Land
d. Byzantine empire felt threatened by the Turks and asked for help from the western Christian nations
e. Pope Urban created the idea of a Holy War and backing it up with many reasons, but his actual ones included:
    i. extra fighting for land in Europe
    ii. devastating wars between nobles
    iii. bringing power and prestige to the Church (if it was successful)
f. three first Crusades (out of eight) were the most important, most deadly
g. First Crusade was People's Crusade and more organized second part— the only Crusade that the Christians won

8. Who was Pope Urban II? What impact did he have on this era?

a. man who called Western Europe to arms after Byzantium's (Alexios') cry for help
b. created a holy motivation for the Crusades, made it seem positive to fight
    i. people will have their souls saved
    ii. a chance to go on a pilgrimage
    iii. a way to take back their land, the Holy Land
    iv. a way to get glory and loot
    v. Muslims are barbarians

9. Who joined the Crusades and what were their motivations for doing so?

a. Byzantium

i. emperor Alexios I: protection against the Muslims, who have raided their territory and taken more absolute control of the Holy Land; economic distress; severe religious devotion; repentance for sins; political and economic gain; glory

b. Western Europe
   i. Pope Urban II: it is God's will; people will have their souls saved
   ii. knights: it is God's will
      1. Godfrey of Bouillon
      2. Robert II of Flanders
      3. Tancred of Taranto
      4. Raymond, Count of Toulouse
   iii. Count Emicho: hates Jews
   iv. Peter the Hermit: it is God's will
   v. peasants and commoners: adventure, loot, battle, plunder, land, defeat the barbaric Muslims, it is the will of God
c. Muslims
   i. Kilij Arslan: defense of their land

10. Who won the Crusades? What were the results and impact? What was the legacy left behind by the Crusades?

a. Muslims won, successfully keeping the Holy Land and many other territories and easily defending against the unruly and unorganized Christians
b. increased military technology
c. some money drained to the East
d. Crusades stimulated trade in sugar, spices, and other Eastern products through the silk road
e. brought luxury goods (e.g. silk) to Europe
f. pope ordered direct taxes to help fund the wars (the Saladin tithe)
g. Crusades encouraged a curiosity about exotic cultures
h. by 13th century European merchants reached China (e.g. Marco Polo)
i. expeditions stimulated trade
j. encouraged growth of towns
k. contributed to the establishment of a stable political order in the West
l. costly failures (lives and money)
m. drained resources
n. worsened relations with the Muslims, Eastern Christians, and Jews (rioting against them and murdering them)

11. Black Death

a. bubonic plague, very contagious and very deadly
b. started from China, spread through Silk Road
c. short-term effects included many deaths, huge panic, rapid loss of manpower and jobs
d. long-term effects included decline in economy and standard of living
e. doctors had no idea what caused it or how it spread, so they did not know how to cure it— instead, they blamed the stars, Jews, and a punishment from God

12. Post-Crusades (1300s and on…: the beginning of the "modern era")

a. overview:
   i. began with one of the most devastating diseases: the Black Plague

   ii. hundred years of sharp contrasts between pope and secular rulers led to hundred years war between France and England
   iii. from it emerged strong ruthless monarchies who trumpeted papal authority and tool over church lands, which led to the rise of monarchies, and strong, stable kingdoms
   iv. hundred years war was devastating— saw introduction to gunpowder and heavy artillery
   v. the presence of death led to an appetite for goods only skilled urban industries could produce, so industry was born as people wanted to live life to the fullest
   vi. faced the life at its worst. as people insisted on having the best (and not living only for the afterlife)

b. dates to remember:
   i. in the 11th century, towns sprung up all over Europe
   ii. 1315-1317 was the greatest famine of the Middle Ages
   iii. 1347-1351 were the worst years of the Black Death

c. people moved to towns because of:
   i. population growth
   ii. reinvigoration of trade (local fairs and crusades)
   iii. increased agriculture and production (now inventions and improved climate)
   iv. the **middle class emerged**: artisans and merchants who were driven from manors because of land shortage
   v. people became more adventurous and wanted to break from their feudal obligations

d. negative views of townsmen by nobility:
   i. merchants (trade and nobility) condemned by clergy as immoral (like they thought Jews were immoral)
   ii. merchants departed from traditional ways of making money (by agriculture) and seemed to pose a threat to political and social order (which they did change, but for the better)

e. commoners admired new merchant class:
   i. there was new economic opportunity
   ii. ambitions and skilled peasants as towns to gain freedom
   iii. newfound social mobility emerged
   iv. new element of medieval society was emerging— one of diversity and change

f. fighting for rights:
   i. most important privilege was personal freedom (people have choice)
   ii. towns next fought for legal and political rights (wanted to control policy)
   iii. guilds and protective associations sprang up in 11th century (similar to fraternities)

g. guilds:
   i. aims of such groups were to protect members from the competition of foreign merchants and maintain commercial standards
   ii. similar to a union
   iii. safety net for you and family
   iv. maintained system of education, whereby apprentices served a master for 5-7 years before becoming a journeyman at age 19 and then a fully-fledged apprentice

h. commercial revolution:
   i. commercialism: excessive emphasis on profit-making
   ii. between late 11th through 13th centuries international trade expanded
   iii. trading and transportation firms opened branch offices
   iv. credit widely extended
   v. a new capitalistic spirit developed (medieval merchants fiercely competitive)

vi. across regular trade routes, Eastern ships carried furs, copper, fish, grain, timber, and wine
vii. goods were exchanged for furnished products, mainly cloths and salts, from western cities

i. sanitation was a constant concern:
    i. people threw dirty water out windows to the street
    ii. children were potty trained in streets
    iii. refuse everywhere led to rats, rodents, and bacteria everywhere
    iv. at 9:00 curfew bell rang so wards would patrol streets to better preserve order and cleanliness
j. black plague symptoms:
    i. nut or apple-sized growth in armpit, groin, or neck (boil, or buba)
    ii. if buba lanced and drained, victim could recover
    iii. black spots under skin because of bleeding under skin
    iv. if coughing up blood, patient died within 2-7 days for sure
k. explanations for the black plague:
    i. punishments from god (according to flagellants)
    ii. Jews poisoned the wells of Christian communities
        1. 16,000 Jews were killed at Strasbourg in 1349

Miscellaneous

- torture was the method of interrogation
- mosaic was most common Byzantine art
- government and church cared for the poor in Byzantium

Jonathan Lam
Mrs. Staley
West Civ. per 7
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A Lesson Learned through *1984*

(*1984* Review by Meltzer)

Would a world like that of George Orwell's *1984* ever exist? Probably not. But even so, many people have read the classic and have learned from it.

The book *1984* is unlike many others - instead of a utopian world with an abundance of happiness and freedom, the world Orwell portrays is the opposite: a world with no freedom nor privacy; no independent thought nor creativity; and an all-powerful, all knowing government.

But if *1984*'s government is unreal, then why would people read it, never mind listen to or learn from it? As I wrote in my essay "Does Fiction Matter?", writing is a moral act: what you write has a real effect on others, often to a rather surprising extent. Even make-believe content has the power to affect - especially by educating - the readers.

In *1984*, "telescreens" invade the privacy that we enjoy today; their press is controlled by the government and eliminates their freedom of press; they cannot practice religion; and any sort of uprising or petition against the current rule would be suppressed. This is against many of the ideals we live by nowadays, declared in the first five amendments of the Constitution. Nobody from the modern day word would like to live in this manner. But to make it even worse, anybody in that world, especially thoughtful people, would live in fear of being turned into the Thought Police by anyone, including even their closest friends and relatives. Winston Smith faces this problem, and no one in this world would want to feel the same terror that he faces.

Therefore, because Orwell did not show us an ideal world with good people and a good government, he showed us what *not* to do: he showed us through this book how a powerful communist government would affect all its citizens in a negative way. And like I said in the essay "Does Fiction Matter?", *1984* also *protects* us - it protects us from the pain Winston had to go through. Because of this book, people would be thoroughly convinced against having a communist government, where individuality is suppressed.

But not only is Orwell's work educating us by scaring us, it also relates to us, and transports us to that world by describing it in vivid detail. *1984* is an elaborate book, and

therefore gives to us a very good sense of what George Orwell felt - and he felt what regular, intelligent people of today would feel like in their world.

You may not believe this, and you may not feel like you've learned anything from reading *1984*, but it really did affect you. Even if you think as you read *1984*, *Oh, that's fake*, or, *That'll never happen*, that's only because anybody who has already read it would have the sense to avoid a situation like Winston's. It's a great, thoughtful book, and it gives readers realistic reasons against the its type of society.

Jonathan Lam

Kilij Arslan I

Seljuk Turk | Sultan of Rum | Islamic Leader | First Crusade

Jonathan Lam
Mrs. Staley
West Civ. per. 7
Holy Land Simulation

Biography: Kilij Arslan

I, Kilij Arslan I, am the Seljuk Turkish Sultan of Rum, similar to an European king, during the first crusade. I was born in 1079 a Muslim and I am always a devout follower of Islam. I was a hostage of another Sultan when my father died, and I became Sultan when that Sultan died. I soon made Nicaea my capital and established my rule. I married the daughter of a military commander of another tribe to become an ally of the powerful Byzantines. I killed the ruler of another tribe, who sought to kill me, under the advice of the Byzantine emperor Alexius.

In the People's Crusade, the first part of the First Crusade, Peter the Hermit and Walter the Penniless arrived at Nicaea, taking me by surprise. They did not manage to breach the strong walls of the city, but terrorized and looted the suburbs. I wanted immediate revenge, but my advisors convinced me to wait.

Only two weeks later, French crusaders came along to Nicaea as well, taking the castle of Xerigordon by surprise. They began planning to use it as a military base but were surrounded by oue Turks in a matter of days. Without water, they starved to death; the ones that came out and renounced Christianity were allowed to live in captivity, and the others were killed.

When more soldiers came at Nicaea to avenge the loss at Xerigordon, they passed through a narrow valley while my men laid in wait in nearby. They were careless: a mob of people joking and laughing without their armor on. Our arrows killed thousands of people at the start, and then light cavalry killed the rest. At the Crusader's camp a few miles back, women and children were slaughtered too. As much as 30,000 Crusaders were killed in this attack, and only 3,000 survived and were saved by the Greeks. This battle, the Battle of Civetot, I ended the People's Crusade.

In the more organized, second part of the First Crusade, a larger Frankish army had arrived. After my easy victory over the peasant's army, I dismissed the alert repeatedly. I fought again with the tribes in his country, and the Crusaders besieged Nicaea. When I returned to the capital, I realized I was foolish and was forced to surrender to the Byzantines.

I teamed up with my former enemy, the tribe of Danishmends, to fight the Crusaders, but they were unsuccessful. I retreated and fought guerilla warfare with the Crusaders, as well as destroying crop and water supplies.

Later, after capturing Bohemond, a leader of the Crusaders, we won a few victories against them. This allowed us to gain major confidence, so that we won a few subsequent battles. Afterwards, we resumed war against the Danishmends again.

Jonathan Lam
Mrs. Staley
West Civ. per. 7
Holy Land Simulation

Answers to Questions (based on Kilij Arslan)

1. **How did this conflict begin?**

The Crusaders attacked us in Nicaea by surprise, and raided our people. We were not ready, and they killed our men. We could not defend ourselves quickly enough. Only two weeks later, another group of Crusaders came and captured to castle of Xerigordon, and we surrounded and besieged them successfully. Only then did we began our offense, avenging the Christians and wiping out much of Peter's army.

2. **Justify your role in the Crusades.**

This crusade was started by the Crusaders when they attacked our capital of Nicaea. We did not start it, and it is not our fault— the Europeans attacked us, and we defended our territory. They raided our suburbs and killed our innocents, taking us by surprise, and not taking on our main army. They picked on our weak, and so we avenged them. When they try to take our land, we defend it— that's what the People's Crusade have been. We had a just revenge for our losses.

3. **Justify your people's actions in the Crusades (what did they do and why?). Who are your allies? Who are your enemies?**

My people and soldiers did not wrong like the Crusaders, who were ruthless and immoral. They preyed on us when we weren't ready, and raided our countryside. Our men followed orders and killed ambushed soldiers of Peter in the Battle of Civetot. We then attacked the other armies in the later part of the First Crusades

At one point, we allied with the Danishmends, a local tribe, against the Crusaders; but most of the time they are our main enemy. When the European Crusaders came, they became our primary enemies.

4. **What events, in your character's opinion, led the aforementioned problems and lasting effects?**

The war did not really matter to us or become problematic until Nicaea was attacked by unruly soldiers. I assume the unruliness of people and the general decline of morality and standard of living in Europe led to the Crusades, so they take out their excess anger and energy on us, the Muslim Turks. The Arab Muslims took Jerusalem, so they were probably angry at us Muslims for that as well. I don't think that there were many lasting effects of the battles of the First Crusade; I think much more fighting is going to happen and power is going to change hands.

5. **Who were the leaders of this fundamentalist movement?**

Pope Urban II who called the men to arms was a major leader, as were Peter the Hermit and Walter the Penniless, who led their Crusading armies towards the Holy Land in the First Crusade. They had their armies targeted at us, and were our enemies in the People's Crusade. There were a few other leaders in the later part of the People's Crusade, such as Bohemond, who we captured with the help of the Danishmends.

Controversial Topics

- **The Christians attacked us— this is a defensive war for the Muslims.**
    - They raided our capital to begin this conflict. A few weeks later, they attacked again, and they have attacked many times over the course of the Crusades.
    - They are entering our territory; we are not fighting in Europe, but on our land, defending our capital.
    - The Christians are attempting to take the Holy Land, which is ours, from us— we are not trying to take Constantinople or any other major cities from the Europeans.

- **The Christians are ruthless, foolish, and cowardly— incompetent to own and protect the Holy Land.**
    - They arrived at Nicaea silently and stole from our suburbs and killed our men outside the city, not giving us time to rally up our troops.
    - They dared not attempt to breach our strong walls and take on our army head on.
    - They moved as a mob, careless and without their armor on, through a narrow valley to attack us.

- **The Christian cause for this fighting is not just, and it does not follow the Commandment, "Thou shalt not kill."**
    - In both our religions, "Thou shalt not kill" is a very important aspect of the religion. Even if the Pope says that your sins will be forgiven, it is not right to ignore one of the basic commandments. However, we have the right to defend our land for our religion, as the Noble Quran states, "Nor take life— which God has made sacred— unless for just cause" (Noble Quran, 17:33), and "Fight in the cause of God, but do not transgress limits; for God loveth not transgressors" (Noble Quran, 2:190). As we are looking to defend our land for our religion, it is right to do so; but it is not right that the Christians fight a holy *war* against us, which surely would be considered transgressing a logical limit.
    - The Christians are just looking for glory and wealth to steal from us, with their supposed "Holy War." We are not looking to obtain anything from this war but to keep our land.

- **We Muslims have a right to the Holy Land.**
    - The Christians are not the center of the universe, and we need to spread our religion as well. The Christians can't keep the Holy Land to themselves forever, because it's an important holy city to us too— it's time we had control over it.
    - Even if the Christians were just looking to pilgrimage to the Holy Land, they don't have to kill and destroy all the way there.

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Jonathan Lam
Mrs. Staley
West Civ. per. 7
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Crusades Simulation Reflection

In the simulation, I learned a lot about the reasoning behind the terrible violence that happened during the Crusades. Acting as Kilij Arslan, the Muslim Sultan and leader during the First Crusade, I researched the Crusades from the Muslim perspective, and accusations were hurled at me from the Christian perspective. Even though it was a simulation, the renewed arguments of the tenth and eleventh century Crusades helped me better understand the reason behind the hatred and discrimination the Christians, Jews, and Muslims began to feel during this time period. Out of context, in the modern world, their arguments may seem completely immoral and unjust, but by listening to a debate consisting only of deeply-religious, old ideas, it is easier to empathize with the different perspectives from the Crusades.

I learned how the Muslims considered the war a defensive war, in a time after Seljuk Turks had been conquering land and taken the Holy Land. They felt that the ruthless Christians were immoral and the Crusades were unnecessary. The Christians took it as a defensive war as well, because the Muslims had taken the Holy Land (former property of the Christians), and because some Turks were attacking Byzantium. Alexius called for help, and Pope Urban II created and called on the Crusaders to fight (with some propaganda). They considered the Muslims barbaric and lowly because they were not Christian. Therefore, both sides mutually hated each other for being ruthless and trying to take over *their* Holy Land, which was interesting to me— they thought of each other as thieves of the Holy Land, and themselves as the only rightful owner of it. I think this had the largest impact on me— how two groups can both have their reasons to consider that they are "good" and the other is "bad," completely contradicting each other. I also found it interesting that both sides had a very small attempt to achieve peace, and that there were really no realistic ideas for the future of the Holy Land, other than their own domination.

I feel that my contribution to the discussion was minor. The conversation was dominated by the Pope Urban II (Nathaniel), and I could not argue against him. He repeatedly went back to the idea that the Turks had invaded Byzantium and stolen the Holy Land, and I repeatedly could not defend myself. Kilij's ancestors were the ones to conquer other lands; in his reign, his only

conflict with the Europeans were in the form of defending against invasion. I did not know what his ancestors thought, nor could I blame them, because it seems wrong to blame elders. To defend myself, I had to bring up other subjects, such as the Muslim right to the Holy Land, the ruthlessness of the Crusaders, and the defensive position of the Muslims. I did contribute, but it was somewhat repetitive and did not rebut all of the arguments against me.

To make this "debate" more interesting and thoughtful, I think that if we could discuss with our allies or subjects, then we would be able to formulate better arguments with a stronger, wider perspective and without the possible misunderstanding that results from one person. I was a little unclear on some of the topics and ideas brought up, and I would have liked to talk about it with the Turkish soldier and Turkish metalworker to support a new argument.

Anti-Gravity TV

Impossible to Put Down!

with Julian Marlowe

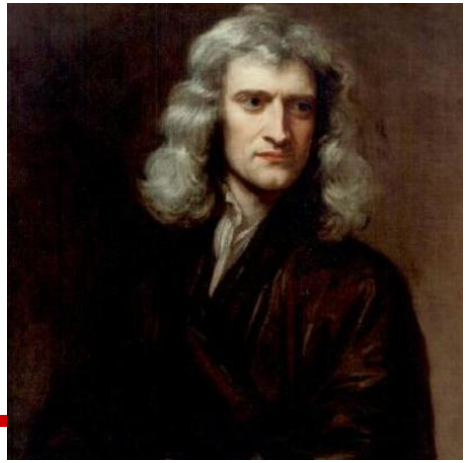
March 31

1727

Tomorrow	Wed	Thu	Fri	Sat	Sun
65º	72º	67º	65º	56º	60º

Isaac Newton

His Life, Death and Science

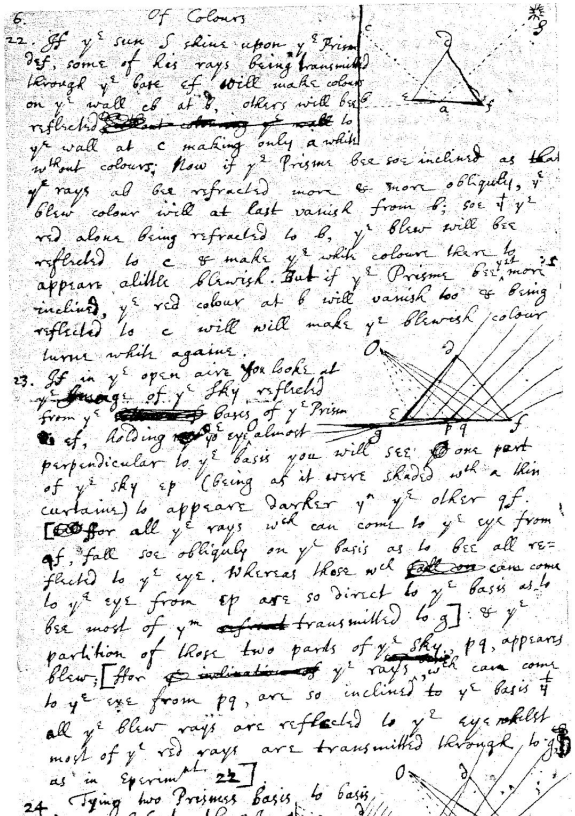


with Nathaniel DeMelis

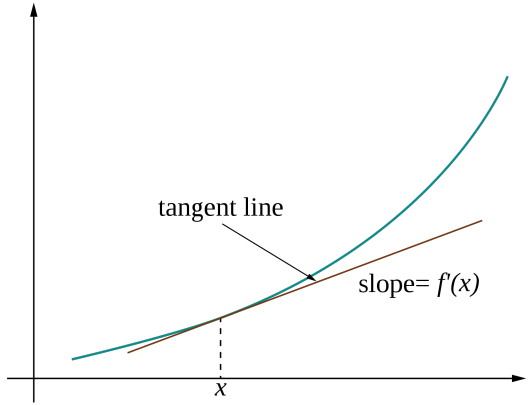
Some Major Discoveries

Optics

his own work →



Differential Calculus



Isaac Newton: Before and Now

Before

Now

Edmond Halley: Funder & Friend

PHILOSOPHIÆ NATURALIS PRINCIPIA MATHEMATICA.

Autore *ℑS. NEWTONO* Trin. Coll. Cantab. Soc. Matheseos Professore *Lucasiano*, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, *Reg. Soc.* PRÆSES.
Julii 5. 1686.

LONDINI,
Jussu *Societatis Regiæ* ac Typis *Josephi Streater*. Prostat apud plures Bibliopolas. *Anno* MDCLXXXVII.

Laws of Motion

"Every body continues in its state of rest or of uniform motion in a straight line, except in so far as it is compelled to change that state by forces impressed upon it" (Principia Mathematica, 1687)

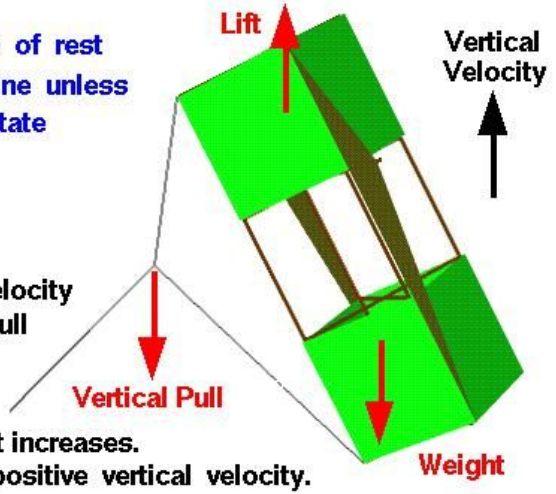
"To every action there is always opposed an equal reaction: or, the mutual actions of two bodies upon each other are always equal, and directed to contrary parts" (Principia Mathematica, 1687).

Laws of Motion (explained)

Newton's First Law
Applied to Kites

Glenn Research Center

"Every object persists in its state of rest or uniform motion in a straight line unless it is compelled to change that state by forces impressed on it."



Initial Conditions:

Kite in stable flight. Zero vertical velocity
Lift balances Weight and vertical Pull

Wind Increases:

Lift depends on wind speed – lift increases.
Forces unbalanced – kite climbs – positive vertical velocity.

Tension in line increases:

Vertical pull depends on line tension – vertical pull increases.
Forces balanced – zero vertical velocity – kite in new stable flight.


404 ERROR: GOD NOT FOUND

Anti-Gravity TV

THANKS FOR WATCHING… Next Story Soon

Impossible to Put Down!

with Julian Marlowe

Jonathan Lam
Mrs. Staley
West Civ. per. 7
5 / 16 / 15

Hidden Threads of Technology in the Fabric of Civilization

Technology is everywhere— any application of science by human beings, built to solve a certain problem or fulfill a certain craving to improve life. It is a fluid idea, always changing to amaze people time and time again— ideas such as smartphones, “rocket science,” and artificial intelligence are emerging and evolving as our knowledge grows exponentially. But many people nowadays may not consider what really changes our life as “technology,” because these inventions are common and too well integrated into our lives. To many people, the word “technology” refers to modern, sophisticated gadgets that appear "cool" and are new to the world— powerful computers, robots, and the applications of nanosciences to medicine— but what really has the greatest impact on our lives are the fundamental technological inventions we use everyday, ones simple enough so we forget that they have an impact on us. For this reason, the most useful technologies are the ones that are so tightly wound with civilization that they become an everyday occurrence, a fact of life that goes unnoticed and taken for granted. Accurate timekeeping, firearms, and even paper used to be new technologies that changed life drastically, and now they can be found everywhere, something that we cannot and will not be able to live without. The Internet and social media are new ideas that have reached billions of people, so that the terms “iMessage,” “Skype,” and “Google” have even become *verbs* in our language and part of our culture despite being nonexistent only a few years ago.

The advent of new technologies in the great ancient civilization of China, the late Middle Ages of Europe, as well as some modern inventions of the modern superpower we live in best exemplifies this process. New technological advances always begin as insignificant desires to improve or make more convenient one small aspect of life, but the technologies quickly assimilate into a community or civilization: they become indispensable and take on a role in society, even if they weren’t in existence only a few years before. They not only become items tightly wrapped into society, difficult to let go of; common technological devices can also become similar to our basic needs of food and shelter in the way that they become a requirement to surviving and thriving in a more complex society.

No matter how revolutionary or new it is, any technological invention providing a beneficial solution to a problem in society will quickly become infused so that it loses its characteristic as a new technology and gains traction in society. It becomes something that people could not imagine living without. This is especially prevalent in modern technologies, where their spread is catalyzed by the far reach of the Internet, something nearly impossible in ancient times.

Before the Middle Ages, the only ways to keep time was by the position of the sun, water clocks, or hourglasses. There was no accurate method of timekeeping, especially for the general public. After the invention of the mechanical clock, an accurate and reliable timekeeping device, in Europe during the Middle Ages, town centers started to become outfitted with a communal clock that the public could use for their daily needs. Scheduling for religious events, work hours, and even cooking improved as timing improved. The first major public clocks were placed in Paris in 1300, with bells ringing at the hours. In 1335, another major public clock was placed in Milan, and within the century they became more popular in larger cities, especially to show prestige (Johnson). However, as technology improved as clocks have become more accurate and smaller, clocks no longer are items that was regarded as "special." With many people wearing a watch (and the new "smartwatches" that have come out this year) and the clocks that adorn most rooms, clocks are certainly not an item that we find difficult to obtain. Although they are not the most advanced or interesting technology, they are practical items, and therefore are still so widely used even today.

Another common invention that is very tightly woven into our world are gunpowder weapons. Accidentally created and first used by the Chinese, gunpowder was originally used to fend off the Mongolian invaders, and for fireworks. When China was taken over by the Mongols, the Mongols used the new firearms against the rest of Eastern Asia (Xu). Eventually, the invention spread through Arabian countries to Europe. It is still used with the same effectiveness today. The number of guns owned today by citizens in just the USA is enormous, in the hundreds of millions, with over a third of Americans owning a gun (DeSilver). The majority of the owners possess guns for defensive reasons, which they are well-built for. Any new technology that can benefit many people will quickly spread to others, within a very short time in the span of history.

Most technological inventions are created to solve a practical problem— a solution to help society in some way. Some are created by accident, such as gunpowder, but are nonetheless quickly brought into a community because of its effectiveness. Whatever the technology, its improvement of standard of living, convenience and efficiency, or cost for a community is the major reason why we can take them for granted so easily.

Found in every school, press, and other institutions, essential for the quick and efficient reproduction of documents, the idea of printing is certainly one of the most useful tools in society. With the invention of wood-block typography and then movable type in China's Song dynasty— in which movable letters could be arranged to reproduce the same document multiple times— the creation of books and other important documents could be completed in a fraction of the time, without necessitating learned scholars to copy the text and with greater accuracy (Blackwell). Later on, the invention of the mechanical printing press in Europe again revolutionized the world, as it added much more potential to education, now printing hundreds of pages per hour, fast enough to engender the rise of periodicals and newspapers ("Printing Press")— another invention we still heavily utilize today in our everyday lives. And finally, in the last century, the "digital age" brought about new "laser" and "inkjet" printers that have the ability to print documents for any type of user, including students, businessmen, and politicians. Because of the enormous capability of even a small, household printer in the 21st century for professional reproduction of documents, printing is another example of a great technological advance that has worked its way into our lives.

Similarly, the dollar, the euro, the yuan, and other forms of paper currency are another artificial idea. Without understanding those systems of currency, the idea of bartering seems more fair and less prone to cheating— why trade a piece of worthless paper for something of real value? For this reason, bartering was the primary system of trade from the ancient days. However, as civilizations progressed, people started to use spices and other somewhat-common products to provide a more standardized and reliable trading system. This allowed more consistency throughout the people, with set prices for certain items. Next, this led to the trade of valuable metals: gold and silver coins— these added even more consistency, providing a stable monetary system. Unfortunately, there was still the problem of real value, along with the

inconvenience of weight. Eventually, as nations grew more secure with more loyal, honest members, paper currency was created. In this system, items could be bought with carefully printed, difficult-to-reproduce paper (in which again the advancement of printers can play an important role). The result is an efficient, easier monetary system that allows for convenient travel and consistency throughout a whole country or group of countries, also allowing for the creation of the credit system (Newman). Without it today, purchasing any type of product, especially expensive ones, would take a lot of effort and time to barter and argue about prices. This, like the idea of printing, was quickly absorbed into our society because of its amazing productivity.

Similarly, during the large urbanization movement of the late Middle Ages, new problems arose with city life. Fires were a prime example: with wooden houses, thatched roofs, and cramped quarters, there was much difficulty putting them out when they started. Tile roofs and the chimney sprung from that— although more expensive than thatch, it was worth the potential cost of rebuilding a house in event of a fire (Johnson). Furthermore, houses improved as a whole from mud, single-story and sometimes single-roomed houses from the Middle Ages to two-storied, wooden houses with better insulation and strength. These improvements have stuck with us also, because of their simple build and ability to withstand the elements.

Also, it is important to know that the most "important" inventions have to be complex— or simple. Whatever it is, if it is useful it will become implemented into someone's life, whether it is synthetic insulin or the plow. Thousands of years ago, farmers had no efficient way to till land except manually, by hand. With the wedge, a simple machine, a plow is a simple tool that converts the walking of a plow animal into the turning over of the soil for easier farming, rather than breaking the backs of farmers (Frater). Many mechanical machines also have this simple concept— even scissors and door stops— but they are nonetheless essential, even in our lives today. In contrast, very complex technologies can catch on to a society quickly as well as a simpler one, especially in the field of medicine: a method was invented to create synthetic insulin that is chemically identical to our own natural insulin, that diabetic people can use in place of insulin from animals. Therefore, without killing animals (but rather using bacteria such as E. coli), these complex molecules (which are sophisticated organic molecules that are made up of

51 amino acids) can be obtained easily and used in humans, safely and effectively ("Synthesis of Crystalline Insulin") (see Appendix 3: "The Variety of Useful Inventions").

Another example of the improvement of life from an invention is consideredfacebook.com

China's fifth greatest technological invention (after their "Four Great Inventions": the compass, printing, gunpowder, and papermaking) is "hybrid rice" — cross-bred rice created by scientists to reduce the problem of overpopulation and starvation in China. Like most cross-breeding or genetic engineering, it was created to get the most desirable traits of different plants— in this case, it was the ability to grow more rice, faster, in a smaller plot of land, and without being too different from regular rice. People could harvest much more of the hybrid rice than regular rice, so that less acreage had the potential to feed billions more people than it had been previously. This modified strain therefore it was quickly implemented into China's farming industry. It made possible "the feeding of 22% of the world population on only 7% of the world's total arable land … From 1976 to 1987, the total cultivated area of the hybrid rice developed by Yuan reached 1.1 billion mu (15 mu=1 hectares), and increased rice yield by 100 billion kg." ("Father of Hybrid Rice -- Yuan Longping."). It's an amazing feat of genetic engineering that can help civilization on a grand scale, and again supports that the practicality of an invention is the reason behind quick employment.

It's also crucial to highlight the prominence of the technologies as they weave into society. How do they become strands of silk in that cloth of civilization, strong and woven in so tightly that they will never fall out? What makes them a necessity of life after a short time? The answer is human nature's characteristic to continue growing: learning more knowledge, advancing in efficiency, and improving standard of living. What was once an acceptable standard becomes an easy threshold to pass after only a few short years as technology advances. Without these common technologies, people could survive, but existence difficult, simple, and meaningless as it was in ancient eras— we would still survive as living beings, but not ones of importance or intelligence like we are now. Printing and paper currency were both invented in the Song dynasty as ideas to help strive towards a better life, so that we now are stuck in a world (for the better) with these in many aspects of our lives. Without printing, newspapers, books,

schoolwork, legal documents, and religious works would not be as widespread as they are today that allow us the education and political and religious literacy that we enjoy. Without paper currency, we would be stuck in the past with trading of cumbersome and high-risk possessions for items without a set price, making life difficult and more unfair. Without clocks or glasses, both non-essential items in our lives, we could still survive— but with a strong hindrance to our lives. Without clocks, important scientific discoveries would be set off as time is estimated, and events would not start at an exact time, delaying or being too early for people who just estimate time. If glasses and lenses did not exist, people with myopia, or nearsightedness, would have much more difficult lives, especially as an increasing number of people stare at screens all day and damage their eyes. People will still survive, but that survival will be limited and greatly inconvenienced, not enough to thrive.

An additional example is the rise of the Internet in the United States. As of today, the Internet is only about a quarter of a century old, but 40% of the world's population is already using it, with over three billion people online at any given moment (Internet Live Stats). There is already an enormous range of applications of the web, most of which are to connect the people using it and share data. To many of those Internet users, especially in modernized societies, life without it would be very difficult. For us students, much of schoolwork is online, as well as main methods of distance communications besides phone calls (video chatting via Hangouts, Skype, and FaceTime; social networking; and email) require the Internet, and the constant searching of solutions and answers to everyday problems and questions are all dependent on the Internet. When I was away for vacation just a few weeks ago, the lack of Internet worried me as I could not connect to those sites that I depend on so often, and often people describe the same feeling when they are away from their smartphones. With social media and video games taking over the lives of teenagers today and over half of Americans playing video games (see Appendix 1: "American Gaming Statistics"), and new digital "smart" devices entering the market, people are lured into buying these ideas, and actually also buying a ticket to the future of technology, allowing new technologies to advance. All in all, the reason technology can become so important to us humans is because we will not accept a mediocre existence, but an exceptional one.

To say that the quick assimilation of technologies into mankind is only positive would be misleading: sometimes new inventions can be detrimental to society, even if they were created with a good intention. One of the best examples for this would be the invention of electronic cigarettes, abbreviated to "e-cigarettes." Although its inventor, a Chinese scientist who focused his work on creating a healthier, toxin-free cigarette that does not damage your lungs, and wanted to create a smoke-free but cigarette-like experience, it did not benefit too many people (and therefore, it did not catch on too well nor become too popular). He was motivated by the death of his father due to smoking-related lung disease, and wanted to prevent it in smokers throughout the world. However, the potential health risks associated with the still-present nicotine- which the FDA and other organizations claim makes e-cigarettes as dangerous as regular cigarettes but is unproven- and the controversy that it caused over its safety fueled enormous debate globally, eventually leading to its banning in many countries and a loss in popularity ("E-Cigarette History). Another problem with it, similar to tobacco products and other drugs, is that there is no essential benefit that it can provide to people. It might invoke a feeling of bliss (a "high" feeling), but it does not promote the advancement of society, and therefore it cannot and will not have a positive impact on people.

Similarly, there has been recent speculation about the negative consequences of using digital devices, especially smart-devices. Besides making some work, especially calculations, extremely simple, they also are built to be attractive to consumers and as a result use up a lot of people's time— especially teenagers who tend to be more distracted and perhaps more susceptible— with billions of people using social media and the Internet (see Appendix 2: "Internet and Social Media Penetration Statistics").

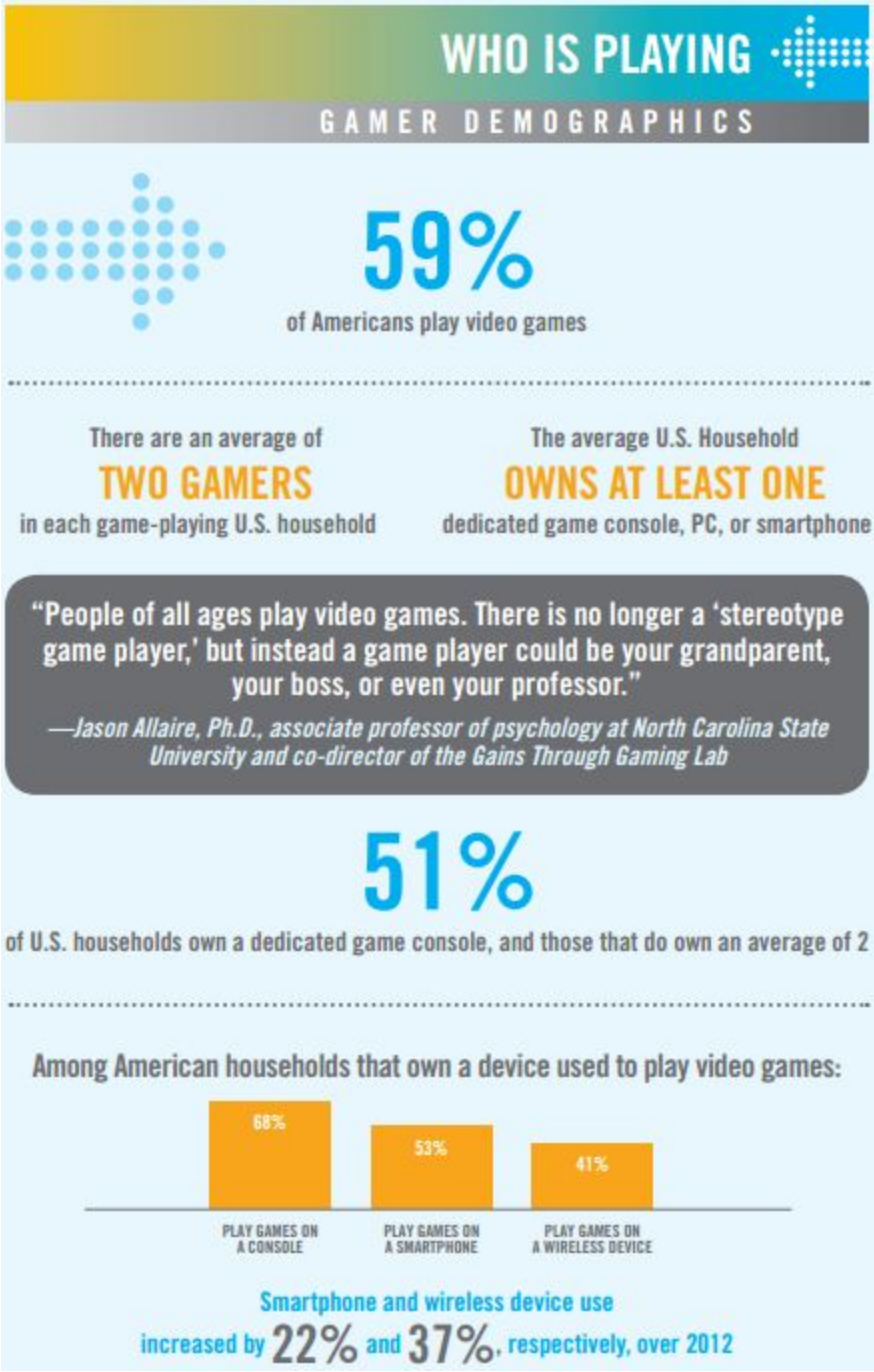
Lastly, there is also occasionally the circumstance in which an item over-accomplishes its task to an undesirable degree, one that may harm others. Guns and other gunpowder explosives are the most prominent ones, with gun violence being a significant crime issue in the United States. Although gunpowder projectile weapons are acceptable in war, for soldiers, it is very unethical to fire at civilians. This is becoming a larger issue today as guns become so easily manufactured and bought— now, as aforementioned, there are almost as many guns in America as there are people, and two-thirds of the murders in the United States were done with firearms

(Agresti). However, when the power of gunpowder and other explosives is abused, disaster can result. Therefore, even "positive" technological inventions can be harmful to society, even if it was originally intended to improve society.

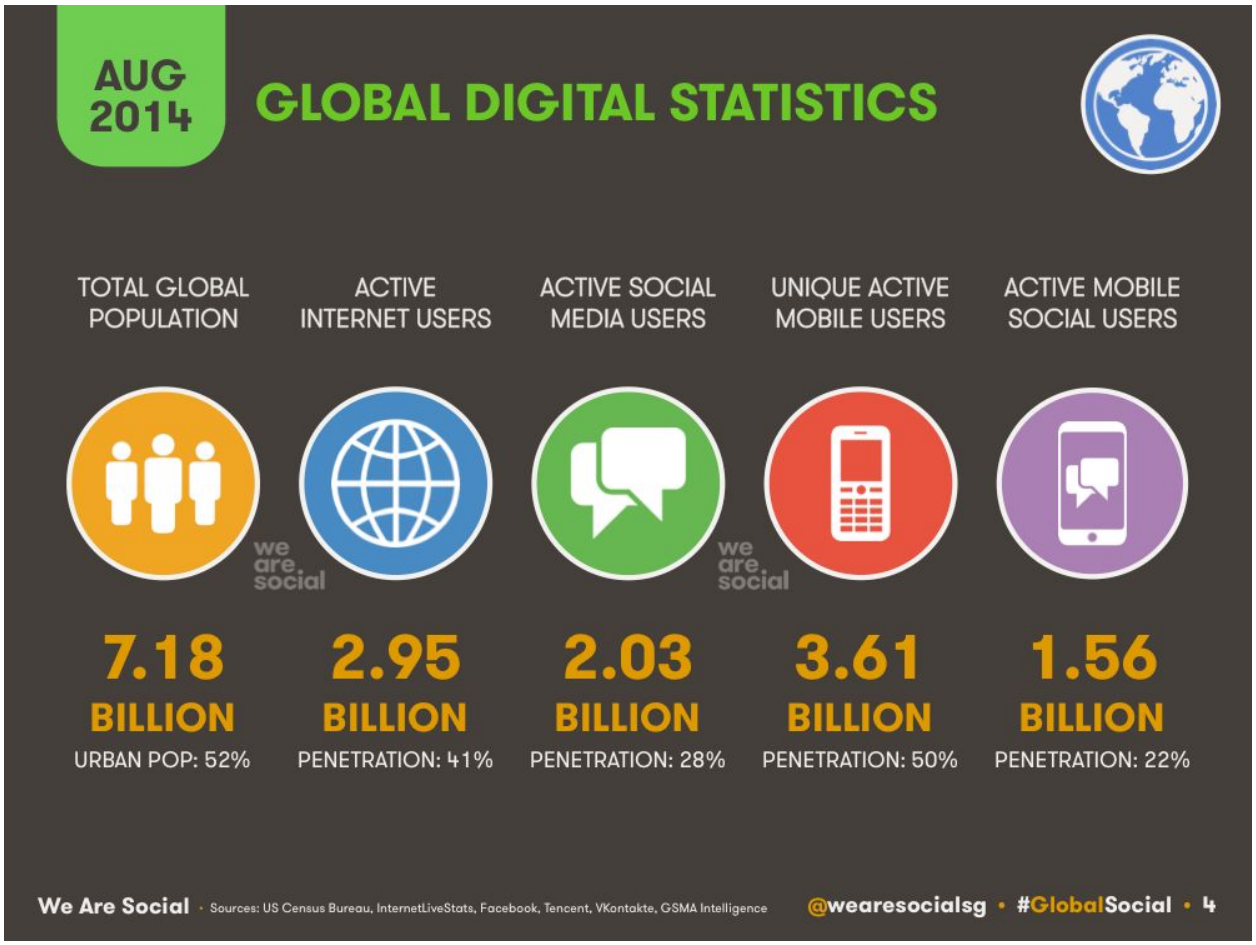
Mankind is continuously advancing, but only because they keep their technology updated. Whether it is a clock, printing press, or gunpowder, the result is always the same: they get placed into the human culture, fitting in seamlessly. Many times there is no evidence of a new technology, so that one could assume it has always been there. This is because the invention of new technology is always dependent on our demand for them, but more on the utility that they possess— after an invention is established, people could not imagine life without them and accept life as it is with them. The constant, progressive nature of mankind drives this process; the result is the continuous knitting of the strands of technology into the core of the ever-growing fabric of civilization.

Appendix

1: American Gaming Statistics

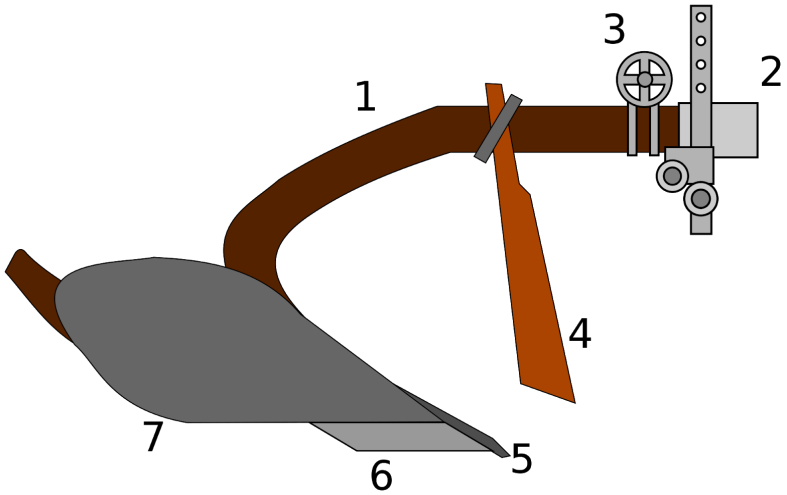


2: Internet and Social Media Penetration Statistics



3: The Variety of Useful Inventions

The Relative Simplicity of the Moldboard Plow



The Sophistication of Synthetic Insulin

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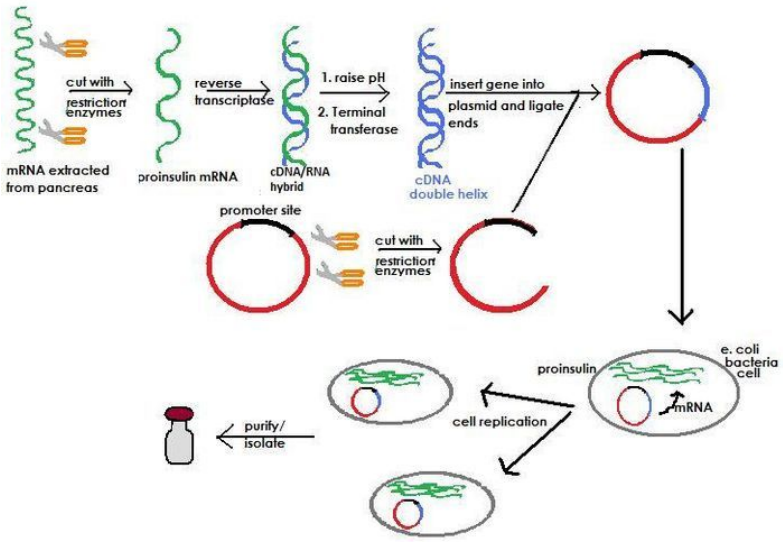

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Jonathan Lam
Mrs. Staley
West Civ. per. 7
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Western Civilizations Midterm Review

Vocabulary

- civilization
    - advanced society of self-governing people with a developed culture and rule
    - Macedonian Empire
    - Roman Empire
    - Byzantine Empire
    - civilizations were the basis of invention and history - all people live in a civilization, and are thoroughly influenced by it; different cultures think differently and produce different ideas
- monotheism
    - a belief in a single god, that is exclusive: omnipresent, omniscient, and all-powerful
    - Judaism
    - Christianity
    - Islam
    - civilizations, starting from Rome, began to be heavily influenced on religion as some peoples' greatest loyalty and belief, rather than the rulers of their nation or empire; this caused the breakup of Rome and led to the strong support the Byzantines had for their religious leader
- polytheism
    - a belief in multiple, less-powerful deities, usually relating to nature
    - Roman polytheism
    - Greek polytheism
    - Hinduism
    - the common type of religion before Christianity became popular and the largest religion, in the Roman Empire; eventually became paganism
- city-state
    - a Greek city: it was its little nation by itself, self-governing and self-sufficient; however, all of them were linked with the culture of Greece; arranged this way because Greece was an archipelago, and it was difficult to rule over many separate states by themselves
    - Athens
    - Sparta
    - Delphi
    - the Greek city states were the major structure of Greece
- democracy
    - "power to the people"- started with Athenian ideals; people get to vote on their leaders
    - Athens
    - Roman Republic
    - USA
    - democracy was an idea introduced in Athens, and continued to be one of the great modern-day ideas, that many nations are fighting to achieve so that their people have a voice in their government
- covenant
    - the agreement between people and God that if they truly believed in him as the all-powerful deity and their only savior, then he would grant divine favors and grant them deliverance
    - initiated by Abraham with God
    - restated by God to Isaac
    - restated by God to Moses (Ten Commandments)

    - the code of ethics and idea that governs Judaism
- sovereignty
    - rule over a state; autonomous states
    - emperors had sovereignty over Roman and Byzantine Empire
    - Rome, Greece, and Byzantium were sovereignties
    - Senate had sovereignty over Roman Empire
    - empires had to be sovereignties, being self-sufficient; in Rome, the emperors took sovereignty over Rome, starting from Julius and Augustus Caesar
- rule of law
    - a law that restricts people from doing something
    - Solon's Constitution in Greece
    - Twelve Tables in Rome
    - *Body of Civil Law* in Byzantium
    - important because all empires have to have laws, so that they keep their citizens in check and keep a steady rule over their people
- egalitarianism
    - a government system in which everyone is equal (legally)
    - Sparta Lycurgan system
    - Athenian democracy
    - Roman Republic laws to protect the plebs
    - a democracy (and republic) are forms of egalitarianism
- philosophy
    - the rational examination of truths and principles of knowledge, being, or conduct
    - Socratic Method
    - Socrates, Plato, Aristotle, Pythagoras
    - Athens had a lot of philosophers
    - philosophers were often criticized for their creative thinking that we credit to them today as brilliant; we still use these ideas today
- monarchy
    - The ruling by sovereign ruler
    - Most of the time a dictatorship
    - Example: Roman empire (emperor)
    - Still present in modern-day world (England)
    - The main form of government followed by democracy
- aristocracy
    - The ruling by the wealthy, usually an oligarchy (the wealthy are the minority)
    - examples: beginning of Athenian government; Roman Republic (before reforms)
    - common in ancient times because the rich often had more power
    - also common in the fiefdoms, because the kings were wealthier than the peasants
    - this was an important method of rule in the ancient world, but most systems evolved to become democracies, because the people wanted a say
- oligarchy
    - the ruling by a few (usually by wealthy or military generals)
    - often an aristocracy, sometimes a military oligarchy
    - examples: rule under the Triumvirates, Sparta
    - another common form of rule, where there is an obvious hierarchy
    - this was a common type of rule in the ancient world, because usually only a few people rule
- citizen

    - a member of a civilization, usually a legal inhabitant with special privileges
    - usually has some privileges, that people would yearn for
    - example: Roman citizenship offered legal and military protection, but they had to pay taxes and supply soldiers
    - not being a citizen could have potential risks, such as higher taxes, being annihilated
    - being a citizen of a civilization was and still is an important idea; to be an official part of a greater whole is something that people value and would fight over; this idea of citizenship helped with loyalty and patriotism
- republic
    - a form of indirect democracy in which the people elect their representatives; sovereignty rests with representatives rather than directly with the people
    - examples: U.S., Roman Republic
    - people choose representatives to elect and make decisions for them, feel like they would be more educated than themselves (solving Plato's problem with a direct democracy)
    - one of the major types of democracy
    - first developed with Roman Republic, used still today to govern the U.S. and most other democratic countries
- philosopher-king
    - the sole leader (monarch) of a form of government that Plato proposed; would be educated and selected from many candidates for being the most wise; an older man who puts forth the good of the citizens and state before himself
    - Plato came up with it
    - it solved the problem of "mob mentality" (which a Republic also solved, because the people did not directly vote on decisions)
    - Plato used the allegory of the cave to help explain it
    - did not ever come into effect, but shows Plato's ideas about an educated society
- antiquity
    - ancient times and civilizations, usually before the dark ages (including Egypt, Greece, Macedonia, Rome, Byzantium, China, etc.)
- dictator
    - an autocratic leader, usually ruthless, who has complete rule (sovereignty) over the state
    - examples: Julius Caesar, all of the emperors of Rome, pharaohs of Egypt
- BC / AD / BCE / CE
    - relating to time before and after 0AD
        - BC: before Christ (<0)
        - AD: ado domini, in the year of our Lord (0+)
        - BCE: before common era (<0)
        - CE: common era (0+)
- Abrahamic religions
    - Judaism, Christianity, and Islam are the three major ones; founded by Abraham's covenant with God in Judaism (other religions used Jews as model)
- hierarchy
    - ranking people (or other objects) so that every level has power over the level beneath them

Ancient Greece

- polis
    - Greek city-state; organized this way because Greek was archipelago, hard to govern centrally
- direct democracy

    - form of democracy in which everyone has a direct say and participation in the government by being able to vote and make decisions by themselves
- theocracy
    - form of government in which God or prophet of God rules (God rules directly or indirectly)
- autocracy
    - form of government with all-powerful ruler
- Athens
    - Greek city-state that invented (direct) democracy,ruled Greece, in conflict with Sparta (and lost rule); great arts and architecture
- Sparta
    - Greek city-state that was very militaristic, used Lycurgan system, practical and effective, eventually winning Athens in a war and taking rule (briefly) over Greece
- Lycurgan system
    - system that ruled Sparta, created by lawmaker Lycurgus; made people equal and practical
- Greek philosophy
    - lead by philosophers like Pythagoras, Socrates, Plato, and Aristotle; people who tried to find truth logically, and were usually rejected by society; some great schools of philosophy that lasted for a long time
- Socrates
    - Greek philosopher who tutored Plato and was killed for keeping to his beliefs that angered others; came up with the Socratic method of philosophy
- Aristotle
    - Greek philosopher who was the student of Plato and tutored Alexander the Great and focused on the sciences and maths and a method of reasoning
- Plato
    - Greek philosopher who was student of Socrates and tutored Aristotle; came up with ideas of ethics and government; founded an important academy
- Socratic method
    - a method of philosophy through questioning; developed by Socrates and highly unpopular in Greece but praised today
- oracle
    - person who has power to connect to gods; famous one at Delphi (probably intoxicated); had to go through a strict ritual to consult
- rhetoric
    - art of persuasion, either orally or written
- skepticism
    - doubt about the truth of something, often used in philosophy
- “Funeral Oration” (Pericles)
    - speech given by Pericles after first year, to raise spirit of Athenians, praise the dead, and recruit more; important now to show what Athenians thought of themselves
- “Apology” (Plato, Trial of Socrates)
    - Plato’s recording of the trial of Socrates, Socrates’ sarcastic view on others
- Peloponnesian War
    - war between Athens and Sparta for sovereignty over Peloponnesian peninsula, Sparta wins; 3 parts; Sparta wins control over Greece
- “The Republic” (Plato)
    - Plato’s idea of an ideal government, given as Socratic method, with dialogue between Socrates (as himself) and other people, eventually leading to his idea about government

- allegory of the cave
    - Plato's analogy to his idea of a philosopher-king; shows that the philosopher king will enlighten the ignorant people, and be right (shows mob mentality)
- Alexander the Great
    - military leader of Macedonia, who conquers Greece and spreads it to become a huge empire in only 10 years before his death (by malaria); tutored by Aristotle
- Alexandria
    - great city in Egypt founded by Alexander, led Egypt and was main trading and science center for hundreds of years

Jonathan Lam
Mrs. Staley
West Civ. per. 7
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Modern Day Machiavelli

Review what we have learned from Machiavelli's *The Prince*. Now think about a local leader, an elected official, a family member, a celebrity or even a fictional character from a television show or character from a novel whom exhibits those characteristics that Machiavelli claims makes a good leader.

Write a 1-2 paragraph response describing the selected person's attributes. What makes this person Machiavellian? Provide specific examples and provide evidence using Machiavelli's quotes from class.

My Machiavelli: Grandma

From when I was born to when I was six years old, my grandma was closer than my mom, raising me with many of the morals I still believe in today. She has— and still is— always my role model for a great leader, as she continues to age but takes care of my younger cousins much in the same way that she took care of me and my siblings, and still teaching me when we get together.

One aspect of my grandmother was that she was very strict, although we did not hate her— one of the main ideas of Machiavelli, who states in *The Prince*: "Ideally, one ought to be both feared and loved, but it is difficult for the two sentiments to go together." My grandma had just the right mix: when I was little I mostly was afraid of her, but (usually) didn't loathe her save for a few instances when I didn't get my way. Her strictness also brings about another point: she always went to do the right thing, and to have us children learn to do so as well. When there was a chore left undone, somebody to be helped, or something that could be improved upon, she did it— and she made our morals more righteous at the same time. Machiavelli said that "a man who did only what was right would soon fail among so many who are untrustworthy." In this case, my grandmother, who is that rightful person amongst us lying and rather untrustworthy tried to change us so that we would grow up as better people that would allow our family to advance farther.

Another reason that my grandma could fit under the description of Machiavelli's great ruler would be because of her amazing decisions and decision-making skills. She first of all made the choice to be very frugal, to the point that she could be thought of as a miser, which Machiavelli points out as not always a negative attribute: "A [leader] must not worry if he becomes known as a miser. He must be a miser if he wishes to be able to defend himself and to avoid becoming disliked, robbing his subjects, and exploiting his citizens." Although this applies to old times and political leaders, the consequences of overspending would also be very negative, and I think this idea was essential to our finances and wealth. She is also flexible in her mindset and not restricted to too many morals, and she makes decisions swiftly— which Machiavelli again considers is the best way. *The Prince* states that "it is better to be impetuous than cautious, and it is necessary, if you wish to master her, to conquer her by force." The many decisions that my grandma has made, including the decision to live with and directly raise of all of her ten grandchildren, have been bold and great decisions that have improved all of our lives for the better just as Machiavelli's perfect leader would have.

Jonathan Lam
Mrs. Staley
West Civ. per. 7
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The Modern Era (to WWI) Study Guide

Exploration

Motivation for exploration

- gold, glory, God
- examples:
    - Marco Polo went to the East, came back with riches, inspired others to do the same
    - Hernan Cortez went to spread Christianity; killed and plundered Aztec empire
    - Columbus claimed land for Spain (glory), brought luxuries and trade to North America, sponsored by English and French royalty (King Ferdinand & Queen Isabella)

Spanish treatment of Native Americans in the New World by conquistadors & justification

- terrible treatment, many people killed:
    - territorial disputes
    - diseases from Europe
    - loot plundered
    - mercantilism
- Sepulveda: famous Italian philosopher, historian, theologian, astronomer
    - thought of Greeks and Europeans as civilized and most others as barbaric
    - Spanish have the right to rule them: Spanish are clever and humane with true faith, while they are barbaric and are not clever
    - (Bartolome antagonized Sepulveda, saying that the Native Americans are clever, having a civilization advanced like Europe; they are not barbaric; they are clever; torture and killing is not the way to get people to accept Christianity)

Why was exploration now a possibility more than ever?

- scientific discoveries (scientific revolution): astronomy, navigation, Earth is round
    - Galileo
        - telescope and other astronomical observations/discoveries
        - goes past religion, frowned on by pope, goes through inquisition
    - Kepler
        - heliocentric theory
        - astrology and mathematics and philosophy
    - Newton
        - gravity and motion
        - principles of natural history
        - heliocentric theory

Define mercantilism. Significance?

- economic system in which a country exploits natural resources of another region for their own gain
- Spain stole American resources, turned them into manufactured goods, forced America to buy it back
- Triangular Trade: most well-known form of mercantilism
    - manufactured goods and rum from Europe to Africa
    - slaves from Africa to the colonies
    - raw materials and sugar from colonies to Europe
- made countries very profitable

Define joint-stock company. Significance?

- system to raise money for something by pooling money
- no one gets extreme risk, everyone gets potential gain
- used to pool money for expensive expeditions to the Americas

Define commercial revolution. Benefits to Europe?

- age of colonialism and mercantilism that led to extreme economic growth in European countries
- monarchs amassed huge wealth, and countries were rich

Absolutism

Define absolutism. Compare to Renaissance ideals.

- age of all-powerful, ruthless, careless rulers with a divine right to rule and an extreme social divide
- Renaissance ideals and comparisons: basically opposites; absolutism was a step back
    - skepticism: exercised later, in the enlightenment, when questioning absolute power; not so much in the Age of Absolutism
    - humanism: well-being of people not looked after
    - individualism: the monarch helped himself to this
    - secularism: divine right still in place
    - well-roundedness: not really important; monarchs just too lavish
    - classicism: went against ancient Greek and Roman ideas, especially of democratic governments
    - liberalism: progress and reform not encouraged, and freedom suppressed

Divine Right

- ability to rule is derived from God
- have political and religious power

Hobbes' theory on state of nature

- defender of absolutism
- humans were evil, warring
- people need a strong leader and be willing to give up all rights to be progressive
- opposite of Locke

King Louis XIV of France

- the "sun king" because of his extravagance
- lavish spender: built palace of Versailles
- very extravagant life
- symbolises suppression of lower class— they had to pay all the taxes for the expensive building
- made sure he had absolute power: suppressed nobility

Philip II of Spain & Spanish Inquisition

- Philip II was defender of absolutism
    - wanted to expand Church and get absolute power
    - thought he was guardian to people and Church
    - strong, ruthless king
    - heavily involved with Inquisition (but not created by him)
- "Roman Inquisition" was strict agency of obedience that looked for any sign of heresy
- guilt was assumed; lots of torture; especially for philosophers and scientists

England as the exception to absolutism

- had a parliament, a ruling body of multiple men
- parliament imposed the English Bill of Rights on the monarchs
    - suppressed their power
    - many of rights given in our Bill of Rights (e.g. freedom of speech and religion)

Enlightenment

Define the enlightenment. Why was it created?

- an intellectual movement that was created in response to the Age of Absolutism and inspired by the Scientific Revolution marked by thinkers that revolutionized many ideas, especially government and rights
- it was created in response to the Age of Absolutism, when philosophers started questioning the absolute rule of the rulers
- it was also inspired by the Scientific Revolution, and they hoped to promote reason
- a period of:
    - reason
    - natural law
    - humanism (hope and happiness)
    - progress
    - liberty

Some enlightenment thinkers

- John Locke
    - the "social contract"
    - if government doesn't protect natural laws, then it can be overthrown
    - opposite of Hobbes
    - in a state of nature people will try to achieve peace and safety
    - natural rights: life, liberty, and property (later changed by founding fathers to "life, liberty, and the pursuit of happiness")
    - people are born with a "tabula rasa" — a blank slate— so they are not evil, and everybody learned through their environment (and through science)
        - made him a leader and inspirer of the Enlightenment
- Montesquieu
    - separation of powers into a three-branch government
        - executive
        - judicial
        - legislative
    - each limits each other's power, thus preventing domination of one branch and ensuring the freedom of hate people
    - based off of English government
    - American government later based off of this idea
- Voltaire
    - challenged the Church
    - created idea of deism, a religious philosophy in which God created the Earth and set it spinning, but the world is governed by scientific, natural laws
- Diderot
    - created "the Encyclopedia"

    - huge collection of knowledge
    - allowed many people to easily access information
    - led to more discoveries and thinking
    - allowed him to change the general mindset of the people with his own words
        - targeted old French society
        - talked for religious tolerance
        - called for reforms in government
- Rousseau
    - the "social contract" (along with Locke)
    - "Man is born free but is always in chains"
    - people have to get up some rights and abide by the general will of their people
        - if not, they are forced to— Rousseau believed he is forcing upon them their freedom
- American founding fathers
    - used many of the ideas of the Enlightenment, especially Locke

Key terms

- salon: a place of meeting and chatting with others, elegant drawing rooms, where Enlightenment ideas spread the quickest; also, women who worked as maids could suggest ideas or pass on ideas they heard to others
- reason: application of scientific evidence (not superstition or unproved religion) to understand life better, which can be used to better society
- social contract: Rousseau and Locke's idea that people should abide to the general will of the people, but giving up some rights, so that there exists the greatest freedom; if the social contract (or natural law) is not held up by government, then the government should be overturned
- natural rights: life, liberty, and the pursuit of happiness/property; every man has the right to these freedoms from birth, and they should not be violated by government or it should be overturned
- separation of powers: no one branch of government should hold all the power, or else freedom would be unlikely; the branches have a system of checks and balances to equal out power

Declaration of Independence, Declaration of Rights of Man and Citizen

- Declaration of Independence:
    - American declaring separation from England because natural law was not held by government
    - used many of the ideas of the Enlightenment, especially Locke
- Declaration of Rights of Man and Citizen:
    - inspired by the (successful) American Revolution
    - written by National Assembly after King gave in to them (after storming of Bastille and accompanied by the giving up of many first and second estate rights)
    - rights of liberty, property, security, freedom from oppression, freedom of liberty, freedom of speech, and right of equal justice were guaranteed

Impact of enlightenment on society and culture?

- caused people to start thinking more and bettering life, especially about government and human rights
- http://www.ushistory.org/us/7a.asp:
    - "The old way of life was represented by superstition, an angry God, and absolute submission to authority. The thinkers of the Age of Reason ushered in a new way of thinking. This new way championed the accomplishments of humankind. Individuals did not have to accept despair. Science and reason could bring happiness and progress. Kings did not rule by divine right. They

had an obligation to their subjects. Europeans pondered the implications for nearly a century. Americans put them into practice first."

French Revolution

Causes

- absolutism
    - King Louis XVI and Queen Marie Antoinette were extremely lavish spenders
- nobility
    - had all the rights, most of the land, and didn't pay taxes
- third estate
    - 97% of the population, very little say in government (always overruled by combined first and second estates), owned very little land, owned very little money, and had to pay all of the taxes

Bourgeoise and the National Assembly

- drove the revolution (first stage)
- wealthy, educated, upper middle class
- inspired by American Revolution, tried it in their own country
- could get the most gain from the revolution
- created the National Assembly during the Tennis Court Oath
- created a limited constitutional monarchy, gave themselves some power
    - National Assembly
        - group of third-estate delegates who decided to create a limited monarchy
        - were not let into the Estates general hall
        - went to a tennis court, took Tennis Court Oath
        - eventually King gave in, after storming of Bastille (a symbol of political oppression) during the Great Fear
    - Tennis Court Oath
        - oath not to disband until they had written their own constitution, one without suppression of the third estate

National Convention

- second, more radical party and stage of the French Revolution
- Jacobins, the radicals, sat on the left side of the political spectrum (and of the court) — wanted extreme further reforms
    - moderate Girondists in the center
    - conservatives on the left (wanted to conserve limited monarchy)
- Jacobins took power as army did worse and worse
- leaders:
    - Robespierre
    - Marat
    - Danton
- National Convention created
- wanted a republic (not a limited monarchy) — one step farther
- riots broke out
- King executed
- Committee of Public Safety established as war dictatorship

Robespierre and Reign of Terror

- fierce civil war (revolutionaries and counter-revolutionaries)
- Marat was killed
- Queen was executed
- Reign of Terror was created to completely crush opposition to the revolution
    - thousands killed of the slightest suspicion
- Danton killed by Robespierre
- Robespierre killed by the people

Directory

- short-ruling council of men
- wealthy bourgeoise ruled now, as only the wealthy could vote
- became unpopular as it could not solve the debt crisis

Napoleon's Rise to Power and Rule

- had great military campaigns, was popular and was hero of the people
    - lied to public about some defeats, especially one in Egypt that he had to cut short to help out France
- he rose with a military coup d'etat (quick seizure of power) in 1799
- stormed the unpopular directory
- created French Consulate with him as first consul for life, and then emperor
- controlled most of continental Europe
- first huge defeat was Britain
    - navy was too powerful
    - Napoleon ordered blockade, Britain did too
    - Britain's blockade prevailed, Napoleon's economy affected more than Britain's
    - Britain free from blockade by Pope and Russia
- marched with enormous army of half a million to Russia, where they found a depleted and destroyed town (unwilling for him to take it)
    - it was winter, and many people died
    - returned severely weakened
- many countries teamed up against him and France
    - he was defeated
    - he was exiled
    - he returned
    - he was defeated (again)
    - he was exiled (again)

Outcome? Legacy?

- not a success: went from limited monarchy to republic to war dictatorship to ruling council to dictatorship to back to monarchy (only much later did it become a democracy)
- legacy:
    - what people would go through for a democracy
    - Constitution: The Declaration of Rights of Man and Citizen
    - "Liberty, Equality, Fraternity"

Jonathan Lam
Mrs. Staley
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Ancient Rome: Study Guide

Introduction to Rome

Geographic Appeal of Rome

- on a peninsula
    - harder to attack
    - easier trade (by sea)
    - prompted a strong navy
    - fish was constant food source
- much more united than Greece (Greece was an arpelegio)
- inland enough to stop pirates (15 miles)
- built on the Tiber River, good freshwater source
- built on seven hills for easier defense
- crossroads between East and West
- moderate climate like Greece

Founding of Rome

- Indo-European speakers migrated and created upper warrior class
- nomadic/clan-like society at first, many warrior tribes
- Phoenicians were
    - wealthy
    - sea-faring
    - shipbuilding
    - people who invented purple dye
    - people who influenced Roman alphabet
    - also known as Palestine, Israel, Canaan, the “Land of Milk and Honey”
- Etruscans
    - lived north of Rome
    - established a monarch
    - influenced Rome’s language
    - taught Romans engineering and water control/drainage
    - created idea of urban life
    - were good weapon makers
    - wore the toga
- Greeks
    - cultivated olives and vines before the Romans
    - influenced Roman alphabet
    - gave artistic, cultural models of of fine arts and architecture
- in 509 B.C. the Roman Republic was founded
- according to legend, Romulus and Remus founded Rome:
    - raised by she-wolf
    - stood on the seven hills
    - Romulus killed Remus and named the city of Rome after himself

The Republic

Jonathan Lam
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Introduction to the Republic

- republic means “concern of the people”, is an indirect democracy like the U.S.
    - democracy means “power to the people” (Greeks)
- government positions:
    - all positions were, at the end of the Republic, allowed to be held by either class
    - consul
        - 2 most powerful rulers of Rome
        - lead the government and the military
        - one year term
    - praetor
        - 2 judges of Rome
        - commanded Rome when consuls were absent
    - quaestor
        - official of Rome who controlled finances
    - aedile
        - official that maintained public buildings
    - tribunes of the plebs
        - ten officials to protect the rights of the plebs
    - censors
        - officials who led the census of Rome
    - Senate
        - most powerful assembly that was the main power behind Rome
        - 300 (later 900) people, whose word was as powerful as law
    - Centuriate Assembly
        - council that thad the right to elect higher officials
        - made of patricians
    - Council of the Plebs
        - council that had the right to make laws binding to all people
        - made of the plebs
- from 509-27B.C.
    - from overthrowing of last Etruscan king
    - to beginning of Augustus’s reign and the beginning of the Pax Romana
- engaged in war for the first two centuries - where the beliefs of Rome originated
- Livy tried teaching Romans what made them great, such as the story of Cincinnatus
- devised the Roman Confederation
    - some people (especially Latins) had full citizenship
    - most remaining communities were allies (provide soldiers, taxes) that could run their own governments without interference
- very successful because:
    - good diplomats
    - cruel or firm
    - accomplished, diligent soldiers
    - very practical (built great infrastructure)
    - strong beliefs:
        - strengths:
            - government
            - law

        - engineering
    - values
        - courage
        - dedication
        - determination

Cincinnatus (by Livy)

- Rome in "state-of-emergency", needed dictator for efficient ruling
- Cincinnatus on 3-acre farm, called upon by Senate for help
- raised an army, defeated the enemy, and resigned within 15 days
- his accepted position's term was six months, but he retired to farm
- shows that:
    - not all power comes with wealth
    - not all powerful people are corrupted
    - duty, humbleness, and powers of Roman ideals
- he was a patrician, a Senator

Consuls

- 2 leaders elected annually to rule Rome (run government and lead military)
- similar to president and vice president
- most important and powerful leaders of Rome were consuls, including the members of First Triumvirate
- chief diplomats

Senate

- body of 300 (raised to 900 by Caesar) that ruled the Republic (lost some power under emperors)
- couldn't make laws, but decrees were still as powerful as law

Social Classes

- patrician class
    - the wealthy people
    - landowners
    - originally only patricians could become the highest officials
- plebeian class
    - the poorer people
    - merchants
    - poorer landowners
    - craftspeople
    - small farmers
- struggle for equality
    - both were citizens:
        - both fought in wars
        - both paid taxes
        - both could vote
    - centuries-long struggle for equality ended in plebeian victory
    - tribunes for the plebs and Council of the plebs created to protect their rights
    - eventually had all the rights of patricians, so they were supposed to be equal under the law by 287 B.C., but they never really became equal
        - it was always biased in favor of the wealthy

        - patronage system:
            - votes for legal protection
            - a hierarchy- the richest and most powerful stayed that way

Women and Slaves

- didn't have many rights at first
    - Etruscans established a patriarchal system over Rome, major idea behind Rome
    - gained rights over time
- slaves supported Rome for centuries
- lots of slaves (~2 million, ¼ of the population)
- slaves were completely dependant on owners
- slaves rarely escaped

Twelve Tables

- 450 B.C.
- first attempt to create code of law
- by ten men, binding to both classes
- consuls had to enforce it

Roman Citizenship

- Romans did two things when conquering
    a. first, they threatened annihilation
    b. then, they showed justice if the city acknowledged and resigned to their power
        - they gave them partial or full citizenship
- had to supply soldiers and pay taxes
- backing of most powerful military
- Twelve Tables to protect rights
- lighter taxes (than non-citizens)
- Roman courts
- access to public grain

Punic Wars

First

- 264-261 B.C.
- Carthaginians of North Africa became commercial rivals with Rome in 300 B.C., very powerful and rich, great navy
- tried to conquer Sicily, but Rome helped Greece
- Rome had to build navy, and won the battle
- gained Sicily, important to them because of proximity

Second

- 218-201 B.C.
- Hannibal led troops down from Spain through the Alps to Rome, Rome lost many battles but kept their city
- Scipio led army to Carthage, defeated Carthage, destroyed their navy, and gained Spain
- effectively destroyed the power of Carthage

Third

- 149-146 B.C.
- destruction of Carthage
- Rome saw it as an emerging threat, so they made sure it was gone

- much wealth and slaves to Rome
- gained northern Africa, controlled entire western Mediterranean

Fall of the Republic

Last Voices of the Republic

Tiberius and Gaius Gracchus (The Gracchi Brothers)

- grandsons of Scipio
- rich patricians, both became Tribunes of the plebs because they were champions of the plebs
- Tiberius returned land to the plebs from the patricians
- Gaius stored grain from good years for bad years of the plebs
- got patricians extremely angry at them
- killed when leading revolts against Roman government
- tried to close gap of economic polarity
- last ones to make reforms to the government before the empire

Cicero

- conservative of the Republic- liked old Roman ways
- thought that a dictatorship would be rash and that was not the idea that Rome was founded on
- last important Republican voice eft
- killed by Marc Antony, hands and head put on a podium, threat to new ideas
- a great orator, liked rhetoric and philosophy
- actually invited to enter first Triumvirate, but declined- he was exiled but then pardoned

First Triumvirate

- Julius Caesar, Crassus, Pompey - three most powerful men in Rome
- well liked, rich, and good military
- ruled over Rome even after their consulships expired
- joined together to overcome Senate
- Crassus died first, then Pompey by Caesar, then Caesar died, leading to second triumvirate

Julius Caesar

- “master of propaganda” similar to Octavian, so was extremely popular
- gained wealth and military experience
- gained a lot of wealth and land and soldiers for Rome from Gaul
- created military dictatorship to overrule Senate
- gaine and defeated many enemies of Rome
- nephew and adopted son was Octavian
- killed by Brutus and Senators who hated him for attempting to end the Republic
- in first Triumvirate with Crassus and Pompey - made them popular, lasted longest
- killed Pompey by chasing him to Egypt, killed on a statue of Pompey
- Senate caused him to lead civil war against Pompey and city of Rome - he defeated Rome
- very dishonest, corrupted b y money, very ruthless
- conquered Gaul to accumulate wealth, power (loyal army), and fame (defeating long-enemy of Rome)
- Crassus tried to get fame in the same way, died in battle, Pompey alone in Rome
- Senate decreed Julius enemy of Rome - he knew it
    - when he crossed the Rubicon, he told his troops “the die is cast!” - there was no turning back - he couldn’t lose his reputation
- ensured Cleopatra’s rule over Egypt, returned to Rome as dictator-for-life, all honors on him as an absolute dictator

- many people were insulted, people killed him, left power vacuum of second Triumvirate

Pompey (the Great)

- member of the first Triumvirate
- great military general
- "friend" of Caesar, was pitted against him by Senate
- could not defend Rome - too hectic - and fled to Egypt
- Pharaoh Ptolemy of Egypt beheaded him, sent his head to Caesar to try to appease him
- Caesar died on statue of Pompey
- Crassus was third member of Triumvirate: he burnt down houses, and renovated them for a profit

Second Triumvirate

- Octavian, Marc Antony, and Marcus Lepidus
- good speaker, good military
- Octavian and Marc Antony bound together to overcome Senate
- Marcus Lepidus resigned in fear
- Octavian killed Marc Antony, proceeded to become first emperor

Marc Antony

- member of second Triumvirate
- best friend of Julius Caesar and was his bodyguard
- led astray by accomplices when Caesar was killed
- underestimated Octavian as a little naive boy
- took eastern provinces of Rome, and Octavian took west
- married Cleopatra, had children with her, Romans were disgusted
- Octavin created faults about him, plotted civil war against him
- committed suicide when surrounded and defeated by Octavian
- killed Cicero defeated Crassius's and Brutus''s revolts against Rome

Cleopatra

- smart woman and politician, cunning and seductive
- had child with Julius and multiple with Marc Antony (Octavian killed Julius's one)
- power secured over her brother to become ruler of Egypt by Julius Caesar, who favored her
- when Caesar died, started forming relationship with Marc Antony to achieve power over Rome
- wanted to secure Egypt's power and wealth in Rome for the long term
- disgusted Romans - got Marc Antony killed
    - Romeo and Juliet love story based on their story
- went back to Rome with Octavian to try and persuade him to release her and Egypt - committed suicide
- Egypt became province of Rome ("the breadbasket of the Mediterranean"), made Rome wealthy

Octavian

- underestimated by Marc Antony, proceeded to become first emperor
- declared war on Antony after he was acquainted with Cleopatra
- in 29 he established a new government on Rome so that much was similar (still had a Senate, courts, assemblies, officials), and he did not use military force openly
- granted himself (from Senate) many important, powerful powers that ultimately led to his becoming of a dictator
- avoided titles of dictatorship, but took the title "Augustus" and "princeps", meaning first citizen, to avoid Julius's fate
- master of propaganda - people liked him as memories of civil war faded
- beginning of Empire and the Pax Romana
- the first emperor

Jonathan Lam
Mrs. Staley
West Civ. per. 7
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The Roman Empire

Pax Romana

- literally “Roman Peace”
- 200 years (27 B.C. to 180 A.D.)
    - from beginning of reign of Augustus (first emperor)
    - to death of Marcus Aurelius (last “great emperor”)
- tune if relative tranquility and no threat of destruction
- honored Republican ideals, but put competent officials up
- revived religion
- adopted children to avoid war when transitioning power
- empire expanded to Trajan’s rule
- officials more closely watched
- citizens and provincial people held less differences
- free market economy (supply and demand)
- roads, ships used for trade, easy travel
- most emperors were mature, great men who sought to improve Rome

Roman Emperors

https://docs.google.com/document/d/1G07CQTOh2YUa1wZO-AlO4W94BT0Iz7Grs6wlXZjt2QM/edit

Monotheism

History and Importance

- Rome originally polytheistic like Greeks and Etruscans - monotheism didn’t really exist yet
- polytheism was a belief in many gods and divine spirits, especially tose f nature
    - local entities - reduced their power
    - frequently unreliable
    - distant, non-personal
- monotheistic god is exclusive, solves problems of polytheism
    - all-powerful
    - only one to adore
    - omnipresent
    - omniscient
    - personal but also saves the whole world
- based on the Jewish covenant: if they believed in him as their only savior and most powerful being, he would help them with divine favors and deliverance (escape from enslavement)
- gave people a set of ethics (including moral, spiritual)
- all the monotheistic religions based on those: impacts billions worldwide
- Judaism: small religion, 20 million people
    - Yahweh is god, Torah is book
    - original monotheism
    - Abraham of 2000 B.C. from Arabia, Ur (Mesopotamia)
    - Moses of 1300 B.C. le out of enslavement from Egypt
        - met with God on top of Mount Sinai
        - got Covenant and Ten Commandments (the code of ethics)
    - Joshua crossed river, fought with Canaanites and Philistines for the promised land

    - after 200 years, King David won
    - diaspora (spreading of Jews) caused by destruction of King Solomon's temple by Babylonians
- Jews disregard Christians, Muslims
- Christians hate Jews and Muslims
- Muslims accept Christians, Jews (as lesser forms)
- Hebrew = Israelite = Jew
- Abraham is biblical patriarch
- shapes most of the world today
- Hebrews originally nomadic shepherds
- Abraham patriarch, led people from Ur
    - father of Judaism, making covenant
    - descendants of him and Sarah included Isaac, Jacob, and eventually Jesus
    - descendants of him and Haggar led to Ishmael, and eventually Muhammad
- own government based on Christian principles
- Israel established
- results of Hebrewism: monotheism, code of Ethics
- all fight in Jerusalem, a holy city for all

Rise of Christianity

- born in 4 B.C. in Bethlehem, Judea, as a Jew
- did not try to create a separate branch of religion, but tried to improve the ideas behind Judaism
- fled to Egypt during "slaughter of the innocents" - the king worried about him
- actual teachings were not offensive, but his existence as the son of God was
- conflict with conservative Jews and Romans
- Jews condemned him first for blasphemy, left him alone
- Romans put him on Trial by Pilate, found him innocent
- Romans choose him to die over the mass murderer Barabbas
- faith in Jesus is huge, extremely strong
- refused to worship emperor as god, thought of as treason
- a lot of people died for this, thinking that life after death is so much better (Heaven)
- early Roman emperors (e.g. Tiberius) persecuted Christians wrongly
- later ones did not (Constantine, Theodosius)
- Christianity used as a unifying force, replace Roman pagan gods
- Nero blamed Great Fire of Rome on Them

Fall of Rome

Main Causes

- too large, citizens not protected
    - Hadrian attempted to stop this by building a wall and stopping the expansion of Rome
- army chose emperors, more of a military dictatorship
- local leaders started breaking off from Rome
- Eastern Rome became stronger than Western Rome
- taxes high, debts unpaid
- trade routes damaged by war
- regulation of business by emperors failed
- economic polarity increased
- Roman soldiers not loyal

- “salad bowl: of religions and cultures of new people into Roman were not loyal to Rome, but their own cultures and beliefs
- troops deserted as they lost patriotism
- Christianity preached against the emperor worship and killing that strengthened Rome
- the number of slaves and unemployed citizens grew
- health and birth rates declined (from poisoning of pewter bowls, lead pipes)
- invaders killed Romans, Rome could not defend itself, then stormed Rome
- barbarians took over western Rome, and the city of Rome
- Rome disregarded barbarians earlier, did not stop their threat

The Study of Stereotypes

Stereotypes are at the heart of racial and religious prejudice and intolerance. They are created by religious groups to target other religions, a form of persuasion that with just a few words causes mass hatred and conflict. The problem with stereotypes throughout antiquity to modern day is that people do not understand stereotypes— the reason they are created and the effect they are meant to cause— and therefore racial tension and hate crimes still exist today. It often becomes so blended with regular life that people do not realize that they are hurting others, and the ones taking the hatred continue to be battered. Thus, the best way to educate for racial tolerance is to reveal the nature of racial stereotypes: their use, immorality, and terrible potential.

Offensive stereotypes that lead to hatred and prejudice are actually a mixture of fact and opinion— to say that it is only one or the other would not be correct. Stereotypes are based on fact, sometimes a simple physical feature or reality. In our discussion, for example, Noah mentioned that "Jews have big noses"; in our reading, Jews were known as "greedy moneylenders" because many of them held the position of banking and sinning (according to Christianity) by collecting interest on loans (Anti-Judaism: A Case Study in Discrimination). Of these, both are believable: maybe Jewish people were observed to have large noses, a simple observation that became a widespread generalization; and Jewish people actually did hold many banking positions in the Middle Ages. The difference between the two is that the former is almost a silly joke, and the latter is offensive, a negative description of Jews. This is because although the big-nose idea is not based much of opinion, the idea of Jews as people who are greedy is twisted very far from the truth. To do fair banking doesn't mean they steal money or are sinning even if a religion deems it so, but the stereotype was altered with some loathing opinion. Another way that facts are altered is if a generalization is created from an abnormality of a certain group, especially when Al-Qaeda, an extremist Islamist group, had terrorist attacks on the metropolises of the U.S. From then on, almost all Muslims immediately became despised and feared to be terrorists— even though Islam is a peaceful religion. As a result of this over-generalizations, many people have been falsely accused. For instance, Najwa Ahmed, a Muslim teenager, has been "spit at in the face. This guy literally tried to run over [her] and called me a suicide bomber," among many other hateful actions (Zero Tolerance: Racial Harassment in

School Worsens for Scapegoated Students). Lastly, the most important part of form a stereotype is to be able to fully exploit the persuasive power by generating and using misunderstanding and lack of knowledge to their advantage. An example would be during the Middle Ages, when Jews were thought negatively of and separated into a ghetto part of the city. The Christians had little to do with them, but heard propaganda against them. In the book *A Boy of Old Prague*, a boy was sent into the ghetto to work for a Jew and was absolutely frightened, because what he had heard about them were "all the tales of witchcraft and black magic … a Jew had cut himself up in pieces, and put himself into a flash, and had become immortal; another had made himself invisible with the herb Andromeda when the Devil came for his soul …"— once he had met the Jewish person for himself, he discovered the falsity of what the public had taught him (Reading 18: A Return to Tradition?). It is essential to know that there is usually truth behind a stereotype in order to be somewhat plausible, and sometimes, in offensive generalizations, there is almost always some distortion in the truth, not based on fact, that creates the hatred. To be able to differentiate between the two will help many people lower their anger— most of the time, the anger is created by opinion *and* fact.

Another important point to consider about stereotypes is that they establish a justification to hurt others and consolidation of power. Therefore, stereotypes are a means to injure others that are different and less powerful (usually a minority) than themselves. This has been the case repeatedly throughout mankind, from the blaming of the Christians for the Great Fire of Rome to the Holocaust. By determining a scapegoat to direct all the blames at, the people have something to direct their anger towards *and* a way to get rid of people that are "different"; a two-fold benefit for them. Because of this, people should be taught that prejudice and hate towards another religion typically is irrational, done with no regards to human decency but only for personal benefit. Secondly, people don't know the extent to which racial hate can injure others, so the numbers of hate crimes are enormous and rising. A long-term Muslim citizen of the U.S. said, "I don't think there's a single Muslim out there who hasn't felt some sort of fallout since 9/11" (USA's Muslims Under a Cloud). According to a 2009 survey of religious hate incidents, there were 1,211 hate crimes against Jews in the U.S., including a shooting and bombing plans (DL Audit: Anti-Semitic Incidents Across the Country in 2009). Another example of a hate crime is a

newly-immigrated boy from Afghanistan who was severely beat up in school and was severely injured. “He’s terrified. You can see how damaged he has been. He won’t look you in the eye; he just shrinks away. He won’t talk” (USA’s Muslims Under a Cloud). It simply isn’t humane to cause all that pain; if only they knew, many people can change their mindset on racial tolerance.

Besides causing pain in the scapegoats, blaming a weak group creates huge amounts of anger and fear, ingredients that inevitably mix to create unnecessary violence. For example, soon after a terrorist attack by Muslim extremists in India, Motaz Elshafi, a Muslim and American citizen, was sent an email by one of his coworkers as if he were a terrorist. The email warned him and other Muslims at the company that “such violent acts wouldn’t intimidate people. but only make them stronger,” and was addressed to him with, “Dear Terrorist” (USA’s Muslims Under a Cloud). “‘I was furious,’ said Elshafi. ‘What did I have to do with this violence?’” Obviously, he didn’t have anything to do with the incident, besides that the terrorists followed his religion. If he were younger and more naive, he may have started a fight and created more anger. As somebody else describes the situation, “Muslims have the same anxieties and anguish about terrorism as everyone in the U.S. At the same time, they’re being blamed for it. They’re carrying a double burden” (USA’s Muslims Under a Cloud). This misdirected blame has lead to, in more extreme cases, riots started by the angry victims. After a Christian church was bombed in Egypt, hundreds of Christians and Muslims fought, the Christians clearly angry about the injuring of their people, and the Muslims indignant, knowing that it was not the fault of their religion but only a few individuals. This only led to more violence, injuries, and anger between the raging groups— as a result causing more hate crimes and more retaliation. Hate crimes from prejudice only leads to more anguish and trouble in a vicious cycle, if it is allowed to continue.

Stereotypes can be simple, objective descriptions of a certain group of people, or they can be powerful statements quietly attacking those people. They are usually twisted ideas, but sometimes it is difficult to distinguish it from a logical observation. However, the gullible public and strong media associates untrue ideas with religions, such as the fear of Muslims in America after the 9/11 bombing, come together and create huge amounts of racial intolerance. Only when people finally learn that stereotypes are not true will they be able to learn to tolerate others.

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In-Class Discussion.

"Reading 18: A Return to Tradition?" *Facing History and Ourselves*. N.p.: n.p., n.d. N. pag. Print.