

Biology Study Guide for Finals

U1-C1 The Study of Life

1. Introduction to biology

1. Define biology.

- The study of living things and how they respond to stimuli

2. Identify possible benefits from studying biology.

- Cure diseases
- Learn more about the world
- Improve agriculture

3. Summarize the characteristics of living things.

- Made of one or more cells
- Displays organization
- Grows and develops
- reproduces
- Responds to stimuli
- Requires energy
- Maintains homeostasis
- Adaptations evolve over time

2. Nature of science

1. Explain the characteristics of science.

1. Expands scientific knowledge
2. Challenges accepted theories
3. Questions results
4. Tests claims
5. Undergoes peer review
6. Uses metric system

2. Compare something that is scientific with something that is pseudoscientific.

1. Fake science, not open to criticism
2. Lone workers instead of peer reviewed
3. No evidence

3. Describe the importance of the metric system and SI.

- Important so all scientists use the same quantities
- All proofs are repeatable

3. Methods of science

1. Describe the difference between an observation and an inference.

- Inference is an educated guess
- Observation is reading

2. Differentiate among control (positive and negative), independent variable, dependent variable and controlled/constant variable.

- Positive control: Expected to have results (like the current best medicine vs new medicine)
- Negative control: Not expected to have change (water pill vs new medicine)
- Independent variable: The thing you purposely change
- Dependent variable: the thing you observe the results of
- Control variable: The variable that is held constant the whole time to ensure this it is not effecting the dependent variable

3. Identify the scientific methods a biologist uses for research

- Observation
 - You see something intriguing
- Asking question
 - Ask why it happens
- Hypothesis
 - A potential answer to your question
- Variables (independent, dependent, controlled/constant)
 - See above [^65c217](#)
- Data analysis
 - Look at your data to see what it proves
- Conclusion
 - Draw conclusions to what you have observed

U2-C6 Chemistry in Biology

1. Enzymes

- Define the term catalyst and enzyme.
 - Catalyst: something that speeds up a reaction
 - Enzyme: a natural catalyst in cells and living things

- Describe the role of enzymes in catalyzing reactions in living cells.
 - Speeds up the reactions (like digestion)
- State factors that affect the rate of an enzyme-controlled reaction and their effects
 - Temperature
 - Too hot = denatured
 - Too cold = no reaction and denatured
 - PH
 - Too high = deformed, can be recovered
 - Same for too low
 - Concentration
 - More = faster

2. Properties of water

1. Evaluate how the structure of water makes it a good solvent.

- Hydrogen bond
 - Makes a strong intermolecular force between water molecules
 - Cohesion
 - Binding to itself
 - adhesion
 - Binding to other polar things
 - surface tension
 - Edge of water beads up because it wants to minimise surface area
- Polarity
 - Water is polar from its hydrogen bonds
- Specific heat and heat of vaporization
 - High specific heat, take a lot of energy to heat it up
 - Resistent to temperature change
 - 100 degrees to vaporize
- Density
 - Hotter = less dense
 - When water freezes, it is less dense
 - Gets a crystal lattice structure

3. Biological macromolecules

1. Structure, function, monomers/basic units, food tests

1. Describe the role of carbon in living organisms.

- The glue of life
- Bonds to a lot of things
- 4 valence electrons

2. Compare the functions of each group of biological macromolecules.

- Carbohydrates
 - C, H, O
 - Quick energy
 - Provides a little structure
 - Made of monosachhrides (simple sugars)
 - Monomer:
- Lipids
 - C, H, O
 - Stores energy
 - Polar phosphate head, 3 non-polar fatty acid tails
 - Polysacchrides
 - Not a polymer (everything else is)
- Saturated
 - Single bonds
- Non-saturated
 - Double bonds, has space to bond
- Protein
 - C, H, O, N
 - 20 types of protein from the R group
 - Structure, muscles
 - Enzyme, other cell functions depend on protein
 - 4 types of structures
 - Primary - sequence of amino acids
 - Secondary: alpha helices or beta pleated sheets (due to hydrogen bonding)
 - Tertiary: interactions of side chains leads to a folding of the molecule
 - Quaternary: sometimes multiple chains come together to create a larger protein
 - Amino Acid structure:
 - Carbon, NH_2 , Carboxyl ($COOH$),
- Nucleic acids
 - C, H, O, N, P
- DNA
 - Two strands (double helix)

- RNA
 - Single strand (single helix)
- TESTS
 - Test for reducing sugar:
 - Benedict's test: Fill a beaker with 2/3 of water and boil it. Add 2 mL of a solution of the reducing sugar to a test tube, or crush your food entirely and add in water up to 2 mL. Add an equal volume of Benedict's solution. Shake and bring gently to the water bath, allow it to boil.
 - Observation: The initial blue coloration of the mixture turns green, then yellowish and may finally form a brick red precipitate.
 - Basis of test: Benedict's solution contains copper sulphate. Reducing sugars reduce soluble blue copper sulphate containing copper (II) ions (Cu^{2+}) to insoluble red - brown copper oxide containing copper (I). The latter is seen as a precipitate.
 - Test for starch:
 - Iodine/potassium iodide test.
 - Place your food on a piece of white tile. Add a few drops of iodine solution.
 - Observation:
 - A blue-black colouration.
 - Basis of test:
 - A polyiodide complex is formed with starch.
 - Test for lipid:
 - Emulsion test:
 - Crush your food entirely and add in 5 mL of ethanol. Place it in the water bath to boil. At the meantime, prepare another test tube with 5 mL of cold water (tap water). Decant the liquid from the first test tube into the one with water. Be careful not to pour in your food debris.
 - Observation:
 - A cloudy white suspension.
 - Basis of test:
 - Lipids are immiscible with water. Adding water to a solution of the lipid in alcohol results in emulsion of tiny droplets in

the water which reflect light and give a white, opalescent appearance.

- Filter paper test:
 - Rub your food on the filter paper and view it under a light source.
 - Observation:
 - Translucent mark.
- Test for protein:
 - Biuret test:
 - Crush your food entirely and add in water up to 2 mL. Add an equal volume of Biuret reagent. No heating is required.
 - Observation:
 - A mauve or purple colour develops slowly.
 - Basis of test:
 - A test for peptide bonds. In the presence of dilute copper sulphate in alkaline solution, nitrogen atoms in the peptide chain form a purple complex with copper (II) ions (Cu^{2+}).
Biuret is a compound derived from urea which also contains the -COHN- group and gives positive results.

U3-C7 Cellular Structure and Function

1. Cell Discovery and Cell Theory

1. Relate advances in microscope technology to discoveries about cells.

- Robert Hooke
 - Saw cell through microscope
 - Named them cells because looked like monk cells
- Anton van Leeuwenhoek
 - Named them animocules
 - Made a microscope

2. Compare compound light microscopes with electron microscopes.

- Light microscope
 - Uses optics to magnify small things (glass)
 - Can see living things
- Electron microscope
 - More magnification
 - Can only see dead things
 - Uses magnets to aim electrons to see things

- 3 types
 - Transmission
 - Scanning
 - Scanning tunneling (working on living things)
- 3. Summarize the principles of the cell theory.
 - Every organism is made out of cells
 - Cells are the basic units of life
 - Arise from only preexisting cells
- 4. Differentiate between a prokaryotic cell and a eukaryotic cell.
 - Prokaryotic
 - Simple
 - No nuclear membrane
 - No membrane bound organelles
 - Have a cell wall
 - Eukaryotic
 - Complicated
 - 100x bigger than prokaryotic
 - Nucleus has a membrane
 - Has organelles

2. The Plasma Membrane

1. Describe how a cell's plasma membrane functions.
 - Maintains homeostasis
 - Selective permeability
 - Help signal other cells (comms)
 - Holds the cell together
2. Identify the roles of proteins, carbohydrates and cholesterol in the plasma membrane.
 - Proteins
 - Tubes and other things that help facilitate diffusion
 - Only let certain things in
 - Carbs
 - like antennas
 - Comms
 - Bind to outside things
 - Cholesterol
 - Keep the tails inside the wall from sticking to each other
3. Structure
 - Heads are made of hydrophilic molecules (attracts water)

- Tails are made of hydrophobic molecules (repels water)

3. Cell structures and organelles

1. Identify the structure and function of the parts of a typical eukaryotic cell.

- Check textbook Ch 7.3

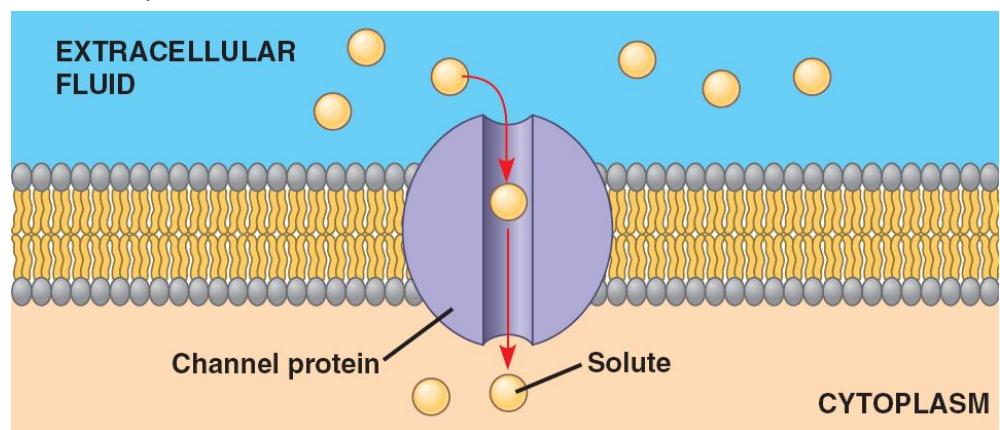
2. Compare and contrast structures of plant and animal cells.

- Plants
 - Have cell walls
 - Central vacuole
 - Chloroplasts
- Animals
 - Don't have that

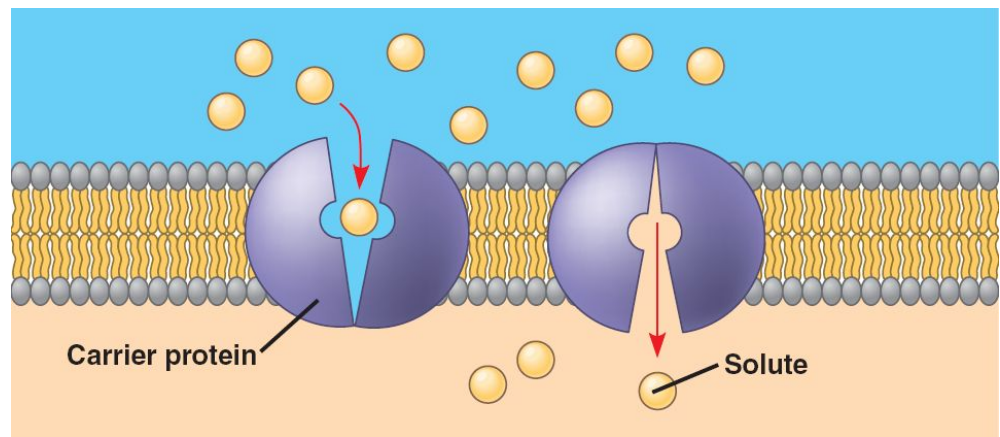
4. Cellular transport

1. Explain the processes of diffusion, facilitated diffusion, and active transport.

- Diffusion
 - High concentration to low concentration
 - Happens naturally
- Facilitated diffusion
 - Use the movement from high to low through a protein
 - Uses transport proteins
 - From high to low
- Active transport
 - Pumps from low to high forcefully
 - Needs ATP and a carrier protein
 - Channel proteins (facilitated)



- Carrier protein (active)



2. Predict the effect of a hypotonic, hypertonic, or isotonic solution on a cell.

1. All of these are in comparison to something else

- Hypotonic solution
 - The cell is hypertonic
 - A solution with less solute concentration
 - Cell will receive water
 - Cell will swell = Lysed
- Hypertonic solution
 - The cell is hypotonic
 - A solution with more solute concentration
 - Cell will send water
 - Cell will shrivel = Shriveled
- Isotonic
 - Two solutions with the same solute concentration

3. Discuss how large particles enter and exit cells.

1. Requires energy

- Endocytosis
 - When big things enter the cell
 - Cell membrane surrounds the object
- Exocytosis
 - When big things exit the cell
 - Vesicles bring the things to the cell membrane
 - Dumps the trash outside

4. Define osmosis

- Diffusion of water through a selectively permeable membrane
- Low to high solution concentration

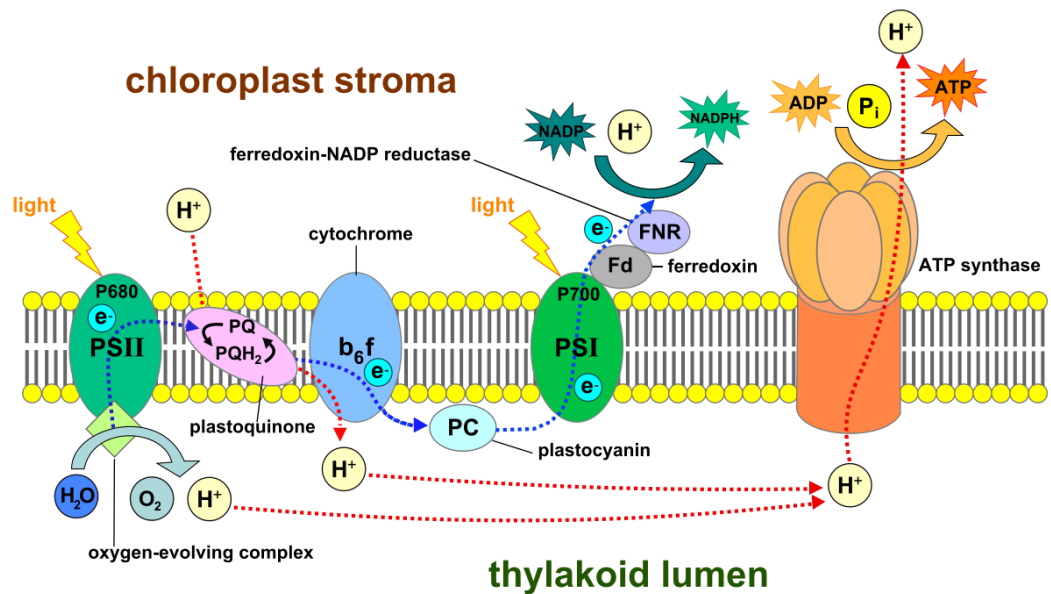
U4-C8 Cellular Energy

1. How organisms obtain energy

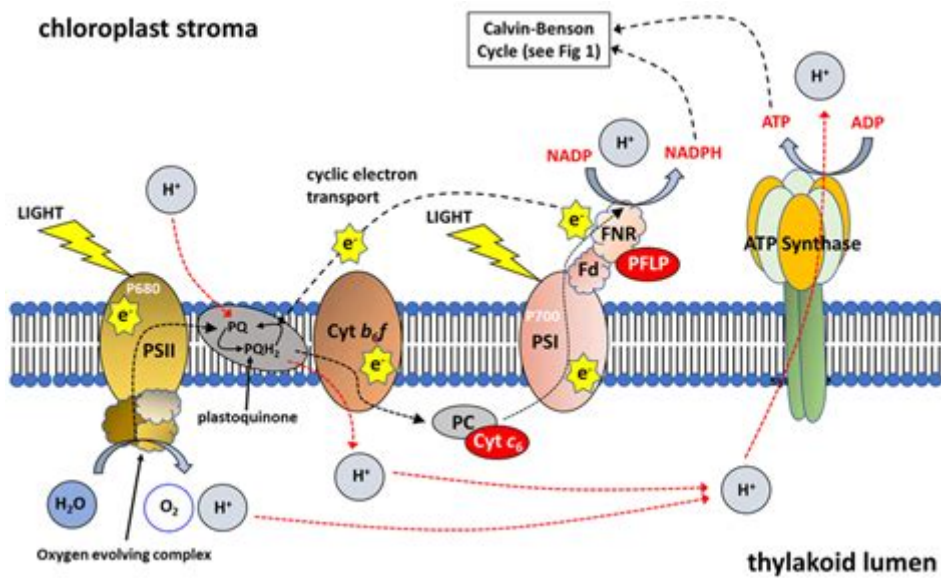
1. Summarize the two laws of thermodynamics.
 1. Cant create or destroy energy
 - Can only change the form of energy
 - Total amount of energy does not change
 2. The amount of useful energy forms over time (**entropy**) decreases
 - Unusable energy (such as heat) increases over time
2. Compare and contrast autotrophs and heterotrophs.
 - Autotrophs
 - Feed themselves
 - Plants
 - Gets energy from other surrounding things (chemicals)
 - Photoautotrophs
 - Energy comes from sun
 - Heterotrophs
 - Find food
 - Animals
3. Identify anabolic and catabolic pathways.
 - Anabolic
 - Put together
 - Photosynthesis
 - Making glucose
 - Storing energy
 - Catabolic
 - Tearing apart
 - Respiration
 - Using glucose
 - Using energy
4. Describe how ATP works in a cell.
 - It is useful chemical energy for a cell
 - Stores energy
 - Breaking off one phosphate group makes usable chemical energy
 - Turns into ADP once the energy is released

2. Photosynthesis

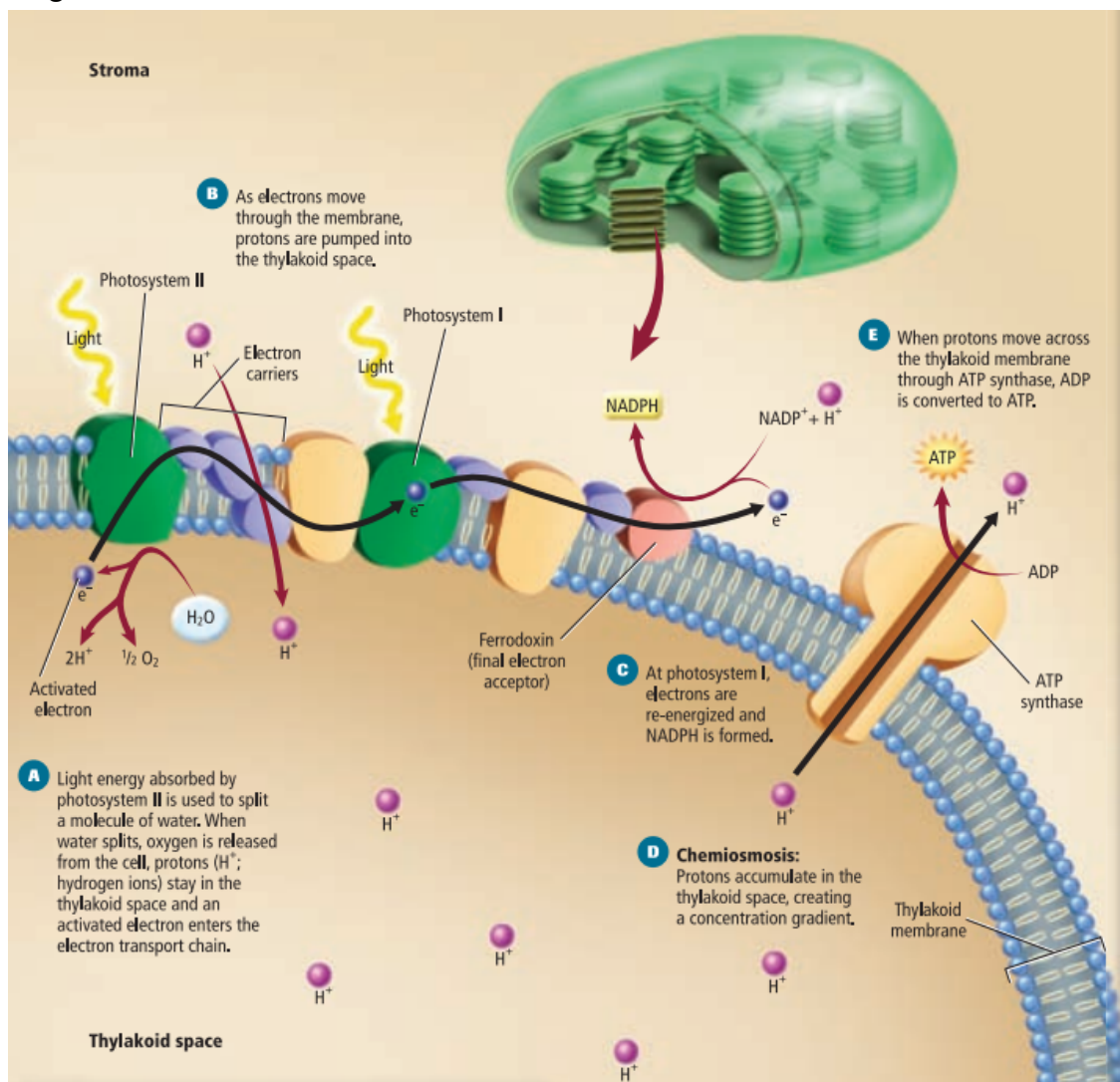
- https://www.youtube.com/watch?v=sQK3Yr4Sc_k
1. Summarize the two phases of photosynthesis.
 - Light-dependent reaction



-
- Uses light
- Happens inside the thylakoid
- High gradient from Thylakoid space to the stroma
- Calvin cycle
 - https://www.youtube.com/watch?v=00jbG_cfGuQ
 - Where most of the energy is made
 - Uses 18 ATP and 12 NADPH to make one glucose
 - Inside the stroma
 - Start with 10 RuBP (5 Carbon molecule) and carbon dioxide and produces one glucose, with 10 RuBP left over for the next cycle
 - Takes 2 full cycles to produce one glucose
- 2. Explain the function of a chloroplast during the light reactions.
 - Allows light into the cell to excite the electrons
 - Site of photosynthesis
 - Its green because it reflects off the green light
 - absorbs violet and red light
- 3. Describe and diagram electron transport.



- Page 225 in the textbook



3. Cellular respiration

1. Summarize the stages of cellular respiration.

1. Glycolysis

1. Glucose \rightarrow Pyruvic Acid + 2 ATP

2. Goes into Aerobic or Anaerobic after glycolysis

- Aerobic
 1. Formation of Acetyl CoA (**optional learning**)
 - Pyruvic Acid + CoA \rightarrow Carbon Dioxide + Acetyl CoA + Energy
 2. Krebs Cycle (Citric Acid cycle or TCA)
 - Acetyl CoA \rightarrow CoA + 2 Carbon Dioxide + 4 NADH + 1 FADH
 3. Electron Transport chain
 - NADH \rightarrow 2.5 ATP
 - FADH \rightarrow 1.5 ATP
 - Total produces 36-38 ATP
 - Anaerobic
 - Called fermentation
 - Two types
 - Yeast fermentation (Alcoholic Fermentation)
 - Pyruvic acid \rightarrow Ethanol
 - Cannot repay the oxygen debt
 - Toxic
 - Lactic Acid fermentation
 - Pyruvic acid \rightarrow Lactic acid
 - Can be paid back
 - Also toxic
2. Identify the role of electron carriers in each stage of cellular respiration.
 - NADH
 - FADH₂
 - Drop electrons off at the mitochondria

U5-C9 Cellular reproduction

1. Cellular growth

1. Explain why cells are relatively small.
 - Highers surface area to volume ratio
 - Helps remove waste
 - Helps comms
 - Helps get substances into the cell
2. Summarize the primary stages of the cell cycle.
 - G_1
 - S
 - G_2
 - Mitosis

- Prophase
- Metaphase
- Anaphase
- Telophase
- Cytokinesis

3. Describe the stages of interphase.

2. Mitosis

1. Describe the events of each stage of mitosis.

- Prophase
 - Nucleus is still there
 - Chromosomes are condensing from the DNA
 - DNA gets **shorter** and **thicker**
 - Nucleus membrane disappears
 - Formation of microtubules
 - Attach to the chromosomes (centrometer of it)
- Metaphase
 - Chromosomes line up to the middle of the cell
- Anaphase
 - Chromosomes split (chromatins separate)
 - The chromosomes move away from the center to the edges of the cell
 - The spindles (microtubules) help pull them to the edges
- Telophase
 - Chromosomes reach the poles
 - Two new neuclei are formed
 - Microtubules disappears

2. Explain the process of cytokinesis.

- The cytoplasm splits and two cells are separated.
- This part is **not** considered part of Mitosis

3. Cell cycle regulation

1. Summarize the role of cyclin proteins in controlling the cell cycle.

- Cyclins
 - They are proteins
 - Regulate the cycle
 - Make sure everything is ready for the next step
 - Will start apoptosis if failed
- CDKs

- Cyclin dependant kinases
 - Manages the Cyclins itself
 - Makes sure the cyclins are present and active
- 2. Explain how cancer relates to the cell cycle.
 - Cancer is uncontrolled cell growth
 - Unhealthy cells do not go through apoptosis
 - Trick cyclins into thinking it is healthy
- 3. Describe the role of apoptosis.
 - Kills bad cells
 - Makes sure stuff is healthy
- 4. Summarize the two types of stem cells and their potential uses.
 - Adult stem cells
 - Specialized
 - Can only form certain cell types
 - Embryonic stem cells
 - Unspecialized, can form anything
 - Found in the embryo
 - Healing permanent spinal damages (theoretically possible)

U6-C10 Sexual Reproduction and Genetics

1. Meiosis

1. Explain the reduction in chromosome number that occurs during meiosis.
 - After DNA synthesis, each chromosome will have two sister chromatids
 - Then, after meiosis 1, instead of the sister chromatids separating, the paired chromosomes will separate
 - After anaphase, each cell will have half the amount of chromosomes, making them haploids
2. Recognize and summarize the stages of meiosis.
 - Round 1
 - Important because it creates new DNA recombinant from the mom and dad's DNA.
 - 1. Prophase 1
 - 1. Nucleus is still there
 - 2. Chromosomes are condensing from the DNA

3. DNA gets **shorter** and **thicker**
4. The Homologous pairs of chromosomes get close to each other and switch portions of DNA
 1. This is called **Synapsis**
 2. This process does not need to be symmetrical across both daughter chromatids
 3. Synapsis is why we have 4 distinct and different gametes in the end
2. Prometaphase 1 (sometimes considered part of the metaphase)
 1. Nucleus membrane disappears
 2. Formation of microtubules
 1. Attach to the chromosomes (centromere of it)
3. Metaphase 1 (Middle)
 1. Chromosomes line up to the middle of the cell
 2. They line up next to each other in homologous pairs down the middle of the cell
 3. They will not all line up in the same order, so the random assortment creates a new combination of genes
4. Anaphase 1 (Away)
 1. The homologous chromosomes get separated
 2. The sister chromatids do not get separated like normal mitosis
 3. The chromosomes move away from the center to the edges of the cell
 4. The spindles (microtubules) help pull them to the edges
5. Telophase 1 (Two)
 1. Chromosomes reach the poles
 2. Two new nuclei are formed
 3. Microtubules disappear
- Round 2
 - Round 2 happens **similar to normal mitosis**, except for the cells are already Haploids
 - This results in 4 haploid cells from the original single precursor before meiosis

3. Analyze the importance of meiosis in providing genetic variation.

- Law of segregation
 - Each parent only contributes one allele of each gene to the offspring
- Law of independent assortment

- Each gene is inherited independently of each other
- This means that hair color does not effect eye color
- Everything is random
 - Synapsis
 - Orientation of the lining up in metaphase 1
 - Orientation in metaphase 2
- Exception is linked genes (on the same chromosome)
- Synapsis (crossing over)
 - During Metaphase 1
 - When two homologous chromosomes are close to each other
 - Swaps the ends of the chromatids

2. Mendelian genetics

1. Explain the significance of Mendel's experiments to the study of genetics.

- Austrian Monk
- Wanted to breed some peas
- He cross bred green and yellow peas and only noticed that green peas resulted
- but in F2, a quarter of them were yellow
- Theory of dominant and recessive genes
- Inheritance was not from the blood

See [Ch10-11 Study Guide Topics](#) for more information

Index

Word	Definition
Polymer	
entropy	
Apoptosis	Controlled cell death, then eaten my lysosomes