

2013-2014 Biology Semester 1 Final Exam Study Guide Answer Key

Chapter 1 Biology in the 21st Century

1. What is biology the study of? **Biology is the study of life.**
2. What are the 4 characteristics of life? **1. All organisms are made up of one or more cells. 2. All organisms need a source of energy for their life processes. 3. All organisms must respond to their environment. 4. Members of a species must have the ability to reproduce and develop.**
3. How are structure and function related in biology? **Structure and function are related at the level of chemicals in cells. Different types of cells have different functions that depend on their specialized structures (i.e. brain cells have branches that receive info from other cells). Structure and function are also related on the level of the organism (i.e. ducks have webbed feet to swim and walk).**
4. What is homeostasis? Give an example of how you maintain homeostasis. **Homeostasis is the maintenance of constant internal conditions. Sweating when you are hot and shivering when you are cold are examples.**
5. List and explain the general steps of the scientific method. **Observation, Hypothesis, Experiment, Collect data, Evaluate results, Draw a conclusion, and Retest.**
6. What are independent and dependent variables? (Explain) **A variable is a factor in the experiment that is being tested. The independent variable is the factor that is controlled/manipulated by the experimenter. The dependent variable is the factor that is being observed/measured.**
7. What are constants and controls? **The experimenter makes a special effort to keep other factors *constant* (the same) so that they will not affect the outcome. Those factors are called control variables.**

8. Sugar dissolves in, or mixes completely with, water. The solubility of a substance in water is determined by measuring the maximum amount of the substance that dissolves in a given amount of water at a given temperature. HYPOTHESIS: The solubility of sugar in water increases as the temperature of the water decreases. Identify the independent and dependent variables. **Ind. var – temp. of water
Dep. var – solubility of sugar**

9 An electromagnet can be made by wrapping insulated wire around an iron nail and connecting the ends of the wire to a 6-volt battery. HYPOTHESIS: Increasing the number of coils of wire wrapped around the nail increases the strength of the electromagnet, as measured by the number of paper clips the magnet can pick up. Identify the independent and dependent variables. **Ind. var – number of coils wrapped around nail; Dep. var – strength of electromagnet**

Chapter 2 Chemistry of Life

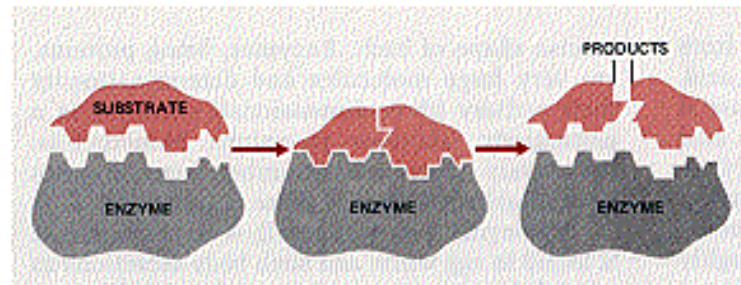
1. What is the difference between a covalent bond and an ionic bond? **A covalent bond involves the sharing of electrons while an ionic bond requires the transfer of electrons.**
2. What are the 4 properties of water? **Water is a polar molecule. It has hydrogen bonds that are responsible for water's high specific heat, cohesion, and adhesion.**
3. Is water polar or non-polar, and why is this important? **Water is a polar molecule; this is important because it allows water to have charged regions which in turn allows hydrogen bonds to form.**
4. What is adhesion? (give an example) **Adhesion is the attraction among molecules of different substances (i.e. water molecules sticking to the sides of a glass).**
5. What is cohesion? (give an example) **Cohesion is the attraction among molecules of the same substance (i.e. water sticking to water).**

6. Why is the fact that water has a high specific heat important? **This property is important in cells because processes that produce usable chemical energy in cells release a lot of heat; water absorbs the heat, which helps to regulate cell temperatures and maintain homeostasis.**
7. What is a monomer? **A monomer is each subunit in a complete molecule.** What is a polymer? **A polymer is a large molecule, or macromolecule, made of many monomers bonded together.**
8. Fill in the chart below.

Polymer	Monomer	Function What the body uses it for?	Foods What types of foods do you eat to get it?
Carbohydrate	Glucose	Broken down to provide usable energy to cells.	Sugars and starches (i.e. cereal, pasta, sugars, etc.)
Lipid	Glycerol	Broken down to provide usable energy to cells; some are parts of a cell's structure.	Fats and oils (i.e. Meat, butter, olive oil, peanut oil, etc.)
Protein	Amino acids	For movement, eyesight, or digestion.	Your body makes 12 of the amino acids. Others come from meat, beans, and nuts.
Nucleic acids	Nucleotides	Provide detailed instructions for how to build proteins.	DNA and RNA

9. $2\text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{O}_2$ Explain why this is a chemical reaction; label the reactants and the products of this reaction. **$2\text{H}_2\text{O}_2$ is the reactant and $\text{H}_2 + \text{O}_2$ are the products. This is a chemical reaction in which a compound is being broken apart.**

10. What is a catalyst? (give an example) **A catalyst is a substance that decreases the activation energy needed to start a chemical reaction. It also increases the rate of the chemical reaction.**
11. What is an enzyme? (give an example) **Enzymes are catalysts for chemical reactions in living things (i.e. amylase is an enzyme in saliva that breaks down starch).**



12. Use the diagram above to explain how an enzyme works.

Substrates bind to an enzyme at certain places called “active sites”. The enzyme brings substrates together (or breaks them apart) and weakens their bonds. The catalyzed reaction forms two products that are released from the enzyme.

Chapter 3 Cells and Organelles

- Cell Theory – list the 3 parts of the cell theory
All organisms are made of cells. All existing cells are produced by other living cells. The cell is the most basic unit of life.
- Two types of Cells – describe the difference between prokaryotic and eukaryotic cells
Prokaryotic cells do not have a nucleus or other membrane-bound organelles. They consist of a cell membrane, cytoplasm, and DNA. All single-celled organisms are prokaryotic (i.e. bacteria)
Eukaryotic cells have a nucleus and other membrane-bound organelles. The genetic information (DNA) is inside the nucleus. Eukaryotes may be multi-cellular or single-celled organisms (i.e. plant & animal cells).

➤ **Organelles :**

- What are they? **Structures specialized to perform distinct processes within a cell (i.e. nucleus protects a cell's DNA).**
- Describe the functions of the following organelles and be able to pick them out of a diagram:
 - **Nucleus – the storehouse for most of the genetic information (DNA). Serves to protect DNA; the nucleolus is in the nucleus.**
 - **Mitochondria – bean-shaped organelle that has two membranes; responsible for supplying energy to the cell.**
 - **Lysosomes – membrane bound organelles that contain enzymes. They defend a cell from invading viruses and bacteria; they also break down damaged or worn-out cell parts.**
 - **Chloroplast – organelle found in plant cells that carry out the process of photosynthesis by converting carbon dioxide, water, and solar energy into glucose and oxygen.**
 - **Ribosomes – tiny organelles that link amino acids together to form proteins. Ribosomes are either on the rough ER or in the cytoplasm.**
 - **Vesicles – small membrane bound sacs that divide some materials from the rest of the cytoplasm and transport these materials from place to place within the cell.**
 - **Golgi Apparatus – closely layered stacks of membrane-enclosed spaces that process, sort, and deliver proteins.**
 - **Endoplasmic Reticulum (ER) – an interconnected network of thin, folded membranes; the production of lipids and proteins occurs in the ER. There are two types: smooth and rough; the rough ER is studded with ribosomes.**
 - **Cell membrane – consists of a double layer of phospholipids interspersed with a variety of other molecules. The cell membrane forms a boundary between the cell and the outside environment and controls the passage of materials into and out of a cell.**

- **Cell wall – a rigid layer that gives protection, support, and shape to plant cells.**

Phospholipid Bilayer

- What is it made of (which parts are polar and which are non-polar)? **A phospholipid is composed of three basic parts: a charged phosphate group, glycerol, and two fatty acid chains. The head is polar and the fatty acids chains are nonpolar.**
- What is selective permeability? **The cell membrane has the property of selective permeability which means it allows some, but not all, materials to cross.**

Passive Transport – what is it? **The movement of molecules across a cell membrane without energy input from the cell.**

- Diffusion –
 - What is it? **The movement of molecules in a fluid or gas from a region of higher concentration to a region of lower concentration.**
 - What is a concentration gradient? **The difference in the concentration of a substance from one location to another.**
- Osmosis –
 - What is it? **The diffusion of water.**
 - In what direction does the water move in the following solutions:
 - hypotonic – **into the cell**
 - isotonic – **into and out of the cell at an equal rate**
 - hypertonic – **out of the cell**
- Facilitated Diffusion –
 - What is it? **The diffusion of molecules across a membrane through transport proteins.**
 - How does it work? **Transport proteins make it easier for molecules to enter or exit a cell. This is still a form of passive transport because molecules move down a concentration gradient.**

Active Transport – what is it? **A process in which a molecule is driven across a membrane from a region of lower concentration to a region of higher concentration.**

- Endocytosis –
 - What is it? **The (entrance) process of taking liquids or fairly large molecules into a cell by engulfing them in a membrane.**
 - Phagocytosis – **a type of endocytosis in which the cell membrane engulfs large particles.**
- Exocytosis –
 - What is it? **The release (exit) of substances out of a cell by the fusion of a vesicle with the membrane.**
 - How does it work? **During this process, a vesicle forms around materials to be sent out of the cell. The vesicle then moves toward the cell's surface where it fuses with the membrane and lets go of its contents.**

Chapter 4 Cells and Energy

1. What is ATP? **Adenosine triphosphate is a molecule that transfers energy from the breakdown of food molecules to cell processes. Energy is transferred when a chemical bond is broken by releasing a phosphate group and energy is released.**
2. What is the difference between the energy stored in food and the energy in ATP? **Food molecules store chemical energy in their bonds. Food is broken down into smaller molecules that are broken down further to transfer this energy to ATP.**
3. What is the purpose of cellular respiration? **The purpose of cellular respiration is to release chemical energy from sugars and other carbon-based molecules to make ATP when oxygen is present. This is an aerobic process (requires oxygen).**
4. Where does cellular respiration occur? **In the mitochondria because they make most of a cell's ATP.**

5. What is aerobic respiration? (include the advantages and disadvantages) **Aerobic respiration is a process that requires oxygen to take place. Cellular respiration is an aerobic process.**
6. What is anaerobic respiration? (include the advantages and disadvantages) **Anaerobic respiration is a process that does not require oxygen to take place. Glycolysis and fermentation are anaerobic process.**

Match the following processes with the statements below:

a. Glycolysis	b. Kreb's cycle
c. Fermentation	d. Electron Transport chain

7. Which process(es) are aerobic? **B & D**
8. Which process(es) are anaerobic? **A & C**
9. Which process(es) starts with sugar and ends with pyruvate? **A**
10. Which process(es) allows glycolysis to continue if oxygen is not readily available? **C**
11. Which process(es) produces the most ATP? **D**
12. Which process(es) has the products of: 2 ATP, 6 CO₂, 8 NADH, and 2 FADH? **B**
13. Which process produces Lactic Acid? **C**
14. Which process is the first step of cellular respiration? **B**
15. What are the products of glycolysis? **2 ATP & two pyruvates (three-carbon molecules)**
16. How many ATPs can be produced by the electron transport chain? **34**

On the line below each picture, classify the organism as either an AUTOTROPH or a HETEROTROPH.



Heterotroph

Hint: What color are mushrooms



Autotroph



Heterotroph

PHOTOSYNTHESIS: An Overview

Plants gather the sun's energy with light-absorbing MOLECULES called chloroplasts.

- A. thylakoids
- B. pigments
- C. chloroplasts
- D. glucose

The Calvin cycle is another name for D. light-independent reactions

- A. photosynthesis
- B. the electron transport chain
- C. light-dependent reactions
- D. light-independent reactions

How is the Calvin cycle different from the light-dependent reactions?

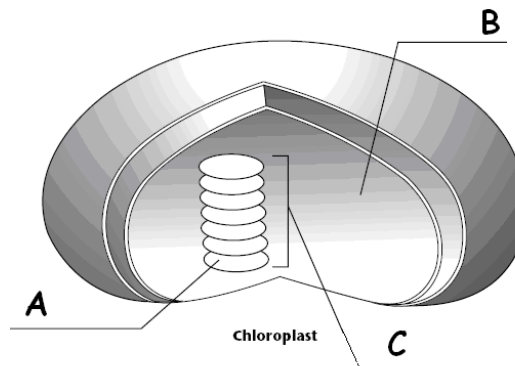
- A. It takes place in chloroplasts.
- B. It takes place in the stroma.
- C. It requires light.
- D. It takes place in the thylakoid membrane

Oxygen produced during the light-dependent reaction is C. is released into the atmosphere.

- A. used in the Calvin cycle to make sugar
- B. joined with the NADPH to make water
- C. is released into the atmosphere
- D. None of these, oxygen is NOT produced by the light-dependent reaction

USE THE LETTERS IN THE DIAGRAM AT THE LEFT TO IDENTIFY:

- B stroma
- A thylakoid
- C granum



USE WORDS FROM THE WORD BANK TO FILL IN THE CHART COMPARING AND CONTRASTING THE LIGHT-DEPENDENT REACTIONS AND THE CALVIN CYCLE: (You can use them more than once!)

in stroma in thylakoid membrane Requires light	O ₂ ATP Doesn't require light	CO ₂ H ₂ O SUGARS (glucose)
--	--	---

	LIGHT-DEPENDENT REACTIONS	CALVIN CYCLE
LOCATION	in thylakoid membrane	in stroma
REACTANTS	H ₂ O	CO ₂
PRODUCTS	O ₂	SUGARS (glucose)
LIGHT?	Requires light	Doesn't require light

CELLULAR RESPIRATION

MULTIPLE CHOICE

_____ **C. Glycolysis** _____ is the first step in cellular respiration that begins releasing energy stored in glucose.
 A. Alcoholic fermentation
 B. Lactic acid fermentation
 C. Glycolysis
 D. Electron transport chain

If oxygen is NOT present, glycolysis is followed by _____ **B. fermentation** _____.
 A. Krebs cycle
 B. fermentation

Name the 3 carbon molecule produced when glucose is broken in half during glycolysis.
 A. pyruvic acid
 B. lactic acid
 C. Acetyl-CoA
 D. citric acid

Since fermentation does not require oxygen it is said to be _____ **B. anaerobic** _____.
 A. aerobic
 B. anaerobic

Which of the following shows the correct sequence during cellular respiration?
 A. Electron transport chain → glycolysis → Krebs cycle
 B. Glycolysis → Electron transport chain → Krebs cycle
 C. Krebs cycle → Electron transport chain → glycolysis
 D. Glycolysis → Krebs cycle → Electron transport chain

Because cellular respiration requires oxygen it is said to be _____ **A. aerobic** _____.
 A. aerobic
 B. anaerobic

How many total ATP molecules are produced by 1 molecule of glucose completing cellular respiration?
 2 6 24 **36**

Which stage of cellular respiration produces the most ATP?

A. glycolysis

B. Krebs cycle

C. Electron transport

D. Acetyl-CoA charging

Write the complete overall chemical equation for cellular respiration using chemical symbols instead of words:



Tell the kind of fermentation used in each example (alcoholic or lactic acid):

Yeast uses this to make bread dough rise alcoholic fermentation

Your muscle cells use this during rapid exercise when oxygen is low lactic acid fermentation

Bacteria and yeast use this to make beer and wine alcoholic fermentation

Bacteria use this to make cheese, yogurt, and sour cream lactic acid fermentation

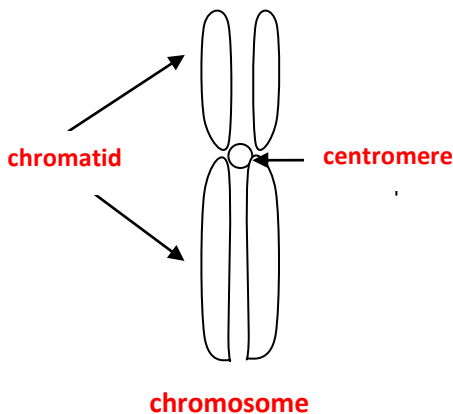
Chapter 5 Cell Growth and Division

Cell Cycle

- Name and describe what occurs during each step of the cell cycle. **The cell cycle is the regular pattern of growth, DNA duplication, and cell division that occurs in eukaryotic cells. The four main stages of the cell cycle are: Gap (G₁), Synthesis (S), Gap 2 (G₂) and Mitosis (M).**
Gap 1 – cells grow, carry out normal functions, and replicate their organelles; checkpoint.
Synthesis – DNA is copied
Gap 2 – additional growth and checkpoint
Mitosis – cell divides its nucleus and its contents (cytokinesis occurs immediately after); resulting in two identical daughter cells.
- What types of checks occur during the G₁ and G₂ stages before the cell can move on to the next step? **Checks for undamaged DNA and adequate cell size.**

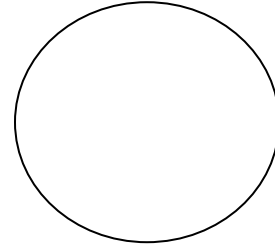
Mitosis

- What is the purpose of mitosis?
The purpose of Mitosis is to produce two identical daughter cells (somatic/body cells) that are diploid (46 chromosomes each).
- What do you end up with at the end of mitosis?
two identical daughter cells
- What is the difference between a chromosome and a chromatin? (label the parts of the figure below)
A chromosome is one long continuous thread of DNA that has numerous genes along with regulatory information. A chromatin is the loose combination of DNA and proteins.



- What occurs during Interphase? (draw and explain)

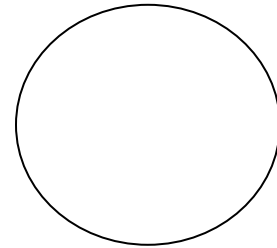
See pg. 141 of textbook



The cell copies its DNA and grows in preparation for division. The DNA is loosely organized during interphase.

- What occurs during Prophase? (draw and explain)

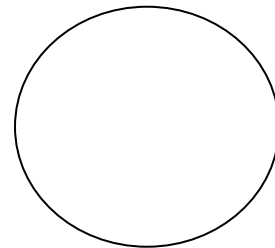
See pg. 141 of textbook



DNA and proteins condense into tightly coiled chromosomes. The nuclear membrane breaks down, centrioles begin to move to opposite poles and spindle fibers start to form.

- What occurs during Metaphase? (draw and explain)

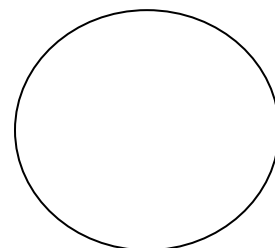
See pg. 141 of textbook



Spindle fibers attach to each chromosome. They align the chromosomes along the equator.

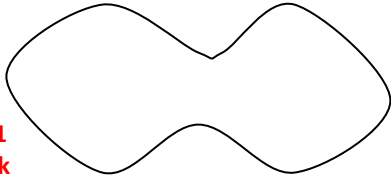
- What occurs during Anaphase? (draw and explain)

See pg. 141 of textbook



Chromatids separate to opposite sides of the cell.

- What occurs during Telophase? (draw and explain)

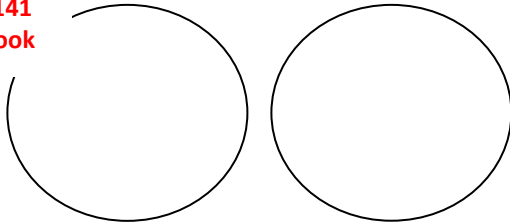


See pg. 141 of textbook

Nuclear membranes start to form, chromosomes begin to uncoil, and the spindle fibers fall apart. The cell pinches in the middle as it prepares to go through cytokinesis.

- What occurs during Cytokinesis? (draw and explain)

See pg. 141 of textbook



Cytokinesis divides cytoplasm between two daughter cells, each with a genetically identical nucleus.

Cancer

- What is cancer? **Uncontrolled cell division**
- Why does cancer occur? **When regulation of the cell cycle breaks down, when mutation occurs, and due to exposure to carcinogens (i.e. ultraviolet radiation and pollutants).**
- What is the difference between Benign and Malignant tumors? **Benign tumors are characterized by cancer cells that remain clustered (or clumped) together. These tumors are usually harmless. Malignant tumors have cancer cells that metastasize (break away) and spread, forming other tumors.**
- Why are Malignant tumors so dangerous? **Malignant tumors are dangerous because they can break away and spread.**

Chapter 6

Meiosis and Mendel

Meiosis

- How are somatic cells different from gametes?
Somatic cells are body cells (such as liver cells, heart cells, skin cells, etc.). These cells are diploid ($2n$) and have 46 chromosomes; they are produced through the process of mitosis. Gametes are sex cells (eggs and sperm). Gametes are haploid (n) which means they have 23 chromosomes; they are produced through the process of meiosis.
- How do haploid cells differ from diploid cells?
Haploid cells have only one copy of each chromosome and are represented as n . Gametes are haploid cells. The haploid number in humans is 23. Diploid cells have two copies of each chromosome: one copy from mom and one copy from dad. They are represented as $2n$. Body cells are diploid. The diploid number in humans is 46.
- How do autosomes differ from sex chromosomes?
Autosomes are chromosome pairs 1-22 and they directly affect body traits (physical traits). Sex chromosomes are chromosome pair 23 and directly affect the sexual characteristics of an organism (male or female).
- What genetic material does an organism receive from their mother?
23 chromosomes come from the mother; 22 of these are autosomes and 1 is a sex chromosome (X).
- What genetic material does an organism receive from their father?
23 chromosomes come from the father; 22 of these are autosomes and 1 is a sex chromosome (X or Y).
- What occurs during fertilization?
Fertilization is the actual fusion of an egg and a sperm cell.

- Draw homologous chromosomes.



- Illustrate crossing over.
Refer to Figure 6.20 on textbook page 190.

- Illustrate genetic linkage.

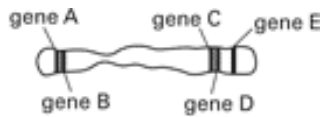


FIG. 6.2

Genes A and B are linked. Genes C and D are also linked. These genes are linked due to the fact that they are so close together, so they are most likely to be inherited together.

- What is the purpose of meiosis?
Meiosis is a form of nuclear division that creates 4 haploid cells (gametes) from one diploid cell. This process involves two rounds of cell division – Meiosis I and Meiosis II. The final product of meiosis is 4 unique gametes (eggs or sperm).

- What are the stages of meiosis? (draw and explain)

Diagram 1

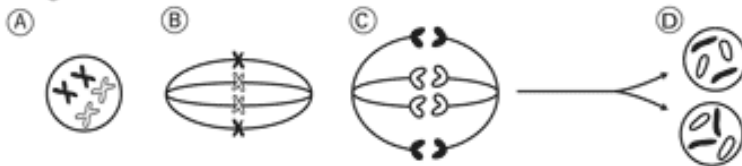


Diagram 2

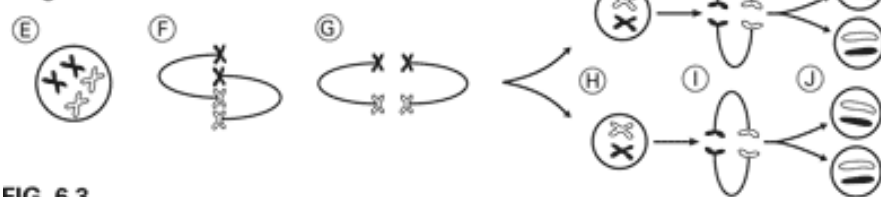


FIG. 6.3

- Process of Meiosis
 - Cells go through (1 round/ **2 rounds**) of division to produce genetically different (**haploid**/diploid) cells.
 - How do homologous chromosomes differ from sex chromosomes?
Homologous chromosomes are two separate chromosomes – one inherited from the mother and one from the father – that have the same length and general appearance. Sex chromosomes are chromosomes that directly control the development of sexual characteristics. Humans have two very different sex chromosomes - X and Y.
 - When do homologous chromosomes separate? **Homologous chromosomes are separated during Anaphase I of Meiosis I.**
 - When do sister chromatids separate? **Sister chromatids are separated during Anaphase II of Meiosis II.**

- Gametogenesis
 - What does the sperm contribute to the embryo? **DNA**
 - What does the egg contribute to the embryo? **DNA, organelles, molecular building blocks, and other materials such as nutrients that an embryo needs to begin life.**

Chapter 7

Extending Mendelian Genetics

Chromosomes and Phenotype

- What is a carrier? What would be the genotype for a carrier of Cystic Fibrosis (C-normal, c- Cystic fibrosis)?
A carrier is someone who does not have a disorder but carries the recessive allele and can pass on the disease-causing allele to offspring.
The genotype for a carrier of Cystic Fibrosis would be Cc.
- What are sex-linked genes? **Genes that are located on the sex chromosomes (X and Y chromosomes).**
 - What are the sex chromosomes for males? **XY** for females? **XX**
 - Do sex-linked traits occur more frequently in males or in females? **Males** Why? **Males have two different sex chromosomes (XY) so they cannot have X-chromosome inactivation to mask alleles on one chromosome like females can due to the fact that they have two of the same sex chromosomes (XX).**

Complex Patterns of Inheritance

- What is incomplete dominance? Provide an example.
Incomplete dominance results in a heterozygous phenotype that is a blend of the two homozygous phenotypes; neither allele is completely dominant or recessive (i.e. red flower crossed with a white flower yields pink flowers).
- What is codominance? Provide an example.
Codominance results in a heterozygous genotype that equally expresses the traits from both alleles; both alleles of a gene are expressed completely and neither is dominant or recessive (i.e. red flower crossed with a white flower yields white flowers with red speckles).
- Identify the following as examples of **incomplete dominance** or **codominance**:
 - a red flower is crossed with a white flower and the offspring are all pink **incomplete dom.**
 - a black cat and a white cat have kittens that are black and white **codominance**
 - a mother with A blood and a father with B blood have a son with AB blood **codominance**
 - a green betta fish and a blue betta fish have offspring that are teal **incomplete dom.**
- Could a baby with O blood have parents with A and B blood? Draw a Punnett Square to explain.

	I^A	i
I^B	$I^A I^B$	$I^B i$
i	$I^A i$	$i i$

Yes, these parents could have a baby with type O blood if both parents were heterozygous ($I^A i$ and $I^B i$) for their blood types then they could each give the baby a recessive allele, which would result in type O blood (ii).

- Define polygenic. Give two examples of polygenic traits. **Polygenic traits are traits produced by two or more genes. Examples of polygenic traits are eye color and skin color.**
- What is represented on the axis (or outside) of a Punnett square? **Genotype of parents**
- What is represented on the inside of a Punnett square? **Possible genotypes of offspring**

Human Genetics and Pedigrees

- What is a pedigree? How is it useful? **A pedigree is a chart that can trace the phenotypes and genotypes in a family to determine the chance that child might have a certain genetic disorder. It is useful because it allows you to determine the chances of offspring inheriting various traits through generations.**
 - squares on a pedigree represent **males**
 - circles represent **females**
 - a circle that has been halfway filled in means: **the female is a carrier of the trait or disease**
 - a circle that has been completely filled in means: **the female has the trait or disease**
- Can a male be a carrier of an autosomal trait? **Yes** of a sex-linked trait? **No**
- How does a son inherit colorblindness? Can he inherit colorblindness from his father? **A son inherits colorblindness if the X chromosome given to him by his mother has the allele for colorblindness on it. A son cannot inherit colorblindness from his father because he only receives a Y chromosome from his father.**
- How does a daughter inherit colorblindness? **A daughter can inherit colorblindness if her mother is a carrier of the trait and her father is colorblind as they can both give her an X chromosome with the allele for colorblindness on it, which would cause her to be colorblind.**
- What is a karyotype? How can it be used to study human chromosomes? **A karyotype is a picture of all of the chromosomes in a cell. It can be used to study abnormalities in chromosomes. For example, an individual with 3 chromosomes, instead of just two, on their 21st chromosome pair would have Trisomy 21.**