

A VERY brief review for the Living Environment regents... some concepts you MUST know.

The Basics: Characteristics of Life, Cells, and Scientific Inquiry

Scientific Inquiry

- A theory is a scientific explanation that is **STRONGLY** supported by a variety of experimental data.
- In order to trust an experiment, the same experiment should be done **MORE THAN ONCE** and get **repeated results**
- A hypothesis is a **PREDICTION**.
- An experiment is carried out to test a prediction.
- If you are told what the prediction is... then this is the hypothesis. For example, "A person claims that plants grow better in increasing amounts of salt. The hypothesis is then "Plants grow better in increasing amounts of salt.
- Every experiment needs a control group.
- The **control group** DOES NOT get the treatment that the prediction/hypothesis is testing. Everything else should be kept the same. Example: Control group DOES NOT get salt.
- The **experimental group** gets the treatment that the prediction/hypothesis is testing. Example: Experimental groups get increasing amounts of salt!
- Be sure that other conditions are kept the same between the control group and the experimental group **EXCEPT** for what you are testing. *Poor experiments are those which do not keep other conditions constant! Improvements to experiments often include minimizing differences between control & experimental.*
- The data to be collected is the **dependent variable**. You collect data based on your prediction. If the hypothesis is that plants grow better with increasing salt then you will measure **if plants really do grow better! So you will measure plant growth.**
- Data that supports your prediction would be if the data you're collecting supports your prediction. So, if plants grew the most in the highest salt concentration.

OR....ask yourselves....

How does _____ affect _____ ?

Independent variable

What you're testing!!

This is the treatment your

Experimental groups will get!

dependent variable

What you're measuring!!

How does salt concentration affect plant growth?

Independent variable

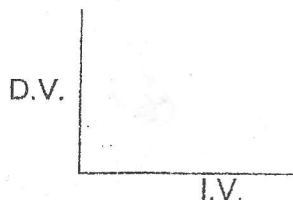
Your experimental groups

will get different salt

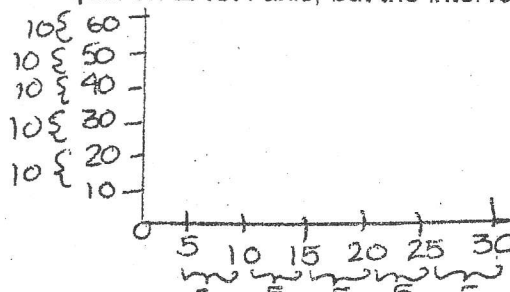
concentrations

dependent variable

You will measure *plant growth*! This is the data you will collect

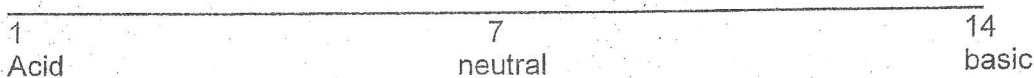


- When graphing, your intervals **MUST** be equal on EACH axis, but the intervals do not need to be the same for the x-axis and the y-axis.

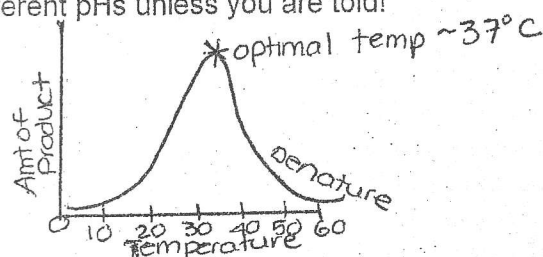
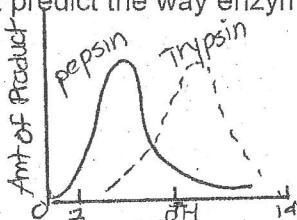


Enzymes

- Enzymes are proteins!
- Enzymes are catalysts!
- Enzymes affect the rate of any chemical reaction **but they are not changed** themselves.
- Enzymes are needed to speed up the rate/increase the speed of ALL chemical reactions in the body! When you think chemical reactions, you think enzymes! (synthesis, digestion, cellular respiration, photosynthesis, DNA replication)
- **ALL organisms in an ecosystem depend on biological catalysts (enzymes).**
- Enzymes are **specific!** Enzymes only work with specific substrates. An enzyme that digests protein will NOT digest starch because each enzyme has a **specific shape**.
- **Temperature** affects enzyme productivity.
- Enzyme productivity can be measured by the amount of **PRODUCT** made. The more product, the better the enzyme is working! If the enzyme is not working well, you will not get as much, if any, product.
- Enzyme activity increases as temperature increases up until a certain point, then enzyme activity decreases.
- The optimal temperature for enzymes is about 37 degrees Celsius (average body temp). This is the temperature at which enzymes work best.
- If the temperature is higher than 37, then enzyme activity decreases. They begin to **denature**, which means that their shapes **CHANGE**, and they can no longer fit their substrate, which means the chemical reaction cannot take place! Be sure you can recognize a graph showing the effect of temperature on the rate of enzyme action OR the amount of product produced. * Die from high fever!
- pH is a measure of whether a substance is acid, neutral or basic.

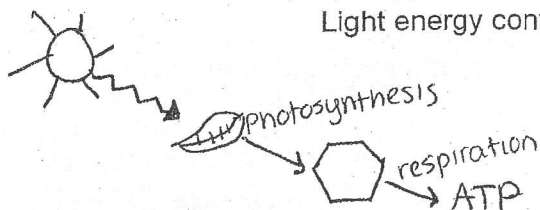
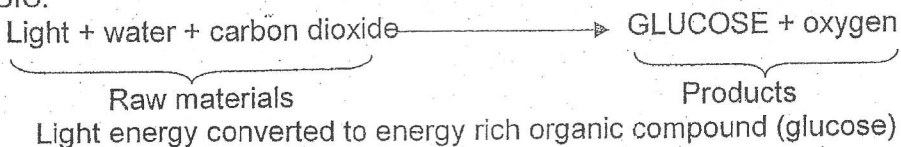


- While most enzymes work best at a neutral pH, all enzymes **DO NOT** have the same optimal pH. Pepsin (enzyme that digests protein in the stomach) works best in an acidic environment (pH of 3) while trypsin (enzyme of small intestine) works best at a pH close to 8.
- You cannot predict the way enzyme will work at different pHs unless you are told!



Cellular Respiration and Photosynthesis

- Cellular respiration and photosynthesis is ALL about the conversion of energy and the cycling of gases.
- It all starts with the sun's energy. The sun is the original energy source.
- Energy from the sun (light energy) comes in contact with the leaf of a plant. **LIGHT** is very important. **LIGHT is needed in order for photosynthesis to occur.** This concept is often tested.
- The sun's energy (solar energy) is used to change (convert) **carbon dioxide and water** into **glucose** (an energy rich organic compound). **Oxygen** is also produced during **PHOTOSYNTHESIS**.
- **Photosynthesis:** Light + water + carbon dioxide → **GLUCOSE + oxygen**



- **Photosynthesis** occurs in the chloroplasts of plant cells. ANIMALS CELLS cannot perform photosynthesis because they do not have chloroplasts.
- **Photosynthesis** is the process by which plants/producers/autotrophs make their OWN food.
- **Photosynthesis produces GLUCOSE. Only plants make glucose. BUT, both plants and animals USE glucose. Plant and animal cells have MITOCHONDRIA that uses glucose.**
- **LIGHT is needed for the synthesis of glucose by plants.**
- Glucose may be referred to as an organic nutrient.
- **Cellular Respiration** is the process where stored energy from glucose (energy rich organic compound) is released and converted into usable energy for the cell, which is ATP.
- **Cellular Respiration** occurs in the mitochondria of plant and animal cells.
- ATP is an energy rich molecule that is produced from the process of **cellular respiration**
- **Cellular respiration NEEDS oxygen.** The oxygen comes from plants- a product of photosynthesis. This is **IMPORTANT**- this is how oxygen is cycled throughout an ecosystem.
- **Cellular respiration:** $\text{Glucose} + \text{oxygen} \rightarrow \text{carbon dioxide} + \text{water} + \text{ATP}$

Raw materials
Glucose- energy rich compound

Products
ATP- energy rich compound

- **PLEASE NOTE** that oxygen and carbon dioxide are gases that are cycled through an ecosystem. **Oxygen produced by plants through the process of photosynthesis** is used by organisms for the process of cellular respiration. **Carbon dioxide produced through the process of cellular respiration** is used by plants for the process of photosynthesis. **THIS IS VERY IMPORTANT.**
- When carbon dioxide is produced, cellular respiration has occurred.
- When oxygen is produced, photosynthesis has occurred.
- When organisms break the bonds of organic compounds (such as glucose), the organisms can obtain (get) energy or reassemble the resulting materials to form different compounds.

Endocrine System/Homeostasis/Feedback Mechanisms

- Glands secrete hormones.
- Hormones are chemical messengers that will FIT with certain **receptor molecules** on target cells.
- Hormones are important for communication between cells. This is cellular communication.
- When a hormone arrives at its target cell, fits on the cell's **receptor molecules**, an action occurs.
- The **PRIME EXAMPLE** of the endocrine system and feedback mechanisms is insulin.
- **Insulin** is a hormone that signals/prompts glucose to move from the blood into the cells. Insulin is responsible for lowering **blood glucose level**.
- The **pancreas** is the gland that secretes insulin.
- If a person does not produce insulin, their blood sugar level will be **high**. This is a sign of diabetes. If the blood sugar level is high, homeostasis is not maintained.
- Feedback mechanisms is a cycle that detects deviations from the normal state of homeostasis.
- Insulin secretion and blood sugar level are maintained by a feedback mechanism.
- Homeostasis/dynamic equilibrium in an organism can be accomplished through the release of insulin to lower blood sugar level, sweating (perspiring) when you are hot, shivering when you are cold.
- **HORMONES AND SECRETIONS OF THE NERVOUS SYSTEM ARE CHEMICAL MESSENGERS THAT COORDINATE SYSTEM INTERACTIONS.**
- **In plants, GUARD CELLS** are specialized cells that surround openings or pores on the **surface of the leaf**.
- At these pores, stomata, gas exchange occurs.
- Guard cells close when the leaves detect a water shortage (a very hot dry day). The guard cells close so that the leaves will not lose water. This is a feedback mechanism within leaves to maintain homeostasis.

Digestive/Respiratory/Circulatory/Excretory/Nervous Systems

- Digestion- food is passed through and broken down so that nutrients can enter cells.

- Digestion- nutrients(glucose) are absorbed at the small intestine and diffuses into the blood.
- Digestion is important because food is processed into molecules that are small enough to pass through cell membranes and that can be transported to wherever nutrients can be used in the body.
- As blood flows through the digestive system, there is an INCREASE in glucose in the blood.
- Respiratory- exchange of gases between blood of circulatory system and environment. Breathe in oxygen and exhale carbon dioxide.
- Gas exchange occurs at the alveoli of the lungs.
- The respiratory system works HAND IN HAND with the circulatory system. When you breathe in oxygen (respiratory system), at the alveoli, the oxygen diffuses from the alveoli into the blood. The blood then carries oxygen to your cells for the process of cellular respiration.
- On the same note, carbon dioxide produced as a waste product from cellular respiration diffused from the blood into the alveoli which is then exhaled (exits the body).
- IT IS VERY IMPORTANT TO UNDERSTAND THE WAY THE RESPIRATORY SYSTEM AND THE CIRCULATORY SYSTEM WORK TOGETHER. Circulatory system is blood travelling throughout the body delivering materials to cells and removing their wastes.
- The faster the heart pumps(circulatory system), the faster materials are brought to the cells and the faster wastes are removed.
- An increase in pulse rate (circulatory system) allows oxygen to be delivered to cells FASTER. This allows for ATP to be produced at a faster rate since oxygen is needed in order to cellular respiration to occur.
- **An increase in heart rate will most likely result in an increase in pulse rate.**
- **The digestive system and the respiratory system provide materials that are required for the human body to produce ATP.**
- Excretory/Excretion- the removal of metabolic wastes from the body. These are wastes produced by cells such as urea, carbon dioxide, salts. THIS DOES NOT INCLUDE WASTE PRODUCTS OF DIGESTION which is undigested food.
- Excretory- removal of nitrogenous wastes.
- Excretory- the kidneys, sweat glands, and the lungs(removal of carbon dioxide), are all used for excretion. The kidneys FILTER wastes.
- **Nervous system**-nerve cells- also used for cellular communication like **endocrine system**.
- Nervous system- neurotransmitters- also chemical messengers- are secreted between two nerve cells next to each other. Also have specific **receptor molecules**. **CELLULAR COMMUNICATION.**
- **HORMONES AND SECRETIONS OF THE NERVOUS SYSTEM ARE CHEMICAL MESSENGERS THAT COORDINATE SYSTEM INTERACTIONS.**

Male Reproductive System

- Testes are the organs that produce sperm(male gamete) through the process of meiosis.
- Testes also produce hormone testosterone – sexual development and reproduction. Brings about a change in physical characteristics.
- System important for the production of sperm and delivery of the sperm **internally** to the female.
- Shares structure with the urinary system (both sperm and urine exit from the same place!)

Female Reproductive System

- Contains structures for **internal fertilization and internal development**- very important. Mammals have adaptations for internal fertilization and internal development.
- Ovaries are the organs that produce eggs(female gamete) through the process of meiosis.
- Ovaries also produce the hormones estrogen and progesterone which are needed for sexual development and reproductive processes. (Menstrual cycle).
- Fertilization (union of the sperm and the egg), occurs in the **oviduct**.
- The oviduct leads to the **uterus**.
- The **uterus** is where the embryo develops into to the fetus.
- Hormones are responsible for all the important changes that occur within the uterus.
- A **placenta** forms at the wall of the uterus. Responsible for the passage (by diffusion) of nutrients and oxygen from the **mother's blood** to the **fetus**. Wastes from the **fetus** also diffuse **to the mother's**

blood through the placenta. ALL about the exchange of materials between the mother and the fetus. This is **NOT** the sharing of blood between the mother and the fetus. It is an **EXCHANGE of materials between mother and fetus.**

- Alcohol and drugs can result in brain damage to a developing fetus. X-rays can cause mutations to a developing fetus.
- External fertilization- lay a lot of eggs because many do not get fertilized. May be eaten by predators.
- In reptiles and birds, the shell does not form until after fertilization, so ~~must~~ ^{must} be internal fertilization.

Human Development

- During fertilization, the gametes UNITE. A sperm meets with an egg in the oviduct. Union of the sperm and an egg.
- A zygote is formed when a sperm fertilizes an egg.
- It is very important to realize that the sperm and the egg each had UNPAIRED chromosomes, which became paired after fertilization.
- The sperm and the egg carry HALF of the genetic information of an organism. Because they have HALF the number of chromosomes.
- When fertilization occurs, the chromosome number is now complete and the chromosomes are paired together.
- Gametes (sperm and egg) contain HALF as much DNA as all other body cells.
- The zygote gets half of its DNA from the sperm and half of its DNA from the egg.
- Since a sex cell (gamete) contains a unique combination of genetic material, the random combination of an egg cell and a sperm cell contribute to VARIATION...differences amongst organisms.
- The zygote divides by **mitosis** to form a multicellular organism.
- The cells that are formed by mitosis undergo **differentiation** or **specialization**. This means that the cells become different from one another. They each have their own purpose.
- The development of specialized tissues and organs in a multicellular organism directly results from **differentiation**.
- The characteristics of a developing fetus are most influenced by gene combinations and their expression in the embryo.
- **Genes, hormones, and cell location** play a direct role in embryonic development.
- **DIFFERENT GENES ARE ACTIVATED OR DEACTIVATED in certain cells causing them to become different from one another.** This activation can be due to environmental influences from within the cell, surrounding cells, or from outside the organism. **THIS IS VERY IMPORTANT.**
- **DIFFERENT PARTS OF GENETIC INSTRUCTIONS ARE USED IN DIFFERENT TYPES OF CELLS!!! THIS IS VERY IMPORTANT.**
- When a gene is activated, this means that the gene is **expressed**. **GENE EXPRESSION CAN BE MODIFIED THROUGH INTERACTION WITH THE ENVIRONMENT.** The GENE does not change due to the environment BUT the environment can play a large role in the *expression of this gene*. **THIS IS VERY IMPORTANT**
- **The environment of an organism can influence the expression of certain genes.**
Examples: Fruit flies supposed to have curly wings will have straight wings if raised in a cooler environment.
If a plant is grown without light, the plant may be white instead of green because sunlight (environment) is needed to STIMULATE the gene that produces chlorophyll.

**** A cell resulting from the fertilization of an egg begins to divide and two cells that are normally attached become separated- identical twins- the cells would each have all of the needed genetic information and both could survive.**

**** Fraternal twins- two separate sperm fertilize two different eggs at the same time. NOT genetically identical.**

osis

- Asexual reproduction!
- Asexual reproduction involves ONE parent
- Asexual reproduction results in offspring that are **genetically identical** to the parent AND each other.
- Examples of asexual reproduction: mitosis (cells); an amoeba divides to form two new amoebas; a yeast cell divided into two cells that are different sizes but genetically alike; **mold spore cells reproduce the mold** (Diagram page 53).
- Mitosis- cell division. ONE CELL TURNS INTO TWO CELLS.
- Mitosis- Before a cell divides, the DNA **replicates- makes a copy of itself**. One copy of this information is distributed to each new cell.
- Multicellular organisms use mitosis for **growth**, cell replacement and **repair**.
- Mitosis produces two cells that have identical information.
- Uncontrolled mitosis/uncontrolled cell division- mitosis out of control is a cause of cancer.

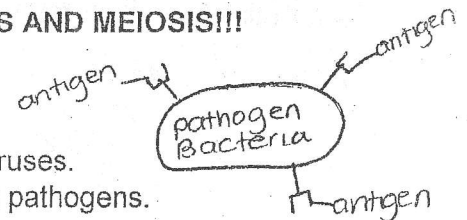
Meiosis

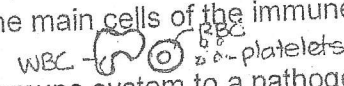
- Meiosis is the process by which SEX cells (gametes) are produced.
- Meiosis is needed in order for sexual reproduction to occur- need a sperm AND an egg.
- Each sex cell, produced by meiosis, has only half the genetic material needed for a cell to function properly.
- Only one chromosome of each pair (remember, chromosomes come in PAIRS), is found in a sex cell.
- When a sperm cell and an egg cell join, through the process of fertilization, all of the newly paired chromosomes and all of the required genetic information are present in the zygote.
- Meiosis (meiotic cell division) begins with a body cell.
- Meiosis ends up with sex cells.
- The offspring of meiosis have HALF the number of chromosomes as the original parent cell.
- Meiosis occurs in the testes and the ovaries.
- In men, in the testes, FOUR sperm cells are produced.
- In women, in the ovaries ONE function egg cell is produced. The other three disintegrate and are known as polar bodies.
- Human egg cells and sperm cells have the same chromosome number.
- Meiosis is a source of **variation**. Due to meiosis, we are genetically DIFFERENT from our siblings because sperm and eggs are not identical to each other when they are produced.
- **The hereditary information (genes) that determines the traits of an organism is located in only those cells produced by meiosis (sex cells!)**
- **Changes in the genetic code of a human can be transmitted to offspring if they occur in GAMETES (SEX CELLS) (CELLS PRODUCED BY MEIOSIS)**
- **Crossing over- the exchange of pieces of chromosomes** that may occur during meiosis also enhances variation. This results in a **unique combination of genetic information**.
- Down syndrome- extra chromosome in the body cells of humans. This occurred in a gamete as a result of an **error in meiotic cell division. Sometimes referred to as NONDISJUNCTION OR TRISOMY.**

****DNA REPLICATION OCCURS BEFORE CELL DIVISION IN BOTH MITOSIS AND MEIOSIS!!!**

Immune System

- Protects the body from foreign invaders known as **pathogens**.
- The body's defense mechanisms from pathogens such as bacteria or viruses.
- Combats invaders- the body's primary defense against disease-causing pathogens.
- Pathogens threaten our HOMEOSTASIS- they throw us off balance!
- Pathogens can be identified by molecules on their outer surface or membranes, known as **antigens**.
- Antigens are **NOT** part of the immune system, they are molecules on the surface of pathogens that **trigger a response from the immune system**.
- Antigens TRIGGER an immune response.
- When cells of our immune system recognize a foreign **antigen**, our defense system responds.



- WHITE BLOOD CELLS are the main cells of the immune system. They are BIGGER than red blood cells and not a perfect circle. 
- A possible response by the immune system to a pathogen, are for white blood cells to **surround and engulf** invading pathogens.
- Another possible response by the immune system to a pathogen, are for white blood cells to produce **antibodies...NOT antigens. DO NOT CONFUSED ANTIBODY AND ANTIGEN.** An antibody is part of OUR immune system.
- Antibodies are proteins that either attack or kill the invaders or mark them for destruction.
- Antibodies are very **specific for specific pathogens.** Antibodies produced for one pathogen will not work for other pathogens!!!
- After you get sick from one pathogen, some specialized white blood cells remain and multiple quickly producing more antibodies of the same kind to fight off later invasion of the same pathogen. This is why you don't get the chicken pox twice! You already have the antibodies!!
- **YOU MUST UNDERSTAND VACCINES!** A vaccine is a dead or weakened pathogen.
- The antigens found on the dead or weakened pathogen **stimulate the production of antibodies.**
- After a vaccine (vaccination), the immune system remembers specific pathogens by leaving behind white blood cells that protect the body for years.
- The body responds SO QUICKLY if it is exposed to the real pathogen that in most cases, the disease doesn't have time to develop because the white blood cells are already familiar with this pathogen thanks to the vaccine.
- Vaccines are specific since antigens are specific! The chicken pox vaccine will not protect again the mumps because the antibodies produced were specific for the antigen on the pathogen!
- **The use of a vaccine to stimulate the immune system to act against a specific pathogen is valuable in maintaining homeostasis because the body will be able to fight invasions of th same type of microbe in the future.**
- AIDS is an attack on the immune system.
- The pathogen that causes AIDS is a virus.
- The AIDS virus invades white blood cells.
- Since a person with AIDS has fewer white blood cells, they will not be able to fight future infections as effectively.
- AIDS can be prevented by not sharing needles, protected sex, not exchanging body fluids etc.
- **Allergies** occur when a person's immune system responds to a substance which should not be harmful. An immune system reaction to potentially harmless substances. The immune system releases substances called histamines which cause runny noses and sneezing!
- **Transplanted organs-** come from another person. So, the immune system may recognize the transplant as invaders and attack the organ.
- To avoid rejection of a transplant, patients received injections of drugs to weaken their immune system. Then, the patient may become ill from a pathogen that would normally not harm it.
- Antibiotics- do not protect against future attacks.

DNA/Protein Synthesis

- DNA is made of thousands of smaller subunits- nucleotides.
- DNA has two strands.
- DNA has a sugar-phosphate backbone.
- The **molecular bases, nucleic bases, nitrogen bases** of DNA are Adenine, Thymine, Cytosine, and Guanine. (A,T,C,G).
- The way the four different molecular bases arrange themselves in sequence is what makes everyone's DNA different!
- of DNA form genes. Genes are carried on chromosomes. Chromosomes are found in the nucleus.
- DNA is passed from one generation to the next through chromosomes. Chromosomes carry genes.
- DNA → gene → chromosome → nucleus. There is more DNA than genes. There are more genes than chromosomes. And there are more chromosomes than nuclei! **YOU MUST UNDERSTAND THIS ORGANIZATION.**

- Proteins are responsible for most of the work in our cells. They are our enzymes and they are responsible for many of our traits.
- Protein molecules (polypeptides) are made up of long chains of 20 different kinds of **amino acids** arranged in a specific sequence.
- The sequence of amino acids in a particular protein influences the shape of the protein.
- Proteins are different from one another due to their amino acids sequence!
- Proteins are made at the **ribosomes!** Ribosomes are the site of protein synthesis in the cell.
- Proteins are made according to the directions stored in the cells DNA code.
- The genetic code of a DNA molecule is determined by a specific sequence of molecular bases.
- The DNA code tells the cell what the sequence of amino acids should be to make a particular protein.
- **Cells contain DNA that controls the production of proteins.**
- Let's say we have a DNA code of AGAGATCCGTATAGGGCGCGTATTATATTCGCCGCG

This section of DNA (9-base DNA sequence) codes for one gene.
This gene codes for a PROTEIN.

- **AGA GAT CCG TAT** are codons.
- Each codon codes for an amino acid.
- Therefore, the sequence of amino acids is determined by the molecular bases of DNA.
- A change in the DNA sequence, in the genetic code, is known as a mutation. A mutation will result in a change in the sequence of amino acids. This will result in a different protein!
- **MUTATION:** a change in the sequence of DNA base. → joining amino acids in sequence → appearance of characteristic.
- An environmental factor that could cause a mutation is radiation, ultraviolet light (sun), chemicals, x-rays.
- DNA is found in the nucleus and proteins are made at the ribosome.
- The nucleus and ribosomes are both needed for protein synthesis. The genetic code, DNA, will determine the amino acid sequence which is joined at the ribosome to form a protein.
- **The synthesis of subunits in a protein is most directly dependent on the DNA in the chromosomes of a cell.**
- Sometimes, you will be asked to change the DNA code to mRNA.
- Don't forget there is no "T" in RNA! "T" becomes "U"! So....DNA code of AACTCTAG becomes... **UUGAGAUC** in RNA..
- You may also be asked to figure out an amino acid sequence based on EITHER the DNA code or the RNA code. PLEASE make sure to read the table they give you. If the table includes RNA codes, then you must change the DNA to RNA.

An example of an RNA table.

Base your answer to question 73 on the portion of the mRNA codon chart and information below.

AUU } AUC } AUA }	ILE (Isoleucine)	ACU } ACC } ACA }	THR (Threonine)	AAU } AAC }	ASN (Asparagine)	AGU } AGC }	SER (Serine)
AUG } AUG }	MET (Methionine)	ACG }		AAA } AAG }	LYS (Lysine)	AGA } AGG }	ARG (Arginine)

- The regents will tell you which table they are giving you! Also, when you see "U", you should know right away we are talking about RNA.
- If, they give you a table with DNA codons, you don't need to waste your time changing to RNA.

An example for a DNA table (next page)

no "U!"

Base your answers to questions 58 through 60 on the table below, which represents the DNA codes for several amino acids.

Amino Acid	DNA Code Sequence
Cysteine	ACA or ACG
Tryptophan	ACC
Valine	CAA or CAC or CAG or CAT
Proline	GGA or GGC or GGG or GGT
Asparagine	TTA or TTG
Methionine	TAC

Look!
It has "T"!

BE VERY CAREFUL!!! READ EVERYTHING VERY CAREFULLY!!

- Don't forget mutations are ANY change in the DNA code, in the sequence of bases. They are NOT all bad! Some are beneficial.

Genetic Engineering

- Technique that humans use to alter genetic instructions in organisms
- Altering organisms to have **more desirable traits**.
- **Selective breeding**- produces new animals and plants that have particularly desirable. The regents will often give you a situation where two organisms each have one positive trait and one negative trait, You want to create an organism that has BOTH positive traits. This is done through selective breeding.
- Hormones can be made in a lab, such as insulin. With a specific enzyme, cut the DNA so that the gene for insulin is removed. Using the same specific enzyme, cut bacterial DNA so that you can insert the human insulin gene into the bacterial DNA.
- The **recombinant DNA**, the plasmid, is put back into the bacteria so that it can be reproduced over and over again.
- You must know that a specific enzyme is needed and that this technique is used to make hormones or enzymes, or other body chemicals that an organism is missing.
- The production of certain human hormones by genetically engineered bacteria results from **combining a portion of human DNA with bacterial DNA and inserting this into bacteria**.
- Cloning- technique that accomplishes the same result as asexual reproduction- **genetically identical organisms. SAME DNA!!!** Cloning will produce genetically identical organisms.
- Cloning produces organisms of the same sex. YOU CANNOT have a male and female produced through cloning.
- Cloning may be done if you want all organisms to have a particular trait.
- Cloning is NOT accomplished sexually. It is like asexual reproduction which is **FASTER** than selective breeding.

Ecology

- When the number of organisms in a ^{population} ~~population~~ quickly increases but then stabilizes, demonstrates that the population size became limited due to factors such as availability of food. It reaches its **carrying capacity**.
- Autotrophs- producers- carry out photosynthesis (plants/algae)
- Heterotrophs- herbivores or carnivores- cannot carry out photosynthesis. Do NOT make their own food.
- A sequence of stages leading from bare ^{field} ~~field~~ to a complete forest is known as **ecological succession or succession**.
- **Ecological succession** is responsible for changes in types of vegetation (plants) over time.
- **Lichens and mosses make the environment suitable for complex plants and that is why they are the first organisms to grow in an area.**

- Preserving endangered species helps preserve biodiversity as well as the availability of genetic material. You can preserve endangered species by preserving their habitats and restricting hunting.
- Global warming, an increase in temperature could reduce the populations of certain species.
- Renewable resources, increase living spaces for wildlife, and increase diversity of plant species is **GOOD**.

State Lab Reminders

Diffusion Through a Membrane

- Indicators are used to test for the presence of a molecule. If that molecule is present a reaction will occur, and the solution will likely change color.
- Understand what happens to a cell when it is placed in distilled water and salt water.
- Made a cell out of a dialysis tubing bag. Added glucose and starch to the "inside of the cell." Tested for the presence of sugar and starch through indicators. When a molecule was present, change in color occurs.
- Glucose was able to leave the cell because it was small enough. Starch was too big, so it did not leave.
- An indicator is a substance that changes color when it contacts certain chemicals. When contacts certain chemicals, change in color occurs! If chemicals not present, solution will NOT change color!
- When making a wet mount- a slide where you add something WET, the coverslip needs to be put on carefully. The coverslip needs to be lowered from one side carefully to prevent the formation of air bubbles.
- If need to change the solution of a slide.. **VERY SPECIFIC STEPS**. If changing from salt solution to distilled water (to see cell expand): Paper towel should be placed along one edge of the coverslip. The water should be placed along the edge of the coverslip opposite the paper towel.

Making Connections

- Increase in heart rate will most likely result in an increase in pulse rate.
- Squeezing clothespin- the more trials, the fewer the number of squeezes...fatigue!
- Respiratory system and circulatory system work together. Faster pulse rate after exercise because the faster pulse rate indicates a faster heart beat. The faster blood is pumped, the faster oxygen is brought to the cells. This will allow for an increase in the rate of cellular respiration which produces energy (ATP).
- Respiratory system is the system by which oxygen is brought into the blood. The circulatory system (the blood) delivers oxygen to the cells.
- Respiratory system eliminates waste of carbon dioxide. Carbon dioxide is carried away from the cells by the blood (circulatory system).
- Understand how pulse rate changes depending on the activity. Pulse rate increases with exercise. Decreases when at rest.

Biodiversity

- **Gel Electrophoresis**- allows scientists to **separate mixtures of large molecules according to size**. Often used to separate DNA.
- The reason the DNA runs from the top of the gel to the bottom of the gel is because the negative charge of DNA is attracted to the positive charge at the bottom of the gel. DNA travelling from a negative charge to a positive charge.
- The bigger molecules get dropped off first! The smallest molecules travel the furthest down the gel.
- **Specific enzymes** are used to prepare the DNA.
- You can tell that the DNA of each species is different if the band patterns on the gel are different.
- The more closely related two species, the more similar the band patterns. The more bands of DNA they will have in common.
- **Paper chromatography** is also a technique used for separating mixtures of molecules! Gel electrophoresis and paper chromatography are used for **separating mixtures of molecules**.

- A small dot of the extract is placed at the bottom of the paper. Then the end where the dots are placed are placed in a solvent (water). As the solvent soaks the paper, substances in the mixture will move along with the solvent and the substances will be moved along at different rates. Bands of colors appear as the separation occurs.
- The rate at which a substance moves along the paper in a given solvent can be used to separate it from other substances. Species with more similar colors are more closely related.
- Take home message--- organisms can LOOK ALIKE but have different DNA! Just because something looks alike, doesn't mean they share molecular evidence.

Beaks of Finches

- *make sure you know how to read them!* Cladograms- the **more recent the common ancestor**, the more closely related the two species.
- The different tools used in the lab represent different beaks.
- Different beak structures demonstrate that there is a large and varied food supply.
- Increased competition over the same food supply decreases survival rate.
- Finches with similar beaks will compete over the same food supply.

... notes / handouts.