**Study Guide For EOC!!**

**DNA**

* **DNA**- **Deoxyribonucleic acid**. This is what makes you, you! It is located in the nucleus of every cell in your body.
* It is a nucleic acid which means it is made of **nucleotides**.

A nucleotide is made of three things- a phosphate, sugar, and a base.

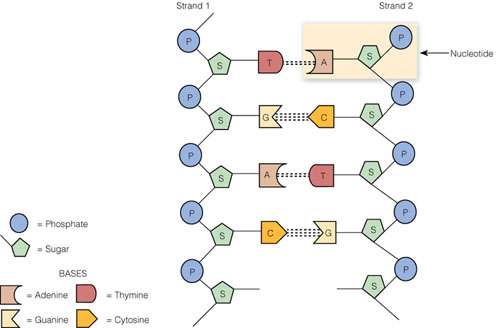
* The sugar in DNA is **deoxyribose** (look at its name).

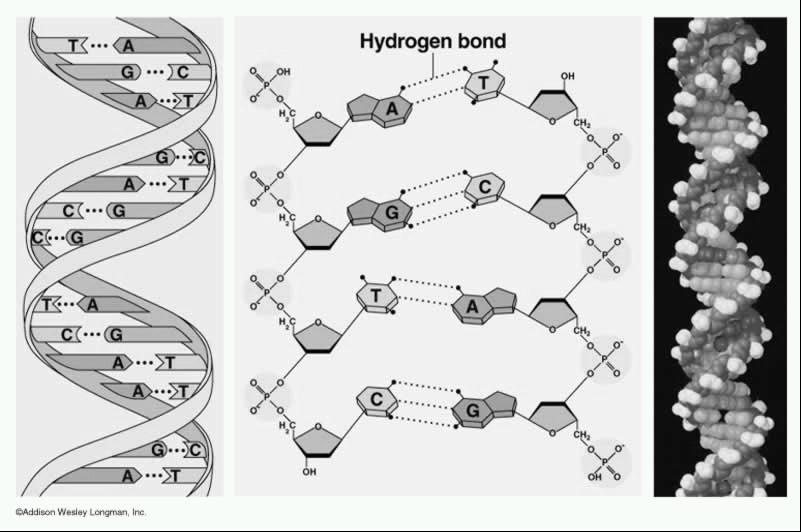
There are 4 bases- **Adenine**, **Thymine**, **Guanine,** and **Cytosine**.

A goes with T G goes with C

* The bonds that connect the bases are called **hydrogen bonds** which are weak so the DNA can unzip. The strong bonds which connect the sugars and the phosphates are **covalent bonds**.
* **Watson and Crick** discovered the shape of DNA which is a **double helix**.

**Hydrogen Bond**

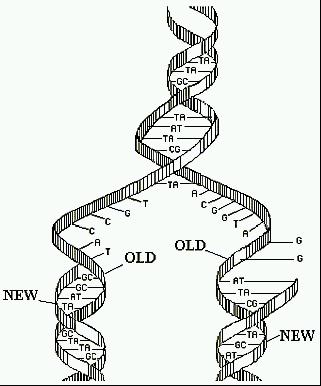




**Covalent bond**

**DNA replication** is how we make more DNA. It happens during the **“S” or Synthesis phase** of interphase. DNA has to be replicated before your body can make new cells or **before cells divide**. This happens in the nucleus. DNA is **semi-conservative** because the new strand of DNA have one strand from the “old” DNA and one “new” or complementary strand of DNA.

The DNA unzips down the middle by breaking the hydrogen bonds and then bases come and match up. The new matching strand is called the **complementary strand**. This makes two identical strands of DNA.



* You should be able to match up DNA during replication like below: If DNA is **AGCTTACTTGG**
* The **complementary strand** would be **TCGAATGAACC**
* **Mutations**- Sometimes when DNA is replicating there are mistakes called mutations. Mutations **can be good or harmful**. They **cause variations** and are passed on to offspring if they occur in the gametes. Mutations can be random and spontaneous or caused by **exposure to a chemical or radiation**.
* **Addition or insertion mutations**: adding a base to the DNA strand
* **Deletion mutation**: deleting a base from the DNA strand
* **Point mutations**: Changing one base to another. For instance changing a “G” to a “T”.

**RNA**

* **RNA**- Ribonucleic acid- used to make proteins
* This is another type of nucleic acid. It is also made of nucleotides.

The sugar is **ribose**.

It is single stranded and has **Uracil** instead of Thymine.

So U goes with A G goes with C

* mRNA is made in the nucleus from DNA and the process is called **Transcription**.
* Be able to match up the correct RNA with the DNA like below:

DNA Strand: AGCTTCTTAGGC

RNA Strand: UCGAAGAAUCCG

* There are three types of RNA:

**mRNA**- messenger RNA—it takes the message from the DNA to the ribosome

**tRNA**- transfer RNA- it bring the amino acids to the ribosome

**rRNA**- ribosomal RNA- this makes up the ribosome

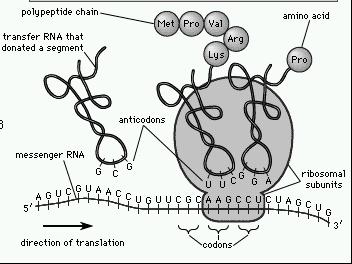
**Codon**- every three bases on an mRNA strand. Used to find the amino acid.

**Anticodon**- three bases on the tRNA

The codon and anticodons will match up during translation.

**Translation**- when the cell makes a protein from RNA. Happens in the ribosome

1. the mRNA hooks into the ribosome
2. the tRNA brings in the amino acid- anticodon matches up with codon
3. a peptide bond forms between the amino acids making a protein or polypeptide chain.



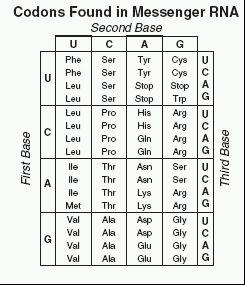
**Translation**

**mRNA**

**Ribosome**

**tRNA**

* In order to find out what amino acid will match up we must use the amino acid chart. We look at the codons on the mRNA to find out the amino acid.



Ex. If mRNA codon is CCG then the amino acid from the chart is Pro

If DNA is TGA then the mRNA is ACU and the amnion acid is Thr

**Translation (ribosome)**

**Transcription (Nucleus)**

**Trait or Phenotype**

**DNA**

**Protein**

**RNA**

* If a mutation occurs in the DNA or RNA then the protein will change which will result in a different phenotype.

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**Genetics**

* **Gregor Mendel** is considered the father of genetics. He worked with Pea plants to discover the basic concepts of genetics.
* Two important Laws that Mendel developed:

**The law of independent assortment**- this law states that the alleles for each of our traits are inherited separately. Or the genes get shuffled. Example brown hair does not have to be inherited with brown eyes.

**The law of segregation**- this states that our alleles for a trait are separated when our sex cells are formed (meiosis)

* **Alleles**- different versions of a gene for a trait. Example either Tall (T) or short (t)

**Dominant**- the trait that takes over or covers up the recessive. (T)

**Recessive**- a trait that gets covered up (t)

**Heterozygous** or **Hybrid**- when a person has two different alleles, Tt.

**Homozygous** or **Pure**- when a person has two of the same alleles, TT or tt.

TT and Tt will show the dominant trait tt will show the recessive trait (all small!)

**Genotype**- the alleles or letters a person has (TT, Tt, tt)

**Phenotype**- the physical trait a person has ex. Tall or short

* **P** generation= parent **F1**- kids **F2**- grandkids
* **Simple Mendelian Inheritance:**

Blue is dominant to yellow. A hybrid blue is mated with a yellow.

Tall is Dominant to short.

If a Heterozygous Tall plant is mated with a Pure Tall plant.

B

b

b

b

B

b

B

b

b

b

b

b

Phenotype

50% blue

50% yellow

Genotype

Bb 50%

Bb 50%

T

T

Phenotype:

100% Tall

Genotype:

TT 50%

Tt 50%

T

T

T

T

T

t

T

T

t

t

* **Incomplete Dominance**: this is when both alleles are dominant. (use two big letters). There are three phenotypes. This is where two traits mix.

Red (RR) X white (WW) = Pink (RW)

* **Codominance**: this is when both alleles are dominant. (use two big letters). There are three phenotypes. This is where BOTH traits show up.

Red (RR) X white (WW) = Roan or Red and white (RW)

**Sickle Cell Anemia** is an example of a **codominant** disease. It is more common

in African Americans. It protects someone from **malaria**. It can cause severe



pain. The blood cells are sickle shaped.

You can be normal (NN), a carrier (NS) or have sickle cell (SS). If you are a

carrier you have both normal and sickle blood cells.

If a person who is a carrier and a person who has sickle cell mated

50% would be carriers (NS)

50% would have sickle cell (SS)



* **Multiple Alleles**- this is when you have more than two alleles. An example is blood type.

There are four blood types:

A- AA or Ai

B- BB or Bi

AB- AB

O- ii

O is the recessive blood type and AB is the codominant blood type. The A and B

represent antigens or sugars on the blood cell.

Diana has blood type AB. Her husband Quentin has blood type A. His parents were A and O.

Their children could be:

25% AB 50% A 25% B

Lori has blood type O. Her husband Bobby has blood type B. His parents were both AB.

Their children could be:

100% B





* **Polygenic Inheritance**- these are traits that are controlled by many genes. It results in a variety of traits. Ex. hair and skin color and height.
* **Sex-linked or X-linked-** Sex in on the X! Girls- XX Boys- XY

Sex-linked traits are on the X chromosome. NOT on the Y. When working a

punnett square make sure to use the X’s and Y’s ONLY if it mentions that its

sex-linked. Sex-linked diseases are more common in males because they only have 1 X.

**Hemophilia** is a sex-linked recessive disease. It is when someone’s blood does

not clot and they keep bleeding even from small cuts.

**Red-green colorblindness** is a sex-linked recessive disease. A person cannot tell the

difference between red and green.

Hemophilia is sex linked recessive. Heather has hemophilia and her husband is normal

Colorblindness is sex linked recessive. Holly is a carrier and her husband is colorblind.





50% of the children are colorblind

50% of the girls are colorblind

50% of the boys are colorblind

50% of the children will have hemophilia

0% of the girls have hemophilia

100% of the boys have hemophilia

There are some genetic diseases that you will have to work with punnett squares with.

**Cystic Fibrosis**- it is a disease that is **autosomal** **recessive** disease

(not- sex linked) and is characterized by the person having a thick mucus

in the lungs and digestive track.



A man is a carrier and his wife has cystic fibrosis

50% of the children normal

50% have the disease

**Huntington’s disease**- In this case the person has nerve damage and results

in death. It is an **autosomal dominant** disease.



A man is normal and his wife is homozygous for Huntington’s.

100% of the children have the disease

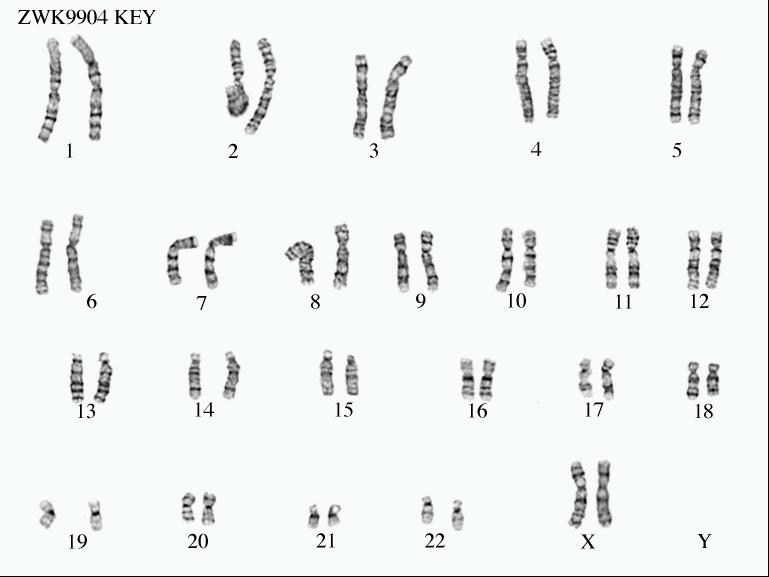
* Sometimes in Meiosis the chromosomes fail to separate called **Nondisjunction**

which results in the baby having too many or too few chromosomes.

* **Karyotype** is a picture of someone’s chromosomes and is used to identify

genetic diseases caused by nondisjunction.

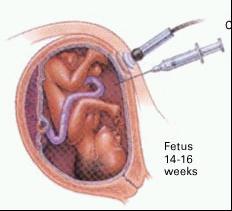
girl

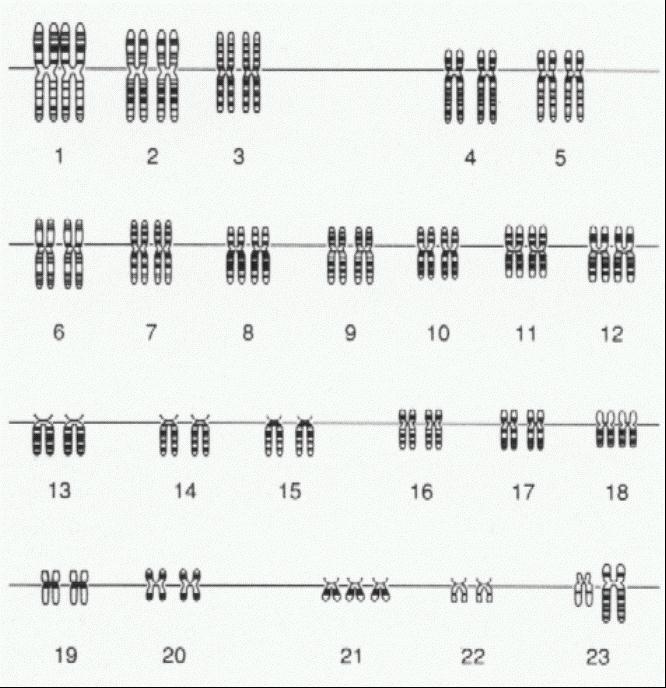


* An **Amniocentesis** is when you take fluid from a pregnant woman and

do a karyotype to determine if the unborn baby has a genetic disease

**Down’s Syndrome**- this is caused by nondisjunction.



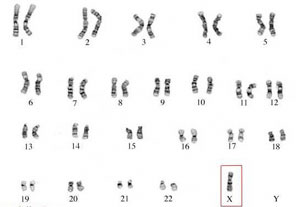


The person has three 21 chromosomes and so a total

of 47 chromosomes. It can also be called trisomy 21.

This person has a low IQ.

Boy



**Turner’s Syndrome**- This is a disease also caused

by nondisjunction. It is when a girl is missing an X.

So she only has 45 chromosomes. It is often represented by XO.

* There are some diseases that are caused by your genes but also by your

environment: **Diabetes, Asthma, Heart or Cardiovascular disease and Cancer**. Remember traits can be entirely based on genetics entirely based on environment, or both. You could have these diseases in your DNA OR you could live in a way that causes you to get these diseases.

**Pedigrees**

A pedigree is a family tree to show how a family inherits their trait.

A is a girl. A is a man. If it is colored in then they have the trait or disease.

If the trait is in every generation then it is a dominant trait

**If the trait is in only a few people and it’s in boys and girls than it is recessive**.

**If it’s in only a few people and they are mostly boys then it is sex-linked recessive**



Autosomal Recessive



Sex linked recessive

* Remember that if the parents are normal and the child has the disease then the parents must be heterozygous.

**Biotechnology**

* **Human Genome Project**- a project that decoded all of the 3 billion bases (AGCT’s) in our human DNA. The purpose of this was to help us locate genetic diseases in our DNA and to perhaps one day find a cure. It could also result in designer babies.
* **DNA Identification or Gel Electrophoresis**:

This is when we cut up our DNA using **restriction enzymes** and run it through

a gel to get a band pattern of DNA. On the gel the short pieces of DNA are at

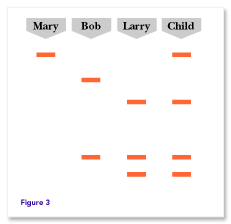
the bottom of the gel and the long pieces of DNA are at the top of the gel.



This can be used to find a criminal-

DNA bands must match EXACTLY.

Suspect B did it



This can also be done to find relatives-

the closer the patterns the closer the relative

This can be used to find the parents of a child-

the child cannot not have any bands that it didn’t

get from mom or dad.

Larry you are the Father!

* **Cloning**- making an identical individual (remember mimi the mouse)

When a nucleus of a body cell (somatic) is placed into an egg.

This allows scientists to make identical copies of an organism quickly.

The first clone was **Dolly**, a sheep. Its **Asexual** Reproduction.

It could allow us to bring back extinct or endangered organisms

The cloned organism wouldn’t be exactly the same due to environment.

* **Transgenic organisms**:

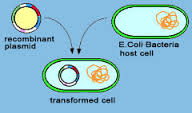
Also known as **GMO’s** or **Genetically Modified Organisms**,

Cut out the DNA from one organism with **restriction enzymes** and put it into another organism. This is **genetic engineering**. Can deliver the gene with a **virus vector**.

Or can use **Bacterial Transformation:**

-**human DNA is put into a** **bacterial plasmid (circular DNA)** and then put into the bacteria

New organism has **recombinant DNA** since it has been recombined



Human DNA has been put into **Cows and Bacteria** so that they both now make

**insulin.** This could be dangerous because it could result in a loss of biodiversity,

could create a new and dangerous disease, or could cause allergic reactions to the

pesticides now in our crops.

* **Gene Therapy**- replacing “diseased” DNA in a person (remember the aliens)

By using a **virus vector,** pieces of “good” DNA is used to replace a piece of “ bad” DNA to cure someone of a genetic disease. They are trying to cure cystic fibrosis but haven’t yet. **SCID** (severe combined immune deficiency disorder), bubble boy, has been cured using gene therapy.

* **Stem Cells**- these are cells that can become any type of cell in the body. They do not yet have a job- **undifferentiated**. This could help cure diseases but are controversial because they come from embryos. Can also be found in adults or cloned.
* All cells have the same DNA and genes. However, **genes are activated or turned on and off in cells** to specialize them or determine their job. This is called **differentiation.** For instance a muscle cell will have different genes activated than a blood cell. Chemical signals are released to control gene activation. Once a cell is differentiated it cannot be changed.
* **Stem cells are in embryos (baby)**.They can also be found in adults like in the bone marrow.

**Mitosis and Meiosis**

Our bodies need to make more cells- there are two types of cells and two types of

processes that our bodies do.

|  |  |
| --- | --- |
| **Mitosis** | **Meiosis** |
| “toes”= makes body cells/ **somatic** cells | Me=Se This makes sex cells/ **gametes** |
| Makes 2 cells | Makes 4 cells |
| ALL of their chromosomes, 2 sets, 2n = **Diploid** Cells | have ½ of chromosomes, 1 set, 1n = **haploid** |
| Makes identical cells or clones | makes different cells or variation |
| **Asexual** reproduction | **sexual** reproduction |

* If a cat has a body cell of 80 chromosomes than they sperm will have? 40
* If an egg of a fish has 100 chromosomes then the tail would have? 200

**Mitosis:** The **Cell Cycle** is a process where **body cells** grow, make copies of chromosomes, and divide to make new cells.

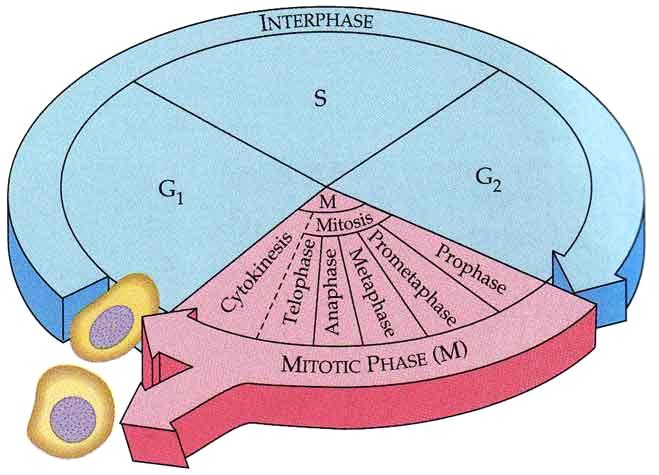
In **Interphase** the cell is living its life (STERNGRR). There are three parts of Interphase:

Growth 1 (**G1**): The cell grows and doubles organelles

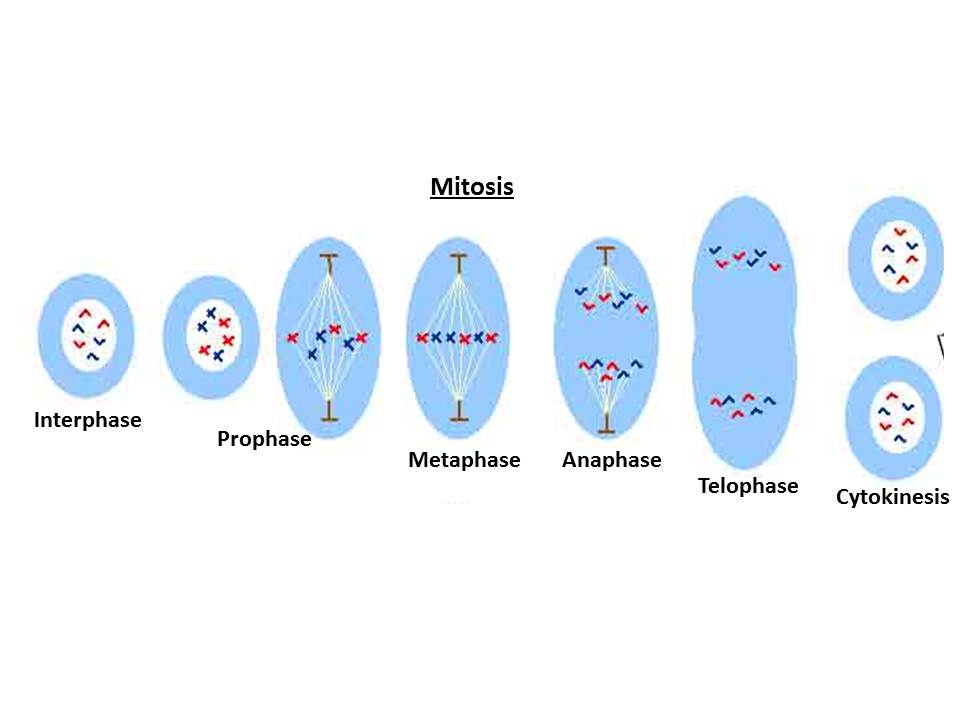
Synthesis (**S**): More DNA is made by **DNA replication**

Growth 2 (**G2**): The cell continues to grow getting ready to divide

Then the cell will divide in two through **Mitosis** or the M phase.



Start

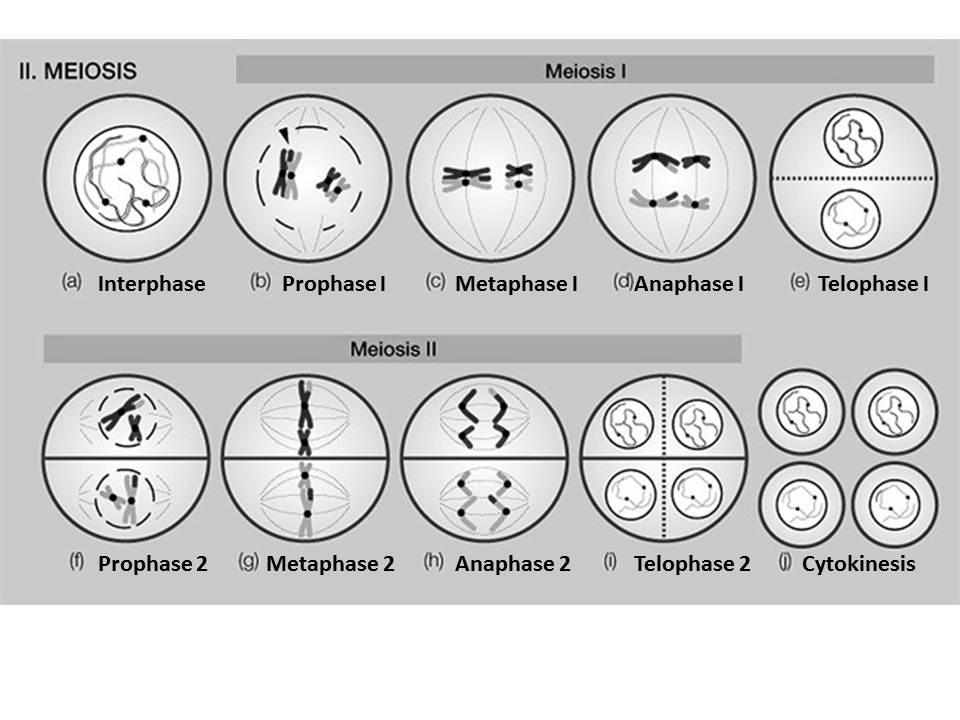


Makes 2 cells with the same chromosomes as the parent

\*Bacteria and protists reproduce asexually through **mitosis** where they divide in two making identical clones.

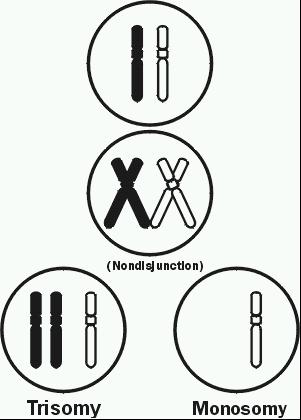
\*Sometimes there is a mutation in the DNA which leads to out of control mitosis divisions. This uncontrolled mitosis results in **cancer**.

**Meiosis** is the processes where sex cells/gametes (egg and sperm) are made.



Ends with 4 cells with half the number of chromosomes and a unique combination

* In Meiosis I sometimes the **chromatids** (the arms of the X) will trade pieces- this provides variety and is called **crossing over.** During Meiosis the genes are “shuffled” called **Independent Assortment** which also creates variation.
* **Homologous chromosomes** are chromosomes that code for the same trait. They **pair up** in meiosis during metaphase 1 before splitting apart. Mitosis has pairs of homologous chromosomes in the final cell “2n”. BUT meiosis does not have pairs so only has “n” chromosomes at the end (half).
* When a sperm and Egg come together this is **fertilization** and forms a **zygote** (baby).
* The Human diploid number is **46** and the haploid number in our egg and sperm is **23**.



* Sometimes in Meiosis the chromosomes fail to separate called **Nondisjunction**

which results in the baby having too many or too few chromosomes.

**Evolution and Classification**

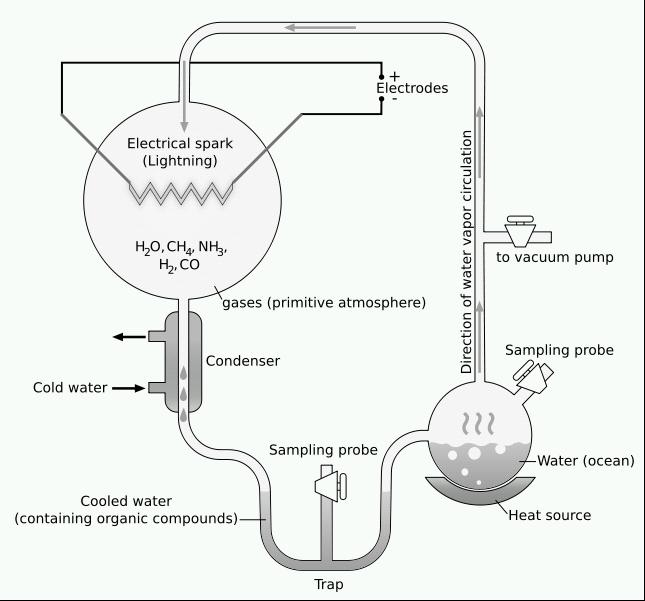
* **Spontaneous generation or Abiogenesis:** life suddenly appears from nonliving things
* **Biogenesis:** Life beginning from life
* **How did life evolve on earth?**

Early earth- no oxygen, volcanoes, oceans, no life

**Miller and Urey**-They mixed gases and water together and zapped it with an

electrode. This did not produce life BUT it did produce some of the

**organic molecules** like amino acid and nucleic acids that are necessary for life.



* **Early Life Theory**:

1. macromolecules organized into **protocells**
2. Protocells become **prokaryotes** which are **heterotrophs (eats) and anaerobic (no oxygen)**
3. Prokaryotes are running out of food so they become **photosynthesizing autotrophs prokaryotes**

**(make own food)**

1. Autotrophs make **oxygen** which in turn builds the **ozone layer**
2. This ozone allows for other more complicated organisms to evolve

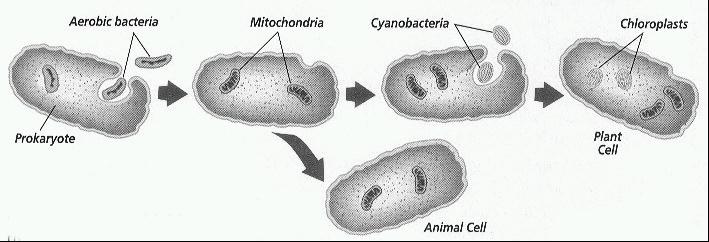
* **Endosymbiosis**- “inside relationship”

This is the theory that prokaryotes ate other prokaryotes but instead of dying

these eaten prokaryotes developed a mutualistic relationship with the

prokaryote that ate them. They became organelles. AND now that the

prokaryotes had organelles they are **Eukaryotes**.



After Eukaryotes evolved multicellular organisms appeared.

* **Charles Darwin**- often called the Father of Evolution.

He first came up with the idea that perhaps species change through time and

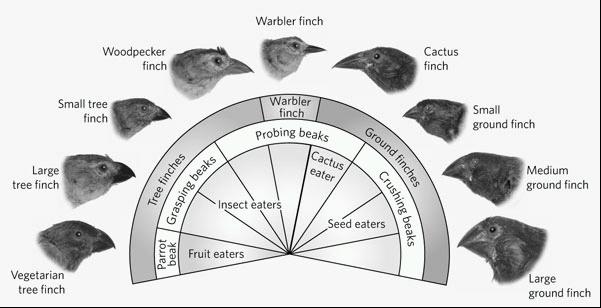
came from one common ancestor. He developed the idea of **Natural Selection**.

**Natural Selection**- “survival of the fittest” But really it is that the organism who

has the **favorable trait** can reproduce and pass on its genes and traits. Competition

for resources means the organism **best adapted to their environment survives**.

Darwin developed this theory when he traveled to the **Galapagos islands**. He studied **finches** and was able to see that perhaps they had a common ancestor. **Adaption to different environments** resulted in different beaks and species over time.



Darwin was able to show that either a species will adapt to its environment or it will die. And that the organism with the best adaptation will reproduce the most to pass this adaptation on to future generations.

* Due to natural selection our pests are becoming **resistant to pesticides** and our bacteria are becoming **resistant to antibiotics** (medicines). **Only the weak ones were killed off which left the strong and resistant ones to reproduce which is now all we have.**

**Immune System**

* **Antigens**- foreign invaders in the body. Bacteria, viruses, etc.
* **Pathogen**- an organism that can make you sick
* **T cells**- cells in our bodies that work to destroy bacteria or viruses
* **B cells**- these will release **antibodies** which will attach to a virus and disable it
* **Memory B cells**- your body remembers every virus you have ever had. When you get the same virus again the memory cell will recognize it and order an attack before you can get sick.
* **Vaccine**- you are given a weakened or dead virus. This allows your body to “remember” a virus that never actually made you sick. It prevents you from ever getting truly sick.
* **Antibiotic**- this is a medicine which will kill bacteria
* **Active immunity**- You make antibodies. This is immunity or resistance that a person has because they have actually had the disease. You can also get this from a vaccine.

Ex. You have had chicken pox so now you have active immunity against it or you get a vaccine

against chicken pox.

* **Passive immunity**- You are given antibodies. This is when you are immune from a virus that you never actually had. Mothers can pass this on to their children when they breastfeed them or you can be given the antibodies.
* **Camouflage**- when an organism blends in with its surroundings

**Mimicry**- when a harmless organism acts or looks like a harmful one.

Mimicry example- the monarch butterfly is poisonous to birds and the

viceroy is not. But the viceroy looks like the monarch so the birds do not eat it.

Camouflage and mimicry help organisms because it allows them to survive to

reproduce—natural selection.

**How do new species evolve?**

* Sometimes a part of a species is separated from the rest of the group either by a highway, mountains, ocean, or any other physical barrier. This is called **geographic isolation**.

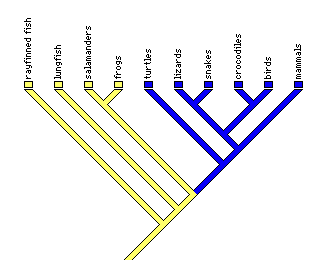
Once they have been separated for a long time each group will change with their

environment—natural selection again.

* This will result in them being so different that even if they were to come back together again they could not mate. This is called **reproductive isolations**. This can be because their bodies no long match up or perhaps their social behaviors are now different (mating seasons or mating rituals).
* When the two can no longer mate they are now two different species and this creation of a new species is called **Speciation**.

(remember the mice on the video and the M&Ms)

**Phylogenetic trees**- a diagram showing branching of organisms from a common ancestor.

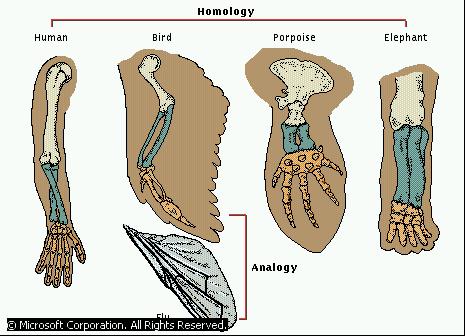


The **closer they are together on the map the closer related they are**. The oldest species branched off first. For instance, Salamanders and frogs would be more closely related than lungfish and frogs.

Ancestor (oldest)

* There are several different “proofs” for evolution:

**Fossils**- show how organisms changed through time and can show relationships.



**Anatomical-** by comparing the anatomy

or body structure of organisms we

can determine how closely related they are.

Human, bird, and porpoise are more **closely related** to each other than the fly. You can tell because their body structure is similar or **homologous**.

* **Biochemical similarities**- by comparing the **DNA or the Amino Acids** in protein we can determine how closely related organisms are. They closer their DNA and proteins are they closer related they are.

**Classification**

* First classification system was developed by **Aristotle**, but it had a few problems.
* The modern day classification that we use today was developed by **Carolus Linnaeus.** At first there were two kingdoms (animals and plants), then five and now 6.
* The **six kingdoms** are: plant, animal, protist, fungi, eubacteria, archaebacteria

He classified organisms on their body structure and on many different characteristics.

* **There are 8 levels of classification**



Did Domain

King Kingdom

Philip Phylum

Come Class

Over Order

For Family

Good Genus

Spaghetti Species

* The largest and most general or broad classification would be the Domain and Kingdom.
* The smallest and most specific classification is the species. Organisms can only **interbreed** if they are in the same species.
* The naming system we use today was also developed by Linnaeus. It is called **Binomial Nomenclature**= the 2 name naming system. It is written in **Latin**.

**Common names** can often be confusing so scientists use the

**scientific name**. The scientific name is the same all over the world. This name

has two parts = the **genus and species**.

Genus is always capitalized. The species is not capitalized.

The whole thing is in italics or underlined.

If two organisms are in the same genus it means they are related.

The tiger, house cat, and lion are closely related. We can tell because they all have the same Genus.



* **Dichotomous Key**—this is like scavenger hunt to find out the scientific name of an organisms



1. Has pointed ears .............. go to 3

Has rounded ears ....... .....go to 2

2. Has no tail ................... Kentuckyus

Has tail ........................ Dakotus

3. Ears point upward ................... go to 5

Ears point downward ..............go to 4

4. Engages in waving behavior ..... Dallus

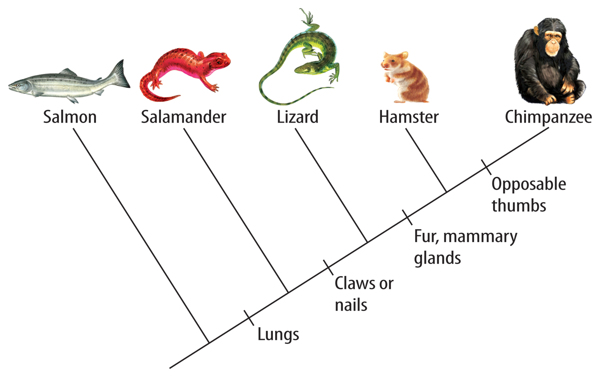
Has hairy tufts on ear...........Californius

5. Engages in waving behavior …… WalaWala

Dallus

**Cladogram**

A cladogram shows an organism’s evolutionary history. It shows what new traits appeared that caused organisms to separate. For instance, the evolution of Lungs separated fish from salamanders. What trait did hamsters get that lizards didn’t have? Fur and mammary glands.



**Biochemistry**

* A **Macromolecule or polymer** is a large molecule. If a molecule had carbon than it is considered an **Organic molecule**.
* There are four main macromolecules that are important to biology:

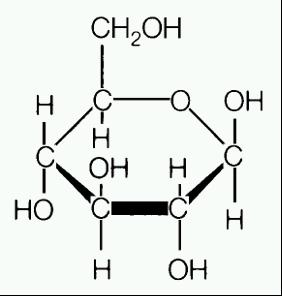
**carbohydrates, lipids, proteins, and nucleic acids**

**Carbohydrates**- these are sugars used for quick energy. Their building blocks or monomers are **monosaccharides**. Remember many sugars end in -ose

Elements made of Carbon, Hydrogen and Oxygen in a 1:2:1 ratio.

Types:

**Monosaccharides**---- one sugar----examples **Glucose** which is made in photosynthesis



**Fructose** which is in honey and fruit

Glucose

**Disaccharides**--2 sugars or 2 monosaccharides connected

**Polysaccharides**---many sugars- examples **Cellulose** which is in cell walls

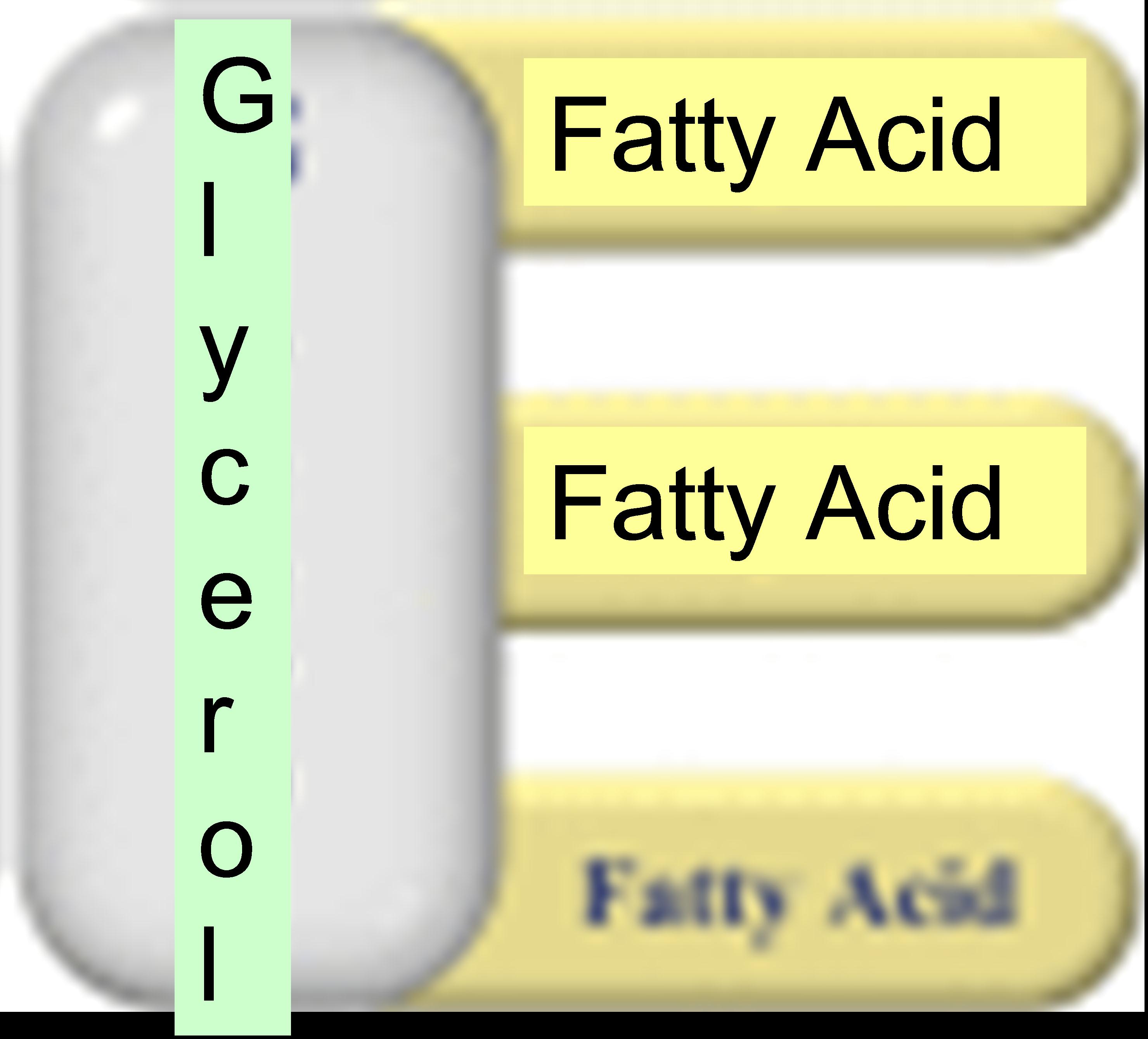
**Starch** which is used for plant energy storage

**Glycogen** which is used for animal energy storage in the liver

**Lipids**- these are fats, waxes and oils. They are used for **long term energy storage** and for **the cell membrane**. Also used for **insulation** to protect animals from the cold.

These are made of long chains of carbon and hydrogen and a little bit of oxygen. **CHO**

**Subunits**- a fat is made of a **glycerol** backbone and three **fatty acid chains**.



**Phospholipids**: fats that make up the cell membrane

**Steroids**: fats which are in rings instead of chains like cholesterol used to make hormones like testerone.

Examples of lipids:

**Proteins**- Made from (subunits) **amino acids** which are held together by **peptide bonds**. There are 20 amino acids. They are made in the **ribosome**. Proteins fold in a 3D shape and this shape determines their function**. CHONS** are the elements

Important Proteins:

**Enzymes** (see enzymes in this packet)

**Hemoglobin**- a protein in a blood cell that helps carry oxygen in the blood.

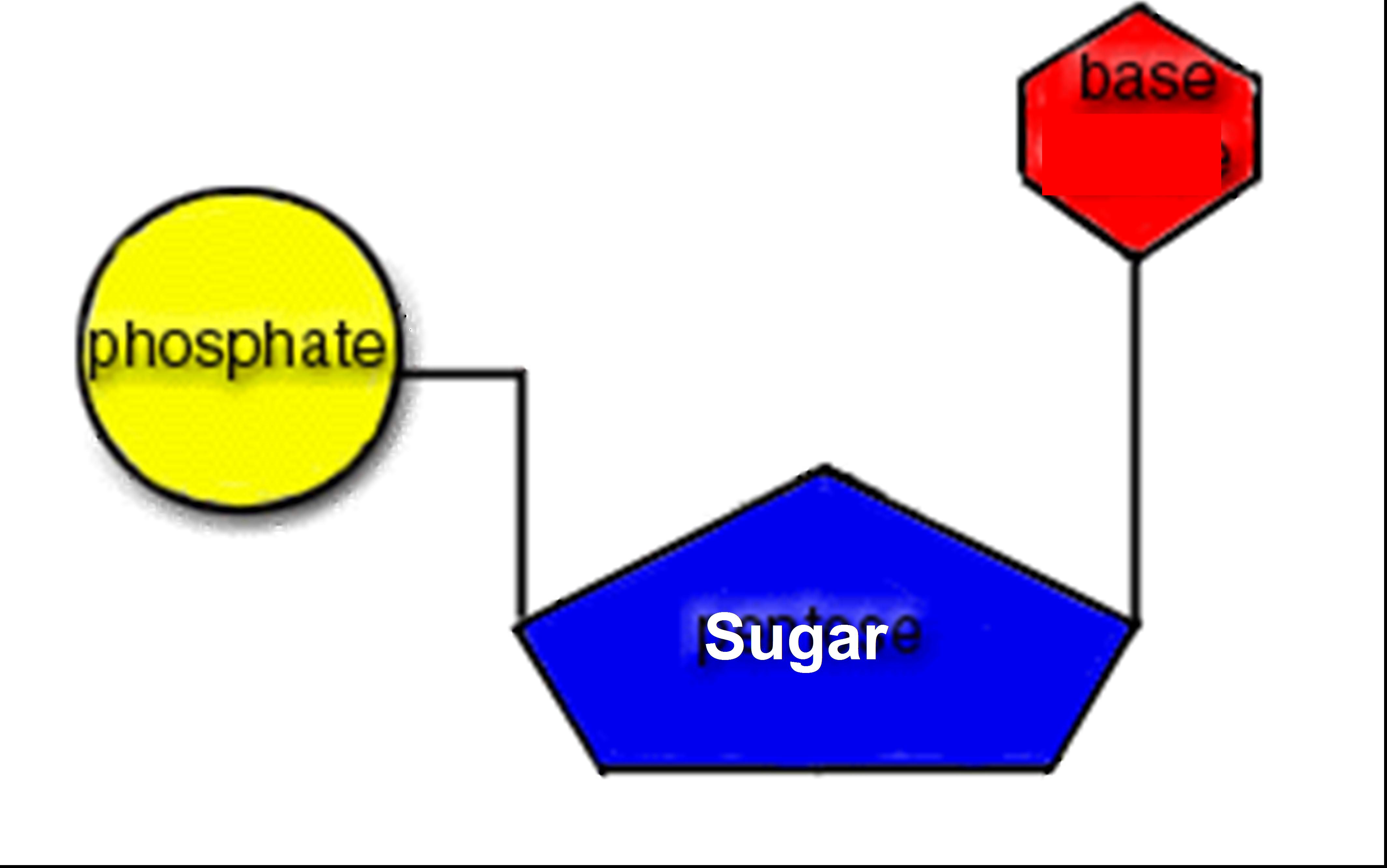
**Insulin-** a protein in the body which helps maintain proper blood sugar levels. If there are problems making insulin than a person could have diabetes.

**Nucleic Acids**:

These molecules are our **inherited genetic information** and **instructions for proteins**.

The two main examples are **RNA and DNA**

They are made of **Nucleotides**. Nucleotides are made of a **phosphate, sugar, and base**.

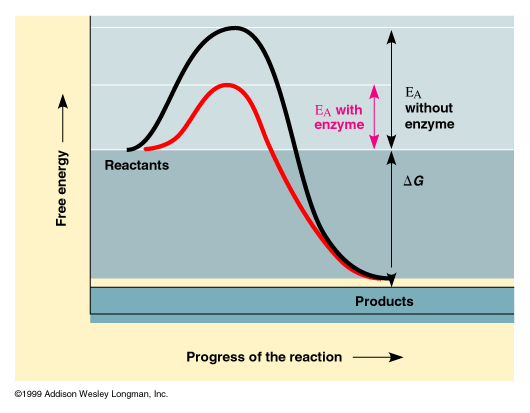


## Enzymes

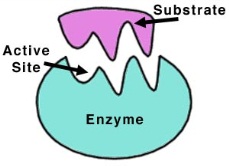
* **Enzymes** can also be called **Catalysts**. Several enzymes end with –**ase**.

Ex. Lactase, Maltase. They can be used over and over again.

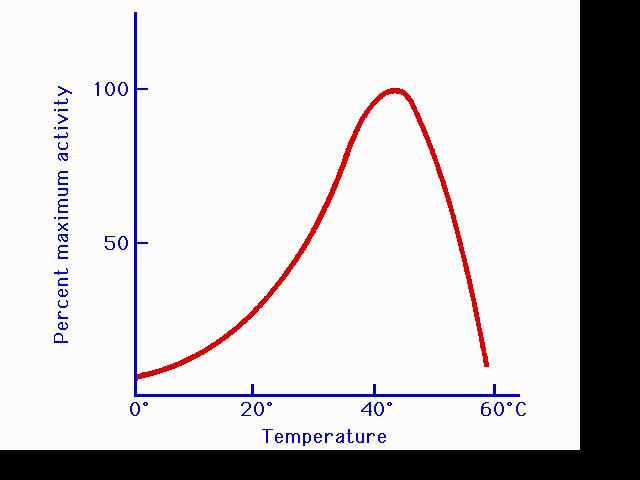
* These are proteins that **help speed up reactions**. Without them most of the reactions that happen in our body would happen so slowly that we would die. They are **reusable**.
* People who lack the **enzyme Lactase are Lactose intolerant**. Meaning they cannot break down the sugar, lactose, in dairy products. So if they were to drink milk they would have an upset stomach.
* Every reaction needs a certain amount of energy to start (**activation energy**). **Enzymes lower the amount of reaction energy needed**. So since the reaction doesn’t need as much energy it can go faster.



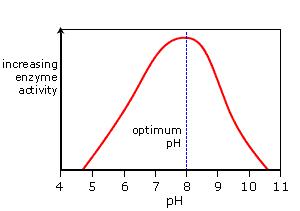
* Enzymes fit together with **substrates**. Substrates are whatever chemical the enzyme is working on. They fit like **a lock and key**. Enzymes only fit their specific substrate.
* The place where the substrate fits into the enzyme is called the **active site**.



* If you change the shape of the enzyme it won’t work anymore. You can do this by changes in temperature or pH level. Its called **denaturation**.



\*Remember the words **optimum and optimal** mean best or highest!



basic

acidic

Remember that **Acids are 1-6**, **Neutral is 7** and **Bases are 8-14**. The lower the number the stronger the acid. The higher the number the stronger the base.

# Cells

* Cells are the smallest living things. Cells make tissues, tissues make organs, and organs make an organism (living thing).

Cells Tissue Organ Organism

Muscle Cell Muscle Tissue Heart Human

* To see a cell you must use a microscope. To determine the magnification: **Lens x Eyepiece= magnification**. Example. Lens= 10x and Eyepiece = 40x so 10 X 40= 400x magnification.

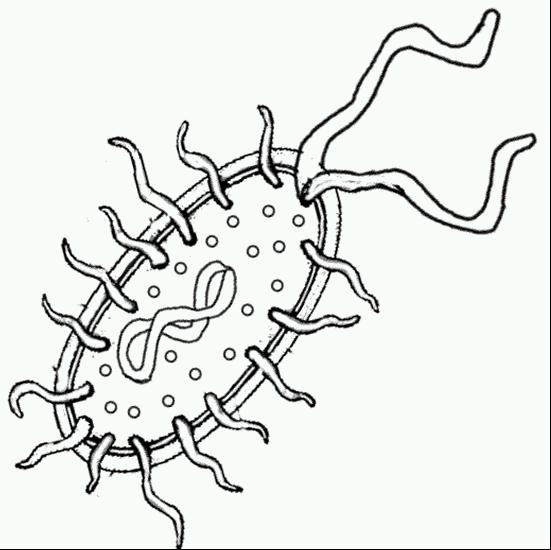
There are two main types of cells: Prokaryotes and Eukaryotes

* **Prokaryotes** do NOT have a nucleus or any other organelles.

They do have ribosomes and DNA. Their DNA can be a plasmid.

They are small, microscopic and unicellular.

Take the “p” and turn it upside down for a “b”= Bacteria!



Ribosomes (the dots)

Flagella

DNA or **Plasmid**

**A plasmid is circular DNA**.

Cell Membrane

Cell wall

Cilia

* **Eukaryotes** DO have a nucleus and all organelles.

Animals, plants, protists and fungi are all eukaryotes.

Can be multi or unicellular and are larger.

**Important Organelles**:

|  |
| --- |
| P & A |
| P, A,& B |
| P, A, & B |
| P & A |
| P & B |
| P |
| P |

**A. Nucleus**- “the brain of the cell” Controls all cell functions. DNA is inside.

**B. Cell/plasma membrane**- controls what enters and leaves the cell. Homeostasis

**C. Ribosomes**- these make the proteins in the cell

**D. Mitochondria**- “powerhouse” of the cell. Provides energy by Cellular respiration.

**E. Cell wall**- this is not in animals. Provides protection and support for the cell

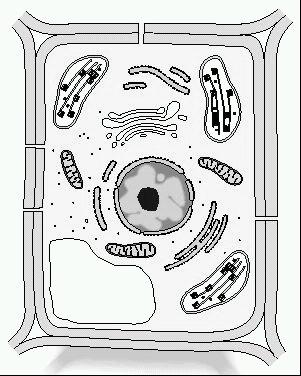
**F. Chloroplast**- this is only in plants and protists. This is where photosynthesis happens. It contains a pigment called **chlorophyll** which keeps the plant green and captures light energy.

**G. Vacuole**- Large vacuole only in plants. It stores food, water, enzyme, and waste.

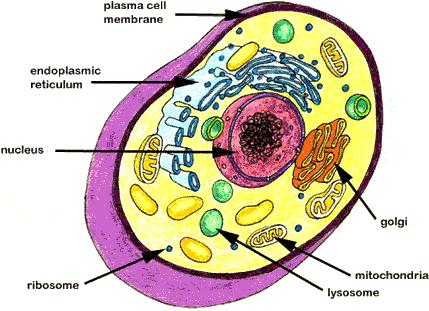
C. Ribosomes are dots

**Animal Cell**

**Plant Cell**



B



B

E

C. Ribosomes are dots

AA

D

AA

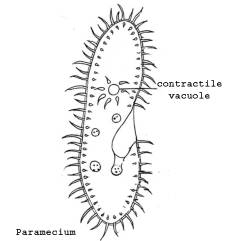
G

D

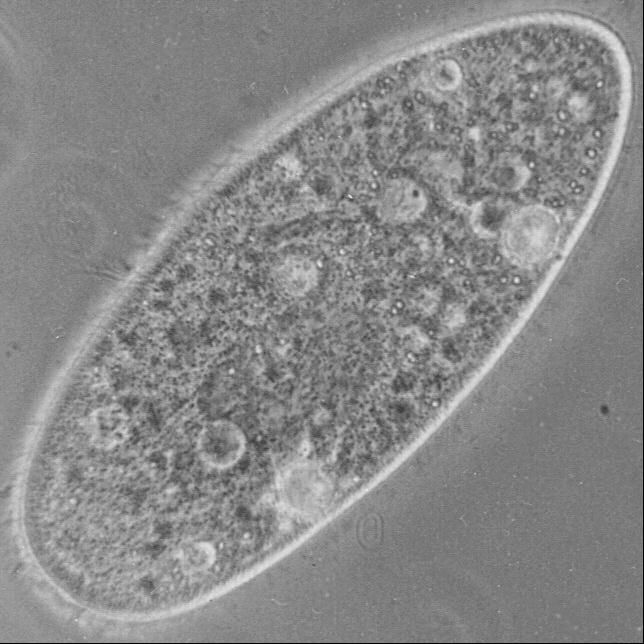
F

**Protists:** They are Eukaryotes because they have a nucleus and organelles

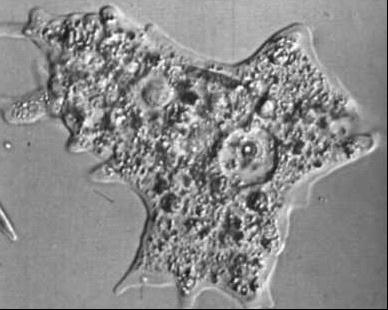
Most protists live in water. Many of them have **contractile vacuoles.** An organelle that helps cells maintain water balance (homeostasis). Excess water is temporarily stored in the vacuole. Then the vacuole contracts to pump the excess water out of the cell.



The Animal like protists-



**Paramecium**



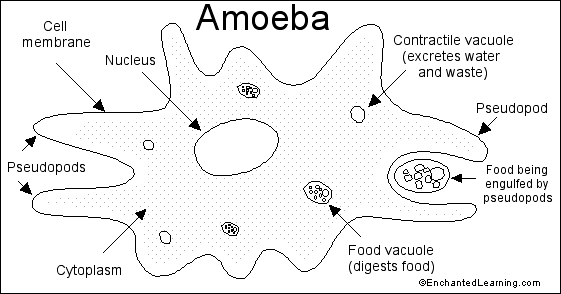
**Amoeba**

Heterotrophs (eat) - absorb their food through membrane

-oral and anal pore- a crude mouth and butt

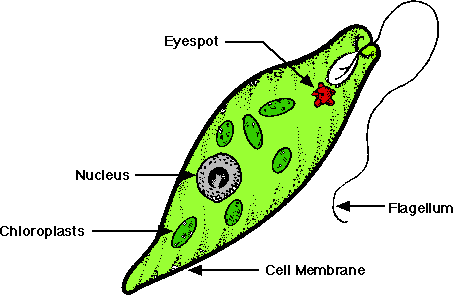
-**Pseudopods-** “false feet” Parts of the cell membrane used to engulf food.





Autotrophs (plant like protists) – do photosynthesis using chloroplast, but can also catch prey

**Euglena**

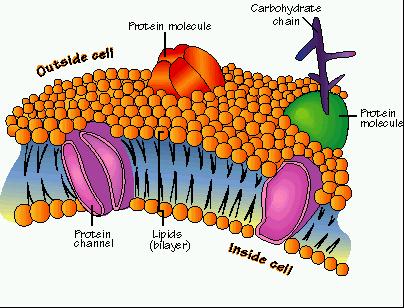


Euglena have **eyespots** which are organelles sensitive to light. The eyespot lets Euglena know where to move so they will have light for photosynthesis.

**Transport in the Cell**

* The plasma membrane controls what enters and leaves the cell. It maintains a balance on the outside of the cell and on the inside = homeostasis or equilibrium. It is important for your body to maintain homeostasis or balance to stay alive.
* Another name for the plasma membrane is the **Phospholipid bilayer**= 2 layers of fat.

Protein

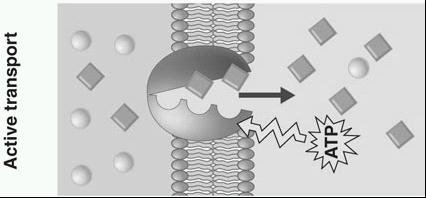


Phospholipids

* Plasma membrane is **semi or selectively permeable**. Means it only lets some things through.
* **Solutes**- anything dissolved in water like salt or sugar. It cannot move through the

membrane without energy.

* There are two types of transport= **Passive** and **Active**
* **Active transport** requires energy (ATP). It moves materials from low to high concentration and requires the help of carrier proteins. It goes against the concentration gradient. It usually moves big molecules like carbohydrates.



High

**Low**

* **Passive transport** does not require any energy. Moves small molecules.

It moves with the concentration gradient.

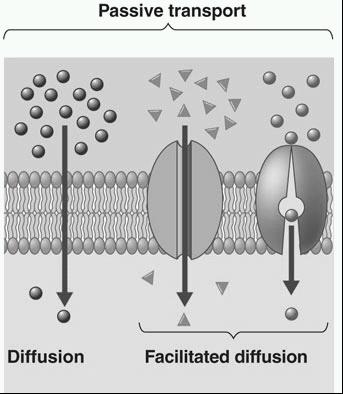
Types of passive transport:

**Diffusion** is a type of passive transport and move materials from a high to

low concentration. Can be move oxygen, water, carbon dioxide.

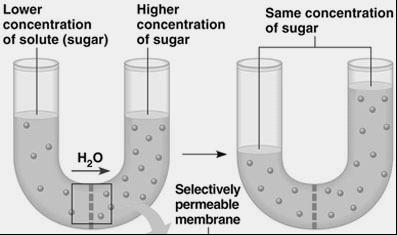
**Osmosis**- the movement of water from an area of high to low

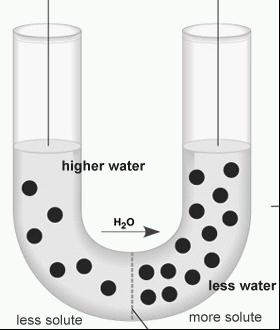
concentration across a membrane.



Osmosis

Passive Transport





45% water

60% solutes

70%

water

10% solutes

This means there is 40% inside and 90% water outside. So water will move in.

Water would move from high to low and leave the cell

There is high water on left and low on right. So water will move towards the right. Making the right side higher.

Homeostasis is maintained in other ways in the body.

* Temperature: when you are too hot you sweat to reduce your body temperature and when you are too cold you shiver to raise your body temperature.
* Your cells need to maintain a neutral pH (7) so there are **buffers** in the blood that helps to keep your blood from getting to acidic or too basic.
* Your body works to keep your blood glucose (sugar) levels balanced. Insulin helps keep this balance and an imbalance can cause Diabetes.
* Homeostasis will be any situation where your body adjusts to keep things balanced or in a normal range.

**Animal Behavior**

* There are two types of behaviors:

a. **learned**- behaviors we will not know until we learn them

b. **innate or instinct**- behaviors that we are born with and no one has to teach us

* There are several innate behaviors:

**Suckling instinct**- this is when a baby automatically knows how to suckle or drink milk from the mother’s breast

**Courtship** – this is mating behavior

**Territorial defense**- protection of an animal’s area, food, or mate

**Estivation**- this is like hibernation in the summer time. Frogs do this in the desert to protect themselves from the summer heat of the desert

**Hibernation**- deep sleep in the winter time

**Migration**- when birds or other animals leave the north and move to the south for the winter and then come back in the summer

**Taxes (taxis)-** this movement. Positive taxes is moving towards and negative taxes is moving away. Ex. Euglena have a positive phototaxis…meaning they move towards the light.

All of these innate behaviors help an organism survive and reproduce…..Natural Selection.

* Ways we learn behavior:

**Imprinting**- this happens in birds. The first animal or object that the new born bird sees, the bird forever sees as its mother.

**Habituation**- becoming so used to something that you cease to be bothered by it or notice it.

Ex. not noticing your ceiling fan anymore or a train that passes by your house

**Classical conditioning**- learning to relate, connect, or associate unrelated things. Pavlov rang a bell every time he fed his dogs. So then the dogs learned to associate bell ringing with food even if no food as around. Ex. can opener with your cat or dog

**Trial and error**- trying something over and over again and learning from your mistakes.

**Energy**

**Photosynthesis**= putting together with light

* This is the process where **producers/autotrophs** make their own food (glucose). The energy for this reaction is from the sun. Sun energy is called radiant energy.
* Plants turn **radiant energy** (sun) into **chemical energy** (glucose).
* **Reactants** (ingredients) = water, carbon dioxide, and light

(remember plants are opposite of us...we breathe in oxygen they breath in CO2)

**Products** (what you get) = glucose and oxygen

* You must know the formula:

Light



* Photosynthesis happens in the **chloroplast** of the cell. Since animals do not have chloroplasts they cannot perform photosynthesis. The **chlorophyll** is pigment in the chloroplast that absorbs the sunlight and makes the plant green.
* The Carbon dioxide enters the leaf and the oxygen leaves the leaf through an opening called the stomata or stoma. The **stomata** are surrounded by guard cells.

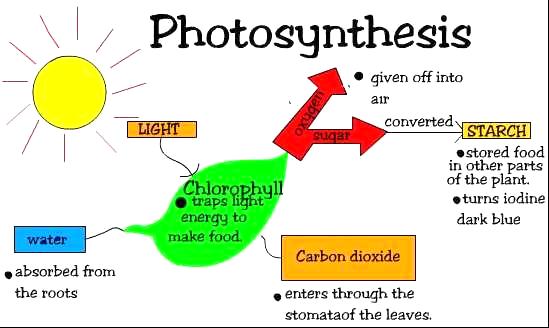


The stoma or stomata

Oxygen out

Carbon Dioxide in

Guard cells



Gives off oxygen

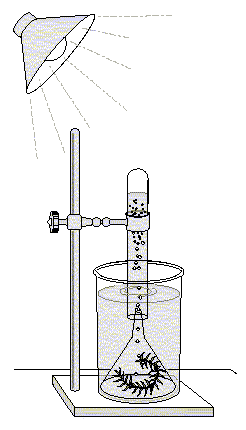
Glucose= a Carbohydrate or sugar

**Chloroplast**

This is an elodea plant which is a water plant. When exposed to light little bubbles appear in the water. What are the bubbles? Oxygen...the plant makes it when it is doing photosynthesis from the light.

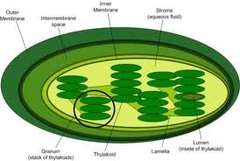
The more light the more bubbles. The more CO2...the more bubbles.

Because more ingredients more oxygen (product)



* Plants have **vascular tissue**: the veins in the leaf. There are two kinds: **Xylem** carries water up from the roots to the leaves and **Phloem** carries sugar down from the leaves to the roots.

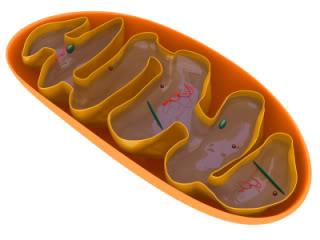
The **chloroplast**. Remember it has stacks on the inside that look like pancakes = sugar!



**Cellular Respiration** – this is how cells break down the glucose made in photosynthesis to release energy. All living things do respiration all of the time.

* Respiration happens in the **mitochondria** of the cell. This is why we call the mitochondria the power house of the cell because it is releasing energy.

The **mitochondria**. Remember it looks like a bean with a river in it.



* Respiration is the opposite of photosynthesis.
* **Reactants** (ingredients) = glucose and oxygen

**Products** (what you get) =water, carbon dioxide and energy (ATP)



(ATP)

* There are two types of respiration-

**Aerobic**- respiration that uses oxygen. Makes more energy or 36 ATP.

**Anaerobic**- does not use oxygen (“An” means not). Makes less energy only 2 ATP.

* Another name for Anaerobic respiration is **Fermentation**.

There are two types of anaerobic respiration or Fermentation:

**Lactic Acid Fermentation**- this makes lactic acid. This is the type of

respiration our muscles do when they run out of oxygen. It is why our

muscles get sore. Bacteria also make lactic acid.

**Alcohol Fermentation**- this is the type of fermentation that is done by yeast.

It makes alcohol and can make it from apple juice.



If we put apple juice or glucose and yeast into a test tube, the yeast will make alcohol. But it will also make some bubbles. What are the bubbles? Carbon Dioxide which is made as the yeast does alcohol fermentation or anaerobic respiration.

|  |  |
| --- | --- |
| **Photosynthesis** | **Respiration** |
| Uses water, light and CO2 | Uses Oxygen and Glucose |
| Makes Oxygen and glucose | Makes water, CO2 and energy (ATP) |
| Happens in chloroplast | Happens in mitochondria |
| Happens in producers | Happens in all living things all the time |
|  | Has two types: aerobic and anaerobic |

**ATP**- is the energy molecule that is made in respiration. It is how our bodies temporarily store the energy made in respiration. The **energy is in the bonds of the molecule**.

**Ecology**

* **Food chains**: show the **flow of energy** in the ecosystem. Every food chain MUST start with a producer because they store energy from the sun (radiant energy) as chemical energy to pass to other organisms.

**Producer or Autotroph**- an organism that makes its own food like a plant

**Consumer or Heterotroph**- an organism that has to eat

\*only 10% of the energy passes from one organism to another. Energy is lost as **heat**.

Decomposer/ worm

**Energy Pyramid**

Carnivore/tiger

In this energy pyramid both energy and **biomass** decrease the higher up you go. Each trophic level gets 10% of the energy from the previous level

Consumer/human

Herbivore/rabbit

Producer/tree

**Relationships**

* All living things are in a relationship and when it is a close relationship it is called

a **Symbiosis.**

* There are three main Symbiotic relationships:

**Mutualism**- ☺ ☺ Both organisms benefit

Example: the sea anemone provides a home for the clown fish and the

clown fish protects the sea anemone from predators

**Commensalism**- ☺ one organism benefits and the other doesn’t care (not

hurt or helped)

Example: a cow walking in a field stirs up insects for the cow bird to eat

**Parasitism**- ☺ ☹ One organism benefits while the other one is harmed

Example- a tic on a dog

* Two other non-symbiotic relationships:

**Predator/Prey and Competition**

\*Competition limits the growth of a population

**Population growth**

Populations will grow unchecked until they are limited by limiting factors. **Limiting factors** are resources like water, space, food, etc that a population can run out of.

**Carrying Capacity**- the number of organisms an ecosystem can support

**J-curve**. This population grows extremely fast (**exponential growth**). At first there are unlimited resources. However, the population uses up all the resources and will crash and all die out. **The highest point is its Carrying Capacity**.

Carrying Capacity



**S-curve**. This population grows until it reaches it carrying capacity. Then it will stabilize over the carrying capacity. There is a limited amount of resources that the population balances with.

Carrying Capacity



**Predator/Prey curve**

Predator and prey population growth are opposite of each other. When the predator is up the prey is down and vice versa. **They help keep each other’s populations in check and from growing out of control**



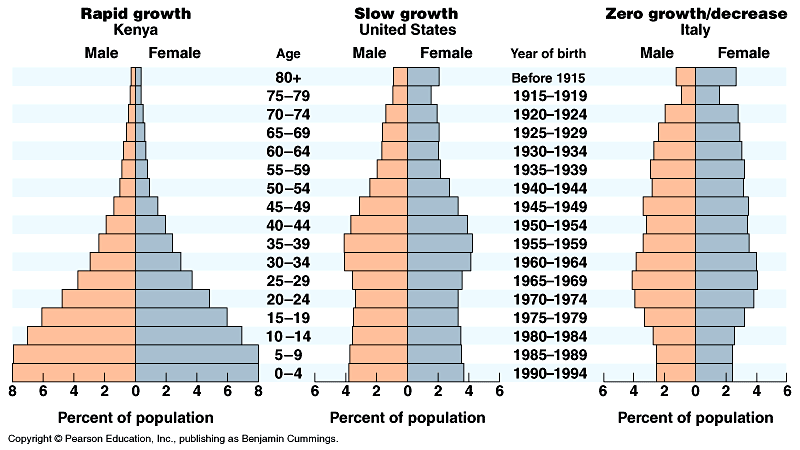
**Age Structure Graphs**: Human population has grown exponentially over the last 250 years. We are quickly using up our resources. The more dense our population is the more quickly our resources will be used.

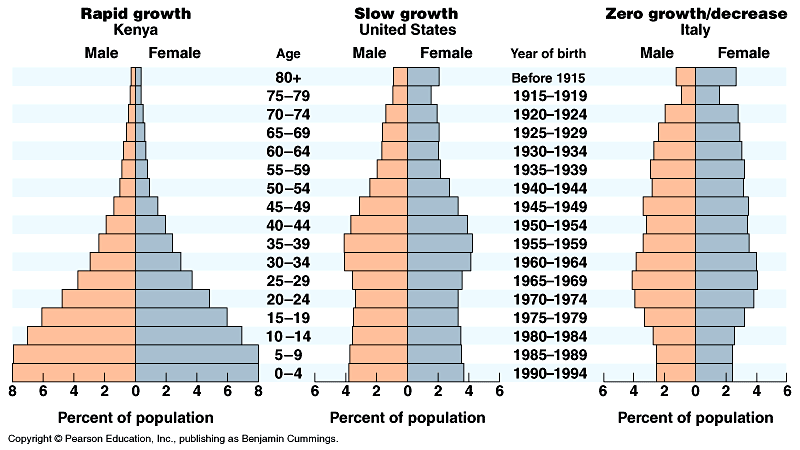
-High birthrate and high death rate

-Rapid Growth

-Developing country

-Poor, not many resources, poor healthcare





-Low birthrate and low death rate

-Stable Growth

-Developed or Industrialized

-Richer country, many resources, and good healthcare

**Environmental problems**

Humans are responsible for almost all modern day environmental issues.

* **Habitat Destruction**- destroying the home of an organism.

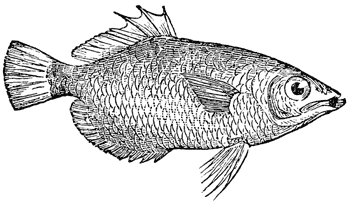
This could happen because of **deforestation** (cutting down trees), or because of invasive species or melting glaciers, etc.

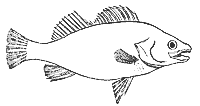
* **Pollution:** We are polluting the habitat of many organisms. The **runoff** from our developed or Urban (City) populations is polluting rivers and lakes. Our **hog lagoons** are flooding and polluting water sources.
* **Bioaccumulation or Biomagnification**- when poisons build up in the food chain. The higher up you go in the food chain the more poison there is.

Ex. The USA used to spray **DDT** which is a pesticide on our crops. It ended up in our rivers and lakes. Small fish would then have this DDT in their system. The big fish would eat the small fish and get even more DDT. Eagles would eat the big fish. Eagles ended up with tons of DDT in their system which caused them to crush their eggs. Rachel Carson discovered the connection between the DDT and the eagles.

Ex 2. There is mercury in our fish. The fish higher up the food chain have more mercury and can be dangerous to humans.







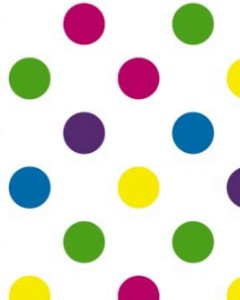
10g of DDT

10,000g of DDT

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1000g of DDT

[](http://rds.yahoo.com/_ylt=A0WTbx8xVBNK5U4AxJajzbkF/SIG=12v71a1ak/EXP=1242867121/**http%3A/www.miamipaks.com/images/tissue-patterns/FC-RC-1009A-Bright-Dots.JPG)

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* **Nonnative or invasive species**- these are organisms which are from another country. They **do not have any natural predators** so they **take over** their new environment pushing out other native species.

Ex. Boa Constrictor has been put into the everglades. It has no natural predators and

is taking over. This is not good for other animal species in the area.

Ex2. **Kudzu** from Asia is a fast growing vine which takes over an area.

* **Acid Rain**- this is rain that has a pH of less than 7. It can kill off whole forests and kill fish in lakes and rivers. It is caused by air pollution like **burning fossil fuels**. The pH scale helps determine if something is a Base or an Acid. Cells and organisms like to be at a neutral pH.

**Basic**

**Neutral**

**Acidic**

1 2 3 4 5 6 7 8 9 10 11 12 13 14

* **Stewardship and Sustainable practices**: when humans work to protect their environment

Ex. recycling, replanting trees, cleaning streams and rivers

**Carbon Cycle**

Carbon is an element that is in all living things on earth. It cycles the earth mainly in the form of Carbon Dioxide and Glucose.

* Five ways Carbon Dioxide gets into the atmosphere:

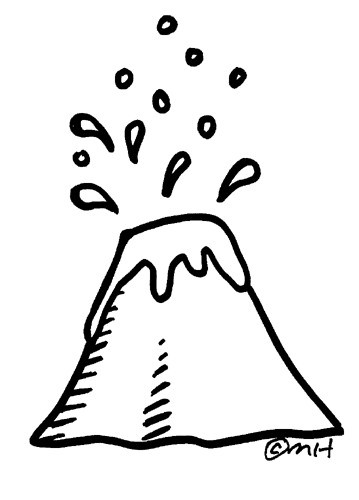
**respiration, burning fossil fuels, open burning, decomposition, and volcanoes**

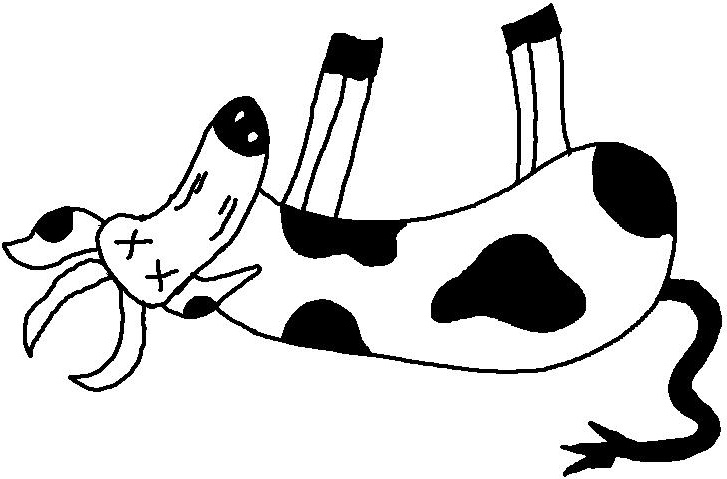
* The main way Carbon is removed from the atmosphere is: **Photosynthesis**



**Volcanoes**

**Decomposition**





* Unfortunately due to the **burning of fossil fuels humans** are releasing way too much carbon dioxide into the atmosphere.
* Too much carbon dioxide (a **greenhouse gas**) is causing the **Sun’s radiation to be trapped** on the earth which is causing the earth’s temperature to rise. We call this the **greenhouse effect** which causes **global warming or climate change**. This causes the glaciers to melt and the oceans to

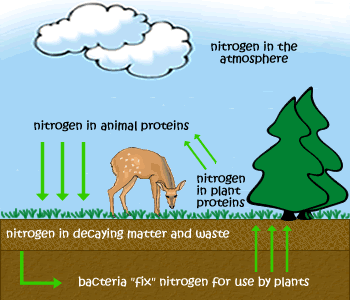
Radiation from sun trapped by CO2 (**greenhouse effect**)

Too much CO2 in Atmosphere

Earth’s temperatures rise = **global warming** or **Climate Change**

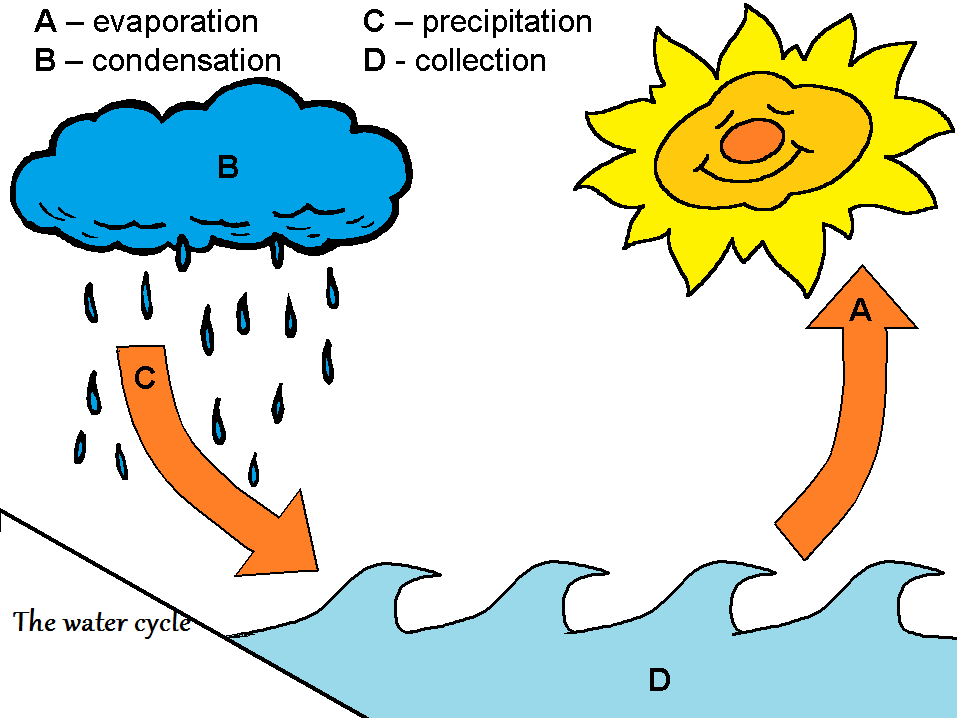
Burning fossil fuels

**Nitrogen Cycle**



* Nitrogen is another important element that cycles in the ecosystem. We **need nitrogen to make DNA, RNA, and Proteins.**
* Animals get nitrogen through the food we eat and we put it back into the environment through our waste and when we die.
* Plants get nitrogen through **Nitrogen Fixation**. Bacteria that live on the roots of some plants fix the nitrogen so plants can use it. In return the bacteria get food from the plant. This is a **mutualistic r**elationship.

**Water Cycle**



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**E.** Transpiration

