

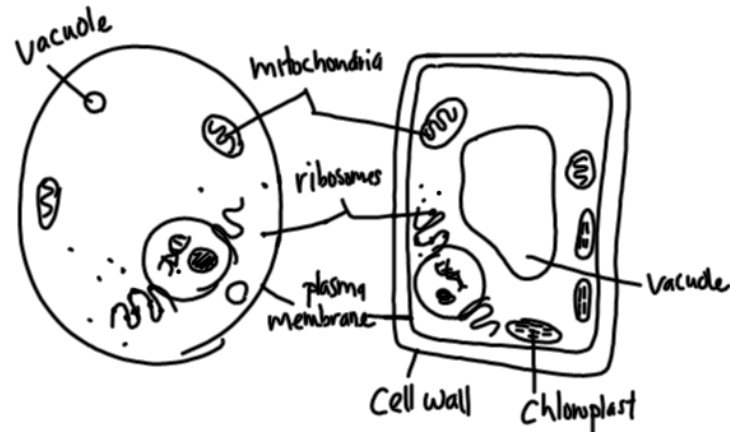
# Biology EOC Study Guide 2012/2013

## 1.1 Cells and Organelles

### 1.1.1- Cells organelles

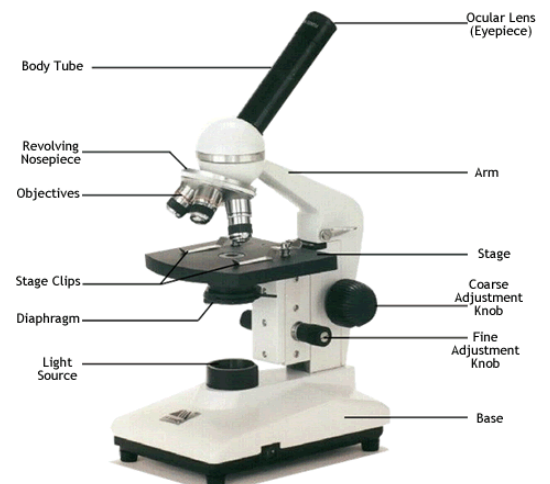
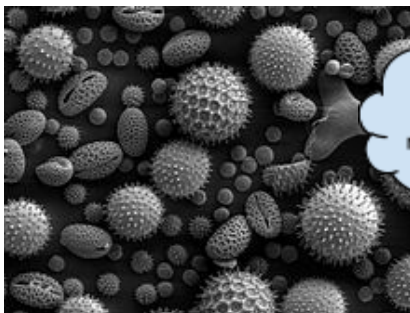
- Nucleus: contains DNA (instructions)
- Plasma membrane: is very flexible and made of phospholipids; controls what goes in and out of the cell.
- Cell wall: found outside of the membrane in plant cells (bacteria and fungi too); forms a rigid, outer protection for the cell
- Mitochondria: creates energy; RESPIRATION occurs here= produces ATP (energy)  
**\*Remember that the mitochondria have folds on the inside that increase the amount of space available for energy production!**
- Vacuoles: sites of temporary storage; plants have a large one
- Chloroplasts: found in green plants and algae; where PHOTOSYNTHESIS occurs
- Ribosomes: site of protein production

***\*ALL organelles work together to perform the many functions of a cell! For example: DNA codes for protein that are assembled by ribosomes and used as enzymes for energy production at the mitochondria!!***



### 1.1.2- Microscope (prokaryote/eukaryote)

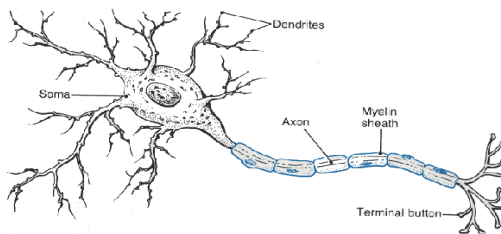
- When using a microscope, always start on low power. It gives you the largest view and allows you better find and focus on what you need. To determine total magnification, multiply the eyepiece x the objective. A compound light microscope is able to magnify an object up to about 1000X. An electron microscope can magnify up to 2 million times!



- Prokaryotes
  - no nucleus or other membrane organelles
  - contains **ribosomes, plasma membrane, cell wall**
  - less complex
  - smaller
  - contain circular DNA strands called plasmids (used in bacterial transformation)
  - bacteria, only
- Eukaryotes
  - has a nucleus and other organelles (mitochondria, vacuole, etc.)
  - larger
  - more complex
  - Every living thing on Earth, except bacteria

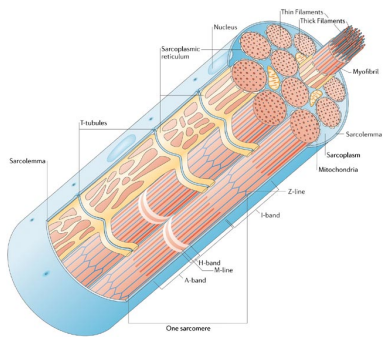
### 1.1.3 Cell specialties

- \* **the structure of many cells determines its function!**
  - neurons (nerve cells): special elongated cells that send electrical signals from the brain to communicate with other parts of the body.



- \* **cells communicate with each other using neurons and other chemical signals**

- skeletal muscle cells: elongated cells that contract and relax to create movement



- red blood cells: red blood cells are special eukaryote cells that do not have a nucleus or organelles. This allows them to pack in protein called hemoglobin that they use to transport oxygen.

- Cell differentiation
  - Organisms begin as an (undifferentiated) mass of cells- cells

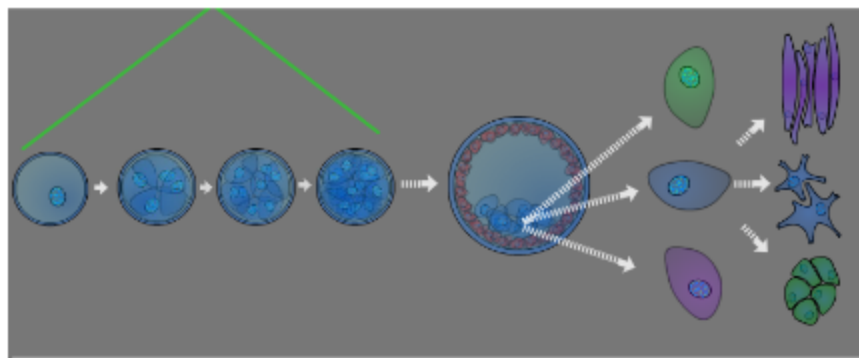


do

not yet have specific functions, they are not yet different from each other. Each cell has the same DNA. In order to create all different types of cells, certain sequences of DNA (genes) must be turned on in some cells and not in others. For example, a nerve cell does not need the gene for skin pigment, so this gene is switched off in nerve cells and switched on in skin cells.

- **These undifferentiated cells are called stem cells. Stem cells reproduce and become specialized during development of the organism.**
- **Stem cells are found in embryos and also in the bone marrow of adults and children.**

undifferentiated cells    blastula (embryo) cells    *stem cells*    *specialized cells*

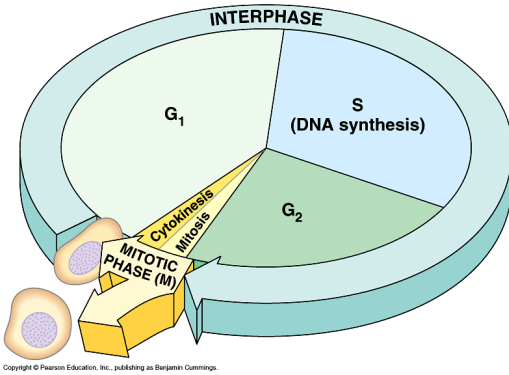


## **1.2 The Cell as a Living System**

### **1.2.1 Homeostasis**

- Cells must maintain temperature, blood sugar (glucose), water, and pH (using buffers) at certain levels. This ability to maintain is called homeostasis. Homeostasis is necessary for life and also includes removing toxins and moving the body to avoid danger or to find food, water, or a mate.
- Cell Transport
  - Materials move into and out of cells using two processes.
  - Passive transport is random and involves materials moving from high to low concentration. When materials move in this way, resulting in an equal distribution inside and outside the cell, it is called diffusion. Osmosis is the diffusion of water.
  - Active transport involves moving materials against their concentration- low to high. This process requires energy. Muscle contraction uses active transport to pump sodium and potassium into and out of the muscle cells. (1/3 of all the body's ATP fuels this sodium-potassium pump.)

## 1.2.2 Cell Cycle

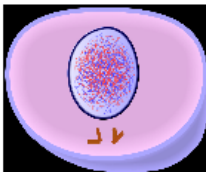


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- A cell spends the majority of its life involved in interphase, in which it is preparing to divide. During the S phase of interphase, chromosomes are copied. A small amount of time is spent completing Mitosis-division of the nucleus. Cytokinesis is when the cell's cytoplasm divides and two new cells are formed. Some cells never enter mitosis and do not divide, such as heart muscle cells and nerve cells.

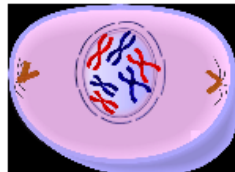
- **Mitosis**

### Interphase



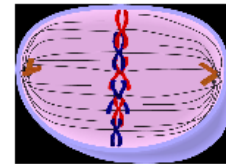
-resting phase  
-chromosomes copied

### Prophase



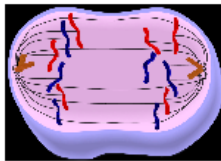
-chromosomes visible  
-nucleus disappears

### Metaphase



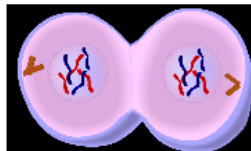
-chromosomes line up in middle

### Anaphase



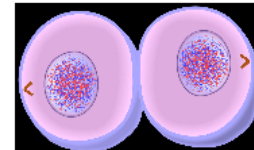
-sister chromatids separate

### Telophase



-nuclei reappear  
-cleavage furrow forms

### Cytokinesis

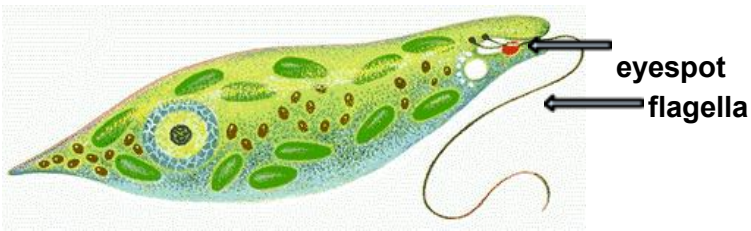
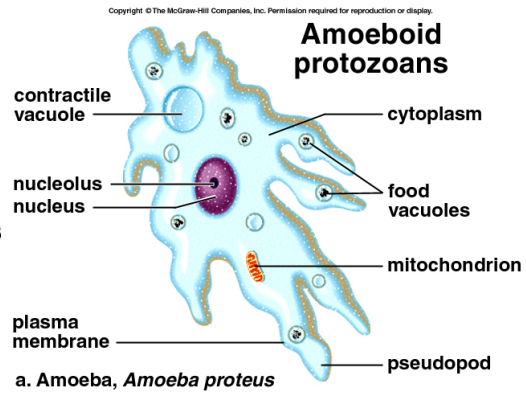
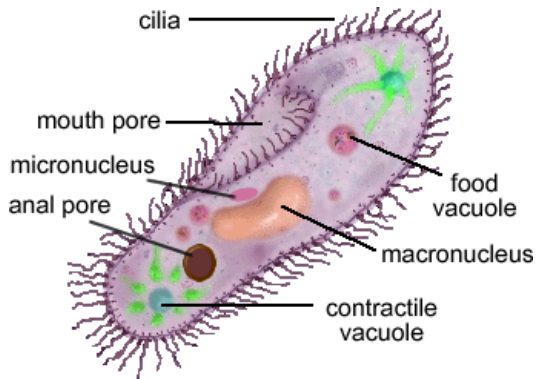


-cytoplasm divides  
-two daughter cells form

### 1.2.3 Unicellular Adaptations

Unicellular organisms have various structures that help them survive

- Contractile vacuoles help certain unicellular organisms regulate water balance.
- Eyespots help certain **photosynthetic** unicellular organisms respond to the light.
- Structures for movement: Cilia, flagella, and pseudopods



## Questions for Standard 1

1. What quality of the nucleus allows it to be in charge of all cell processes?
2. Which cell organelle is flexible due to its arrangement of phospholipids?
3. What type of organisms have cell walls?
4. What is the function of the folds within the mitochondria?
5. What three things regarding cell organelles are different between plant and animal cells?
6. Draw a mitochondrion.
7. What would the magnification be when looking through a 20X eyepiece using a 40X objective?
8. What is the difference between a compound light microscope and an electron microscope?
9. Do prokaryotes have ribosomes? Why?
10. What is the only living thing on Earth that is made of a prokaryote cell?
11. What is the name of the circular DNA that prokaryotes have?
12. If all cells have the same DNA, why are they not the same?
13. Why does the body need different types of cells? Give some examples of different cells..
14. What are cells called that do not have a specific job yet?
15. Define homeostasis?
16. What is the difference between diffusion and osmosis?
17. If a cell is placed in salt water, what will happen to the cell?

18. If a cell is placed in pure water, what will happen to the cell?
19. What is necessary for the process of active transport to occur?
20. In which part of the cell cycle are chromosomes copied?
21. In which part of the cell cycle do cells spend the most time?
22. What phase/term refers to division of the nucleus and chromosomes?
23. When are two new cells formed?
24. Put the following in the correct order:



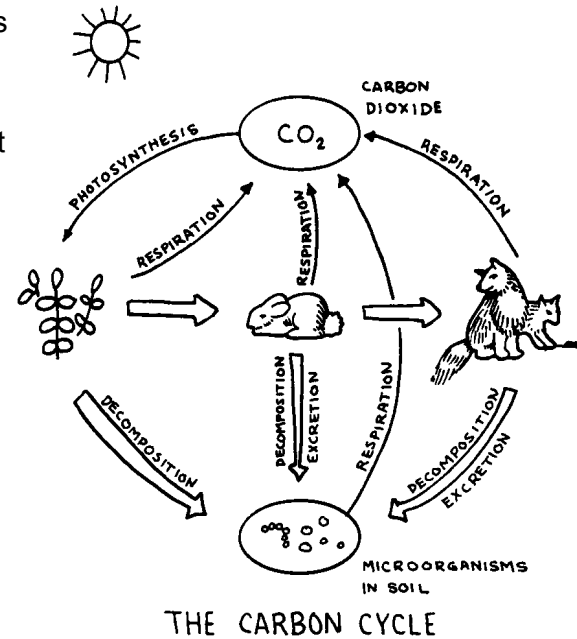

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25. What is the function of the contractile vacuole?
26. What type of organisms have an eyespot?
27. Describe the cilia, flagella, and pseudopods in terms of movement for the cell.

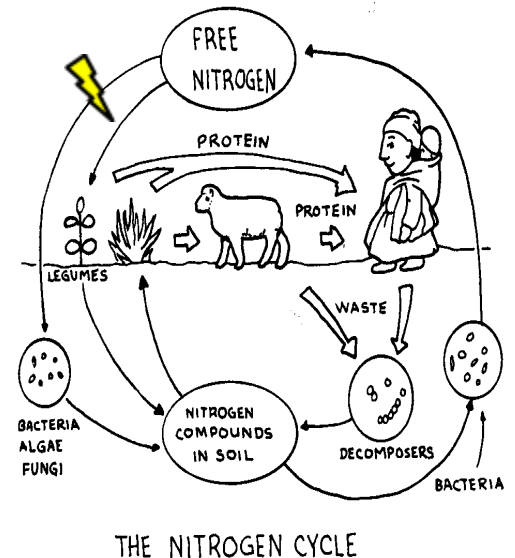
## 2.1 Ecology

### 2.1.1 Energy Flow/Cycling of Matter

- The Carbon Cycle
  - Carbon continuously cycles through our environment. Carbon is found in the atmosphere in the form of carbon dioxide. Carbon dioxide enters plants during photosynthesis. Plants need carbon to create organic compounds such as glucose. Respiration in plants returns carbon dioxide to the atmosphere. Also, when animals eat plants, carbon passes to the consumers and then back into the atmosphere through respiration. In addition, when consumers die, carbon enters the soil and then decomposers return carbon dioxide back to the atmosphere. Carbon dioxide in the atmosphere helps keep the earth warm because it holds heat via the greenhouse effect. Excess carbon dioxide from human activities such as burning fossil fuels and natural processes such as volcanic activity, can contribute to overall global warming.



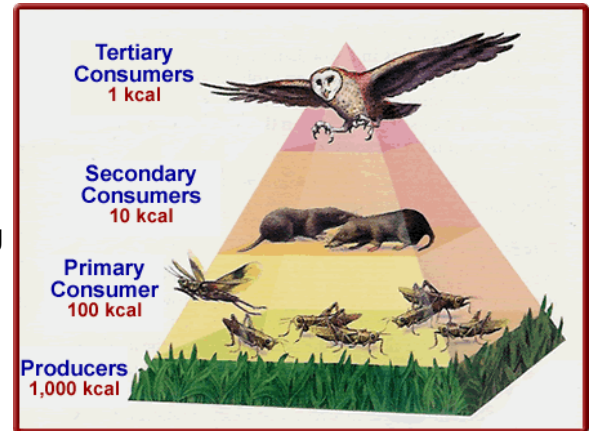
- The Nitrogen Cycle
  - Nitrogen is essential to life because it is a key component of amino acids (proteins) and nucleic acids (DNA). Even ATP contains nitrogen. 78% of the atmosphere is composed of nitrogen, in a form unusable to plants and animals. Nitrogen can be made available to plants by the actions of nitrogen-fixing bacteria, lightning that breaks down atmospheric nitrogen, and animal excretion (urine). Nitrogen is broken down and returned to the atmosphere by bacteria, fungi, and other microorganisms.





- Energy Pyramids

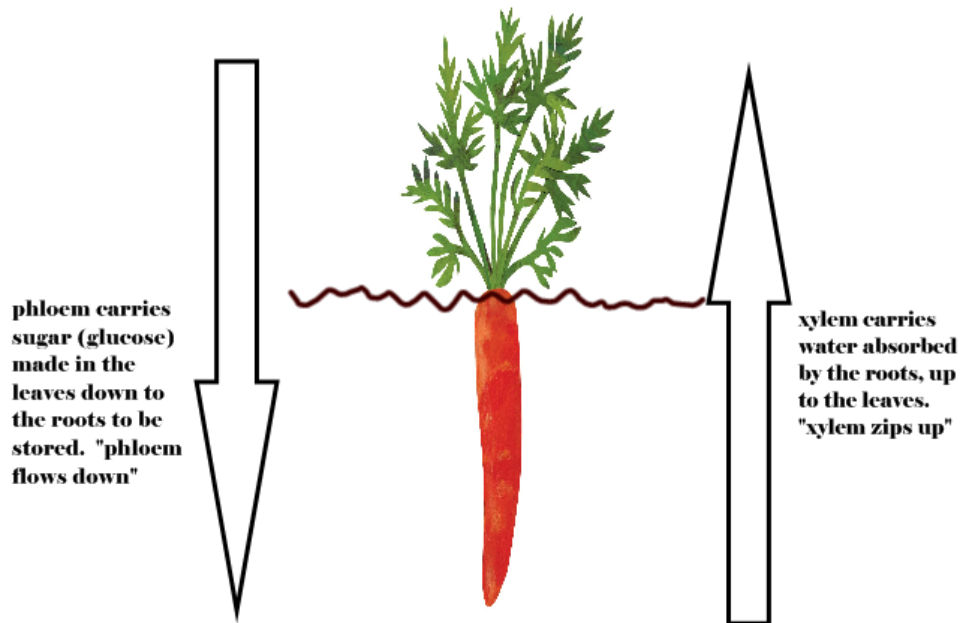
- Energy is needed by all organisms to maintain homeostasis. The ultimate source of energy comes from the sun in the form of radiant energy. This radiant energy is converted to chemical energy. Plants and animals use energy to perform life functions and while doing so, some of this energy is lost as heat. For this reason, energy decreases as it is transferred through a food chain- as you move up a food chain or energy pyramid.



### 2.1.2 Life Functions **\*\*This is a little different on the August 17, 2012 unpacking document**

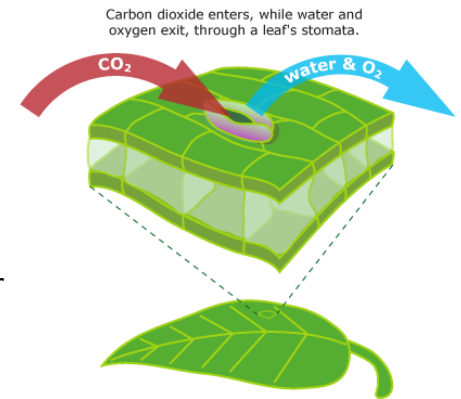
**\*Plants and animals have different ways of accomplishing their many life functions.**

- Transport- How organisms get what they need to their cells
  - Most plants have vascular tissues in their stems called xylem and phloem that transport water and food through the stem.



- Some plants, such as moss, do not have these tissues and are said to be nonvascular. Instead, they rely on close contact with the water(osmosis) and will never grow more than a few inches off the ground.
- Many animals such as insects, amphibians, and mammals use a circulatory system with blood vessels to transport needed materials the their cells.
- Excretion- How organisms get rid of waste

- Animals include amphibians and mammals have a urinary system with kidneys that are used for removing nitrogen wastes from the body. The kidneys also play a huge role in regulating water balance, salt, and pH in mammals.
- Plants have holes in their leaves called stomata that are used to excrete wastes such as oxygen produced during photosynthesis. Plants also lose water from stomata in a process called transpiration.



- Respiration- How organisms take in and release gases
  - All living things participate in respiration to produce energy(ATP) using oxygen within the mitochondria of their cells.
  - Plants take in and release gases through the stomata on their leaves.
  - Animals such as amphibians and mammals have lungs that are used for taking in oxygen. Insects have special structures called spiracles and tracheal tubes.
  - Single-celled organisms such as bacteria and protists use simple diffusion for taking in gases.
- Nutrition- How organisms get nutrition/break down and absorb foods
  - Organisms such as plants and algae that can produce their own food through photosynthesis are called autotrophs. Organisms such as animals that must consume food and are called heterotrophs.
  - Many animals have a digestive system that is used for breaking down and absorbing foods.
  - Mammals have different teeth shapes that allow them to eat certain foods. Birds have different beak shapes that allow them to eat certain foods.

- Growth/Development/Reproduction

- Some plants grow from seeds like plants with flowers and cones. Others grow from spores like moss and ferns. Spores are reproductive structures that do not have to be fertilized. Seed plants use pollen and ovules(eggs) during sexual reproduction. The pollen is the male structure and the ovule is the female structure. Insects, birds, mammals, and the wind are all methods of pollen dispersal.
- Animals such as insects and amphibians go through metamorphosis. This means that the adult takes a different form than the young. The main advantage of this is that the adult and young do not compete for food.
- There is a variety of reproductive methods in the animal kingdom. Animals who



live in the water such as fish and amphibians use external fertilization This means egg and sperm are dispersed to the outside of the body. This ensures that a large number of eggs are fertilized at one time. Animals such as mammals have fertilization on the inside of the body. There are three groups of mammals based on fetal development of the offspring. Mammals that lay eggs like the duckbill platypus are called monotremes. Mammals such as kangaroos that have partial development in a “pouch” are called marsupials. Mammals that have complete development inside the uterus are called placental.

- A fertilized egg is called a zygote. The zygote divides by mitosis multiple times before the embryo is formed. In mammals, the embryo then becomes a fetus after further development. The amount of time within the womb(gestation) varies greatly among mammals.
- Most unicellular organisms such as bacteria participate in asexual reproduction. This means that one cell splits to form two- like in mitosis of body cells.
- **Animal behavior**
  - Behaviors can be inherited or learned. Some inherited behaviors are instincts such as migration, estivation, hibernation, suckling, and phototaxis/chemotaxis.
    - Estivation is similar to hibernation in that the animal must slow down its body activities in response to dangerous conditions. Instead of due to lack of food during the winter months, estivation occurs during the summer months in periods of extreme heat and dryness.
    - Newborn mammals instinctively know how to get food from their mothers. This is called suckling.
    - Many animals are born with the strong social behavior of territoriality. Male Betta fish may fight for several minutes before one finally backs off or even dies.(2.1.3)
    - Another social behavior is demonstrated by ants, bees, and termites as they use chemical signals called pheromones to communicate things such as the location of food. (2.1.3)
    - Courtship behavior involves actions such as those performed by the male peacock as he spreads his tail feathers to attract a mate. (2.1.3)
    - When an animal moves toward or away from a stimulus, this is called a taxis. Phototaxis occurs when insects or even plants or protists are attracted to the light. Chemotaxis occurs when animals are attracted to a chemical such as food.
  - Behaviors are also learned. Some examples are habituation, imprinting, classical conditioning and trial/error.
    - Migration involves traveling long distances to new habitats that are better suited for feeding or reproductive purposes.
    - Habituation is when a behavior is learned by repetition or “habit” and there



is a decrease in response to the stimulus. For example, horses that are brought into the city for police purposes are afraid of the loud noises, but eventually get used to them.

- Imprinting is when an animal forms a social attachment to another animal at an early, critical time of their life. For example, a baby duck will follow the first animal that it sees upon hatching.
- Classical conditioning is when an animal associates one type of behavior with a reward. In the example of Pavlov's dog, Pavlov rings a bell every time that he presents his dog with food. Eventually, all he had to do was ring the bell and the dog would salivate (drool).
- Trial and error involves trying various responses until one is rewarded.

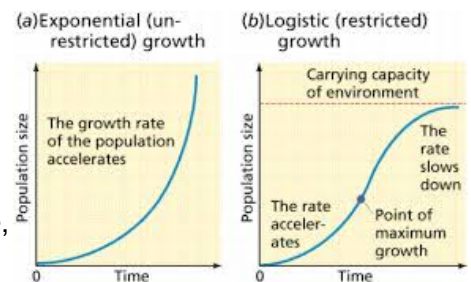


### 2.1.3 Ecology Relationships

- There are many relationships that occur among species in an ecosystem
- Symbiosis is a close and permanent relationship between members of different species. If the relationship is one where both benefit, it is called mutualism. For example, both bees and flowers both benefit from pollination. If the relationship is one where one benefits, but the other is harmed it is called parasitism. For example, mistletoe is a plant that grows within trees and benefits by absorbing nutrients from them. The tree is harmed by being deprived of nutrients.
- Predator-prey relationships are important for population control. When the number of predators is scarce, the number of prey should rise. If the number of predators increases, the number of prey should decrease.

### 2.1.4 Populations

- The human population is growing exponentially- which means that the larger it is, the faster it grows. This is due to the fact that the human population currently has no limiting factors. Limiting factors are factors that would cause a population to decrease in size, or stop growing. For most populations, limiting factors include food availability, disease, climate, water, and territory (space). Once a population reaches the maximum population size that can be supported, some of the members will die. This is called carrying capacity.
- Over time, disease has been one constant factor that has had a local effect of the size of human populations. Disease also affects populations of other animals and plants. Ecosystems maintain a diversity of species in equilibrium. This equilibrium can be upset by the introduction of disease, especially if the disease affects a large number of one species- such as with Dutch Elm Disease.
- An aging population would soon bring an increase to the death rate and a young population (20-40) would soon bring an increase to the birth rate.



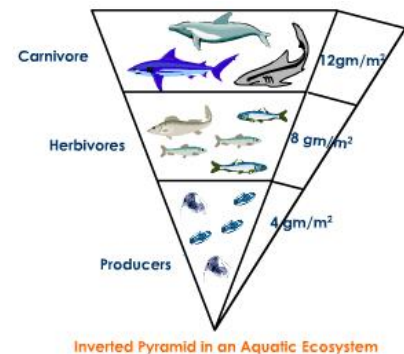
## 2.2 Human Impact

### 2.2.1 Human Impact/NC

- As the human population increases, resources such as fossil fuels are consumed at an increasing rate. Also, with more consumption comes more waste and potential for pollution.
- Technological influences such as timber for building and crop cultivation have also negatively impacted the environment due to deforestation. At least half of the world's forests have disappeared at the hands of humankind. Forest survival is lowest where population density is highest.
- Locally, in North Carolina, there are many effects of human population growth, pollution, and resource consumption.
  - acid rain in the mountains: the rain falling on NC is five to 16 times more acidic than normal. Death of trees in the mountains of NC has been linked to acid rain.
  - beach erosion: 15% of NC's shoreline is critically eroding. One of the causes of beach erosion is a rise in global sea levels. Rising sea levels has been linked to global warming and melting of glaciers.
  - urban development: clearing of forests for agriculture or other purposes and caused destruction of forest habitats and has allowed for runoff of fertilizers and other pollutants into local rivers and streams.
  - waste lagoons on hog farms: hog farms are a part of one of the biggest industries in the state. NC's 10 million hogs produce 40 million gallons of untreated manure every day. This manure also runs off into the local rivers and streams contaminating the water and killing some aquatic species.
  - invasive plants such as Kudzu: Kudzu was brought to the US from Japan for erosion control. Currently Kudzu grows so quickly that it overtakes and kills native species due to competition for light.

### 2.2.2 Bioaccumulation/Stewardship

- Pesticides used by farmers have not only killed the intended plants or insects, they have indirectly killed higher order organisms like eagles because of bioaccumulation. Bioaccumulation is the idea that pesticide concentration increases in the tissues of organisms as you move up the food chain. Organisms that are higher on the food chain eat more. The more an organism eats, the more pesticide that they ingest.
- Humans can work to lessen the negative impact that they have on the environment. Recycling programs are effective in reducing land pollution. Reintroduction programs involve reintroducing animals to environments where their numbers have decreased. Stewardship involve responsible planning and use of resources to ensure their availability in the future.



## Questions for Standard 2

1. How does carbon enter plants?
2. List two ways that consumers return carbon to the atmosphere?
3. What process is explained by carbon dioxide holding heat in the atmosphere?
4. Why is nitrogen important to humans?
5. What are three processes that make nitrogen available to plants?
6. What happens to energy as it moves up the food chain? Why?
7. What two structures do most plants use for transport of materials? What is the difference between the two?
8. What do many animals use for transport?
9. What are the structures within plants' leaves that allow gas exchange and excretion of wastes?
10. What process is described by loss of water from a plants leaves?
11. In addition to gas exchange, what is the overall goal of respiration?
12. How do single-celled organisms exchange gases?
13. How do plants obtain nutrients?
14. What is the advantage of a spore?
15. What is metamorphosis and what is its advantage?
16. What is the advantage of external fertilization?

17. Contrast monotremes, marsupials, and placental mammals.
18. How are estivation and hibernation similar? How are they different?
19. What social behavior is displayed by Betta fish?
20. Give an example of each of the following:
  - a. communication using pheromones
  - b. courtship behavior
  - c. phototaxis
21. After moving to his new home, a man is startled several times per day due to close proximity to a passing train. According to habituation, what should eventually happen?
22. Why might imprinting be necessary for survival of an animal?
23. Which behavior is described by associating a certain behavior with a reward, such as with Pavlov's dog?
24. Contrast mutualism and parasitism.
25. What happens to a prey population if the predator population decreases? Why?
26. What are limiting factors? Give two examples.
27. What happens when a population reaches carrying capacity?
28. Which limiting factor has had the ability to affect the size of local populations?
29. Why might the birth rate soon increase if a large portion of the population is between the ages of 20 and 40?
30. What two things have increased along with increasing human population.

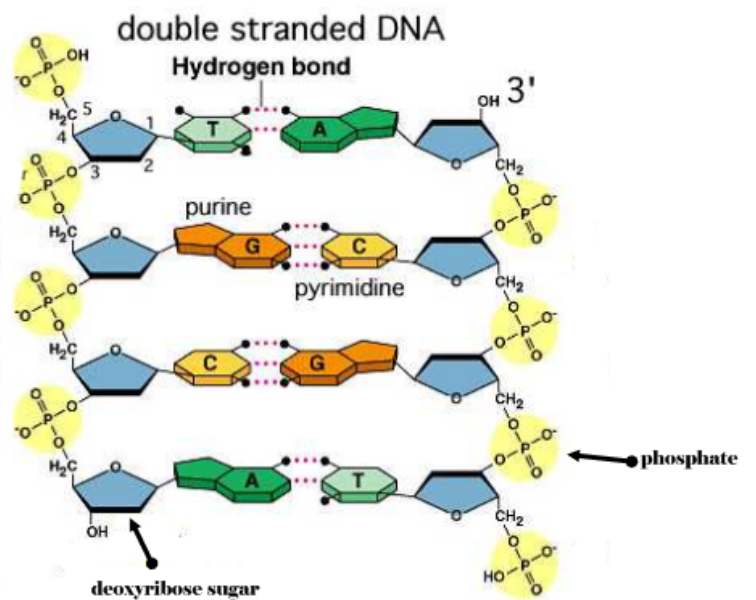
31. How has acid rain affected the mountains of NC?

32. Why are hog farms damaging to NC ecosystems?

33. Why is Kudzu so bad?

34. Why do pesticides kill animals such as eagles?

35. What can you do to have good Stewardship (help preserve the environment for the future)?





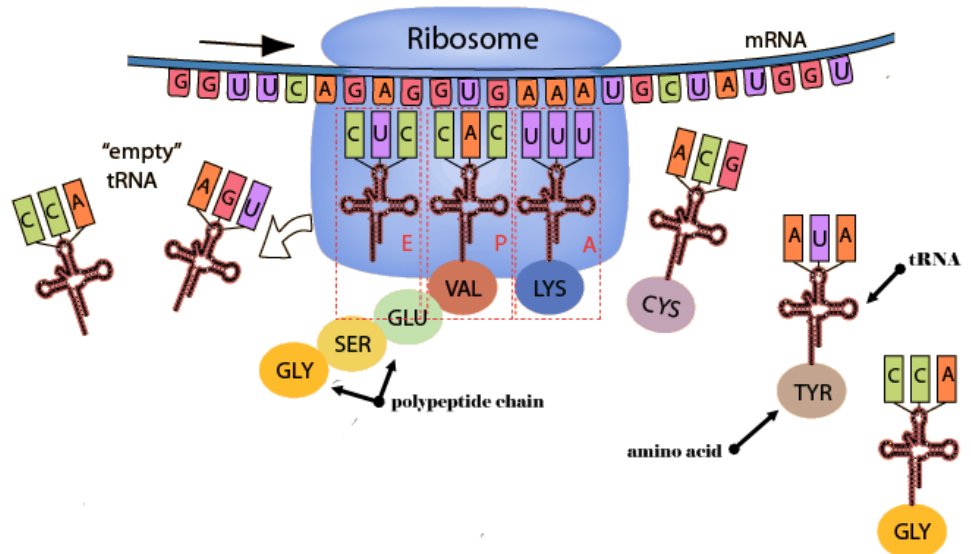
### 3.1 How Traits are determined by DNA

#### 3.1.1 Structure of DNA

- DNA is in the shape of a “twisted ladder” called a double helix. The sides of the ladder are made of alternating phosphates and sugars (deoxyribose). The rungs the ladder are made of pairs of nitrogen bases, A-T and C-G. These pairs are held together by weak hydrogen bonds.
- The sequence of the DNA determines which proteins are made. Proteins are important for building things within the body and in chemical reactions (enzymes). Depending on need, the body produces many different types and amounts of proteins. If you have an injury, clotting proteins will be made to stop the bleeding. However, it is possible to make clotting proteins at incorrect times. This would result in a blood clot in an unbroken vessel that could travel get stuck in an unwanted location such as the lungs.

#### 3.1.2 Protein Synthesis

- Transcription produces an RNA copy of DNA while inside the nucleus. This mRNA then leaves the nucleus and travels to the ribosome. While at the ribosome, rRNA reads the message and helps assemble the protein. tRNAs bring amino acids to the ribosome according to the mRNA codons (AUG). Amino acids are linked together by rRNA using peptide bonds. This process of translating the mRNA codons into amino acids is called translation. A chain of amino acids is called a polypeptide (protein).
- There are two classes of protein. Some proteins build things and are called structural, such as the keratin in your skin and hair. Some proteins are involved in cell processes such as enzymes and are called functional.



#### 3.1.3 Mutations

- A mutation is any change in the DNA sequence.
  - Mutations can be additions or deletions where a base is added or deleted. When this happens, each three letter codon gets shifted and the entire amino acid sequence/protein is altered and will most likely be nonfunctional.
  - Mutations can also be substitutions. This happens when a base or codon is switched with another. This will only alter one amino acid and will result and can result in a slightly altered amino acid- such is the case with sickle-cell anemia. Once amino acid is altered causing the hemoglobin molecules to stick together,

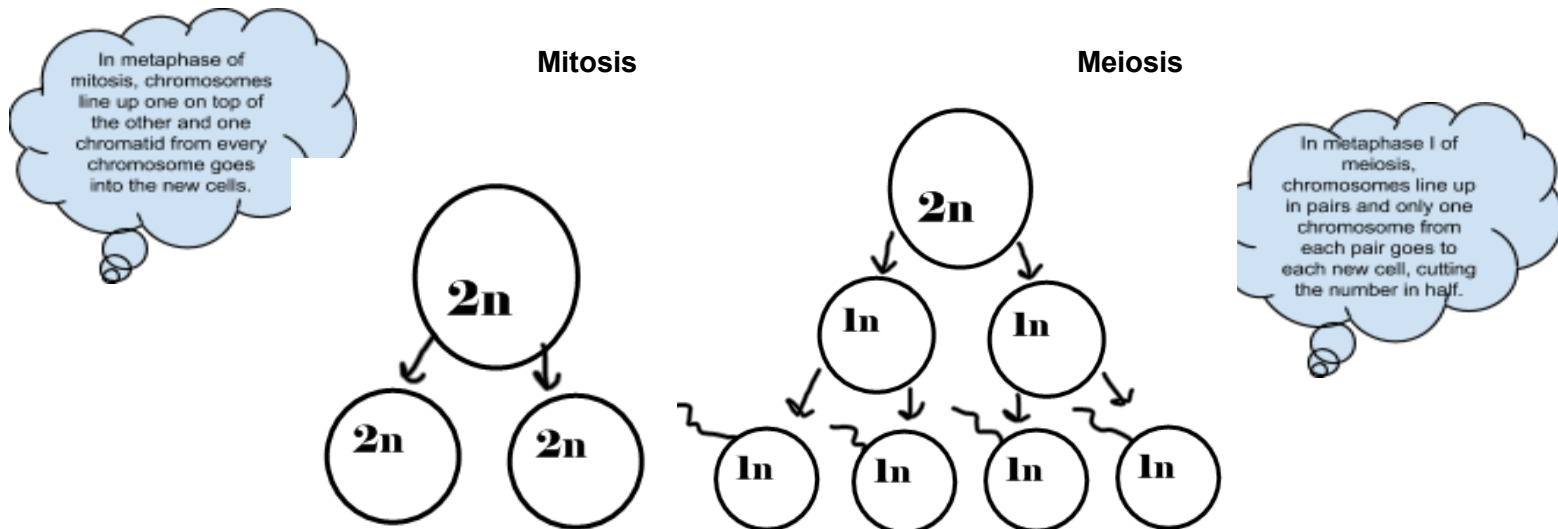
resulting in a misshapen red blood cell. Sickle-cell anemia is a recessive, genetic disorder.

- Some mutations can also be random or caused by environmental influence such as UV rays. Only mutations in sex cells can be inherited.

## 3.2 Heredity

### 3.2.1 Meiosis/Variation

- In preparation for mitosis and meiosis, DNA coils to form chromosomes. Humans have 46 chromosomes in all cells of the body except sex cells (egg and sperm), which have only half, 23. The first 22 pairs of chromosomes are called autosomes. The 23rd pair is the sex chromosomes. Females have XX and males have XY.



- Mitosis
  - asexual reproduction
  - beginning cell has two of each chromosome (diploid)
  - ends with two new cells that have two of each chromosome
  - both cells are genetically identical to each other
  - one cell division
- Meiosis
  - sexual reproduction
  - beginning cell has two of each chromosome

- ends with four new cells that have only one of each chromosome (haploid)
- each cell is genetically different from each other.
- Meiosis allows for greater variation (differences) in offspring.
  - Genes on separate chromosomes are inherited independently of each other.
  - During meiosis, homologous chromosomes exchange genes in a process called crossing over.
  - Nondisjunction occurs when chromosomes do not separate properly during meiosis. This results in new cells having extra or missing chromosomes.
  - The simple act of egg and sperm combining (fertilization) allows for variety in offspring.

### 3.2.2 Punnett Squares/Karyotype/Pedigree

- Dominant alleles are represented by the capital letter of the dominant trait. Recessive alleles are represented by the lowercase letter of the dominant trait. Dominant alleles mask recessive alleles. For dominant traits to be present, only one dominant allele is needed. For recessive traits to be present, two recessive alleles are needed. For example: if Purple petal color is dominant over white petal color, P would represent purple and p would represent white. PP and Pp would both be purple and pp would be white.
- Because you have two copies of each chromosome, you have two copies (alleles) for each trait. When both alleles are the same, it is said to be homozygous. When the two alleles are different from each other, it is said to be heterozygous.
- The genotype of a trait is the alleles that are present. The phenotype of a trait is the physical expression of the alleles. For example: PP would be the genotype and purple would be the phenotype.
- When a trait has two possible alleles, there are always three possible genotypes. Two of one letter, two of the other letter, or one of each. (AA, aa, Aa)
- Some traits are not inherited as simple dominant or recessive.

- Some traits are incomplete dominant which means that two traits combine to form an intermediate phenotype. For example, if a red plant is crossed with a white plant the offspring would be pink. (RR x WW = RW or RR x R'R' = RR', two of the same letter for red x two of the same letter for white = one of each letter for pink).

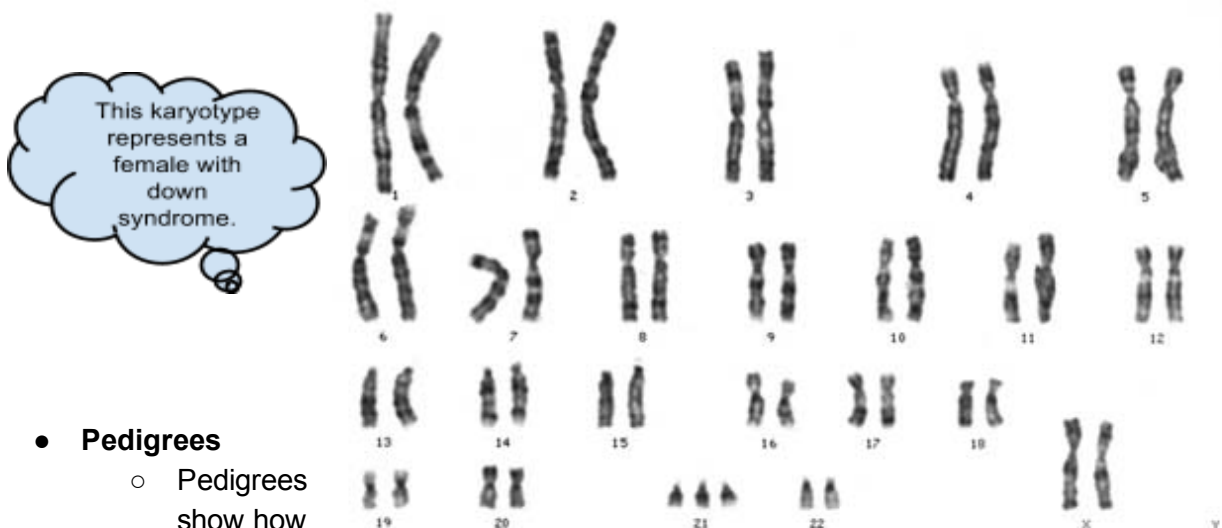


- Some traits are codominant which means two alleles show up at the same time. For example in a certain breed of cattle, if a cow with red coat color is crossed with a cow with white coat color, the offspring will be roan (both red and white).
- Some traits are controlled by more than two alleles. For example blood types have three alleles: ABO. With blood types, there are six possible genotypes and four phenotypes.

- $I^A I^A$  or  $I^A i$  (AA or AO) = Type A



- $I^B I^B$  or  $I^B i$  (BB or BO) = Type B
  - $I^A I^B$  (AB) = Type AB
  - $ii$  (OO) = Type O
- Some traits are inherited only on the X chromosome and are said to be X-linked or sex-linked. Examples of this type of trait are hemophilia and colorblindness. These traits are also recessive. Females must have two copies, one for each X. Males only need one copy because they only have one X. For this reason, males are much more likely to inherit X-linked traits.
- Some traits are controlled by more than one pair of alleles or genes. They are called polygenic. Because there are many alleles expressed, there are many possible phenotypes. Some examples are skin color, hair color, and eye color.
- Most genetic disorders have recessive inheritance such as sickle cell anemia and cystic fibrosis. One dominant disorder is called Huntington's disease.
- A karyotype is a chart that shows all of a person's chromosomes. The chromosomes are paired and lined up in order from largest to smallest. The last pair is the sex chromosomes. A karyotype can be used to determine sex of the individual and to find out if the person has a chromosomal abnormality such as an extra or missing chromosome.



- **Pedigrees**

- Pedigrees show how a trait or disease is passed in a family.
- If two parents have a trait, but their son or daughter do not, the trait is dominant. The parents must be heterozygous dominant and the unaffected offspring will be recessive.
- If two parents do not have a trait, but their son or daughter does, the trait is recessive. The parents must again be heterozygous dominant and the affected offspring will be recessive.

### 3.2.3 Genetics/Environment/Disease \*\*not on updated “unpacking documents” August 17, 2012

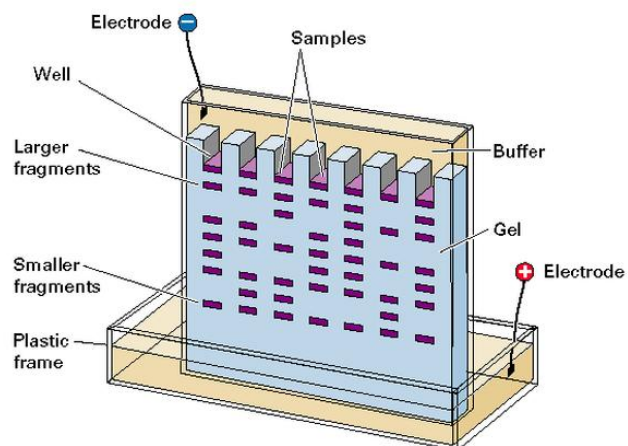
- The following conditions, or susceptibility to them, can be inherited. These conditions all have environmental influences that can be controlled in order to prevent them.

Genetic Condition	Prevention
lung cancer	no smoking
skin cancer	limited sun exposure, vitamin D, folic acid
Type 2 diabetes	diet low in sugar and regular exercise
PKU	testing at birth; diet free of phenylalanine
heart disease	diet low in fat and regular exercise
malaria	<b>*sickle-cell anemia</b>

## 3.3 DNA Technology

### 3.3.1 Gel Electrophoresis

- Gel electrophoresis is a technique used to separate DNA fragments based on size.
- Gel electrophoresis creates a DNA fingerprint that can be used to identify missing persons or crime suspects and to identify and catalogue endangered species.
- To create the gel, DNA must first be cut into smaller fragments by using **restriction enzymes**. The fragments are then placed into wells on the gel and an electric current is applied. The negatively charged fragments are attracted to the positively charged end of the electrophoresis device. **Smaller** fragments travel quicker and



farther in the gel than do larger fragments and will be found at the bottom of the gel.

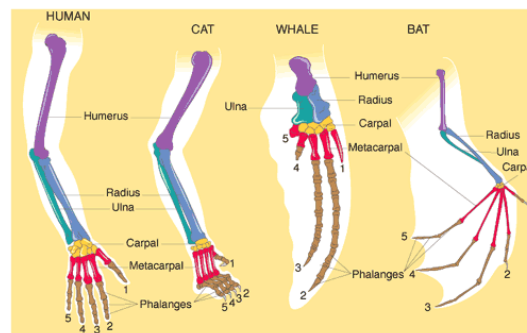
### 3.3.2 Transgenic Organisms

- Transgenic organisms are those that contain DNA fragments from other organisms. Some agricultural crops have been modified to contain genes that make them resistant to certain pesticides. Some bacteria have been modified to contain genes for human insulin (protein that regulates blood sugar). These bacteria then multiply and produce large quantities of the protein (insulin) that can be administered to those with diabetes. This is also done with human growth hormone.
  - The gene for human insulin is first isolated from human DNA. It is then cut and inserted into the bacterial chromosome (plasmid). The bacteria must then take in the plasmid so that it can use the insulin gene to make the insulin protein.

## 3.4 Evolution

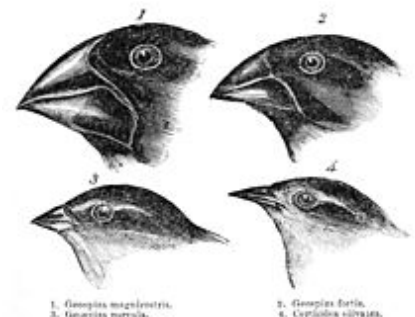
### 3.4.1 Evidence of Evolution

- According to the early earth hypothesis, the atmosphere was hot and lacked oxygen. Because of this, the first living things were anaerobic and prokaryotic. Oxygen was available in the atmosphere only after the evolution of photosynthetic organisms. This allowed for eukaryotic cells. Eventually multicellular organisms evolved.
- Anaerobic prokaryotes → photosynthetic prokaryotes → eukaryotes → multicellular
- Fossils provide evidence of evolution. Older fossils can be compared to more recent ones to show how species evolved.
- DNA and anatomical structures (homologies) can also suggest how species have evolved. DNA provides the best evidence because it can tell us exactly how closely related some organisms are. Anatomical structures suggest that all organisms have a common ancestor.



### 3.4.2 Natural Selection

- In nature, more offspring are born than can survive. When resources are limited, those who have an advantage will live and pass those on those traits to their offspring. These advantages are due to random mutations and variations that appear in populations. For example, if a bird lives in an environment with lots of hard



seeds and nuts, then it would be advantageous for the bird to have a strong beak that would allow it to break apart the seeds. Birds that are born with strong beaks will be able to eat more in this environment and will pass this trait on to their offspring. Such traits are called adaptations. Small changes over time lead to evolution of the species.

- If members of the same species are separated by some physical feature such as a river, volcanic eruption, or earthquake they may evolve separately in different environments. This is called geographic isolation and may also lead to evolution of a new species.

### **3.4.3 Disease/Evolution**

- Bacteria and viruses may also evolve due to random mutations. When antibacterials or antibiotics are used, not all bacteria die. Some of them may be resistant. All offspring of the bacteria will also be resistant. The same is true with insects resistant to pesticides.

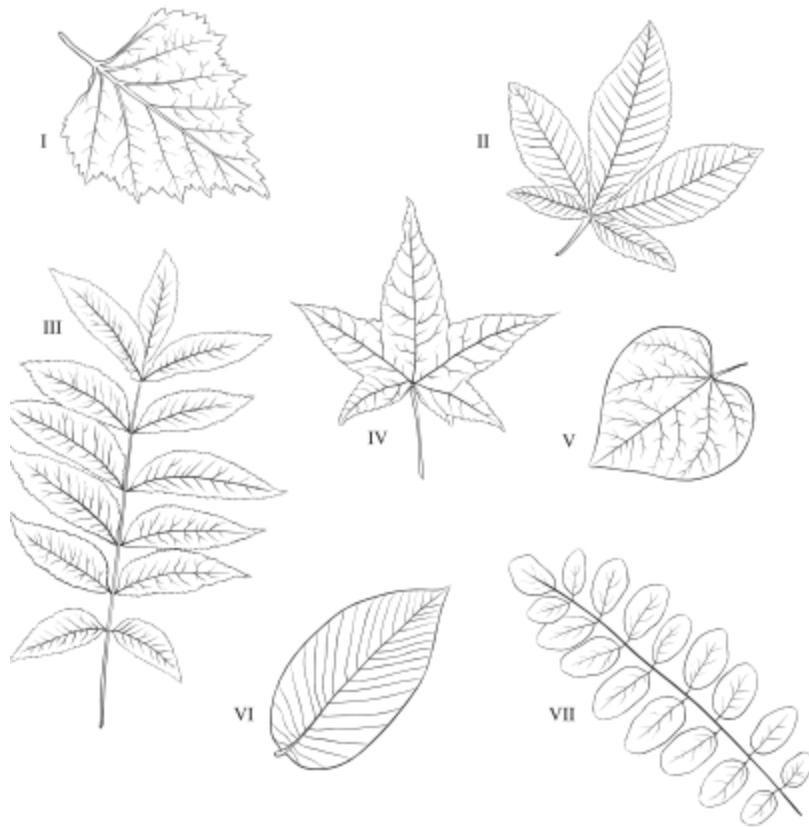
## **3.5 Classification**

### **3.5.1 Changing Nature of Classification**

- Today's system of classification is not the same system that has always been used. As new knowledge is generated by research on evolutionary relationships, new methods arise. Originally there were only two kingdoms of living things- plants and animals. 15 years ago there were only 5 kingdoms- plants, animals, fungi, protists, monera (bacteria). Now we commonly use 6 kingdoms- splitting the one bacteria kingdom into two, archaeobacteria and eubacteria.

### **3.5.2 Dichotomous Key/Phylogenetic Tree**

- A dichotomous key is a system using two part questions used to identify living things. The key gives the user a choice between two characteristics at each step of the key.

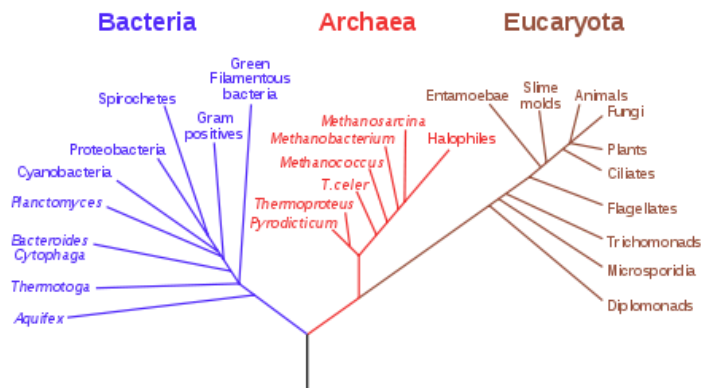


Dichotomous Key for Leaves	
1. Compound or simple leaf	
1a) Compound leaf (leaf divided into leaflets)	.....go to step 2
1b) Simple leaf (leaf not divided into leaflets)	.....go to step 4
2. Arrangement of leaflets	
2a) Palmate arrangement of leaflets (leaflets all attached at one central point)	..... <i>Aesculus</i> (buckeye)
2b) Pinnate arrangement of leaflets (leaflets attached at several points)	.....go to step 3
3. Leaflet shape	
3a) Leaflets taper to pointed tips	..... <i>Carya</i> (pecan)
3b) Oval leaflets with rounded tips	..... <i>Robinia</i> (locust)
4. Arrangement of leaf veins	
4a) Veins branch out from one central point	.....go to step 5
4b) Veins branch off main vein in the middle of the leaf.....	go to step 6
5. Overall shape of leaf	
5a) Leaf is heart-shaped.....	<i>Cercis</i> (redbud)
5b) Leaf is star-shaped	..... <i>Liquidambar</i> (sweet gum)
6. Appearance of leaf edge	
6a) Leaf has toothed (jagged) edge	..... <i>Betula</i> (birch)
6b) Leaf has untoothed (smooth) edge	..... <i>Magnolia</i> (magnolia)

- Phylogenetic Tree

- Shows the evolutionary relationships of several species branching from a common ancestor. The closer the species are to each other on the tree, the more closely related they are. The common ancestor is at the bottom.

### Phylogenetic Tree of Life





### Questions for Standard 3

1. What makes up the sides of the DNA ladder?
2. What is found in between the bases of DNA?
3. What does the sequence of DNA determine?
4. What is transcription and where does it occur?
5. What is being translated into amino acids?
6. Which nucleic acid brings amino acids to the ribosomes?
7. Describe the two types of proteins.
8. What type of cells are created through meiosis? How is the number of chromosomes in these cells different from the original cell?
9. What are two ways do the new cells of mitosis compare to the new cells of meiosis?
10. What are the 4 ways that meiosis creates variation in offspring?
11. What is the difference between heterozygous and homozygous?
12. Which of these would be a genotype? GG or green?
13. What is the difference between codominance and incomplete dominance? How are they alike?

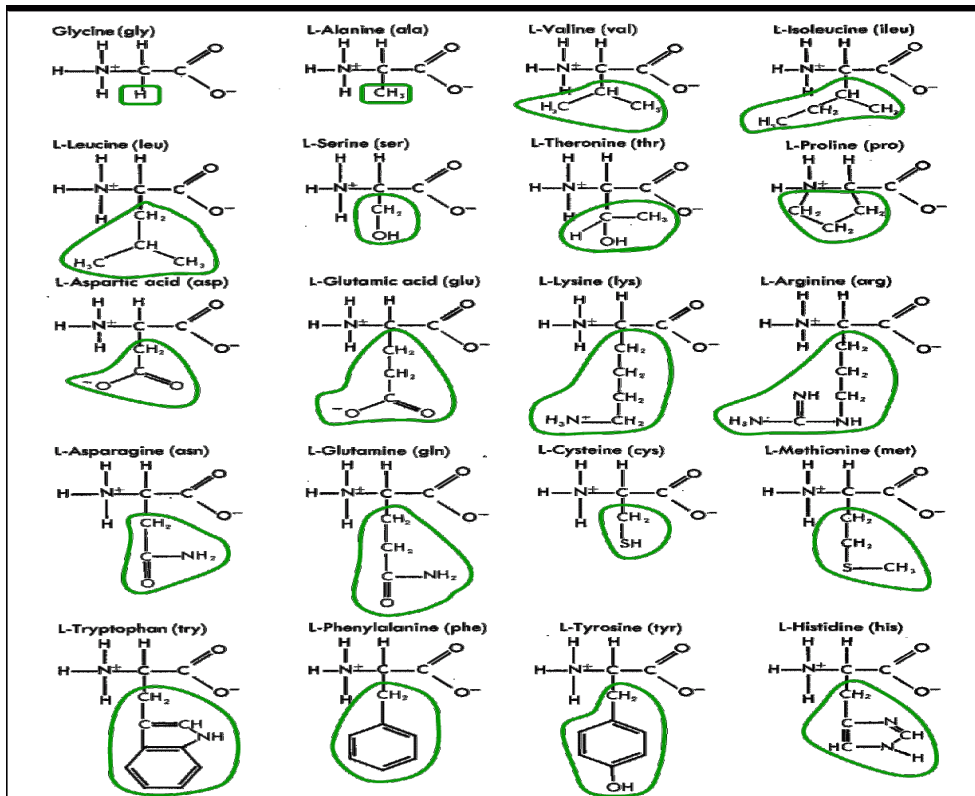
14. Why are males more likely than females to inherit sex-linked traits?
15. What two things can be found from a karyotype? Which chromosomes represent the 23rd pair?
16. If two parents have a trait and their son or daughter do not, what is the genotype of the parents? Is this a dominant or recessive trait?
17. How can PKU be prevented?
18. Having the condition of sickle-cell anemia may prevent you from contracting which other condition?
19. What are restriction enzymes used for?
- 20 . Which fragments travel farther in gel electrophoresis?
21. Give two medical uses of transgenic bacteria.
22. What are some evidences of evolution?
23. What is geographic isolation?
24. What species is leaf IV from the dichotomous key?
25. Which are more closely related: plants and slime molds or plants and fungi?

## 4.1 Organic Compounds

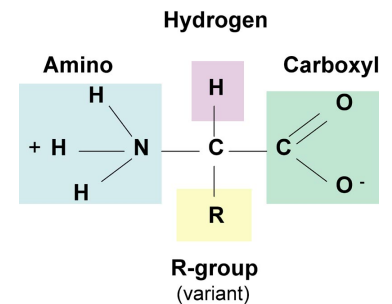
### 4.1.1 Structure and Function of Organic Compounds

Compound	Functional Unit	Function	Examples
Carbohydrates	monosaccharides	energy source	<ul style="list-style-type: none"><li>● glucose (blood sugar)</li><li>● cellulose (plant cell walls)</li><li>● starch (storage for plants)</li><li>● glycogen (storage in mammals' liver)</li></ul>
Lipids	fatty acids and glycerol	energy storage, protection, insulation	<ul style="list-style-type: none"><li>● fats</li><li>● phospholipids &amp; steroids (cell membranes)</li></ul>
Proteins	amino acids	build structures or speed up chemical reactions	<ul style="list-style-type: none"><li>● insulin (regulates blood sugar)</li><li>● enzymes (speed up reactions)</li><li>● hemoglobin (carries oxygen in blood)</li></ul>
Nucleic Acids	nucleotides	store genetic information	<ul style="list-style-type: none"><li>● DNA</li><li>● RNA</li></ul>

## 4.1.2 (Protein Synthesis and Proteins)



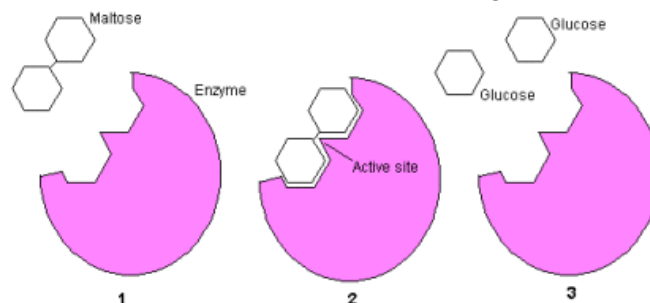
### Amino Acid Structure



- There are 20 different amino acids. They all have the same basic structure, including an amino group and a carboxyl group. They do however, all have different “R” groups (circled in green). This R groups determines their function by determining how they are folded into proteins. Proteins can be either structural or functional. Structural proteins, such as keratin, build things like your hair and nails. Functional proteins, such as enzymes, are involved in chemical reactions.

## 4.1.3 Enzymes

- Enzymes are proteins that have been folded into specific shapes. The shape determines the function. Enzymes:
  - Speed up chemical reactions by lowering the activation energy needed to begin the reaction
  - are reusable (because they are not changed during the reaction)
  - are specific (fit with only one substrate like lock and key)
  - are affected by pH and temperature (their shape is altered in high temperature and extreme pH)

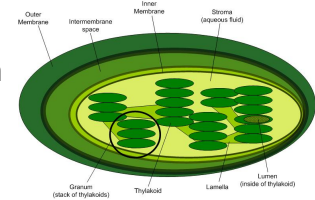


## 4.2 Energy in a Cell

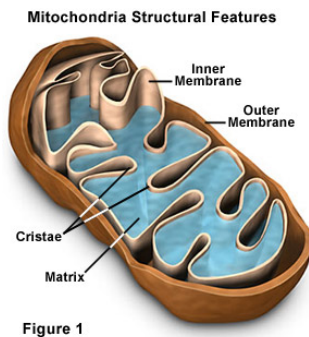
### 4.2.1 Photosynthesis and Respiration

- The original source of energy comes from the sun.
- Plants absorb sunlight energy using chloroplasts.
- Animals get energy by eating plants or eating other animals that have eaten plants.
- Plants convert sunlight energy into chemical energy (glucose) in the process of photosynthesis.
- Photosynthesis

- **Water + Carbon dioxide --> Glucose + Oxygen**
- Plants take in water through their roots and take in carbon dioxide through holes in their leaves called stomata.
- This process produces food (glucose) for the plant and oxygen as a waste product.
- Photosynthesis occurs in the chloroplasts!



- Cell Respiration (Aerobic)
  - **Glucose + Oxygen --> Water + Carbon dioxide + 36 ATP**
  - The glucose, at this point, has potential energy and cannot be used by the plant or animal until it is broken down.
  - Respiration is required by both plants and animals to create energy in the form of adenosine tri-phosphate (ATP).
  - As long as oxygen is available, plants and animals can produce plenty of ATP.
  - Cell respiration occurs in the mitochondria!
  - Aerobic respiration is ideal because it produces much more ATP than does anaerobic respiration.



- Cell Respiration (Anaerobic)
  - **Glucose --> Water + Carbon dioxide + 2 ATP (+ lactic acid or alcohol)**
  - When oxygen is unavailable, such as when animals work their muscles extensively or when fruits are removed from the plant, another method of respiration must begin.
  - **Anaerobic respiration** breaks down glucose in the absence of oxygen and only produces a small amount of ATP. The process is often called **fermentation**.
  - In animals, an additional product is lactic acid and makes your muscles burn.
  - In plants and yeast, an additional product is alcohol.

### 4.2.2 Energy is Necessary for Homeostasis

- ATP (energy) production by all living things is vital for maintaining homeostasis because homeostasis is necessary for life.
  - Examples: Active transport (which uses ATP ) rids the cell of toxins; animals use ATP in moving to avoid danger, find food, water, and mate; ATP is also used to create needed molecules in the body.

#### Questions for Standard 4

1. Glucose is blood sugar and insulin helps to regulate it. From which organic compounds do glucose and insulin belong?
2. 4. Plants and animals must store carbohydrates to use for later. Which carbohydrate is used for storage in plants? Which carbohydrate is used for storage in animals?
3. Which carbohydrate is found in plant cell walls and is indigestible for mammals and other animals?
4. Which organic compound would become your energy source if you were without food for a long period of time?
5. Proteins can be either structural or functional. Proteins that are structural \_\_\_\_\_.  
Proteins that are functional \_\_\_\_\_.
6. The functional units of DNA are \_\_\_\_\_.
7. What makes the 20 different amino acids different? How does this contribute to their function?
8. How do enzymes speed up reactions?
9. How many substrates can one enzyme fit with? What type of analogy can be used to explain this?
10. What happens to the enzymes in your body if your temperature is too high?
11. Which organelle is the site of photosynthesis?
12. What type of organisms can use photosynthesis?

13. Which organelle is the site of respiration?

14. What type of organisms can use respiration?

15. Which two compounds are created at the end of photosynthesis and are used at the beginning of aerobic respiration?

16. Which anaerobic process is responsible for producing ATP in the absence of oxygen?

17. Which compound builds up in your muscles after strenuous exercise and causes them to feel sore?

18. Which compound is produced by plants and yeast during anaerobic respiration?

19. Why is aerobic respiration considered the ideal method of producing ATP?

20. Why is ATP necessary for all living things?