Biology EOC Review

Saturday Session

Bio.1.1.1 Summarize the structure and function of organelles in eukaryotic and ways that these organelles interact with each other to perform the function of the cell.

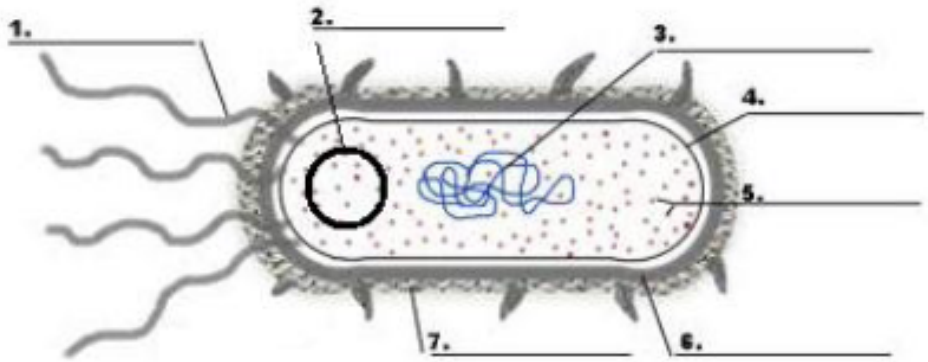
Bio.1.1.2 Compare prokaryotic and eukaryotic cells in terms of their general structures and degree of complexity.

All living things are made of **Cells**. Whether they are simple or complex, all cells contain:

DNA, **Ribosome**, **Cytoplasm**, **Cell Membrane**

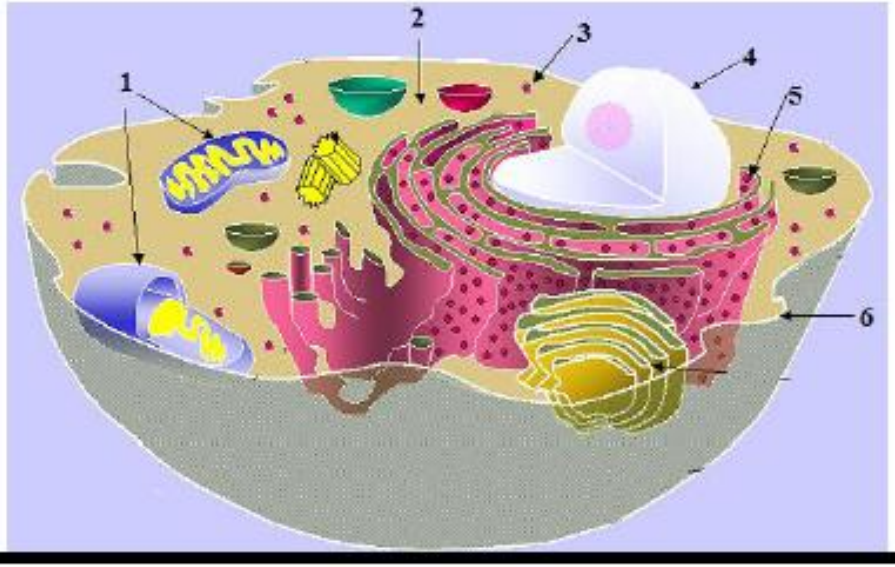
Term	Definition
Prokaryote	Simple cells which do not have their DNA in a nucleus; Also do not have membrane bound organelles.
Eukaryote	More complex cells which protect DNA inside a nucleus; Also have specialized structures called membrane bound organelles.

Complete table below about the basic cell types (Animal, Plant & Bacteria):

Prokaryotic or Eukaryotic? **Prokaryotic**	Cell Type **Bacteria**
	1. **Flagellum** 2. Plasmid (circular DNA) 3. Unwound DNA 4. **Cell Membrane (Plasma)** 5. Ribosomes 6. **Cell Wall** 7. Capsule

Prokaryotic or Eukaryotic? Eukaryotic

Cell Type Animal



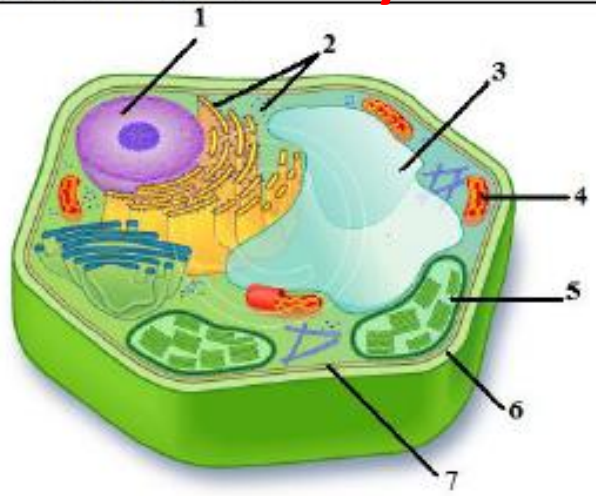
1. Mitochondria
2. Cytoplasm
3. Ribosome
4. Nucleus
5. Rough ER
6. Cell Membrane

Key parts that are NOT found in this cell:

1. Cell Wall
2. Chloroplast

Prokaryotic or Eukaryotic? Eukaryotic

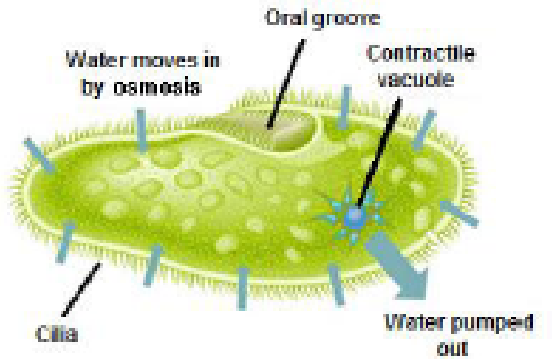
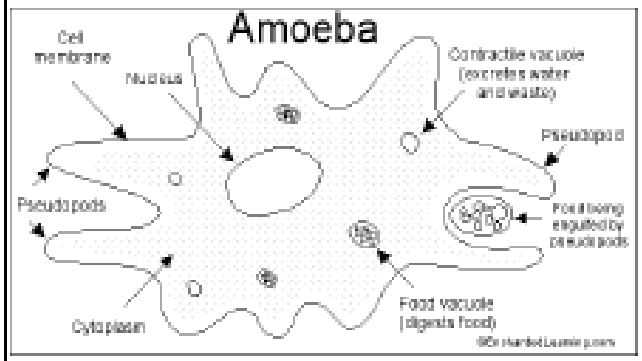
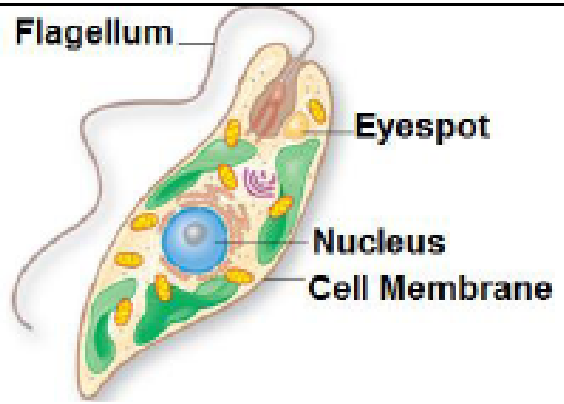
Cell Type Plant

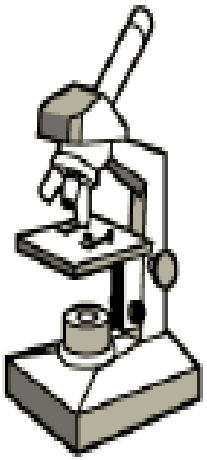


1. Nucleus
2. Ribosomes
3. Central Vacuole
4. Mitochondria
5. Chloroplast
6. Cell Wall
7. Cell Membrane

Identify the correct part of the cell:	**Function – the purpose of this structure in a cell**
1. **Nucleus**	Stores the DNA in eukaryotic cells; Sometimes called the **control center** of the cell.
2. **Cell Membrane**	Controls what enters and leaves the cell; it is ***selectively permeable***.
3. **Cell Wall**	Provides support & structure to plant, fungi & bacteria cells; found outside cell membrane
4. **Mitochondria**	Site of **cell respiration** in eukaryotic cells… Produces **ATP** or usable cell energy.
5. **Vacuole**	Stores water & dissolved material; in plants it is usually the largest organelle.
6. **Chloroplast**	Uses **sunlight**, **carbon dioxide** (CO_2) and **water** (H_20) to make **glucose** ($C_6H_{12}O_6$) and **Oxygen** (O_2)
7. **Ribosome**	Smallest organelle found in all cells; **makes protein**; gets instructions from DNA;

Bio.1.2.1 Explain how homeostasis is maintained in the cell and within an organism in various environments (temp. & pH).
Bio.1.2.3 Explain how specific cell adaptations help cells survive in particular environments (focus on unicellular organisms).

Examples of Protists	Structure	Adaptive advantage
	**Oral Groove**	Opening to bring larger material into a cell
	Cilia	Small hair-like projections on the outside of a cell; sweeps food towards the oral groove
	Contractile Vacuole	Pumps water out of the cell to prevent cell lysis (breaking open due to osmosis)
	**Pseudopodia**	"Fake Foot" – Used to surround food item and bring it into the cell. Can also be used for movement.
	Food Vacuole	Specialized storage food can be broken down by enzymes (inside the cell)
	**Eyespot**	Senses light… beneficial for PHOTOTAXIS (movement towards light)
	Flagellum	Long whip-like tails used for movement (swimming)

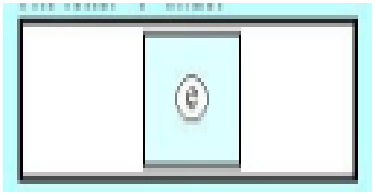


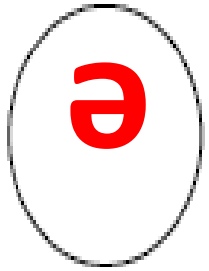
Viewing organisms: Microscopes are use to magnify images and to see more detail. The type of microscope used will determine your ability to do this.

- How do you calculate total magnification when using a compound light microscope?

  Total Magnification = Occular lens X Objective lens

- Draw what you would see in the field of view if looking at the slide of the letter 'e' on the compound light microscope.





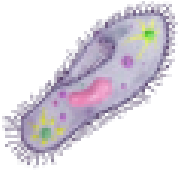
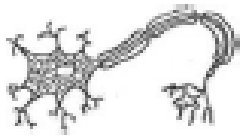
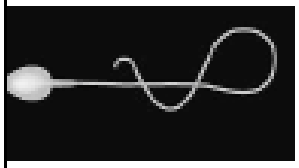
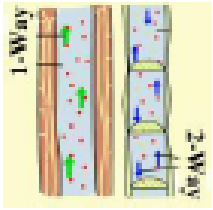
- When viewing bacteria cells or ribosomes in a cell, why would it be beneficial to have an Electron Microscope?

  Electron microscope has a higher magnification power

Bio.1.1.3 Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms.

Match each cell shown below with their possible function:

A cell's **structure** (shape) is directly related to its **Function** (what it does)

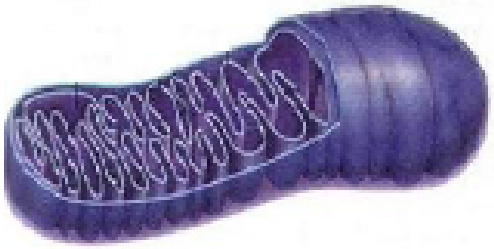
1. **D** My job is to carry genetic info to an egg for sexual reproduction.	2. **E** I allow for gas exchange by delivering O_2 and collect CO_2.	3. **A** I am a single celled organism; I live in pond water.	4. **C** I help send messages between your brain and the rest of your body.	5. **F** I allow water and food to move throughout vascular plants.	6. **B** I assist with movement by contracting & relaxing with other cells like me.
A. 	B. 	C. 	D. 	E. 	F. 
I am a... **paramecium**	*I am a...* **muscle**	*I am a...* **nerve**	*I am a...* **sperm**	*I am a...* **Red blood cell**	*I am...* **Vascular tissue**

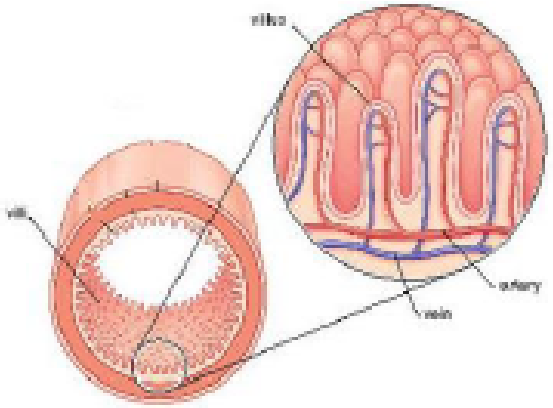
If cells B, C and F came from the same person, the DNA in each of them would be **Identical**. The cells are **specialized** for specific jobs. Therefore each one of these cells utilizes different parts of the instructions found in the DNA at different times.

Specialization = differentiation

Another example of how structure relates to function: Folds in organs and organelles increase Surface Area. This increases the structure's ability to do its job.

Ex: Mitochondria and the villi in the Small Intestines





List the levels of organization of life, starting with the basic unit of life:

All living things are made up of Cells ... many may group together to form → Tissue → Organ → Organ System → Organism (multicellular)

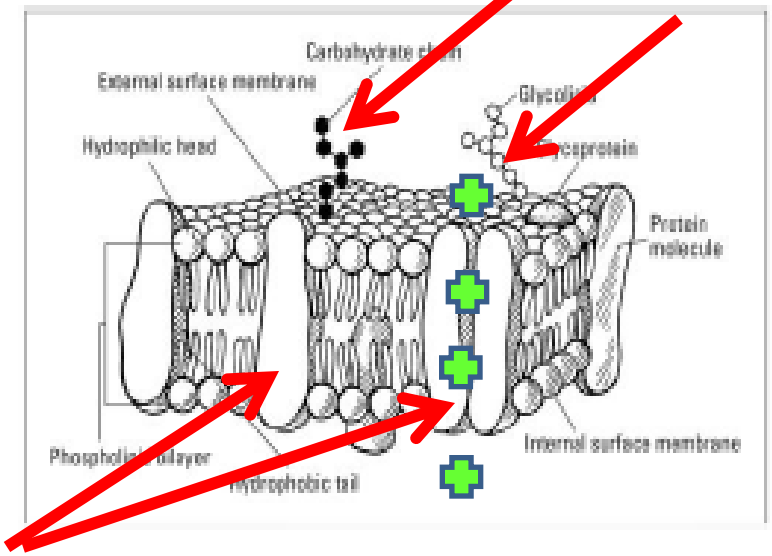
Bio.1.2.1 Explain how homeostasis is maintained in the cell and within an organism in various environments.

Homeostasis or maintaining balance in a living cell is essential for life. Examples of conditions in humans in which homeostasis in *not* maintained included:

- Diabetics often suffer from Hyperglycemia … **High** blood sugar & Hypoglycemia… **Low** blood sugar
- When you are exercising, movement of your muscles creates lots of heat. How does your body respond to help maintain homeostasis? **Sweat evaporating from the skin releases heat and cools the body**

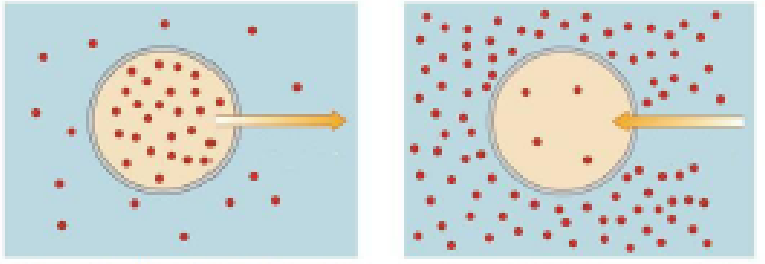
The **Cell Membrane** is the barrier that separates all cells from their surroundings. Its job is to control what may enter and leave the cell. **aka Plasma Membrane**

- **Proteins** - are channels for large or charged material to move in/out of the cell.
- **Carbohydrates** - ID tags found on the outer surface of a cell (i.e. ABO blood type antigens)

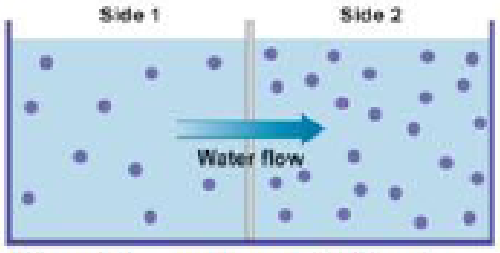


Passive Transport – movement of material across the cell or plasma membrane without the use of energy (molecules move due a concentration difference… a gradient). High to Low concentration.

- The goal of passive transport is to have the concentration be **Equal** inside & outside of a cell.



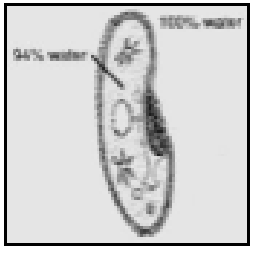
Diffusion (Facilitated Diffusion) = Solute moves from a high to a low concentration



Osmosis = movement of water

Active Transport – movement of material across the cell or plasma membrane using energy (ATP). Energy may be needed for several reasons:

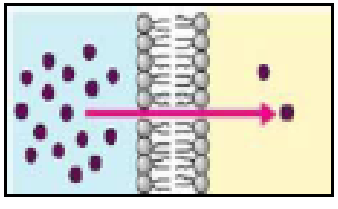
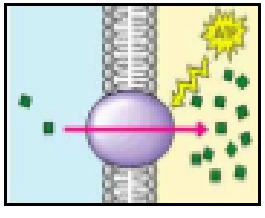
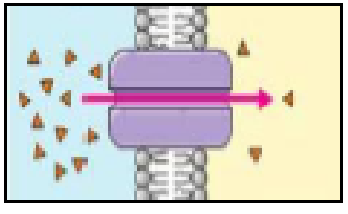
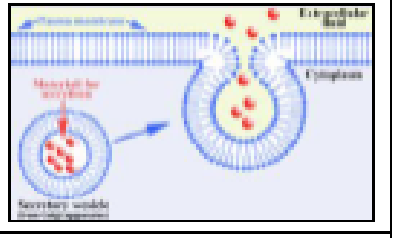
- Material must be pushed against the gradient (through a protein). From low to high concentration.
- Large quantities are being pushed in or out of the cell



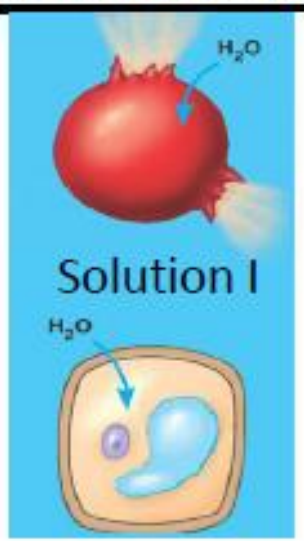
In a living cell, passive and active transport are constantly responding to environmental changes:

- Water moves in to the paramecium due to **Osmosis** (passive transport).
- The cell will then pump (active transport) water out with a **contractile vacuole**

Identify the processes occurring in each picture below:

Movement of material across the cell membrane:				
What process is moving the material?	**Diffusion**	**Pump**	**Facilitated Diffusion**	**Exocytosis**
Is this PASSIVE or ACTIVE transport?	**Passive**	**Active**	**Passive**	**Active**

An animal cell and a plant cell are placed in 3 different solutions below.



Describe what's happened to the cells.

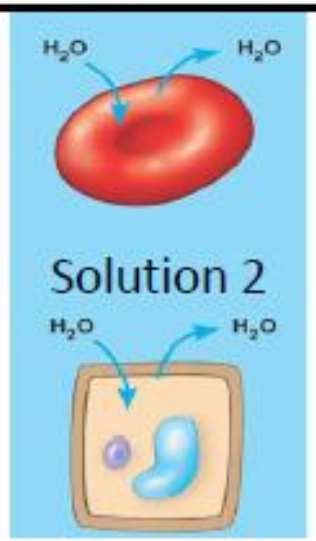
swelling

Describe the type of solution it was placed in?

Pure H_2O

Distilled H_2O

Hypotonic

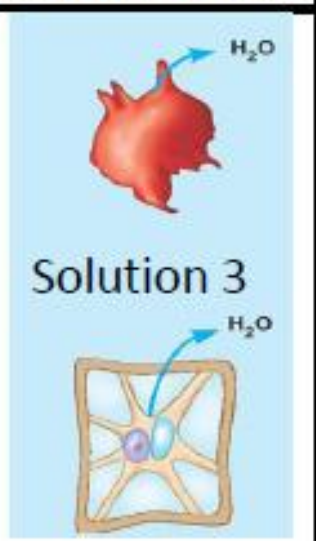


Describe what's happened to the cells.

Staying the same

Describe the type of solution it was placed in?

Isotonic Solution



Describe what's happened to the cells.

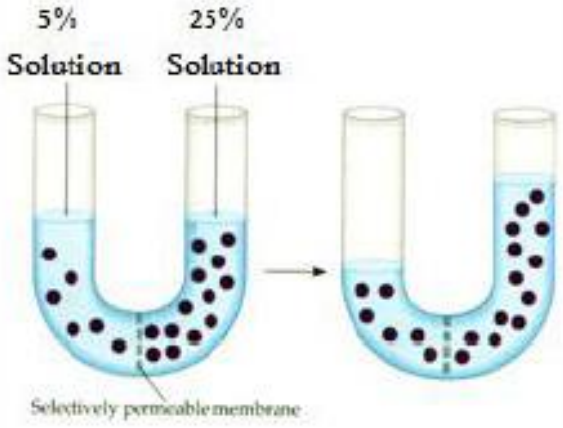
Cells shrink

Describe the type of solution it was placed in?

Salt H_2O

Hypertonic

Refer to the change with the U-tube



Explain what has happened in this picture.

The water moved into the hypertonic solution.

The solute was too large to move across the membrane.

- Why do plant and animal cells respond differently being placed in distilled water?

Plants cells have a cell wall and therefore do not rupture

What is the optimum (ideal) type of solution for animal cells? **Isotonic solution**

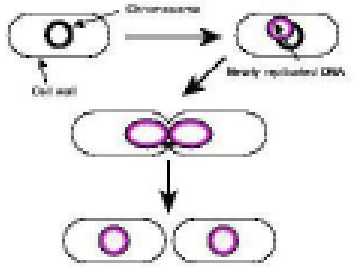
What is the optimum (ideal) solution for plant cells? **Hypotonic solution**

Bio.1.2.2 Analyze how cells grow and reproduce in terms of interphase, mitosis and cytokinesis.
Bio.3.2.1 Explain the role of meiosis in sexual reproduction and genetic variation.

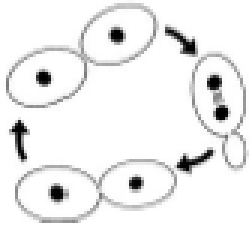
Reproduction – producing more cells/organisms (Sexually or Asexually)

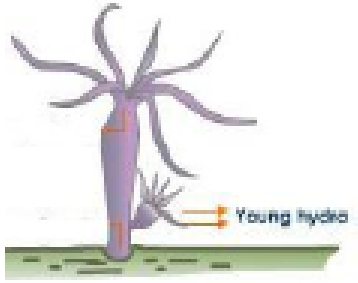
- Asexual Reproduction – the production of a new cell through the division of a previously existing cell.
  - Grow and replacement of worn out cells
  - Daughter cells are genetically identical to the parent cell (clones)

What types of asexual reproduction is shown in each picture?

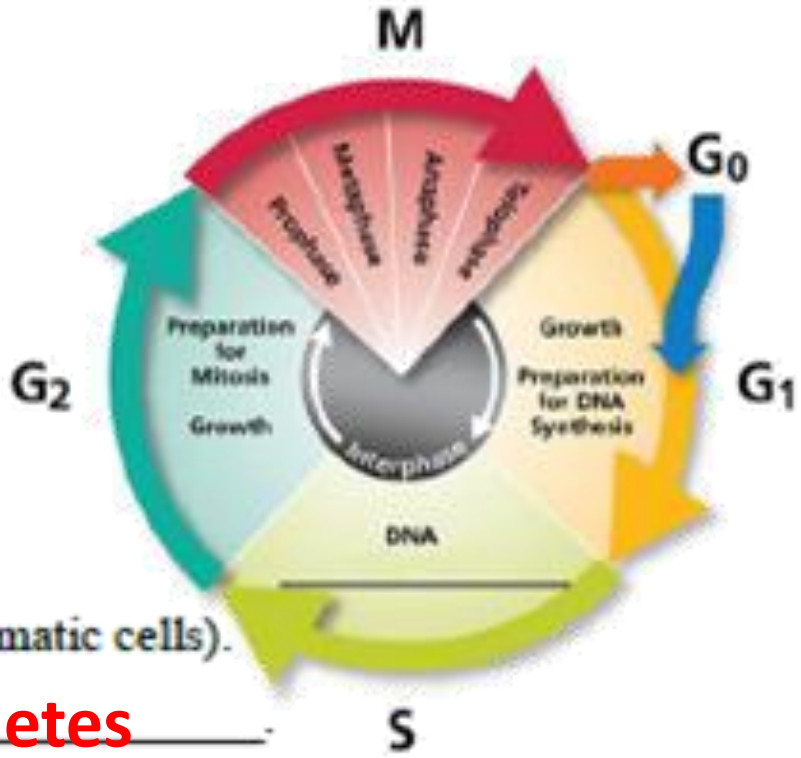


Binary Fission



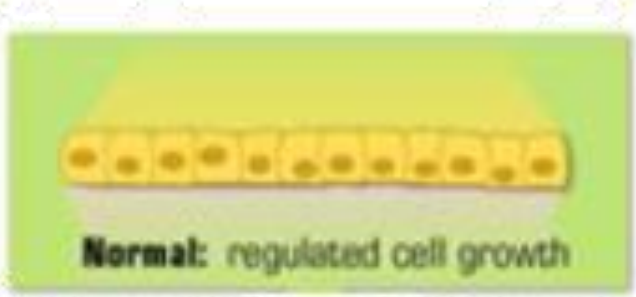


Budding

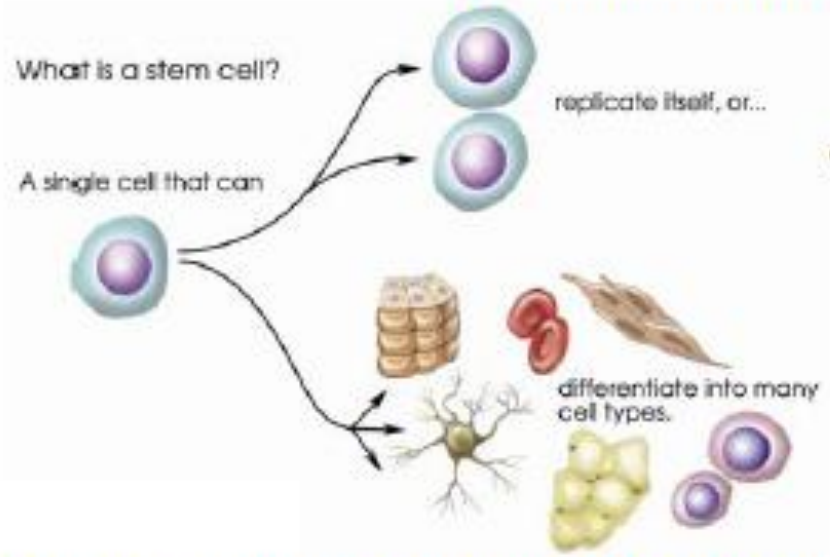


Cell Cycle (Mitosis)

- Mitosis makes almost all the cells of your body (somatic cells).
  - Only cells **not** made by mitosis are **gametes**.
- When cells are not actively dividing – they enter G_0, a resting state.
- **Cancer** is the result of a mutation in which the cells fail to enter into G_0, or don't stop dividing.

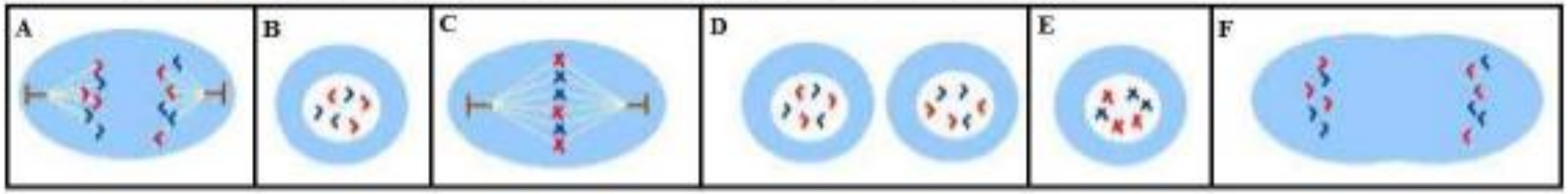


Stem cells are **unspecialized** cells that continually reproduce themselves and have, under appropriate conditions, the ability to **differentiate** into one or more types of specialized cells.



- **Embryonic** cells which have not yet differentiated into various cell types are called embryonic stem cells.
- Stem cells found in organisms, for instance in bone marrow, are called **adult stem cells.**

Place the following pictures in the correct order that shows the phases of Mitosis:



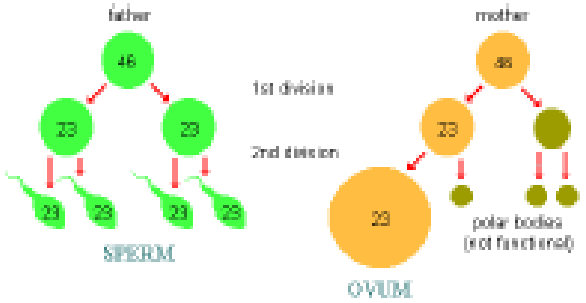
B → E → C → A → F → D

(parent cell) (daughter cells)

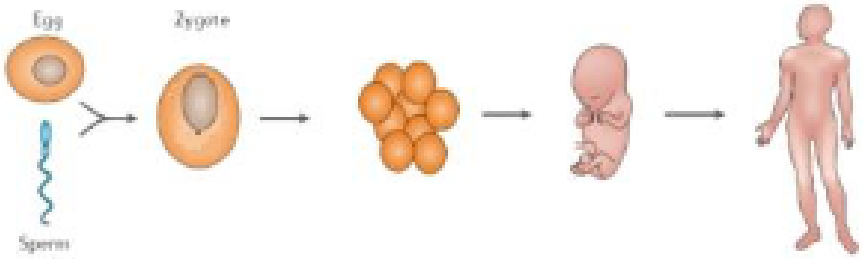
Interphase → Prophase → Metaphase → Anaphase → Telophase → Cytokinesis

Meiosis makes **gametes** (egg or sperm); these are ***haploid*** (1N) cells… they carry **half** the info needed to make a new organism. Provides a huge source of **GENETIC VARIATION due to two reasons:**

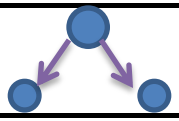
- Independent assortment of chromosomes
- Crossing Over



Sexual Reproduction – the union of two gametes to create an offspring with new combinations of traits



- Fertilization is the process of the two haploid cells (gametes) joining together to create a diploid (2N) cell.
- Benefit – increases genetic **variation** (the cells produced are different from the parent cell) This increases the chance of survival for the species .

	Description	MITOSIS	MEIOSIS
1	Where in the body does this process occur?	**Somatic (Body Cells)**	**Ovaries & Testes**
2	Involved in Sexual or Asexual Reproduction?	**Asexual**	**Sexual**
3	Does the process limit or increases genetic variation?	**limits**	**Increases variation**
4	How many cells are produced at the end?	 **2**	**4**
5	Describe a human cell made by the process (include chromosome #)	**Skin, muscle, bone, nerve (46 chromosomes)**	**Egg or sperm 23 chromosomes**

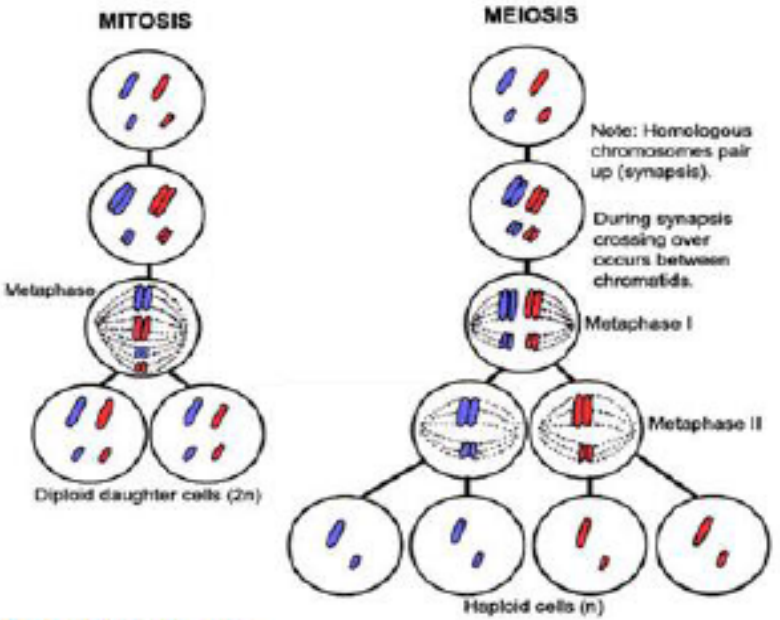
Which diagram most correctly represents meiosis? _____

(1) 2n → 2n

(3) 2n → n

(2) 2n → 2n + 2n

(4) 2n → n + n



Which diagram illustrates fertilization that would most likely lead to the development of a normal human male? __

A. X + X

B. X + XY

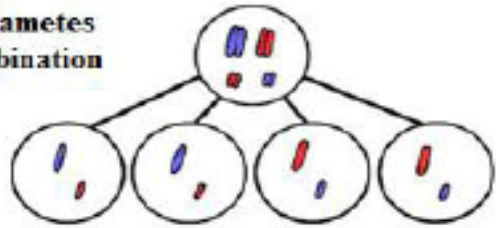
C. XX + X

D. X + Y

If the homologous chromosomes line up in a different order, the gametes have a different combination of chromosomes.

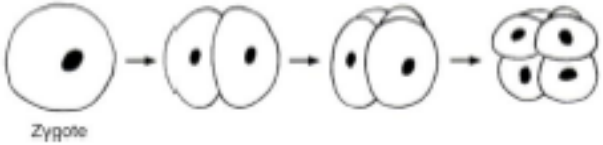
This is called INDEPENDENT ASSORTMENT

or



The diagram to the right represents the early stages development of a human embryo. Which process in the diagram is represented by the arrows as it changes from a one cell to many cells? ____

A. meiosis
B. fertilization
C. mitosis
D. evolution



Bio.3.1.1 Explain the double-stranded, complementary nature of DNA as related to its function in the cell.

Bio.4.1.2 Summarize the relationship among DNA, proteins and amino acids in carrying out the work of cells and how this is similar in all organisms.

The instructions for making living things are written in two types of nucleic acids called DNA & RNA

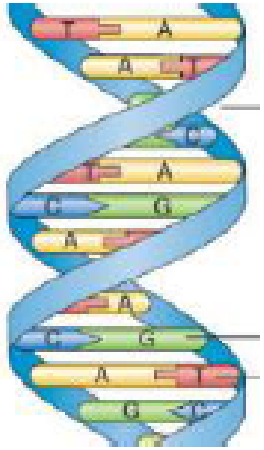
- Both are made up of many monomers or building blocks called nucleotides
  - Every DNA & RNA nucleotide has 3 parts: a sugar, a phosphate group and a nitrogenous base.

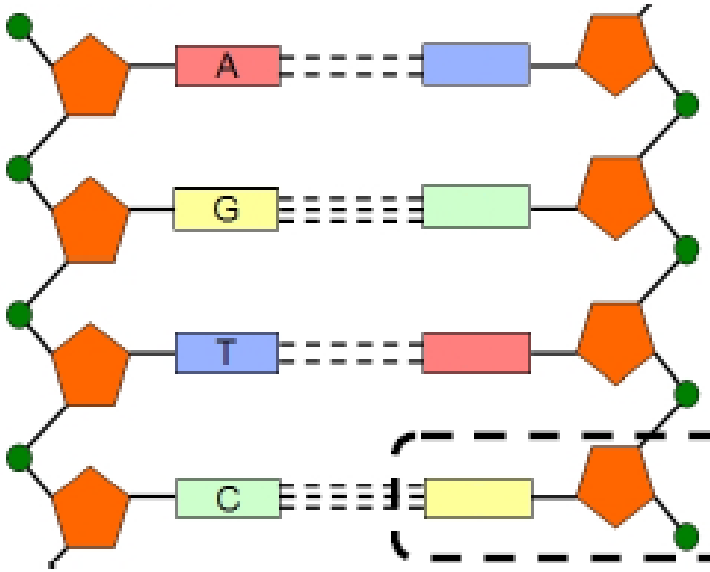
Characteristic	DNA	RNA
Name of sugar in a nucleotide	Deoxyribose	Ribose
Bases found in nucleotides	G, C, A & T	G, C, A & U
Forms	Always a double stranded molecule.	3 Types (mRNA, tRNA, rRNA)
Relative Size	Billions of bases (like a giant cookbook)	Thousands of bases (like a single recipe)

The shape of DNA is called a **double helix** or "twisted ladder".

- The sides (or backbones) are made up of alternating sugar-phosphate groups
- Each step or "rung" of the ladder is made up of a pair of nitrogenous bases:

- Two strands in a DNA molecule are **complementary** so if you know the sequence of one strand, you can figure out the other. **(Label the DNA molecule on the left).**



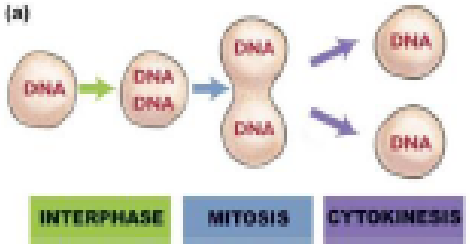


Base pairs are held together by **a weak hydrogen bonds**. This allows the two strands of DNA to unzip for replication & transcription.

nucleotide

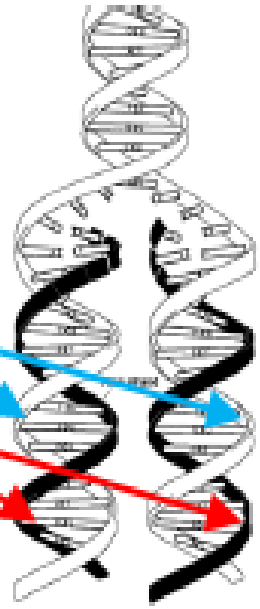
Replication – The process in which an **identical** copy of a DNA molecule is made.

- Must occur before a cell can **divide (reproduce)**.
- In eukaryotic cells, it occurs in the **nucleus** (since this is where DNA is stored)
- Each original strand is used as a template to build a new strand (this is called **semi-conservative replication**)



Original strands

New strands

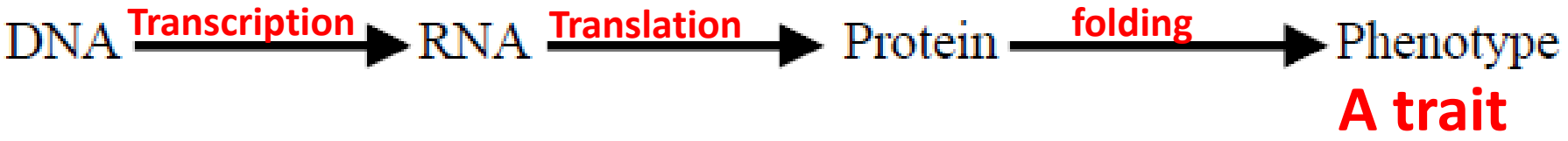


Protein Synthesis = a two step process used by cells to make proteins (Transcription & Translation)

The sequence of nucleotides (G C A T) in DNA codes for proteins. This is the key to cell function and life.

- Cells respond to their environments by producing different types and amounts of protein.
- Proteins can be **structural** (forming a part of the cell) or **functional** (hormones, enzymes, or chemicals involved in cell chemistry).
- Proteins are made at the ribosome, the smallest organelle found in all cells.
- Proteins are made by joining many amino acids together. The amino acids are linked together by a peptide bond (this is why proteins are also called **polypeptides**).
- Once the polypeptide is made, it must be folded to form a 3-dimensional protein.

	Protein Synthesis	
	Transcription	Translation
What is made?	A strand of mRNA	a chain of amino acids
Which nucleic acid(s) is/are involved?	DNA & mRNA	mRNA, tRNA & rRNA
Where does it occur?	Nucleus	Ribosome (in the cytoplasm)



What amino acids would be coded for by the following DNA?

DNA	T A C G C T A A G A C T
mRNA	AUG CGA UUU UGA
Amino Acids	Met - Arg - Phen - STOP

A	Lysine	Arginine	Isoleucine	Threonine	A
	Lysine	Arginine	Methionine	Threonine	G
	Asparagine	Serine	Isoleucine	Threonine	U
	Asparagine	Serine	Isoleucine	Threonine	C
G	Glutamic acid	Glycine	Valine	Alanine	A
	Glutamic acid	Glycine	Valine	Alanine	G
	Aspartic acid	Glycine	Valine	Alanine	U
	Aspartic acid	Glycine	Valine	Alanine	C
U	Stop codon	Stop codon	Leucine	Serine	A
	Stop codon	Tryptophan	Leucine	Serine	G
	Tyrosine	Cysteine	Phenylalanine	Serine	U
	Tyrosine	Cysteine	Phenylalanine	Serine	C
C	Glutamine	Arginine	Leucine	Proline	A
	Glutamine	Arginine	Leucine	Proline	G
	Histidine	Arginine	Leucine	Proline	U
	Histidine	Arginine	Leucine	Proline	C
	A	G	U	C	

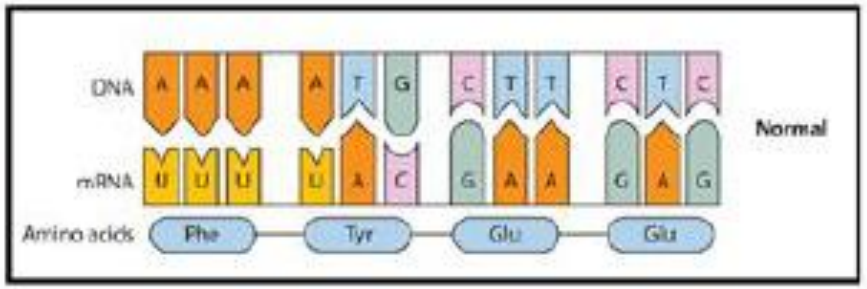
Which DNA mutation below is most likely to cause the largest change to a protein?

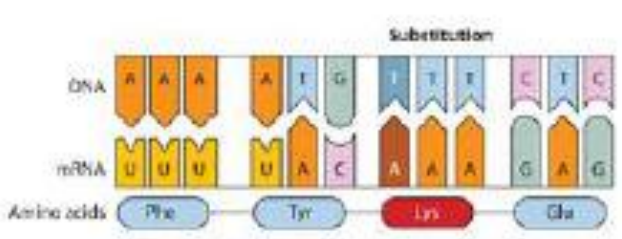
A. GCT TCA CCA TAT (Changing the G to C)

B. GCT TCA CCA TAT (Deleting the A)

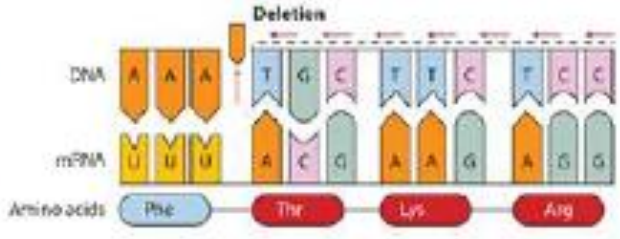
C. GCT TCA CCA TAT (Inserting a C)

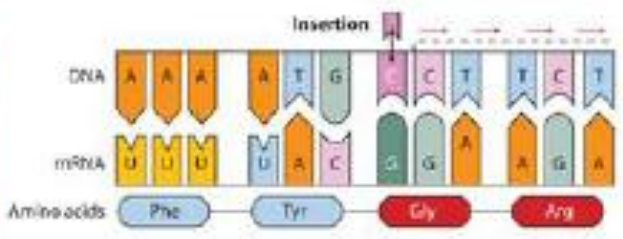
D. GCT TCA CCA TAT (Changing the T to a G)



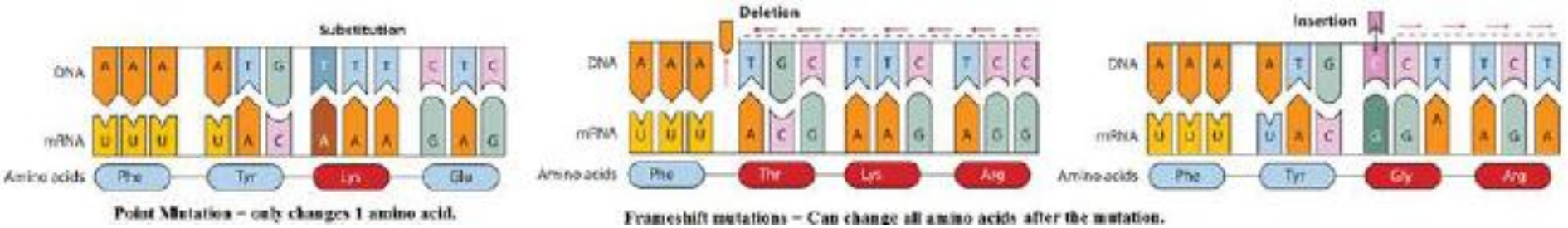


Point Mutation = only changes 1 amino acid.





Frameshift mutations = Can change all amino acids after the mutation.



What would be a likely cause of a mutation in a skin cell? **UV Rays from the sun**.

If a mutation occurs in a skin cell, which of the following statements would be true?

A. All of the cells in the body would contain the same mutation.
B. All of the skin cells would end up with the same mutation.
C. Only cells made from the mutated skin cell would contain the mutation.
D. The reproductive cells would contain the mutation.

Bio.3.2.2 Predict offspring ratios based on a variety of inheritance patterns (including dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traits).

Complete the Punnett square below for a cross between a heterozygous black & a white guinea pig.

In guinea pigs: Black allele = (B); white allele = (b)

	B	b
b	genotype Bb phenotype black	genotype bb phenotype white
b	genotype Bb phenotype black	genotype bb phenotype white

0/4 = BB

2/4 = Bb

2/4 = bb

0 : 2 : 2

2/4 = Black

2/4 = white

2 : 2

Two tabby cats mate produce a litter of 10 kittens: 5 tabby & 5 solid kittens.

A. What is the most likely genotypes of the parents (use the letters TT, Tt or tt)?

Tt x Tt

B. If they were to have an 11th kitten, how likely is it to be a solid color (give a %).

1/4 or 25%

	T	t
T	TT	Tt
t	Tt	tt

In snapdragons, incomplete dominance can be seen in flower color: red = (RR), pink = (Rr), white = (rr)

Cross two PINK snapdragons. What would be the genotypes of the parent plants? Rr x Rr

	R	r
R	RR	Rr
r	Rr	rr

What percent of their offspring are expected to be red? _____ (circle them)

¼ OR 25% ARE EXPECTED TO BE RED

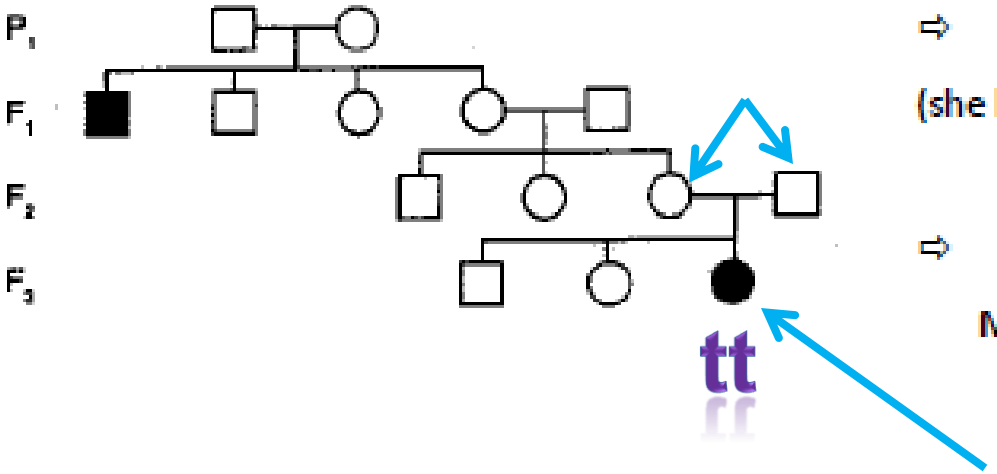
In birds, the allele for blue feathers codominant to the allele for yellow feathers. If a bird with blue feathers is mated with a bird with yellow feathers, what are the possible phenotypes of their offspring?

CODOMINANCE MEANS IN HETEROZYGOTES – BOTH ALLELES SHOW

ALL OFFSPRING WOULD HAVE BLUE & YELLOW FEATHERS

Autosomal Recessive Disorders:

- Disorders such as *Tay-Sachs* are recessive. T = normal t = Tay-sachs



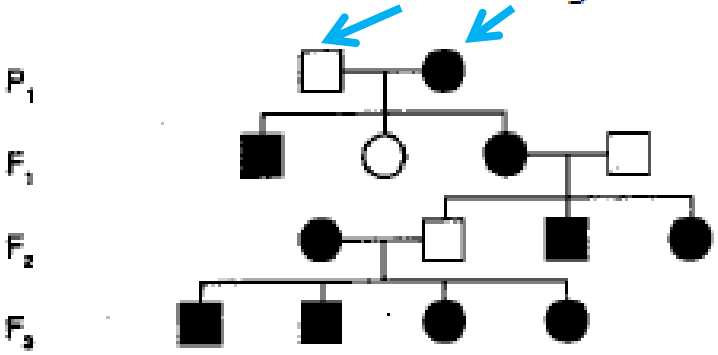
⇨ In the F_3 generation, there is an affected daughter (she has the disease). What is her genotype? **tt**

⇨ What must be the genotpe of her parents?

Mom = **Tt** Dad = **Tt**

Patterns of Dominant Disorders:

- Some diseases such as *Huntington's* are caused by autosomal dominant alleles. H = Huntington's h = normal



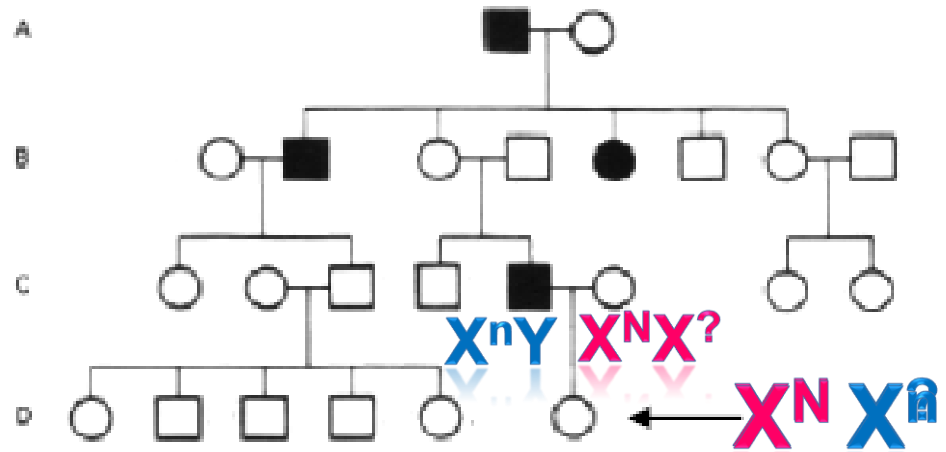
- What is the genotype of the parents in the P_1 generation?

  Mom = **Hh** Dad = **hh**

- If a parent has Huntington's gene, what is the chance that they will pass it on to each child? **1/2 or 50%**
- Can a dominant disorder skip a generation? **No**

X^N = normal X^n = hemophilia

Below is an example of a sex-linked pedigree that shows the inheritance of hemophilia.



⇨ What is the genotype of the last female in the fourth generation? $X^N X^n$

⇨ The oldest son in the second generation has hemophilia. Did he inherit this disease from his father or his mother? Explain. Boys always inherit the Y from their dad & X from their mom. The disease was inherited from his mom.

⇨ How do sex-linked pedigrees often look different from a pedigree for an autosomal trait?

Usually there are more males affected than females.

- boys only need to inherit one copy of an X-linked allele
- girls must inherit 2 copies to be affected

In humans, hemophilia is a sex-linked recessive trait located on the X chromosome. Normal blood is dominant (X^H) to hemophilia (X^h).

- Cross a female that is a carrier for hemophilia with a male that has normal blood clotting.

Parents genotypes: $X^N X^n$ x $X^N Y$

	X^N	X^n
X^N	$X^N X^N$	$X^N X^n$
Y	$X^N Y$	$X^n Y$

A. What percentage of this couple's offspring do we expect to have hemophilia?

1/4 or 25%

B. What percentage of this couple's sons do we expect to have hemophilia?

1/2 or 50%

C. If this couple could choose the gender of their child, which do you think they would pick? Explain.

If they had a girl, they could be sure their child would not suffer from hemophilia

Complete the table below about the ABO Blood Groups

Phenotype / Blood Type	Genotype (s)	Phenotype / Blood Type	Genotype (s)
Type A	$I^A I^A$ or $I^A i$	Type B	$I^B I^B$ or $I^B i$
Type AB	$I^A I^B$	Type O	$i\ i$

If a man has Type AB blood and his wife has Type O blood, what is the chance that their child will have type AB blood? Use the Punnett square below to show the possible blood types of their children

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

50 % of their children are expected to be Type A

50 % of their children are expected to be Type B

0 % of their children are expected to be Type AB

0 % of their children are expected to be Type O

Polygenic traits are often easy to identify since they have a wide variety of phenotypes.

Human examples include: Hair, eye & skin color, height, shoe size, etc.

Each of the following are genetic conditions whose expression is affected by environmental conditions:

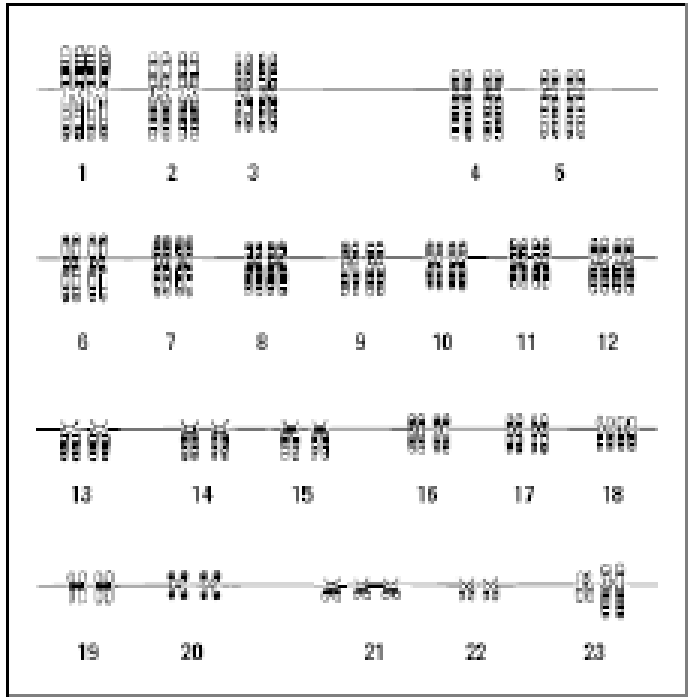
- Lung/mouth cancer – Tobacco use
- Skin cancer – vitamin D, folic acid and uv light exposure
- Diabetes – Diet (what you eat) and exercise/weight.
- PKU – Eat foods with phenylalanine (an amino acid found in many foods)
- Heart disease – diet and exercise

Use the karyotypes below to answer the following questions?

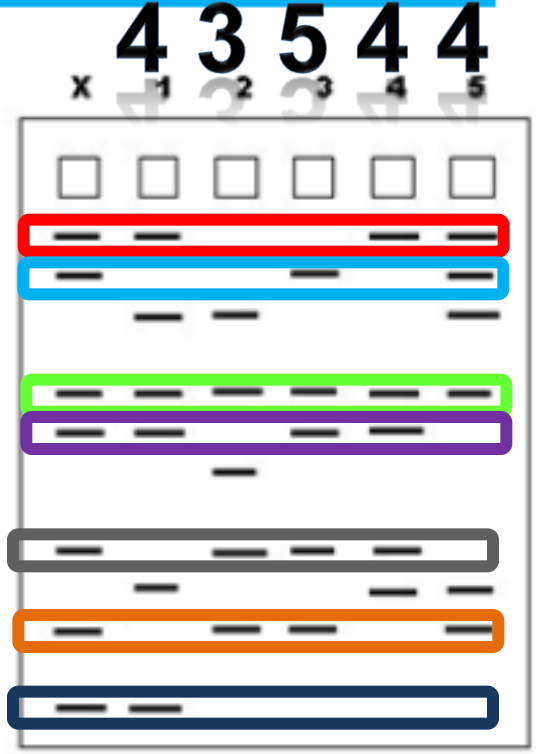
- Is this for a boy or a girl? Boy

This patient does not have a normal number of chromosomes. Circle the mistake in their karyotype.

- When an egg or sperm has too many or too few chromosomes, it is the result of nondisjunction (when pairs of chromosomes fail to separate during meiosis).
- Explain why this is more likely to occur in the mother (rather than the father). A female's eggs are made when she is just a fetus (so when she's 45, so are her eggs)



Bio.3.3.1 Interpret how DNA is used for comparison and identification of organisms.



Before DNA can be loaded into a gel to make a DNA fingerprint, what must be done to the DNA so that it makes the different bands? It must be

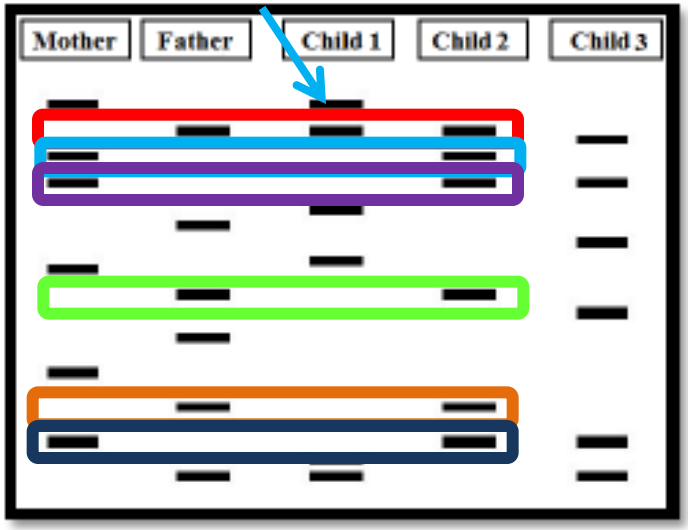
cut with a **restriction enzyme**

What causes the fragments of DNA to move through the gel?

The negatively charged DNA is attracted to the positive charge at the end of the gel.

Which species (1-5) is most closely related to the common ancestor (X)?

3 Why? **Has the most bands that match with the common ancestor**



Which children are the offspring of both parents? **Child 2**

Which child has the largest fragment of DNA in their DNA fingerprint?

Child 1

Bio.3.3.2 Summarize how transgenic organisms are engineered to benefit society.

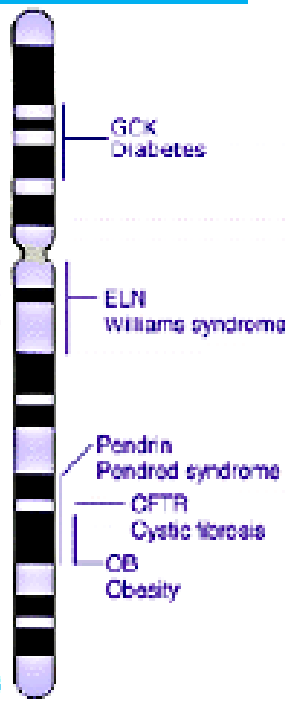
Bio.3.3.3 Evaluate some of the ethical issues surrounding the use of DNA technology (including cloning, genetically modified organisms, stem cell research, and Human Genome Project).

The **Human Genome Project** was an attempt by scientists to read & record the order of the 3 billion bases (Gs, Cs, As & Ts) in a human cell.

- Once done, the goal was to identify the location & sequence of genetic disorders.

Applications of the Human Genome Project:

- Individuals that carry genes for genetic conditions may be candidates for **Gene Therapy** - in which a working copy of a gene is inserted into the cells of an individual with a genetic disorder. Examples include:
  - Severe Combined Immunodeficiency (SCID)
  - Cystic Fibrosis



Chromosome 7

Genetically Modified Organisms (GMOs) contain DNA that has been altered. Examples:

- Agriculture crops→more nutritious, make pesticides, etc.
- Pharmaceuticals to Bacteria/plants or other animals can make medicine
- Industry to create bacteria that can produce plastic while taking in CO_2 rather than releasing it.

- A **Transgenic Organism** is a GMO that contains DNA from a DIFFERENT species
  - Examples include:
    - Toba… …t glowed)
    - Bac… …lin
    - Gol… …gene from a daff…
    - Stra… …(able to surv…

- Place the steps of bacterial transformation in the correct order (Number them from 1-5):

3 - Put the plasmid with recombinant DNA back into the bacteria.

1 - Identify the gene to be inserted into the bacteria.

5 - Isolate the product made by the transformed bacteria.

4 - The transformed bacteria reproduce, making clones that also carry the recombinant DNA.

2 - Insert the desired gene into the bacteria plasmid.

Place a ✓ next to each statement that is a positive outcome of DNA Technology

✓ Curing Parkinson's or Alzheimer's using stem cells (not done yet).

___ Reactions to treatments aren't always known.

✓ Finding cheaper ways to make medicine.

✓ Being able to insert a working gene into a person's cells.

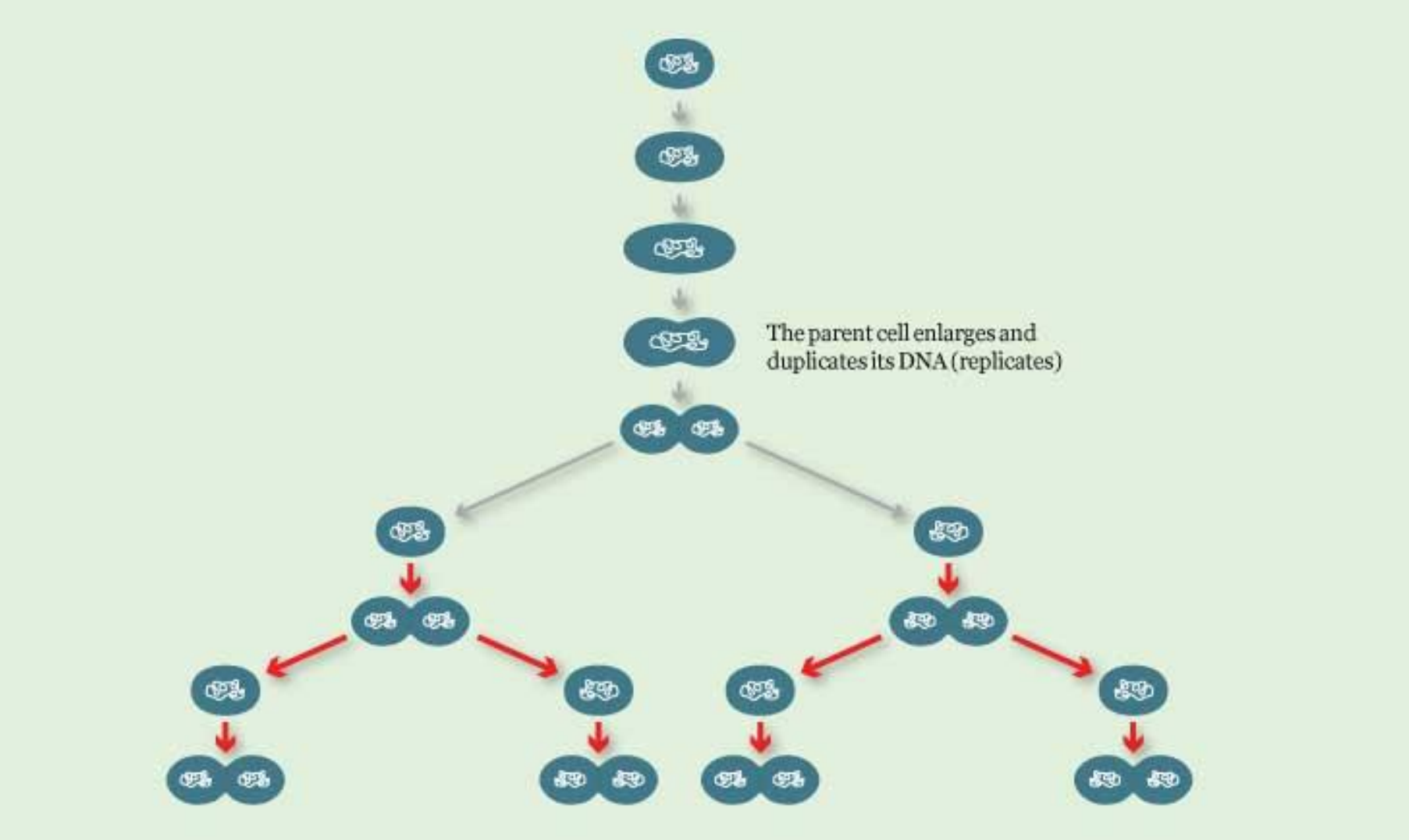
___ Violates moral and ethical beliefs of some individuals.

___ Large amounts of money are spent on research that may not produce any benefit.

✓ Finding better ways to clean up the environment.

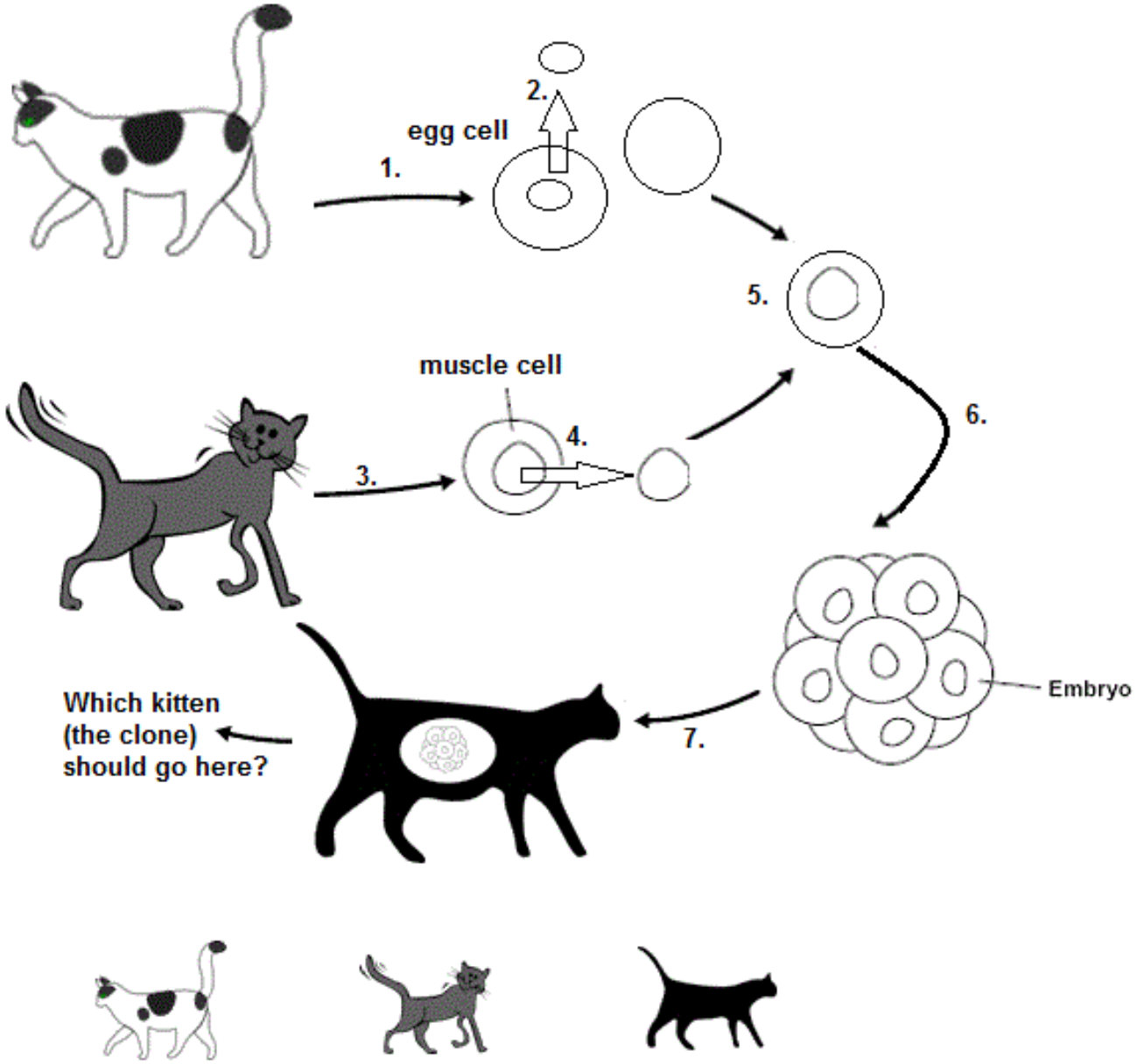
✓ Creating plants that produce their own pesticides.

Are these clones?



Are these clones?

Are these clones?



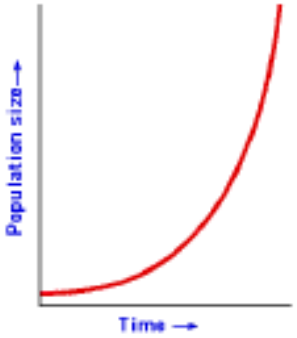
Bio.3.4.1 Explain how fossil, biochemical, and anatomical evidence support the theory of evolution.
Bio.3.4.2 Explain how natural selection influences the changes in species over time.
Bio.3.4.3 Explain how various disease agents (bacteria, viruses, chemicals) can influence natural selection.

Evolution means the **Change** of a species over time. Two key ideas of the theory of evolution state:

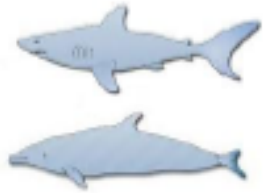
- Newer forms appearing in the fossil record are actually modified descendents of older species. And all species are descendants from one or a few original types of life… Darwin called this *Descent with Modification*.

- The **Environment** determines which traits are favorable and it limits the growth of populations. It increases the rate of death or decreases the rate of reproduction, (or both)… *Modification by Natural Selection*.

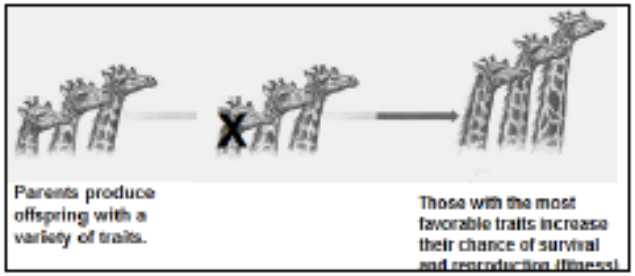
Driving forces for Natural Selection:



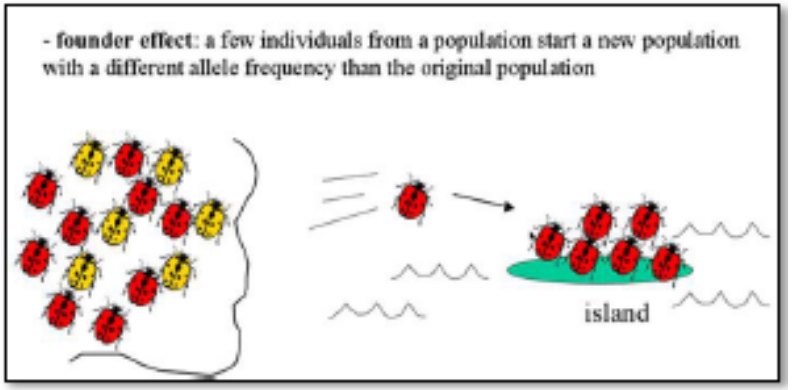
- Species have the potential to increase in numbers **Exponentially**.
- Populations contain **Genetic Variation** due to mutations and genetic recombination (sexual reproduction).
- There is a **Limited** supply of resources required for life… this increases **Competition**, especially between members of the same species with the same needs.
- Changing **Environments** select for specific genetic phenotypes. This is evident when we look at unrelated organisms that live in similar environments. Overtime similar body designs tend to be favored (Example: Shark & Dolphin):



- Those organisms with favorable adaptations survive, reproduce and pass on their alleles… this is what Darwin called *Survival of the* **Fittest**.



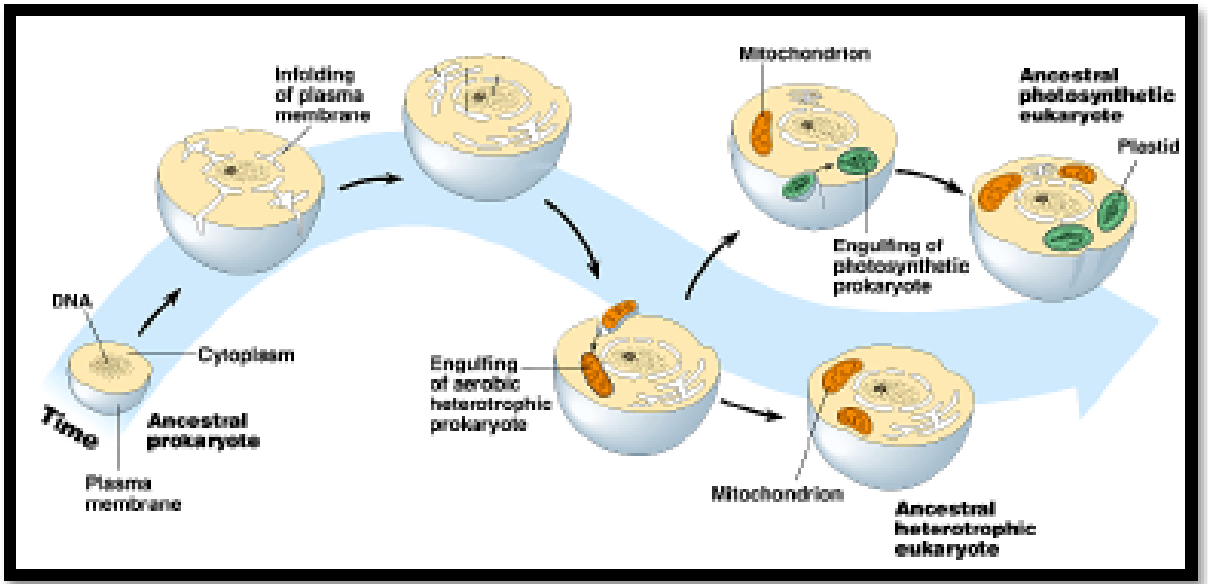
- Changes in an environment can lead to changes in which alleles are favored over time.
- **Geographic Isolation** is an important force that my speed up the process of **Speciation** (forming a new species)



Things tend to start off **Simple** and become more **Complex** over time. Read each pair of characteristics listed below and circle the one that is thought to have appeared first on earth:

- **Prokaryotic** vs. Eukaryotic
- Aerobic vs. **Anaerobic**
- Autotrophs vs. **Heterotrophs**
- Multicellular vs. **Unicellular**

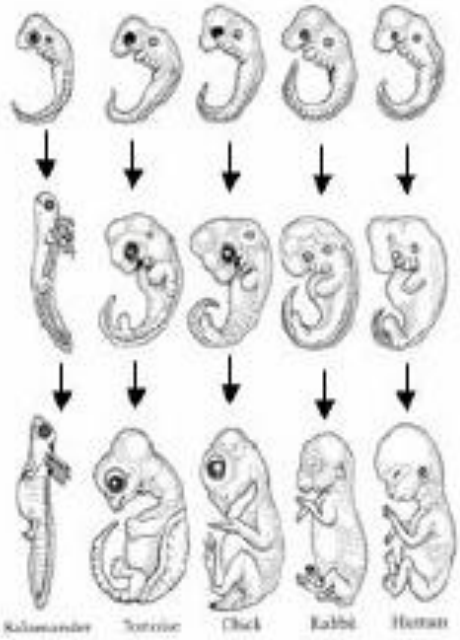
The Endosymbiotic theory addresses the origin of the first **Eukaryotic** cells.

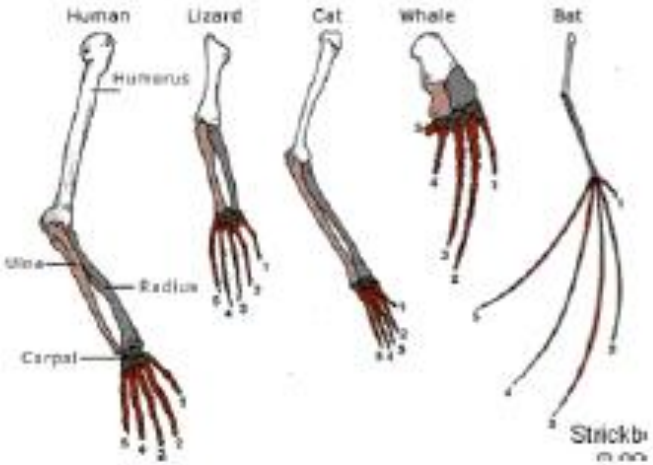


Evidence for Evolution:

The best evidence that supports the theory of evolution is the comparison of **DNA** and **Proteins** (or sequence of amino acids).

- The more closely related two species are, the **Fewer** number of differences will be found in these macromolecules.



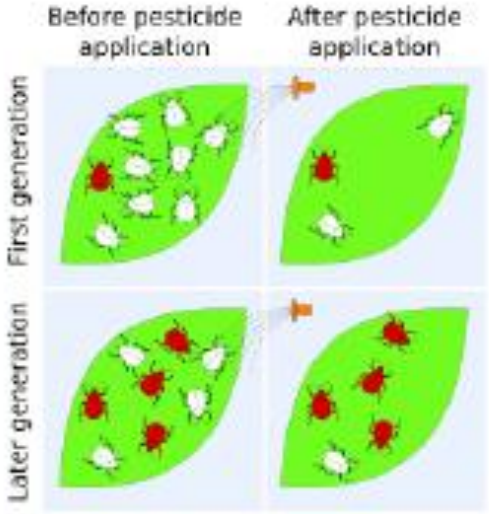


Common Ancestry can be seen by:

- Comparing the development of embryos (directions are written in their **DNA**) **(Genes)**
- Comparing bone structure in related species. Selection favors various designs in different environments.

Examples of how we can see a species change over time (adapting to their environment) include:

- Bacteria resistance to **Antibiotics** and insects that develop resistance to pesticides.
- In order for this to occur, there must be **Genetic** variation present in the population. Those with a mutation that makes them more resistant survive and reproduce to pass the resistance on to their offspring.



Bio.3.5.1 Explain the historical development and changing nature of classification systems.
Bio.3.5.2 Analyze the classification of organisms according to their evolutionary relationships

The system of classifying organisms was developed by Carolos Linnaeus (1700's). This same system is still used today, however it has been modified based upon newly discovered information about evolutionary relationships.

- All organisms were classified into groups or taxa based upon their characteristics (from Largest to smallest):
  - Domain (biggest taxa)
  - Kingdom
  - Phylum
  - Class
  - Order
  - Family
  - Genus
  - Species (smallest, most specific taxa)

- Originally there were 2 kingdoms (Plantae & Animalia). More kingdoms added as knowledge of the diversity of organisms increased.
- Linnaeus gave a *scientific name* for each living organism. Every scientific name is made up the (Genus + species)

If two organisms are in the same order, they must also be in the same: Domain, Kingdom, Phylum, Class

What is the genus of an organism with the scientific name *Passer domesticus*? Passer

Classification of Living Things (Domain & Kingdom System)

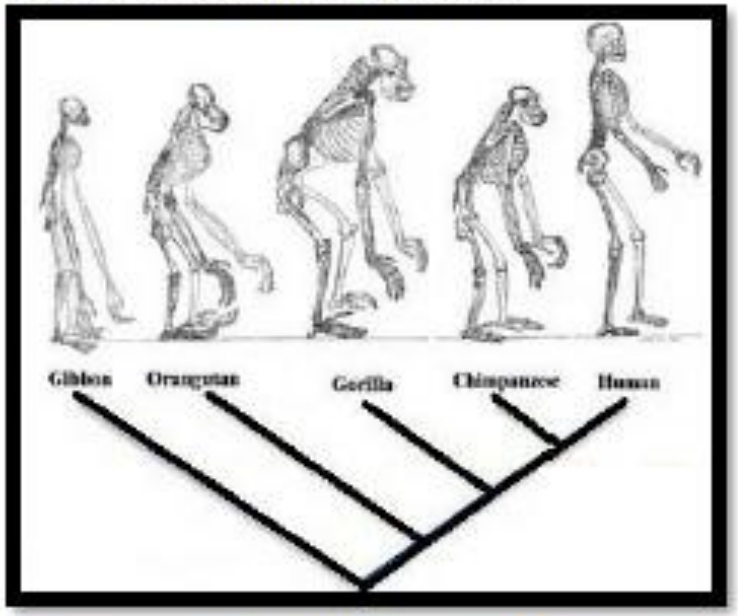
Domain	Archaea	Bacteria	Eukarya			
Kingdom	Archaebacteria	Eubacteria	**Protista**	**Fungi**	**Plantae**	**Animalia**
Examples	Bacteria that live in harsh environments	Bacteria that live in/on you, strep and E. coli	Paramecium, Amoeba and Euglena	mushrooms, mold &yeast	Moss, Fern, Pine tree, Flowering Plant	Sponge, Worm, Insect, Reptile, Fish, Human
Cell Type (Prokaryote or Eukaryote)	**Prokaryotes**		**Eukaryotes**			
unicellular or multicellular	Unicellular		Mostly unicellular	Mostly Multicellular	Multicellular	Multicellular
Cell Wall (absent or present)	Present		Present in some	Present	Present	Absent
If there is a Cell Wall, what is it made of	Various Carbohydrates	Peptidoglycan	Various Carbohydrates	**Chitin**	**Cellulose**	No cell wall
Nutrition (Autotroph or Heterotroph)	Both (some are autotrophs & others are heterotrophs)		Both	**Heterotroph**	**Autotroph**	**Heterotroph**

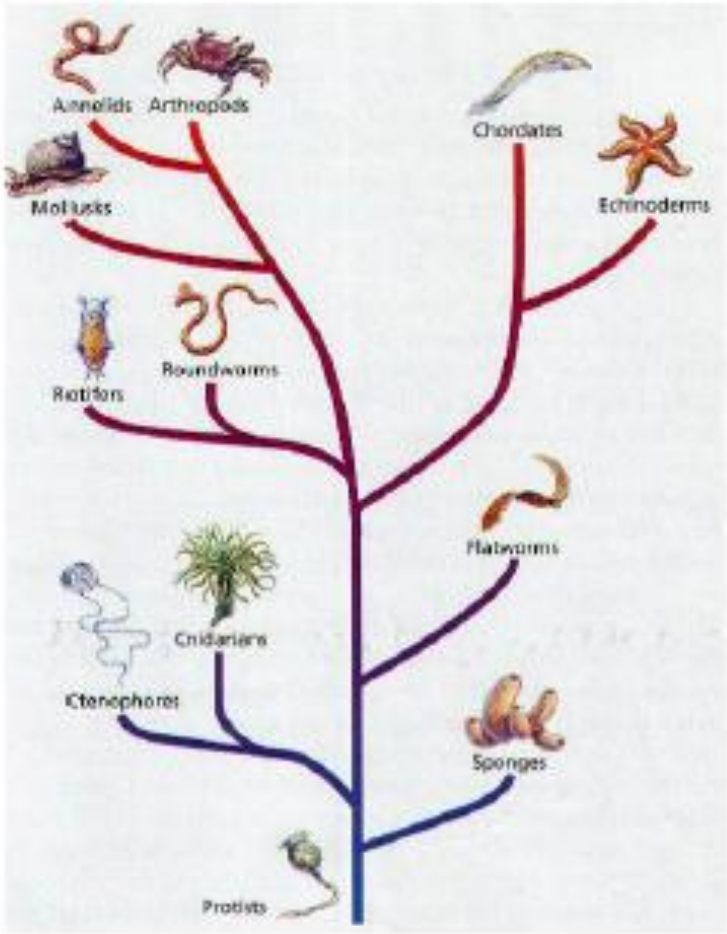
VIRUSES ARE NOT CLASSIFIED AS A LIVING THING AND THEREFORE THEY DO NOT BELONG IN ANY OF THE ABOVE KINGDOMS!

Recent changes in the classification system are based mainly on information that was gained through studying:

- Evolutionary relationships, macromolecules (such as DNA & biochemical analysis), embryology & morphology

Cladograms & Phylogenetic trees such as the one seen below are used to show evolutionary relationships between organisms.





- Which is the most ***primitive*** primate seen in the diagram on the left? **Gibbons**
- Which animal is more closely related to the arthropod – the roundworm or the chordate? **Roundworms**
- According to the diagram on the right, what is the common ancestor shared by all animals? **Protists**

Use the dichotomous key below to complete the following questions:

1. Identify the common name of this salamander. **Spotted Salamander**
2. What is its scientific name? ***Ambystoma maculatum***
3. Is a newt normally larger or smaller than 17cm? **Smaller**
4. Which salamander in the chart is the red backed salamander most closely related to? **Slimy Salamander**

This salamander usually measures about 19 cm long as an adult.

Classification Key to Salamanders

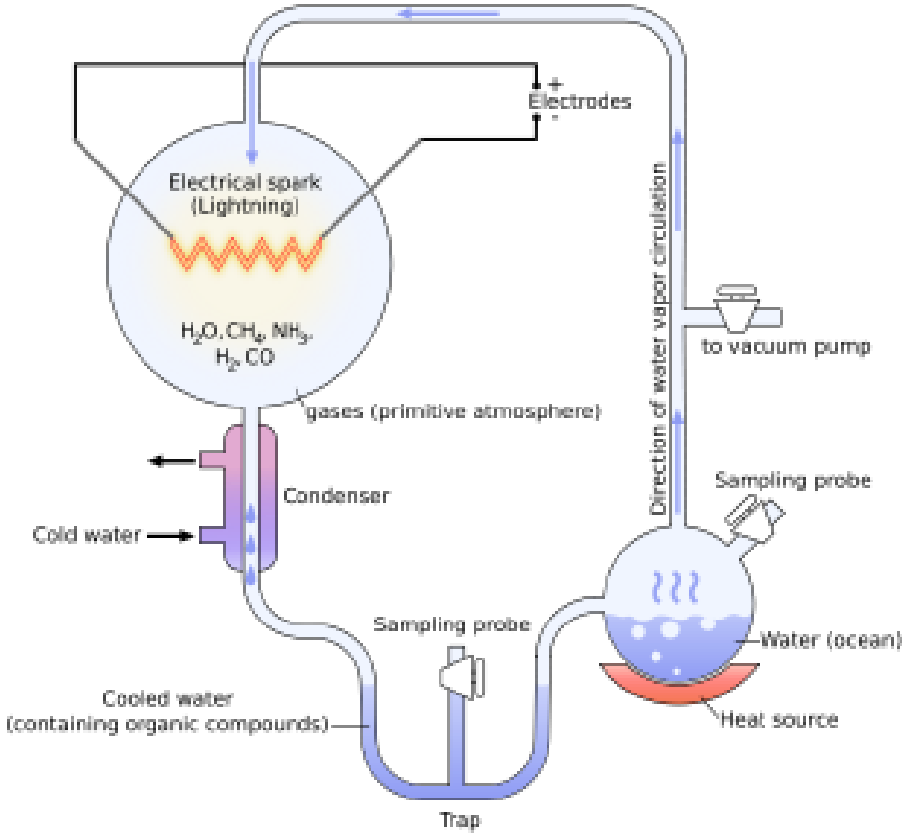
1.	a. Hind limbs (legs) absent	*Siren intermedia*, **siren**
	b. Hind limbs (legs) present	Go to 2
2.	a. External gills present in adults (appear as frilly extensions between the head and the forelimbs)	*Necturus maculosus*, **mud puppy**
	b. External gills absent in adults	Go to 3
3.	a. Large size (over 17 cm long)	Go to 4
	b. Small size (under 17 cm long)	Go to 5
4.	a. Body background black, large white spots irregular in size & shape completely covering body & tail	*Ambystoma tigrinum*, **tiger salamander**
	b. Body background black, small round white spots in a row along each side from eye to tip of tail	*Ambystoma maculatum*, **spotted salamander**
5.	a. Body background black with white spots	Go to 6
	b. Body background light color with dark spots and/or lines on body	Go to7
6.	a. Small white spots on a black background in a row along each side from head to tip of tail	*Ambystoma jeffersonianum*, **Jefferson salamander**
	b. Small white spots scattered throughout a black background from head to tip of tail	*Plethodon glutinosus*, **slimy salamander**
7.	a. Large irregular black spots on a light background extending from head to tip of tail	*Ambystoma opacum*, **marbled salamander**
	b. No large irregular black spots on a light background	Go to 8
8.	a. Round spots scattered along back and sides of body, tail flattened like a tadpole	*Triturus viridenscens*, **newt**
	b. Without round spots and tail not flattened like a tadpole	Go to 9
9	a. Two dark lines bordering a broad light mid-dorsal stripe with a narrow dark line extending from head to	*Eurycea bislineata*, **two-lined salamander**
	b. Without two dark lines running the length of the body	Go to 10
10.	a. A light stripe running the length of the body, bordered by dark pigment on the sides	*Plethodon cinereus*, **red-backed salamander**
	b. A light stripe extending the length of the body, a marked constriction at the base of the tail	*Hemidactylium scutatum*, **four-toed salamander**

Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms.

How did the building blocks of life first form?

- Miller & Urey's experiment used simple inorganic gases (H_2O, CH_4, NH_3, and H_2) sealed inside a sterile glass tubes and flasks connected in a loop.
  - One flask was half-full of liquid water which was heated (evaporation)
  - Another flask fired sparks between the electrodes to simulate lightning
  - The water was cooled again so it could condense and trickle back into the first flask.
- Within a day, the mixture had changed color.
- At the end of 2 weeks, 15% of the carbon was in the form of organic compounds such as:

Amino Acids & **RNA**.



Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms.

Organic Compound	*What it's made of* *(subunits or monomers)*	Primary Purpose	Important examples* (see list below the table)	Test(s) used to identify if its present
Carbohydrates	**Mono-saccharides**	1. Main energy source in cells • Simple carbohydrate • Complex carbohydrates 2. Provides structure & support (i.e. cell walls & exoskeletons)	**Glucose** **Glycogen** **Starch** **Cellulose**	**Benedicts** Sugar Blue→Orange **Iodine** Starch Brown→ purplish-black
Lipids	**Fatty acids Glycerol**	1. Makes biological membranes 2. Long-term energy storage. 3. Insulation & waterproofing.	**Fats, Steroids Phospholipids**	**Brown bag** Translucent spot

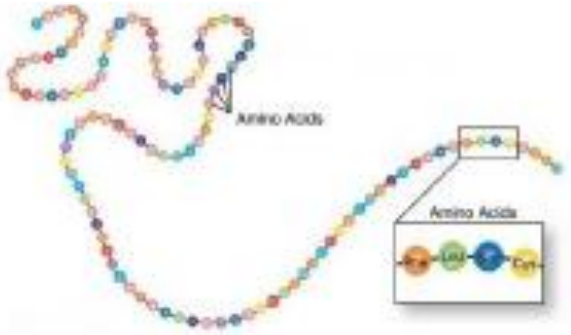
Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms.

Organic Compound	*What it's made of* (subunits or monomers)	Primary Purpose	Important examples* (see list below the table)	Test(s) used to identify if its present
Proteins	**Amino acids**	1. Transports material into/out of the cell (ex: protein channel or pump) 2. Components of cells & tissues (i.e. muscle, hair, tendons) 3. Speeds up the rate of a reaction (it happens using less energy)	**Insulin** **Hemoglobin** **Enzymes**	**Biuret –** **Blue → Purple**
Nucleic Acids	**Nucleotides**	1. Controls heredity information 2. Contains instructions for making proteins	**DNA** **RNA**	

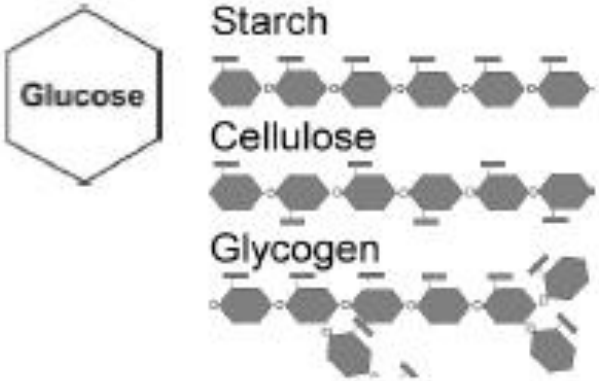
*Examples to know include starch, insulin, phospholipids, glycogen, DNA, glucose, enzymes, steroids, cellulose, hemoglobin, fats & RNA

Identify the type of organic compound pictured below:

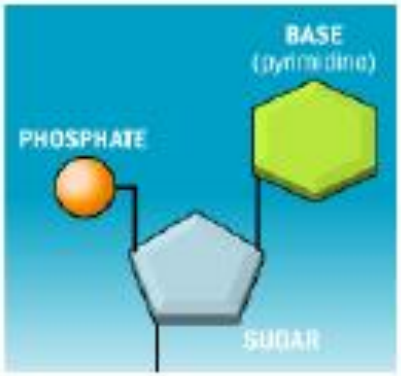
Lipid (triglyceride)



Protein (amino acid chain)



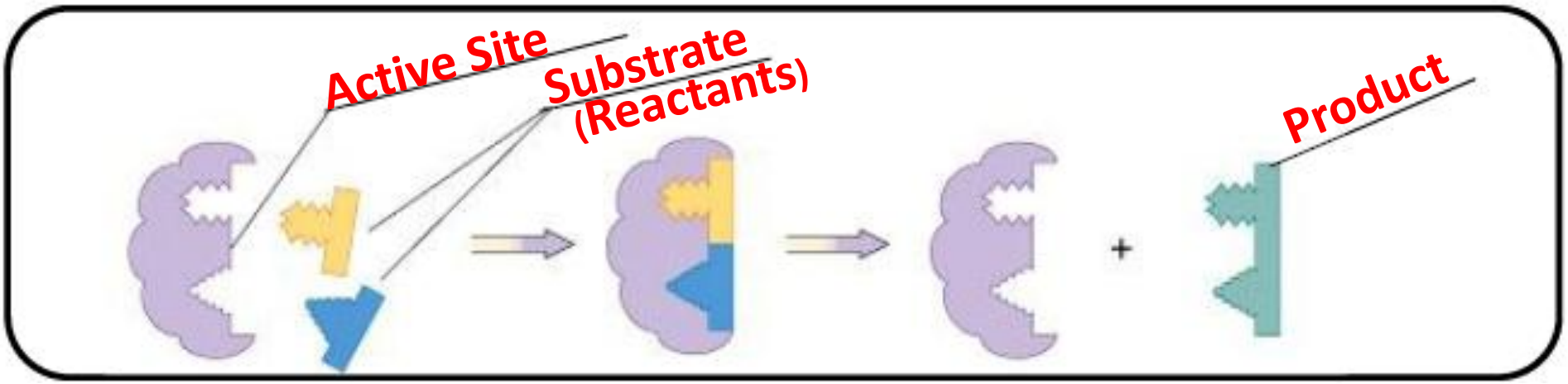
Carbohydrate

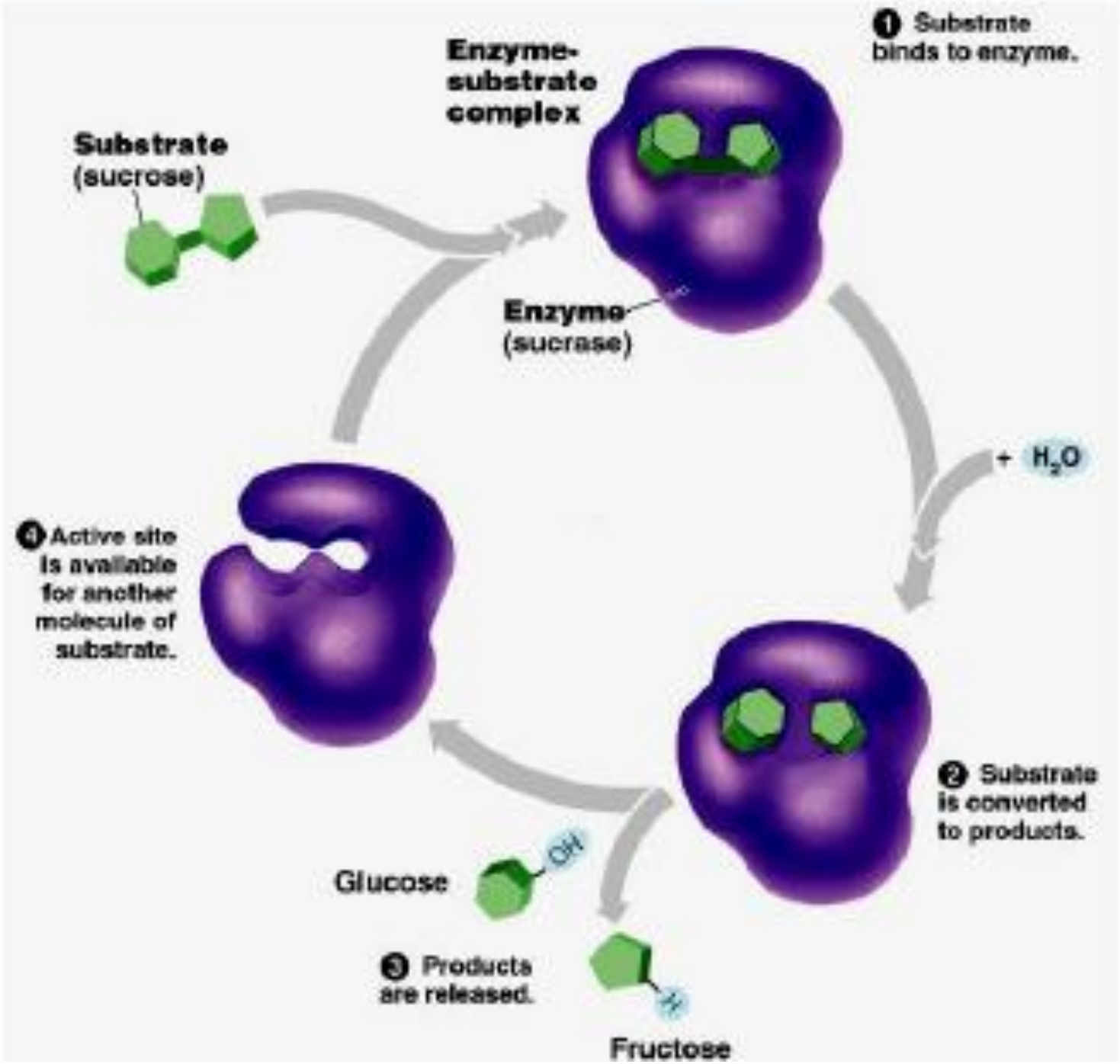


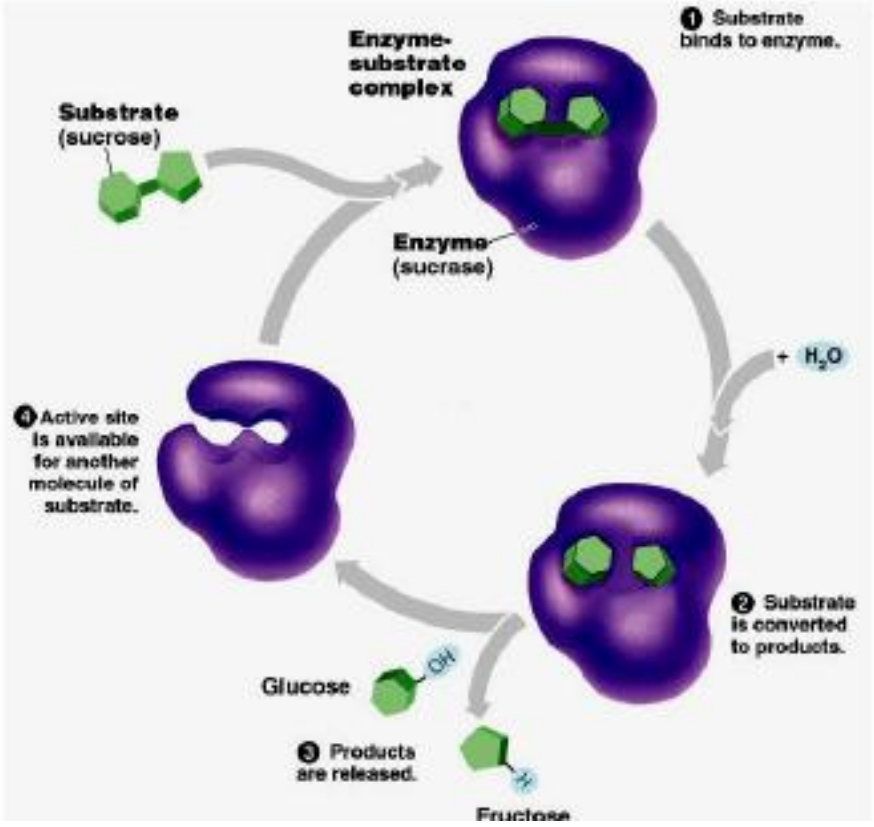
Nucleic Acid (nucleotide)

Bio.4.1.3 Explain how enzymes act as catalysts for biological reactions.

Label the parts of the enzymatic reaction shown below:




1 Substrate binds to enzyme.
Enzyme-substrate complex
Substrate (sucrose)
Enzyme (sucrase)
+ H_2O
2 Substrate is converted to products.
Glucose
OH
3 Products are released.
H
Fructose
4 Active site is available for another molecule of substrate.



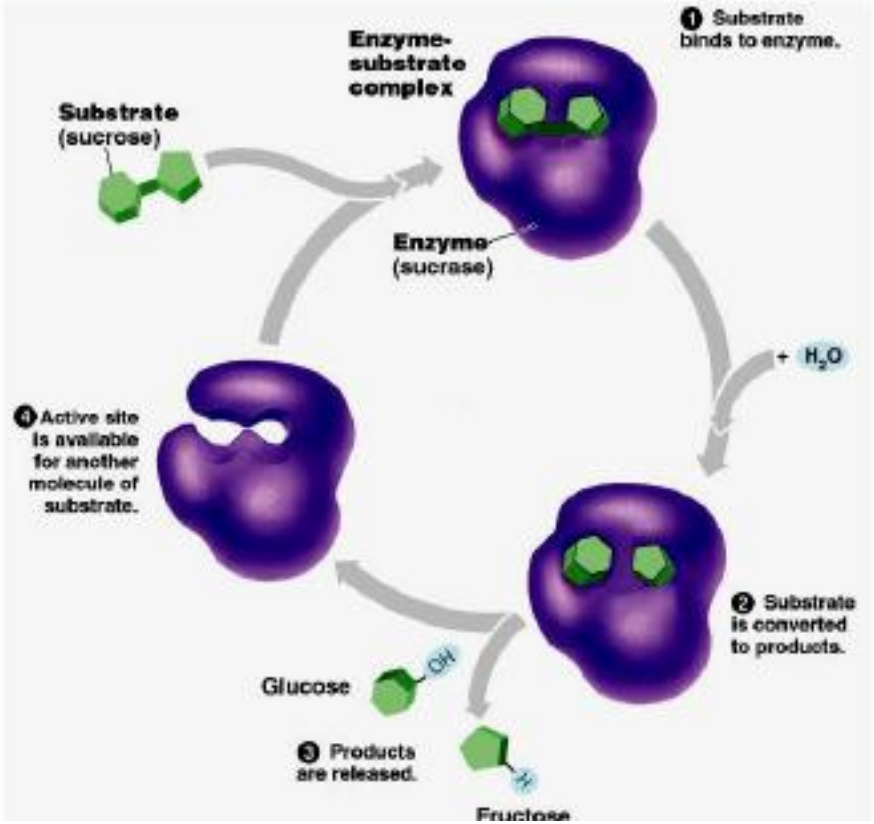
Use the information seen in the diagram on the right to answer the following questions:

1. What is the enzyme's job in this reaction? **To break down sucrose into fructose & glucose**

2. What are the **reactants** in the above reaction ? **Sucrose and water**

3. What are the **products** of the above reaction? **Fructose & Glucose**

4. Does the enzyme get used up in this reaction? Explain. **No, the enzyme doesn't change so it will continue to break down the substrate.**



5. Identify two characteristics about the environment that might cause the enzyme to **denature** or stop working?

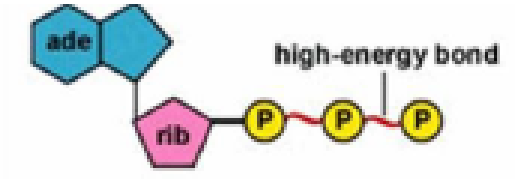
Temperature & pH

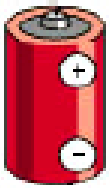
6. To work efficiently, enzymes rely on the presence of Buffer so that changes in pH are minimized.

7. Could this same enzyme be used to break down a protein into its amino acid monomers? No, the enzyme has a specific job/function & substrate.

Bio.4.2.1 Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these systems.

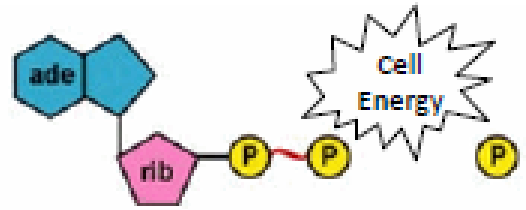
ATP (Adenosine triphosphate) is the **Energy** storing molecule used by cells to move, work & survive.



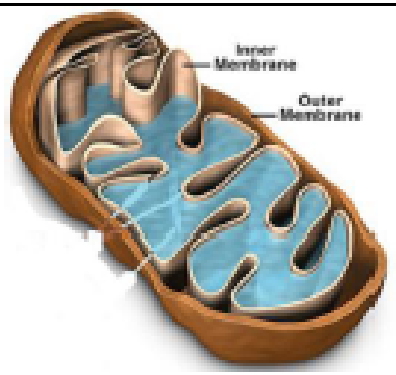
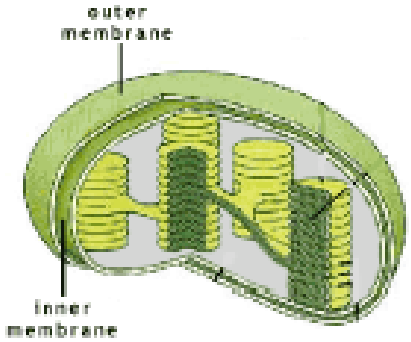


- ATP like a fully charged battery just waiting to provide energy.

- To release energy from ATP one phosphate must be **removed (break bond)**.
  ATP then becomes **ADP** (Adenosine **di** phosphate)

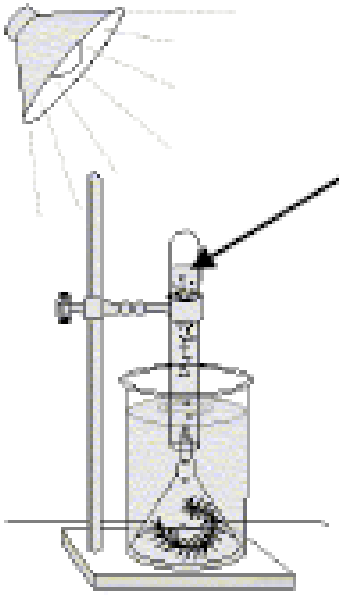


To make more ATP a **Phosphate** must be added back on to a molecule of **ADP**

	Cellular Respiration	Photosynthesis
Function	Takes energy in glucose and stores it in ATP	Using energy from the sun to produce glucose (a sugar)
Location in the Cell	 Mitochondria (organelle)	 Chloroplast (organelle)
In what kinds of organisms?	All Eukaryotes	Plants, algae, some Bacteria

	Cellular Respiration	Photosynthesis
Reactants (What is needed to begin the process)	Glucose ($C_6H_{12}O_6$) + Oxygen (O_2)	Light + Water (H_2O) + Carbon dioxide (CO_2)
Products (What is made by the process)	ATP + Water (H_2O) + Carbon dioxide (CO_2)	Glucose ($C_6H_{12}O_6$) + Oxygen (O_2)

Identify the gases produced by each setup:

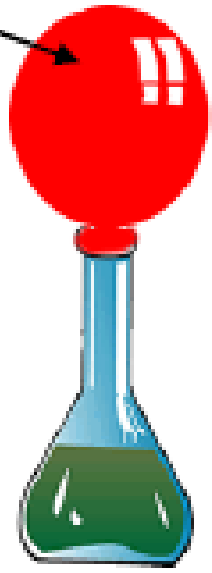


Oxygen (O_2)

Aquatic Plant

PHOTOSYNTHESIS

Carbon dioxide (CO_2)

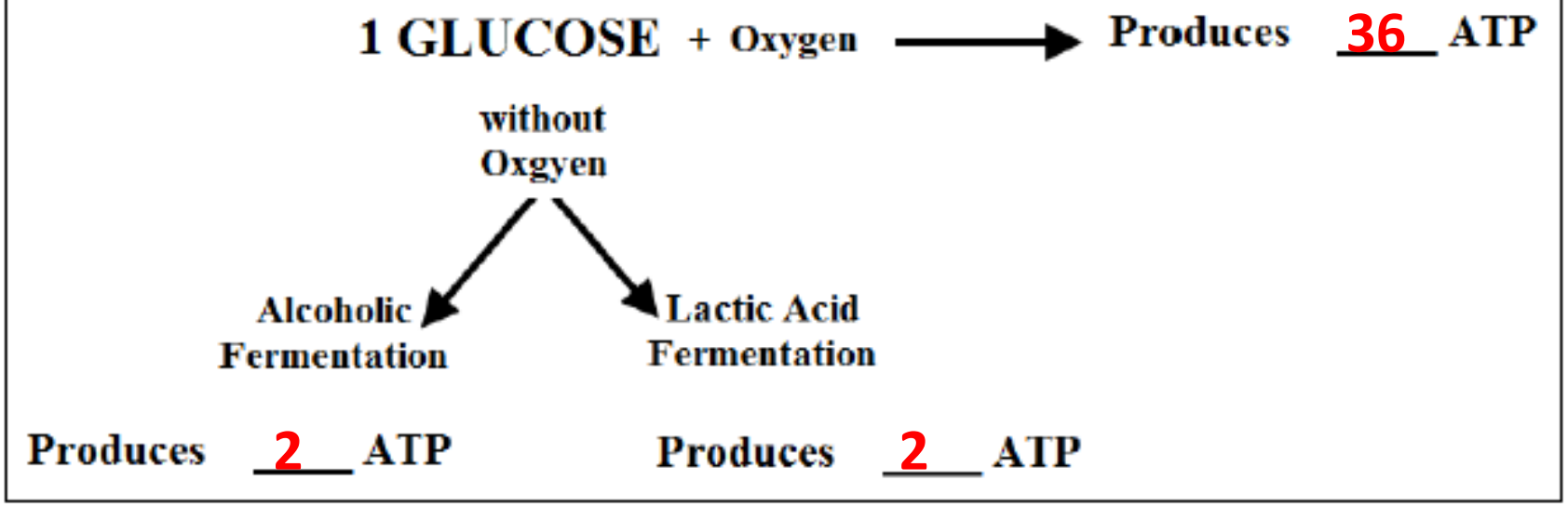


Yeast

Anaerobic RESPIRATION (Fermentation)

Aerobic vs Anaerobic Cellular Respiration:

Cellular Respiration = How the cell makes ATP (usable energy)



In order to make ATP aerobic respiration requires **Oxygen** (anaerobic does not).

- When yeast ferment sugar without oxygen they produce **Alcohol** & **CO_2**
- Without oxygen your muscles produce lactic acid, this causes your muscles to **burn**.

If your muscle cells are able to produce ATP through aerobic & anaerobic respiration, which process would best for them to use? **Aerobic** Why? **It produces more ATP and doesn't cause lactic acid to build up.**