

**Station 1. Analyze how biological traits are passed on to successive generations.**

- a. Distinguish between DNA and RNA.
- b. Explain the role of DNA in storing and transmitting cellular information.

	<u>DNA</u>	<u>RNA</u>
# of strands	2	1
Monomers	Nucleotides	Nucleotides
Major function	Contains Genetic information	Makes proteins
Involved in what processes?	Replication and transcription	Transcription and Translation
4 Bases and the base pairing rules	A, T, C, G	A, U, C, G
Location in cell	Nucleus	Nucleus and then moves to the cytoplasm to find a ribosome
Name of Sugar	Deoxyribose	Ribose
What it stands for	Deoxyribonucleic Acid	Ribonucleic Acid


What are the 3 parts of a nucleotide?  
**1. Phosphate**  
**2. sugar**  
**3. base**  
 Which part has the code for a protein?  
**Base**

What is the term used to describe the shape of DNA?  
**Double Helix**  
 What 2 parts form the “backbone”/ “sides of the ladder” of DNA?  
**Sugar and Phosphate**  
 What’s the bond called between the nitrogen bases?  
**Hydrogen bonds**

The genetic information that determines traits is contained in nucleic acids which are macromolecules. The 2 types of nucleic acids are DNA and RNA.

What happens during DNA replication?  
**DNA unzips. DNA polymerase bonds nucleotides to template**

Make a sketch of DNA.



What are the base pairing rules during DNA replication?  
**A-T and C-G**

Each new molecule is identical to the original molecule of DNA.

What is a chromosome? **Condense nucleic acid that contain genetic information**  
 Traits are determined by small parts of chromosomes. The section of a chromosome that codes for a specific trait is called a **gene**. An organism’s traits depend on the kind and number of proteins in that organism. Remember proteins are macromolecule made up of amino acids. The main function of genes is to control the production of proteins. What organelle assembles proteins? **\_\_Ribosomes\_\_** Where is this organelle found within a cell? **Cytoplasm**

What is protein synthesis? **Process of using genetic information to make proteins. DNA –RNA-Protein**

<u>Protein Synthesis</u>	<u>Transcription</u>	<u>Translation</u>
What happens during this stage?	<b>DNA is used as a template to make mRNA</b>	<b>mRNA is used to link amino acids together to form proteins</b>
Where does this stage take place?	<b>Nucleus</b>	<b>Ribosomes found in the cytoplasm</b>

How many chromosomes do humans have in their somatic cells? **46** or **23 pair** Gametes? **23**

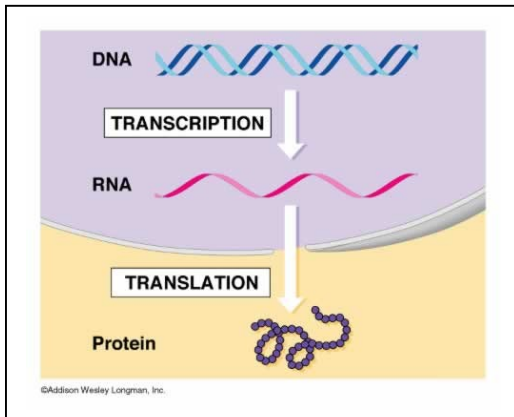
Define:

Diploid: **2 copies of each chromosome (2n)**

Haploid: **1 copy of each chromosome (n)**

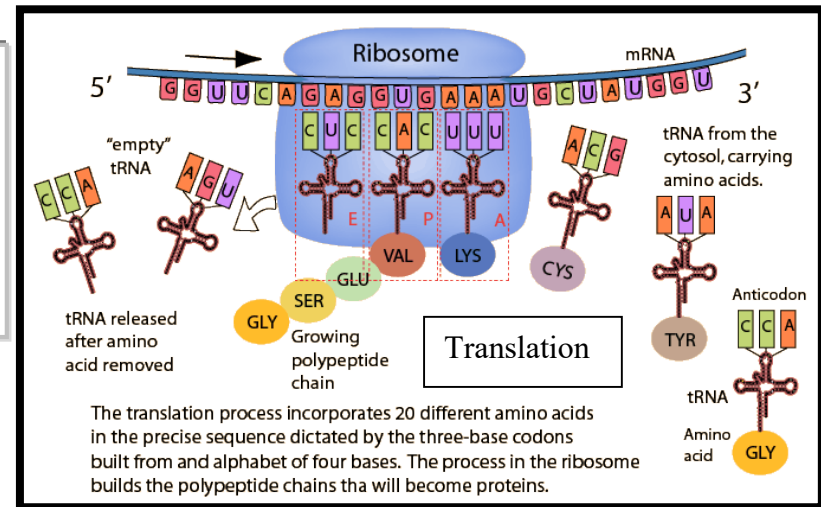
**Word Bank:** codon, transcription, bases, RNA, messenger, protein, anticodon

The instructions in DNA are in a code that depends on the arrangement of nucleotide **bases**. The nucleotides are arranged in triplets called **codon**. A **codon** is a group of 3 bases that codes for a specific amino acid. The code for making a protein is passed from the DNA to an **RNA** molecule during **transcription**. The RNA that carries instructions from DNA in the nucleus to the ribosomes where it will be translated is called **mRNA**. Translation converts the information in the mRNA into a sequence of amino acids that make up a **protein**. In order to translate the code, mRNA codons must join with the correct anticodon on the tRNA. An **anticodon** is a set of 3 nitrogenous bases on a tRNA molecule that is complementary to the codon on an mRNA molecule. Be able to use the codon wheel and chart. (Chapter 8.4 in your book)



What are the 3 types of RNA and what do they do?

1. mRNA-carries genetic message
2. tRNA- transports amino acids
3. rRNA- site of translation



	U	C	A	G
U	UUU = phe UUC = phe UUA = leu UUG = leu	UCU = ser UCC = ser UCA = ser UCG = ser	UAU = tyr UAC = tyr UAA = stop UAG = stop	UGU = cys UGC = cys UGA = stop UGG = trp
C	CUU = leu CUC = leu CUA = leu CUG = leu	CCU = pro CCC = pro CCA = pro CCG = pro	CAU = his CAC = his CAA = gln CAG = gln	CGU = arg CGC = arg CGA = arg CGG = arg
A	AUU = ile AUC = ile AUA = ile AUG = met	ACU = thr ACC = thr ACA = thr ACG = thr	AAU = asn AAC = asn AAA = lys AAG = lys	AGU = ser AGC = ser AGA = arg AGG = arg
G	GUU = val GUC = val GUA = val GUG = val	GCU = ala GCC = ala GCA = ala GCG = ala	GAU = asp GAC = asp GAA = glu GAG = glu	GGU = gly GGC = gly GGA = gly GGG = gly

Use the following DNA strand to do the following:

AGT AGC TAG

Replicate the DNA:

**TCA TCG ATC**

Transcribe the DNA into mRNA: **AGU AGC UAG**

Translate the mRNA into amino acids (remember to use the anticodon):

**SER-SER-STOP**

**Station 2. Analyze how biological traits are passed on to successive generations.**

- c. Using Mendel's laws, explain the role of meiosis in reproductive variability.
- e. Compare the advantages of sexual reproduction and asexual reproduction in different situations.

The process of meiosis provides the opportunity for the shuffling of chromosomes. How is meiosis and sexual reproduction helpful for the survival of a species? **Provides genetic diversity, which increases the chance of survival during environmental changes.**

What is crossing over? How does this relate to the question to the left?  
**Homologous chromosomes pair up and switch genes with each other, resulting in genetically different gametes during meiosis**

- Know these
- Genetic terms**
- ◆ Allele
  - ◆ Dihybrid
  - ◆ Dominant
  - ◆ Gene
  - ◆ Genotype
  - ◆ Heterozygous
  - ◆ Homozygous
  - ◆ Monohybrid
  - ◆ Phenotype
  - ◆ Recessive
  - ◆ Trait

	<u>Sexual reproduction</u>	<u>Asexual reproduction</u>
# of parents	<b>2</b>	<b>1</b>
Are the offspring different or the same as the parents?	<b>Different</b>	<b>Same</b>
Which kingdoms use this method to reproduce?	<b>Protist, fungi, animal, plant</b>	<b>Archeabacteria and Eubacteria</b>
Advantages	<b>Genetic Variation</b>	<b>Don't need a mate</b>
Disadvantages	<b>Can't always get a mate</b>	<b>No diversity</b>

Who was Gregor Mendel? What did he study?  
**He is the father of genetic and she studied 7 traits in pea plants.**

What are the sources of genetic variation in organisms?  
**1. Mutations**  
**2. Recombination during sexual reproduction.**

Define the following words:

1. Heterozygous: **2 alleles are different (Bb)**
2. Homozygous: **2 alleles are the same (BB) or (bb)**
3. Genotype: **Genetic makeup of an organism**
4. Phenotype: **Physical traits of an organism**
5. Dominant allele: **Trait that will show up**
6. Recessive allele: **Trait that only shows up if there isn't a dominant allele.**

### Station 3. Analyze how biological traits are passed on to successive generations.

d. Describe the relationships between changes in DNA and potential appearance of new traits including

- Alterations during replication
- Insertions
- Deletions
- Substitutions
- Mutagenic factors that can alter DNA.
  - High energy radiation (x-rays and ultraviolet) and Chemical

f. Examine the use of DNA technology in forensics, medicine, and agriculture

Define the following: Law of dominance: **Every trait has an allele that shows up more often.**

Law of segregation: **Organism receives one allele from both mom and dad.**

Law of independent assortment: **During meiosis, chromosome will randomly align creating genetic diversity.**

What is a mutagen? List three. **Something in the environment, that causes a mutation. UV rays, chemicals, air pollution**

Explain how a point substitution is different from a frame-shift mutation. **Point substitutions contains the same number of nucleotides while frame-shift either gains or loses a nucleotide.**

What is a somatic mutation? **Mutation that occurs in a body cell.**

What is germ mutation? **Mutation that occurs in a sex cell.**

#### Frame Shift Mutations:

- Deletion Mutation: **Nucleotide is deleted**
- Insertion Mutation: **Nucleotide is inserted**

#### Point Substitution:

- Base-pair substitution: **A nucleotide is replaced with a different nucleotide**

What kind of mutation can be passed on? How is it passed on? **A mutation that has an advantage will be placed on through reproduction.**

What is genetic engineering? **The deliberate modification of the characteristics of an organism by manipulating its genetic material.**

What is recombinant DNA? **DNA that has been formed artificially by combining constituents from different organisms.**

How is recombinant DNA used in genetic engineering? **A selected gene is inserted into a bacterium's plasmid and then reinserted into the bacteria to produce it.**

What is a plasmid? **Typically a small circular DNA strand in the cytoplasm of a bacterium or protozoan**

What is a transgenic organism? **An organism whose genome has been altered by the transfer of a gene or genes from another species or breed**

What is codominance? Give an example. **Both alleles are dominant so they both show up. A cow that is both black and white.**

What is incomplete dominance? Give an example. **Neither allele is dominant so they mix and create a new trait. A red and white allele create a pink color.**

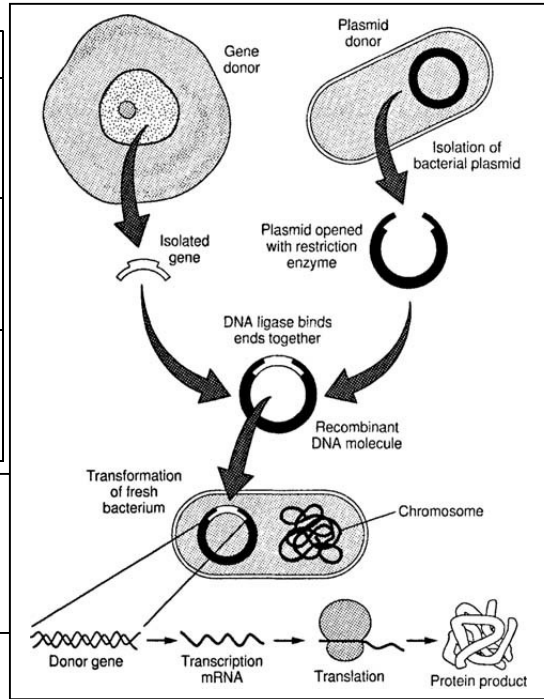
What is a mutation? **A change in DNA**

Are all mutations bad? Explain. **No, because some are good and some do not have any effect.**

Explain the following types of gene mutations:

How can (do) mutations help populations survive and adapt (evolve)? **Some cause new traits that are beneficial. Ex. Pesticide resistance to chemicals.**

	How is genetic engineering used in the following?
Medicine	Genes combined from humans and bacteria to make insulin for diabetics.
Agriculture	Bt corn that is resistant to pest.
Breeding	Traits are selected in animals to make them grow faster or more of them.



What are the risks of genetic engineering? The changes that a genetically engineered species would make on the environment of a region are unpredictable

What is DNA Fingerprinting? Technique where DNA is extracted and used to identifying the base-pair pattern.

What can DNA Fingerprinting be used for in forensics (a branch of law enforcement that uses scientific investigation and evidence to solve crimes)? Discuss at least 2 ways. Use to figure out criminals and also to figure out relationships between people.

How can DNA be used to determine how closely related various organisms are? The bands create a specific pattern and those with similar DNA would have similar patterns.

How can DNA be used to prove paternity (who the father is)? A child would have similar band patterns as a father.

How is DNA separated in gel electrophoresis? A laboratory method used to separate mixtures of DNA, RNA, or proteins according to molecular size.



How do police know that suspect 2 is guilty? Suspects 2 band pattern matches the DNA found at the crime scene.

**Review Questions**

1. A type of mutation that alters DNA by replacing one nucleotide with another is

- a. Crossing-Over
- b. Insertion
- c. Deletion
- d. Substitution

2. Which of the following DNA technologies is MOST likely to be used in forensics?

- a. Genetic Engineering
- b. Development of frost-resistant plants
- c. DNA fingerprinting

## Station 4 Derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems. Chapter 4

a. Explain the cycling of energy through the processes of photosynthesis and respiration.

What is photosynthesis and what organelle does it occur in? **The process of using solar energy by producers and making organic molecules for energy. It occurs in the chloroplast**

What types of organisms carry out photosynthesis? **Producers like plants and algae**

What is the source of energy for photosynthesis? **Solar Energy** What is another word for producer? **Consumer**

What is the equation for Photosynthesis?



What is the equation for cellular respiration?



How are photosynthesis and cellular respiration related? **The products of one process are the reactants of the other process.**

What happens during the light-dependent reactions?

**Light energy is absorbed and produces ATP, NADPH, and O<sub>2</sub>.**

What happens during the light-independent reactions also known as the Calvin cycle?

**It uses ATP and NADPH to produce glucose**

Sketch a chloroplast.



What is stored in the bonds of glucose? **Energy**

What are the reactants in photosynthesis? **Water, Carbon Dioxide and Solar Energy**

What are the products of photosynthesis? **Glucose and Oxygen**

What are the reactants in cellular respiration?

**Glucose and Oxygen**

What are the products of cellular respiration? **Water, Carbon dioxide, ATP**

What is cellular respiration? **The process where organisms use glucose to make energy ATP.**

Why do organisms do cellular respiration? **They need it to help them live.**

What types of organisms perform cellular respiration? **Plants and animals**

What organelle performs cellular respiration? **Mitochondria**

What happens during glycolysis? **Glucose is broken down into 2 pyruvate**

What happens during the Krebs cycle? **Carbon dioxide, 2 ATP, NADH and FADH<sub>2</sub> are produced**

What is the electron transport chain? **Lots of ATP is produced and water is produced.**

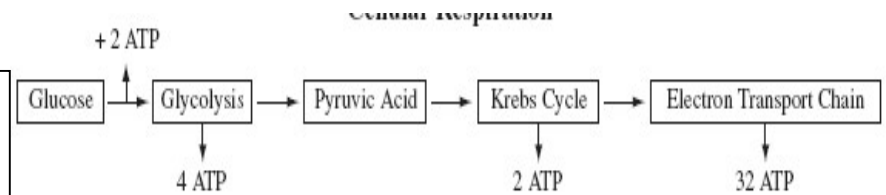
Sketch a mitochondrion.



Anaerobic respiration begins with glycolysis. If no oxygen is present, glycolysis is followed by fermentation. What is anaerobic respiration? **The process organisms use when oxygen is absent to keep it alive.**

What is lactic acid fermentation? **Process of using glucose and making lactic acid. Example. Happens in muscles after running.**

What is alcohol fermentation? **Process of using glucose and making alcohol and carbon dioxide. Example. Used to make beer and makes bread rise.**



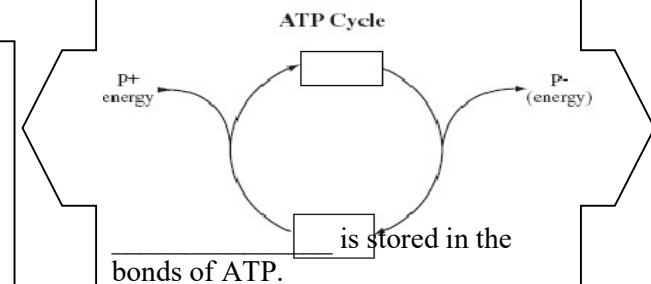
Above are the steps of **cellular respiration**. Which process makes more ATP molecules and thus provides more energy? Cellular respiration or fermentation

What is the difference between anaerobic and aerobic?

**Anaerobic doesn't require oxygen and aerobic does require oxygen**

Chemical energy is stored in the bonds that hold carbohydrates and other organic compounds together. Cells release this energy through respiration. Organisms then use this energy to carry out a variety of activities. When energy is needed in the cell, chemical energy is converted from storage molecules, such as sugar, into adenosine triphosphate, or ATP. ATP then delivers the energy to the places in the cell that need it. ATP is a nucleic acid with 3 phosphate groups in a chain. The phosphate tail of the ATP molecule holds the usable energy. To release the stored energy, the bonds between the phosphates in ATP must be broken. When a phosphate is removed, a molecule with 2 phosphates is left called adenosine diphosphate, or ADP. ADP can be recombined with a free phosphate to form a new molecule of ATP. Combining ADP with free phosphates is called phosphorylation. ATP is like a rechargeable battery. A rechargeable battery may start out filled with chemical energy. As the battery is used, it gives up the energy. The depleted battery is then recharged so it can be used again. ATP is like the recharged battery and ADP is the lower-energy form like the used up battery.

Energy is released when **ATP** is converted into **ADP**.



**\*\*Fill in the boxes in the picture above with: ATP, ADP**

Word Bank: ATP, Energy, ADP

**Station 5 Derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems. Chapter 17-20, 23**

- b. Compare how structures and function vary between the six kingdoms (archaeobacteria, eubacteria, protists, fungi, plants, and animals).
- c. Examine the evolutionary basis of modern classification systems.

	<u>Archaeobacteria (aka the extreme bacteria)</u>	<u>Eubacteria (aka true bacteria)</u>	<u>Protista (aka the Hodgepodge/mixed group)</u>	<u>Fungi</u>	<u>Plantae</u>	<u>Animalia</u>
Domain	Archae	Bacteria	Eukarya	Eukarya	Eukarya	Eukarya
Prokaryotic or eukaryotic	Prokaryotic	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
Uni or multicellular	Unicellular	Unicellular	Some unicellular or multicellular	Most Multicellular or unicellular	Multicellular	Multicellular
Heterotrophic or Autotrophic	Some Autotrophic and Some heterotrophic	Some Autotrophic and some heterotrophic	Some Autotrophic and some heterotrophic	Heterotrophic	Autotrophic	Heterotrophic
Cell wall? If so, what is the cell wall made of?	Cell Wall present made Polysaccharides and proteins	Cell Wall present and of peptidoglycan	Cell Wall present made of cellulose	Cell Wall present made Of chitin	Cell Wall present made Of cellulose	No cell wall
Other distinguishing characteristics	Where do they live? They live in extreme environments	Common bacteria	Why are they the mixed group? If an organism doesn't belong In any of the other kingdoms, They are placed in this kingdom  Amoeba, paramecium, euglena	Mushroom, mildew, yeast	Trees, flowers, grasses	Humans, sponges, insects

What is taxonomy? **The branch of biology that studies the grouping and naming of organisms**

How did Carolus Linnaeus classify organisms? **By their physical and structural characteristics.**

Dumb (Most broad taxon)	What are the 3? <b>Archae, Bacteria, and Eukarya</b>
King	What are the 6? <b>Archaeobacteria, Eubacteria, Protist, Fungi, Plant, and Animal</b>
Philip	
Came	
Over	
For	
Good	Used in the scientific name.
Soup (Most specific)	Used in the scientific name.



Linnaeus created the system for naming organisms that is still used today. This system is called **binomial nomenclature**, because it gives each organism a two-part name.

What is the first part of the scientific/binomial name? **Genus**

What is the second part of the scientific/binomial name? **Species**

Which word is capitalized? **Genus**

Both words italicized in writing.

What language is used for the scientific/binomial name? **Latin**

What are the advantages of using scientific names over common names? **They use latin in the scientific names making it easy for everyone around the world to understand.**

Which of the following is written correctly?

*Quercus rubra* Quercus rubra

quercus rubra Quercus Rubra

How are organisms classified? **They are classified by their behavior, appearance, evolutionary structure and genetic information.**

What is phylogeny? **The evolutionary history for a group of species.**

Why do scientists now look at in DNA to figure out how closely related different organisms are? **DNA is the most accurate way to figure out relatedness between organism making it the best method to classify organisms.**

A **cladogram** is a tree-like diagram that shows evolutionary relationships. Each branch shows where a new group of organisms, called a clade, emerged from an existing group. The cladograms below shows the emergence of the 6 kingdoms.

A cladogram is like a timeline that shows when traits or organisms first appeared on the evolutionary time line.

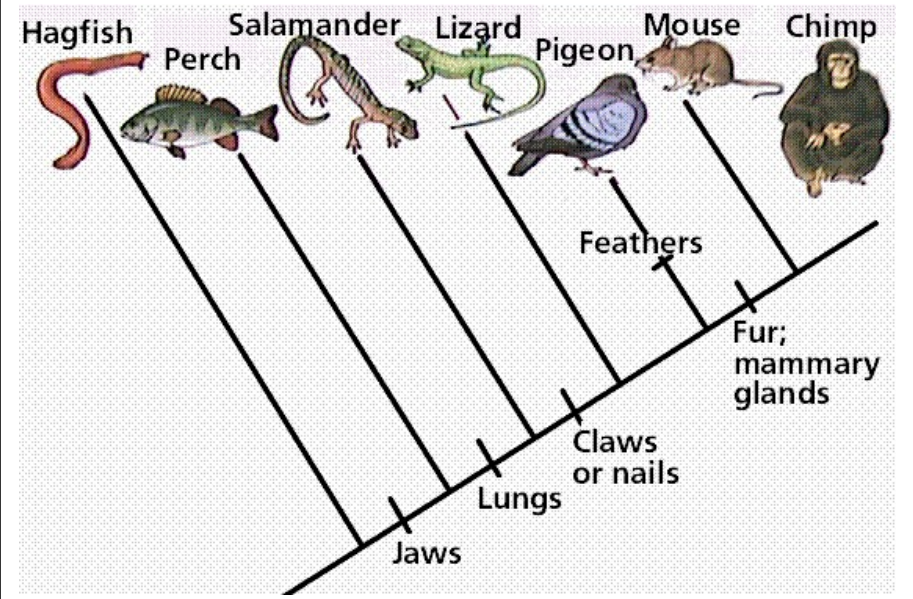
#### Warm-Up Review:

##### 1. A cladogram shows:

- A. Which kingdom is the most diverse
- B. How to name a species
- C. Change over time
- D. Evolutionary relationships

##### 2. From earliest to most recent, which is the correct order of evolution?

- A. Protista, Animalia, Archaeobacteria
- B. Animalia, Archaeobacteria, Protista
- C. Archaeobacteria, Protista, Animalia
- D. Animalia, Protista, Archaeobacteria

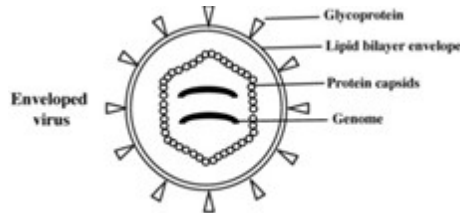


What organisms do not have lungs? **Hagfish and perch**  
How do you know? **They branched out before the trait to have lungs showed up in the gene pool.**

**Station 6. Derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems Chapter 18.1-18.3**

d. Compare and contrast viruses with living organisms.

What is the basic structure of a virus? Make and label a sketch.



Why are viruses considered nonliving particles? Give four reasons.

- 1- Require host for reproduction
- 2- Simple structure
3. Can't produce Energy
4. Can't grow or develop

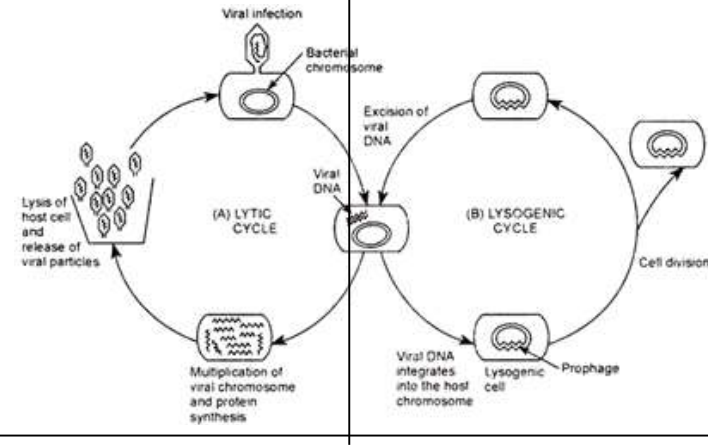
Why is HIV called a retrovirus? **It starts with RNA and makes DNA.**

What is a prion? **Particle that causes disease by causing proteins in the infected organism to fold incorrectly**

Explain how a virus replicates using the lytic cycle & the lysogenic cycle.

**LYTIC CYCLE**

**LYSOGENIC CYCLE**



In which cycle can the virus remain dormant until triggered? **Lysogenic Cycle**  
 What is a bacteriophage? **A virus that infects bacteria only.**

Why are viruses hard to cure? **They are inside a host and they are not living.**  
 Do antibiotics help cure a virus? **NO** If you take antibiotics for a virus, what is it actually curing? **It is curing bacterial infections, not viral infections.**

A virus that causes little or no harm to the host is said to be benign. An example of a benign virus is the common cold.

**1. Why are viruses not considered living things?**

- A. They are not made of cells.
- B. They do not contain hereditary material.
- C. They cannot make their own nutrients.
- D. They can only be seen with an electron microscope.

**2. What determines the shape of a virus?**

- A. its DNA
- B. its RNA
- C. the presence of an envelope
- D. the proteins in its capsid