

SURFIN THROUGH STAAR
SESSION 1: Biochemistry & Cells

Background Information:

Carbohydrates: 1. Elements- CHO (carbon, hydrogen & oxygen)
 2. Monomer (building block- saccharides (sugars))
 3. Function- energy & structure
 4. ex's- glucose, sucrose (table sugar), starch & glycogen

Lipids: 1. Elements- CHOP
 2. Monomer- 3 fatty acids & glycerol
 3. Function- fat & oil give energy, cholesterol and phospholipid for membrane, steroid= chemical messenger
 4. ex's- fats, oils, waxes, steroids, cholesterol & phospholipid

Proteins: 1. Elements- CHONS
 2. Monomer- amino acids (20)
 3. Function- structural, protein channels, enzymes speed up reactions, insulin
 4. ex's- collagen & hemoglobin

Nucleic Acids: 1. Elements- CHOP
 2. Monomer- nucleotide (sugar, phosphate & a base- A, T, C & G)
 3. Function- store & transmit hereditary information
 4. ex's- DNA (deoxyribonucleic acid & ribonucleic acid)

Cells: Prokaryotes (bacteria): lack a nucleus, few organelles; **Eukaryotes** (everything else: including plants & animals): have a nucleus & many organelles

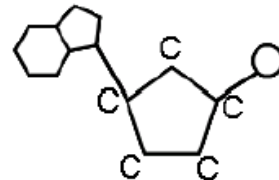
Plant cells: have a vacuole (store water), chloroplasts (carry out photosynthesis), and a cell wall made of cellulose

Animal cells: centrioles (for division), NO CELL WALL, NO CHLOROPLASTS!

ALL CELLS: have a cell membrane, cytoplasm, genetic material (DNA or RNA), and ribosomes (site of protein synthesis)

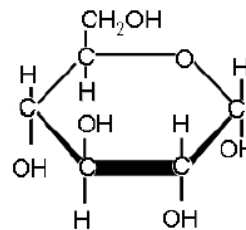
1. The diagram to the right is the **monomer** of **nucleic acids**. What is this monomer?

- a. amino acid
- b. saccharide
- c. 3 fatty acids & glycerol
- d. nucleotide



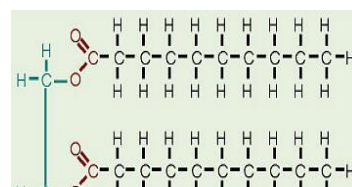
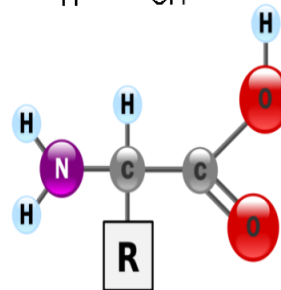
2. The diagram above represents which of the following **biomolecules**?

- a. carbohydrate
- b. protein
- c. lipid
- d. nucleic acid



3. The diagram to the right represents which of the following **biomolecules**?

- a. carbohydrate
- b. protein
- c. lipid
- d. nucleic acid



4. The diagram to the right represents which of the following **biomolecules**?

- a. carbohydrate
- b. protein
- c. lipid
- d. nucleic acid

Nitrogen (N) is used and reused by various organisms and processes as it cycles through the environment.

5. Study the statement above. Nitrogen is NOT a part of which of these biomolecules?

- a. enzyme
- b. amino acid
- c. nucleic acid
- d. carbohydrates

6. Study the statement above. Why is nitrogen important to living things?

- a. Nitrogen is a key component of all carbohydrates.
- b. Nitrogen is a key component of proteins.
- c. Nitrogen is a key component of cellulose.
- d. Nitrogen is a key component of lipids.

Specific biomolecules serve various functions in the body.

7. Study the statement above. Identify the molecule, which is **broken down during respiration** forming water and carbon dioxide and releasing energy.

- a. deoxyribonucleic acid (DNA)
- b. glucose
- c. nicotinamide adenine dinucleotide (NAD⁺)
- d. hemoglobin

8. Study the statement given above. Identify the molecule which forms when the chemical **bond** between two phosphate groups in an **ATP** molecule is **broken**.

- a. hemoglobin
- b. glucose
- c. adenosine diphosphate (ADP)
- d. nicotinamide adenine dinucleotide (NAD⁺)

9. Study the statement above. Identify the molecule which **stores energy** in its chemical bonds for quick, easy use by cells.

- a. nicotinamide adenine dinucleotide (NAD⁺)
- b. glucose
- c. hemoglobin
- d. adenosine triphosphate (ATP)

10. Study the statement above. Identify the molecule which is found in red blood cells that binds to oxygen and carries **oxygen** from the lungs to the body's cells.

- a. glucose
- b. deoxyribonucleic acid (DNA)
- c. nicotinamide adenine dinucleotide (NAD⁺)
- d. hemoglobin

Four major groups of organic compounds are particularly important to living things. Most life processes rely on molecules from one or more of these groups.

11. Refer to the information above. To which group do **sugars** belong?

- a. nucleic acids
- b. proteins
- c. lipids
- d. carbohydrates

12. Refer to the information above. To which group do **RNA** molecules belong?

- a. nucleic acids b. proteins c. lipids d. carbohydrates

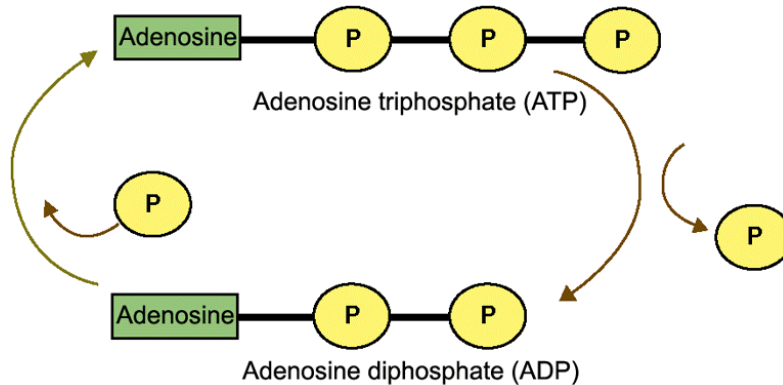
13. Refer to the information above. To which group do enzymes belong?

- a. lipids b. proteins c. carbohydrates d. nucleic acids

14. Refer to the information above. To which group do oils belong?

- a. nucleic acids b. carbohydrates c. lipids d. proteins

15. Study the diagram below which illustrates the cyclic nature of the formation and breakdown of the molecule adenosine triphosphate (**ATP**). What happens when the chemical **bond**, which attaches the **third phosphate group** to the molecule is **broken**?



- a. No energy is made available to the cell for cellular functions.
b. A molecule of adenosine monophosphate (AMP), with one phosphate group, is formed.
c. Energy is released, which can be used by the cell.
d. Energy is lost in the process.

Nitrogen is found in a variety of forms in living things and in the environment. Molecules include N_2 , a diatomic molecule, and NH_3 , ammonia. Other forms include NO_3^- , or nitrate, and $-NH_2$, an amino group.

16. Refer to the information above. Which of these forms is a key component of an **amino acid**?

- a. nitrate b. diatomic molecule c. ammonia d. amino group

17. Certain types of biomolecules are crucial to a variety of life processes and body structures. One of these types of molecules are **proteins**, which are-

- a. composed of building blocks called amino acids
b. insoluble in water and are used by the body for energy storage and insulation
c. complex biomolecules that store genetic information
d. organic compounds used by cells to store and release energy

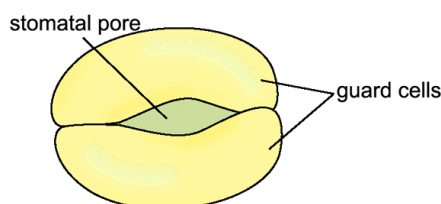
18. Which of these important chemicals forms the framework for **carbohydrates, fats**, and other molecules of life?

- a. nitrogen b. oxygen c. water d. carbon

19. Which of the following statements about **enzymes** is **true**?

- a. Amylase, a digestive enzyme found in saliva, helps break down food molecules.
b. Enzymes do not play a role in metabolic processes of the body.
c. Enzymes are chemically altered during reactions in which they are involved.
d. Enzymes always slow the rate at which a chemical reaction occurs.

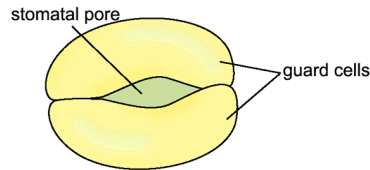
Guard cells are pairs of cells that surround stomata, which are small openings or pores in the leaf. Guard cells control the opening and closing of the stomatal pores.



20. Refer to the information and graphic above. **Guard cells** from a tomato plant are kidney-bean shaped. Which cell type would you expect to look most **similar** to **tomato guard cells**?

- a. root cells from a tomato plant
- b. guard cells from a marigold plant**
- c. leaf palisade cells from a tomato plant
- d. stem cells from a corn plant

Guard cells are pairs of cells that surround stomata, which are small openings or pores in the leaf. Guard cells control the opening and closing of the stomatal pores.



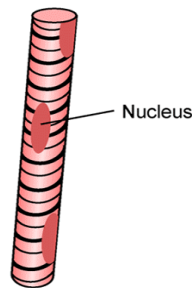
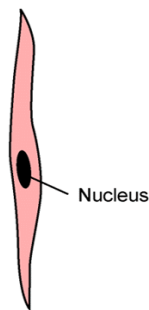
21. Refer to the information and graphic above. The guard cells determine whether or not the stomatal pores are open. When guard cells absorb water, they swell, and the pores open. When guard cells lose water, they shrink, and the pores close. When stomata are open the plant loses water through the pores in a process known as transpiration. What is the **most likely** effect on the plant if the guard cells stay **swollen on a hot day**?

- a. The plant will turn yellow.
- b. The plant will wilt.**
- c. The plant will lose its leaves.
- d. The plant's roots will grow.

22. Suzanne is looking at different types of muscle tissue using a microscope. She notices that cells from a stomach muscle (A) look smooth and spindle-shaped, while tissue from leg muscle appears to be striped (B). What is the reason that the two tissue types **look different**?

A. Stomach Muscle

B. Leg Muscle



- a. The stomach muscle is full of dividing cells.
- b. Stomach muscle functions differently than leg muscle.**
- c. The stripes in the leg muscle do not relate to its function.
- d. The two muscles function the same despite differences in their appearance.

23. The pancreas contains a special group of cells that produce the hormone insulin. Insulin stimulates the liver to remove sugar from the blood. If the cells in the pancreas do not produce enough insulin then **excess sugar builds up in the blood**. The result is a **disease** called-

- a. hypoglycemia
- b. pancreatitis
- c. insulin-deficiency syndrome
- d. diabetes**

Miguel is looking at cells through a microscope. His teacher, Mrs. Sheng, has told him that he is viewing either a tomato cell or a bacterial cell. Mrs. Sheng would like Miguel to answer some questions about the cell he is looking at.

24. Read the information above. Mrs. Sheng asks Miguel to figure out what type of cell he is viewing. What cell **structure** should Miguel be looking for to determine whether this cell came from a **tomato plant or a bacterium**?

- a. ribosomes
- b. mitochondria
- c. nucleus**
- d. DNA

Adrian is watching a movie with his friends. When he sees something scary happen in the movie, his brain sends a signal to the adrenal gland, which releases the hormone adrenalin into the bloodstream. This hormone causes Adrian's heart to pump faster and his breathing to speed up.

25. Refer to the information above. In Adrian's body the effects of **adrenalin** are occurring at the **level** of-

- a. individual cells
- b. groups of cells
- c. a single organ system
- d. multiple organ systems**

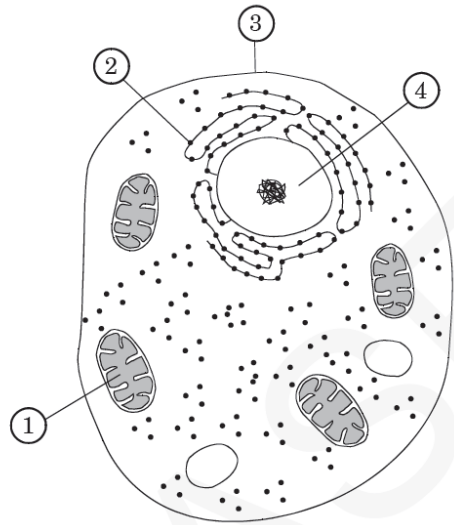
26. Like complex carbohydrates, proteins are biomolecules that serve many functions and can be chemically broken down and restructured. Both **proteins** and complex **carbohydrates** are which of the following?

- a. polymers of smaller subunits
- b. sequences of sugars
- c. lipids of large molecules
- d. nucleotides of DNA

27. An iodine solution is placed on the cut side of a **potato**. Within seconds, a **blue-black** color appears. What is **most likely** occurring?

- a. a positive test for proteins
- b. a positive test for starches
- c. a negative test for proteins
- d. a negative test for starches

28. The diagram below represents a cell.



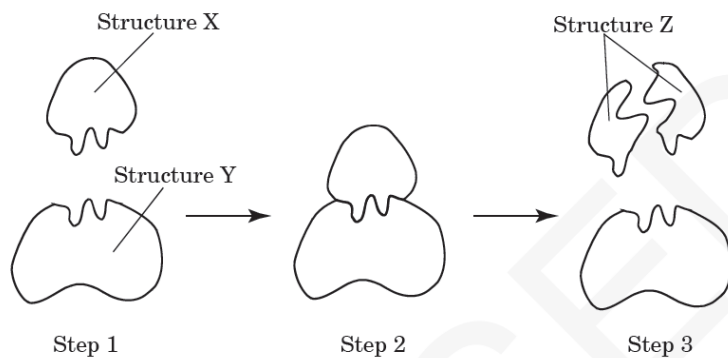
Which **organelle** is the site where **amino acids** are synthesized into **proteins**?

- a. 1
- b. 2
- c. 3
- d. 4

29. **RNA** and **DNA** are which type of **organic compound**?

- a. carbohydrate
- b. lipid
- c. nucleic acid
- d. protein

30. This diagram shows an **enzyme-substrate** complex.



Which is represented by **Structure X**?

- a. substrate
- b. product
- c. enzyme
- d. complex

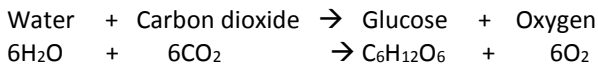
31. What will **most likely** happen if an appropriate **enzyme** is **added** to a **chemical reaction**?

- a. The reaction rate will increase.
- b. The equilibrium of the reaction will be maintained.
- c. The reaction rate will decrease.
- d. The reaction will stop.

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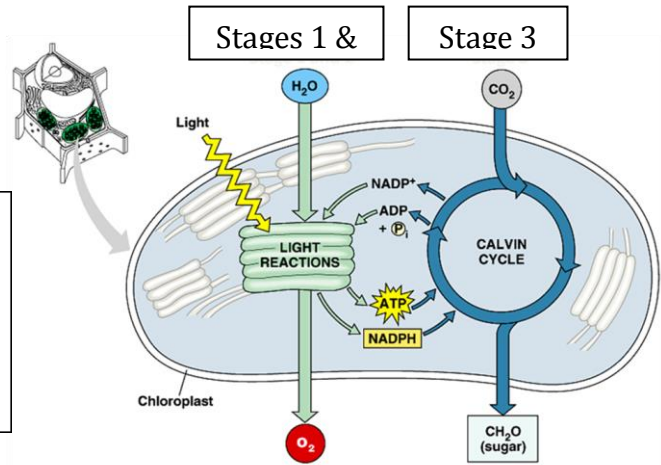
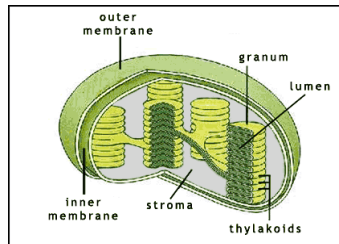
When molecules move from a high to low concentration it is called moving DOWN the concentration gradient.
 When molecules move from a low to high concentration it is called moving AGAINST the concentration gradient.
 When the concentration of a solute is the same throughout a system, the system is at EQUILIBRIUM.
 What kind of transport DOES NOT require energy? PASSIVE What kind of transport requires energy? ACTIVE
 Which CELL PART provides the energy for active transport? MITOCHONDRIA
 Which MOLECULE is produced by mitochondria and provides energy for transport? ATP
 Movement of molecules FROM a region of HIGH concentration TO a region of LOW concentration = DIFFUSION
 The movement of molecules FROM a region of HIGH concentration TO a region of LOW concentration with the HELP of carrier proteins or channels = FACILITATED DIFFUSION
 Membrane proteins that move molecules across membranes by attaching, changing shape, and flipping to the other side like a revolving door = CARRIER PROTEINS
 Membrane proteins that help molecules across membranes by providing a tunnel = PROTEIN CHANNELS
 The movement of WATER molecules from HIGH concentration to LOW concentration across a cell membrane = OSMOSIS
 Which kinds of transport use VESICLES to help molecules across membranes? ENDOCYTOSIS (PHAGOCYTOSIS & PINOCYTOSIS & EXOCYTOSIS)

Photosynthesis Chemical Reaction for photosynthesis:



Process by which plants and some other organisms use light energy to convert water and carbon dioxide into oxygen and high-energy carbohydrates such as sugars and starches

Chloroplast- site of photosynthesis



Cellular Respiration- process that releases energy by breaking down glucose and other food molecules in the presence of oxygen;

Aerobic means **with** oxygen (O₂); **Anaerobic** means **without** oxygen (O₂)

-Glycolysis- Means the splitting of glucose; Occurs in the cytoplasm of all cells in every organism; It does NOT require oxygen; A net of 2 ATP is made during glycolysis.

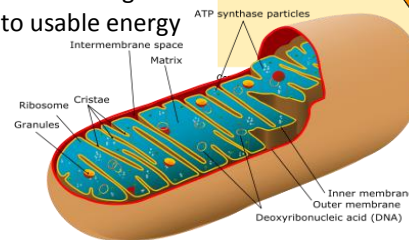
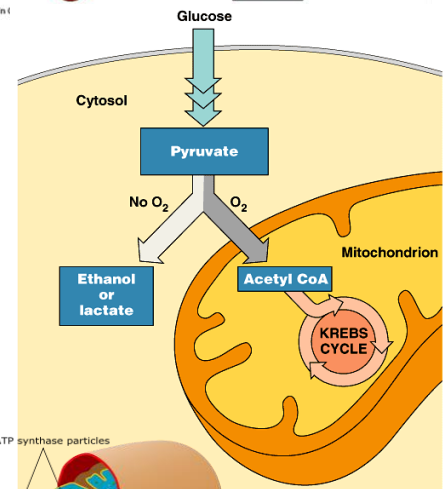
-Fermentation – Anaerobic Pathway-There are 2 types of fermentation:

Alcoholic Fermentation-Occurs in yeasts and bacteria, CO₂ and ethyl alcohol are produced (bread dough rising); **Lactic Acid Fermentation**-Occurs during strenuous exercise (burning & fatigue in muscles)

-Cellular Respiration Totals: Energy produced per glucose molecule; -Glycolysis = Net of 2 ATP; Kreb's Cycle = 2 ATP; Electron Transport Chain (ETC) = 32 ATP;

Total = 36 ATP per glucose molecule

Mitochondria "powerhouse"- site of cellular respiration= **MAKING ENERGY!** Manages the process by which energy stored in food molecules is transformed into usable energy for the cell.



Other cell organelles:

Vacuole- stores water, waster, enzymes and other materials (like a water tower)

Golgi body- sorts and packages proteins (think of UPS)

Nucleus- brain/control center of the cell; instructions for making proteins

Lysosome- digests worn out organelles, food particles, and engulfed bacteria & viruses (like a janitor/clean up crew)

Ribosome- site of protein synthesis (think of meat-has protein in it)

Cell membrane- controls what enter and leaves the cell, "semi or selectively permeable" (like a bouncer)

Mitosis: produces 2 genetically identical, diploid body (somatic) cells

Meiosis: produces 4 genetically different, haploid sex (gametes) cells

Diploid: full set of chromosomes

Haploid: chromosome # is half

Practice Questions:

Cell organelles carry out specific metabolic processes.

1. Study the statement above. Which cell organelle manages the process by which **proteins are sorted and packaged** to be sent where they are needed?

- a. ribosomes b. lysosomes c. Golgi bodies d. vacuoles

2. Study the statement above. Which cell organelle is responsible for **storing enzymes and other materials** needed by the cell?

- a. ribosomes b. vacuoles c. mitochondria d. lysosomes

3. Study the statement above. Which cell organelle manages the process by which **proteins are assembled** based on DNA instructions?

- a. mitochondria b. lysosomes c. ribosomes d. vacuoles

4. Study the statement above. Which cell organelle manages the process by which **energy stored in food molecules is transformed into usable energy** for the cell?

- a. lysosomes b. golgi bodies c. mitochondria d. ribosomes

5. Study the statement above. Which cell organelle manages the process by which **worn out organelles, food particles, and engulfed viruses or bacteria are digested**?

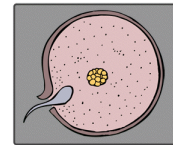
- a. ribosomes b. lysosomes c. vacuoles d. golgi bodies

6. Which of these is **not** an advantage gained by organisms which **reproduce sexually**?

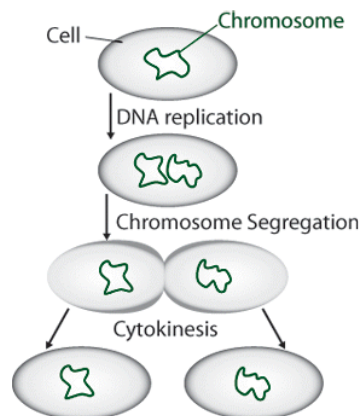
- a. Genetic recombination created genetic diversity within a species.
b. Some percentage of organisms within a species will be likely to survive and reproduce despite harsh environmental conditions.
c. Genetic diversity reduces the risk of species extinction caused by hard environmental conditions.
d. Genetic diversity weakens a species' overall ability to survive harsh environmental conditions.

7. A **fertilized egg** created through **sexual reproduction**-

- a. has a combination of genetic material that is unique in the species
b. is genetically identical to other eggs of the same parents
c. is genetically identical to the parents
d. contains genetic material from only one parent



8. Organisms reproduce asexually in a variety of ways. A **bacterium** reproduces by making a **copy of its chromosome**, growing larger, then **dividing into two separate**, genetically identical cells. This process is called-



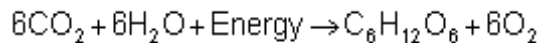
- a. regeneration b. binary fission c. vegetative reproduction d. budding

9. Which of the following statements about **sexual reproduction** is **false**?

- a. Organisms that reproduce sexually produce sex cells called gametes.
b. Fertilization is part of the sexual reproduction process.
c. In sexual reproduction, a single parent produces identical offspring.
d. A zygote is produced through sexual reproduction.

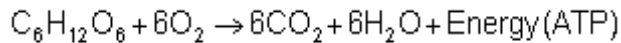
10. Study the chemical reactions below.

Photosynthesis:



(carbon dioxide and water and light energy \rightarrow glucose and oxygen)

Cellular respiration:



(glucose and oxygen \rightarrow carbon dioxide and water and energy)

Plants produce **more oxygen** during **photosynthesis** than they use in cellular respiration. What happens to the **excess oxygen** produced during photosynthesis?

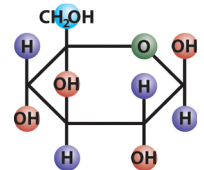
- a. It is used as an energy source by plant cells.
- b. It is released into the air and is used by other organisms for respiration.
- c. It is converted into heat energy.
- d. It is a waste product which is never reused.

11. Which of these is **inhaled by animals**, then **used in respiration**?

- a. carbon
- b. oxygen
- c. nitrogen
- d. water

12. One of the products of photosynthesis is **glucose** ($\text{C}_6\text{H}_{12}\text{O}_6$). Which of the following statements about the **production** and **use** of this molecule is **false**?

- a. Plants use the energy from glucose to convert nutrients to body tissues and grow larger.
- b. Glucose that is not immediately used by the plant is stored for later use.
- c. Plants use the energy from glucose to manufacture a variety of plant products.
- d. Glucose that is not immediately used by the plant is lost as waste material.



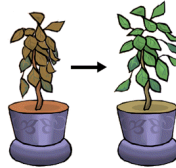
Glucose Molecule

13. Tigers, goldfish, peacocks, and humans all **reproduce sexually**. Which statement is **true** about **sexual reproduction**?

- a. It is not a factor scientists use to define different species.
- b. It involves the joining of an egg and sperm into one cell.
- c. The offspring are genetically the same as their parents.
- d. Sexual reproduction can only take place by internal fertilization.

14. Jackson is growing a bean plant in a pot. One day Jackson notices that the plant is wilting. He waters the bean plant and within a few minutes the plant begins to perk up. This is because the plant has taken up water by osmosis. At what **structural level** does **osmosis** occur?

- a. organs
- b. tissues
- c. cells
- d. organ systems

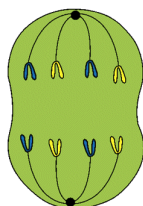


Organisms as different as bacteria, mushrooms, algae, oak trees, and human beings are all made of cells.

15. Read the information above. Which statement is **true** for all cells?

- a. All cells have the same shape.
- b. All cells need energy to survive.
- c. All cells are surrounded by a rigid wall.
- d. All cells belong to organ systems.

Michelle is looking through a microscope at a cell from an onion root. She sees a cell that is in the process of dividing to make a new cell. This is what Michelle sees:



16. Study the diagram and the description above. If Michelle were able to find an **onion cell** that had **completed division**, what **products of cell division** would she see?

a. four different cells

b. only one cell

c. two identical cells

d. four identical cells

17. Study the diagram and the statement above. Michelle is observing cell division in an onion cell, but this type of cell division also occurs in the human body. Which statement is **not true** about this type of **cell division in humans**?

a. This type of cell division in humans produces sex cells as well as body cells.

b. This type of cell division in humans occurs while bones are forming during development.

c. This type of cell division in humans can be affected by viruses.

d. This type of cell division in humans is necessary to heal cuts and wounds

18. Study the diagram and the description above. What is the name for the **process** Michelle is observing?

a. mutation

b. meiosis

c. mitosis

d. metamorphosis

19. Study the diagram and the information above. Which of these statements about **cell division** is **true**?

a. A newly formed daughter cell has less DNA than its parent cell.

b. Cells divide at random times.

c. New cells formed by cell division can replace dying cells in an organism.

d. The phases of cell division can occur in any order.

20. A special type of cell division, called **meiosis**, is used to form **sex cells or gametes**. Which statement is **true** above this type of **cell division**?

a. The products of meiosis are two identical cells.

b. DNA is not copied at all during meiosis.

c. The new cells have half the DNA of the parent cell.

d. Meiosis is complete after only one round of cell division.

21. A person with swollen gums rinses his mouth with **warm salt water**, and the **swelling decreases**. Which has occurred?

a. The swollen gums have absorbed the saltwater solution.

b. The saltwater solution lowers the temperature of the water in the gums.

c. The salt in the solution has moved against the concentration gradient.

d. The water in the gums has moved from a high to a low concentration of water.

22. What **advantage** do **sexually reproducing** organisms have over asexually reproducing organisms?

a. genetic variation

b. genetic stability

c. increased fertilization rate

d. increased reproductive rate

23. What is the **most likely function** of a group of cells that contain a **high number of chloroplasts**?

a. respiration

b. transpiration

c. fermentation

d. photosynthesis

24. In humans, **glucose** is kept **in balance** in the bloodstream by **insulin**. Which concept does this best illustrate?

a. adaptation

b. homeostasis

c. metabolism

d. organization

25. In which way are **photosynthesis** and **cellular respiration** **different**?

a. Cellular respiration stores ATP, while photosynthesis releases ATP.

b. Cellular respiration produces oxygen, while photosynthesis uses oxygen.

c. Photosynthesis releases energy, while cellular respiration stores energy.

d. Photosynthesis uses carbon dioxide, while cellular respiration produces carbon dioxide.

26. Which statement best **distinguishes** **aerobic** from **anaerobic respiration**?

a. Only aerobic respiration involves fermentation.

b. Only anaerobic respiration occurs in the mitochondria.

c. Only aerobic respiration requires oxygen.

d. Only anaerobic respiration produces carbon dioxide.

27. Which most accurately describes the **difference** in **ATP production** between **aerobic respiration** and **anaerobic respiration**?

a. Aerobic respiration produces more ATP than anaerobic respiration.

b. Anaerobic respiration produces more ATP than aerobic respiration.

c. Only anaerobic respiration produces measurable amounts of ATP.

d. Anaerobic and aerobic respiration produce the same amount of ATP.

28. A human **skin cell** contains **46 chromosomes**. How many **chromosomes** are present in a **human sperm cell**?

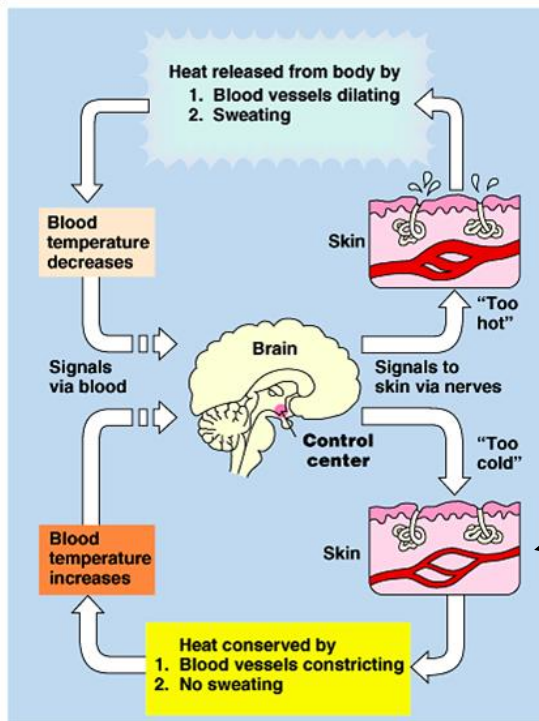
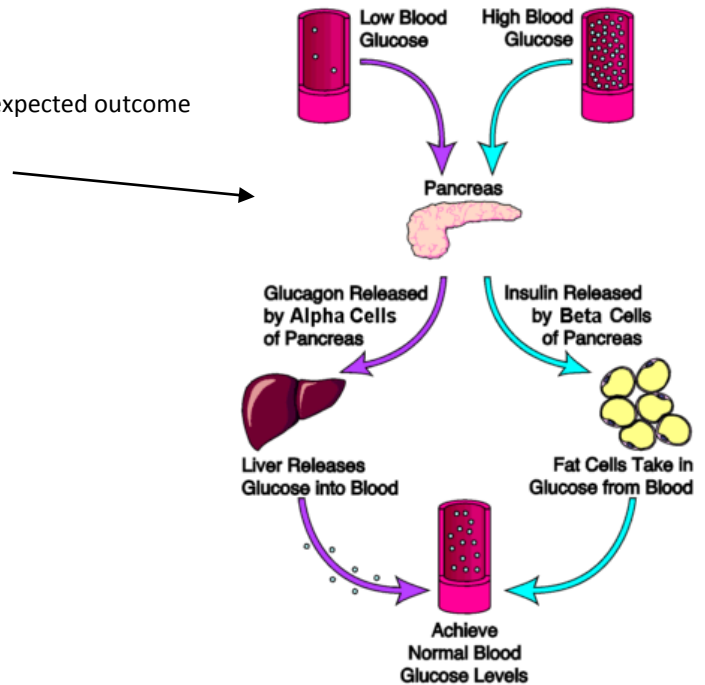
- a. 23 b. 46 c. 92 d. 138

29. What is **homeostasis**?

- a. the ability of an organism to maintain a relatively stable internal environment
b. the production of a hormone by an endocrine gland that works on another endocrine gland
c. a series of events that monitor how hormones work in the body
d. a process in which a change in the environment causes a response that returns conditions to their original status

30. If the body **stopped producing new Beta cells**, what would the expected outcome be?

- a. The pancreas would no longer release glucagon
b. High blood glucose levels would continue to become normal
c. **Insulin would no longer be released**
d. Alpha cells would become beta cells



(b) Control of body temperature

31. You just ran a marathon (26.2 miles) and your body is trying to reach **homeostasis**.

Which of the following statements is **true**?

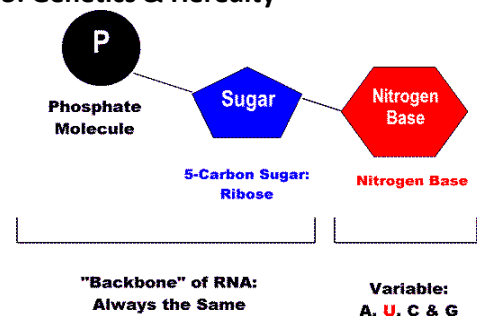
- a. Your blood vessels will constrict to conserve heat
b. **Your blood vessels will dilate to release body heat**
c. Your body's control center will shut down
d. Your brain will tell your body not to sweat

SURFIN' THROUGH STAAR Session 3: Genetics & Heredity

Background Information (Sessions 3 & 4 Info):

DNA- deoxyribonucleic acid- large, complex macromolecule (polymer) makes up our chromosomes, located in nucleus of the cell, controls all activities of cell, double helix structure

Nucleotides- monomers (building blocks) that connect together to make up the polymer DNA



3 Parts: **sugar** (deoxyribose is sugar for DNA, ribose is sugar for RNA), **phosphate group**, & **one of 4 nitrogenous bases** (DNA- adenine, thymine, guanine, cystosine & uracil replaces thymine in RNA)

Bonds: The strong, covalent bonds between the sugar-phosphate-sugar backbone of DNA are called **phosphodiester bonds**. They hold the nucleotides together.
The “steps or rungs” of the twisted ladder of DNA are made up of two nitrogen **bases** that are connected in the middle by weak **hydrogen** bonds.

Complementary base pairs:

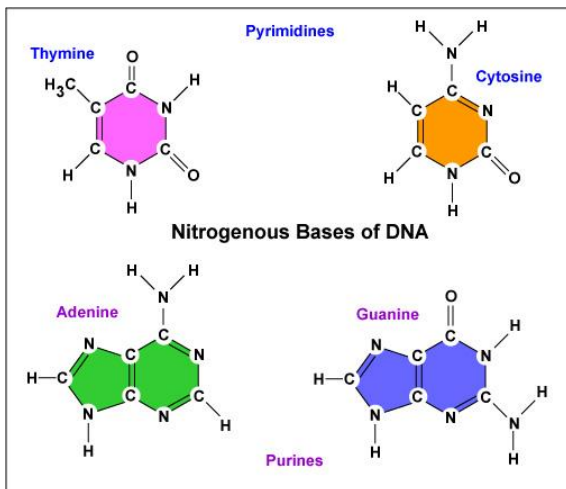
Adenine and thymine always pair up to form a step/rung. They are held by a double hydrogen bond.

Cytosine and guanine always pair to form a step/rung. They are held by a triple hydrogen bond.

Purines- adenine (A) and guanine (G)- larger size

Pyrimidines- cytosine (C) and thymine (T)- smaller size

A trick to remember which bases pair together is to remember that the letters made with straight lines go together (A & T) and the letters made with curved lines go together (C & G).



DNA Antiparallel Structure:

- Most DNA is twisted/coiled to the right
- one strand is the 3' (3 prime)= the side with the free OH group on the end
- one strand is the 5' (5 prime)= the side with the free phosphate on the end

DNA Replication:

The process by which a strand of DNA is copied occurs during something called replication. In order to do this, the enzyme DNA helicase moves down a

molecule of DNA and breaks the weak hydrogen bonds between the nitrogen bases (A, T, C and G).

When they do this they “unzip” the ladder, which comes apart and the two sides of the ladder separate.

A different enzyme, DNA polymerase comes along afterward and links the sugar and phosphate molecules back up again, making new nucleotides and creating a new ladder side for each of the old strands that came apart.

Each new strand of DNA now has half of the old strand that came apart and half of a new strand that was just created.

At the end of replication, there are 2 new identical strands of DNA- 1 side is from the original DNA strand (template)- The other side is the newly formed strand that was “copied”

Replication is the process in which a DNA model is copied and that replication occurs during the S (synthesis) phase of Interphase right before mitosis.

DNA, Proteins & Genetic Coding: DNA is directly connected to proteins because it contains the “master plan” for all living organisms. Proteins are made up of smaller units (monomers) called amino acids, which are linked together in a specific order to make specific proteins.

These nitrogen bases link together in three’s to form a codon and many codons link together to form a person’s genetic code.

Codons, DNA triplets, code for one amino acid.

Amino acids link together to form polypeptides-chain containing 2 or more amino acids

Polypeptides make up proteins.

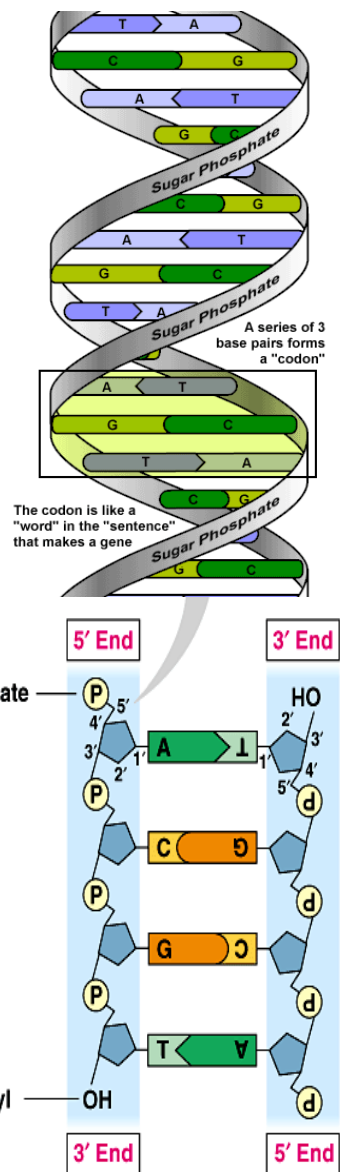
Genes code for polypeptides. Gene- a specific sequence of nucleotides forming part of a chromosome that codes for a trait (protein)

Codons are made up of 3 nitrogen bases, so they look like this: base + base + base = codon (Ex. ACG = a codon)

When you read one codon at a time it can be used to determine which amino acid (and this determines which protein) each strand of DNA or RNA will code for.

Transcription: Changing DNA to RNA:

It is important to realize that DNA and proteins have a direct relationship.



In other words, DNA is used to make proteins and the first step by which it does this is a process called transcription.

RNA Bases:

The nitrogen bases are named as follows: adenine (A), uracil (U), cytosine (C), and guanine (G).

Notice- RNA does not contain the base thymine (T), instead adenine (A) will pair with uracil (U).

In transcription, an RNA (ribonucleic acid) strand is made from a strand of DNA.

In order for this to occur, a DNA strand unzips and RNA bases come along and pair up with the exposed DNA bases.

Enzymes reassemble the nucleotides and the strand is now called mRNA, or messenger RNA.

This is called messenger RNA because it will now deliver a message telling the ribosomes in the cell to get ready to start making proteins.

Recall... what is the function of a ribosome? Synthesize proteins

Differences in DNA & RNA:

DNA

Double strand

Deoxyribose sugar

Thymine

In DNA, thymine pairs with adenine.

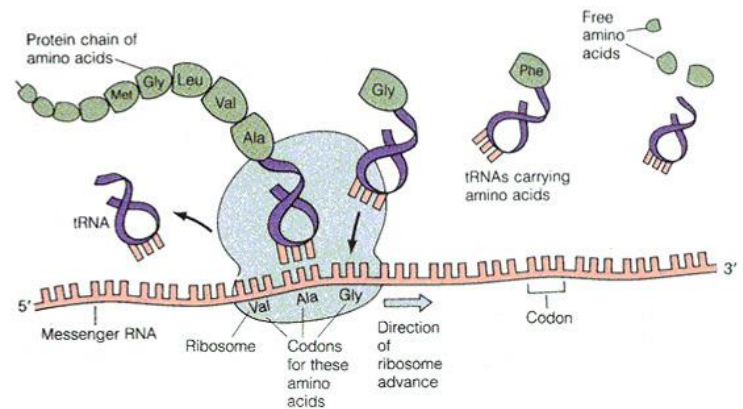
RNA

Single strand

Ribose sugar

Uracil instead of Thymine

In RNA, uracil pairs with adenine.



Translation: Converting RNA to Proteins

Translation is the process by which proteins are made using RNA.

This process occurs in the ribosomes of the cell.

Translation happens when the ribosome reads the mRNA code and translates it into a specific amino acid sequence, which becomes a protein.

Amino acids continue to link together to form proteins inside the ribosomes until a “stop” codon is read and the finished proteins are released into the cell.



Genetics: The scientific study of **heredity** is called **genetics**. **Heredity** is the study of how traits are passed from parent to **offspring**.

A **genotype** is what we call the genetic make-up of organism.

A person's **phenotype** is a **physical** description of their genotype.

For example: A genotype that reads BB for hair color probably means that a person's phenotype for hair color is black

An individual that has two **different** alleles for the same trait is said to be **heterozygous** (Bb).

An individual that has two **identical** alleles for one trait is said to be **homozygous** (bb or BB).

Mendel:

A scientist named Gregor Mendel used purebred **pea plants** in order to understand how traits are inherited. In his experiments, Mendel discovered that each trait is controlled by **one gene** that occurs in two **different** forms. These different forms are referred to as **alleles**.

Mendel's Theories:

Theory of Dominance: Mendel concluded that some alleles are dominant & some are **recessive**. When an organism inherits a dominant allele that trait is **visible** and the effects of a recessive allele cannot be seen. *Example: Brown eyes are usually dominant over blue eyes.*

This doesn't mean that a recessive allele just **disappears** only that it is masked by the dominant one, making it invisible.

Theory of Segregation: Mendel concluded that alleles separate when sex cells (egg & sperm) are formed. Each sex cell carries only one copy of each **gene**.

Law of Independent Assortment: Mendel found that genes that control one trait (like hair color) do not affect genes that control another trait (like hair texture). Each gene sorts **independent** of all others during the formation of **sex** cells.

Some alleles are neither dominant nor recessive, and many traits are controlled by multiple alleles or multiple genes. Here are some exceptions to Mendel's principles:

Incomplete dominance: Occurs when one allele is **not** completely dominant over another. *For example, a cross between a red-flowered plant and a white-flowered plant that results in pink-flowered offspring.*

Codominance: Occurs when **both** alleles contribute to a one's **physical** characteristics (phenotype). For example, in some species of chicken black feathers and white feathers are codominant, therefore chickens that have these genes display speckled black and white feathers

Monohybrid Crosses

- A cross that provides data about **one** set of traits. (mono = one, hybrid = cross)
- Each box is filled with two letters: one from the left side of the square and one from the top of the square; note that the dominant trait is always written first.
- The letters indicate the possible **genotypes** of the offspring.

❖ For example: A cross between homozygous dominant (TT) and homozygous recessive (tt) plant:

Tt x tt

	T	T
t	Tt	Tt
t	Tt	Tt

In this cross, all resulting offspring are heterozygous for the tall trait.

For example: A cross between two heterozygous plants (Tt x Tt).

Dihybrid Crosses

- A cross that involves **two** pairs of **contrasting** traits

(di = two, hybrid = cross).

- In these crosses, alleles must be independently sorted and then listed for the cross.
- For example: A cross between two heterozygous guinea pigs (SsBb x SsBb):

	T	t
T	TT	Tt
t	Tt	tt

In this cross, the resulting offspring ratio is 1:2:1 with one being homozygous dominant, two being heterozygous and one being homozygous recessive.

SsBb x SsBb

	SB	Sb	sB	sb
SB	SSBB	SSBb	SsBB	SsBb
Sb	SSBb	SSbb	SbBb	Ssbb
sB	SsBB	Ssbb	ssBB	ssBb
sb	SsBb	Ssbb	ssBb	ssbb

S = short
s = long
B = black
b =

The offspring that result from the cross of these two heterozygous guinea pigs have **four** different phenotypes:

9/16 = short, black hair 3/16 = short, black hair
3/16 = long, black hair 1/16 = long, brown hair

9:3:3:1 ratio

Specific biomolecules serve various functions in the body.

1. Study the statement above. Identify the molecule which contains the instructions used to create an organism's enzymes and proteins.

- a. nicotinamide adenine dinucleotide (NAD⁺)
- b. hemoglobin
- c. deoxyribonucleic acid (DNA)
- d. glucose

2. RNA molecules use instruction from DNA to assemble proteins. There are three types of RNA molecules: mRNA, rRNA and tRNA. What specific **function** does **mRNA** perform in the process of **making proteins**?

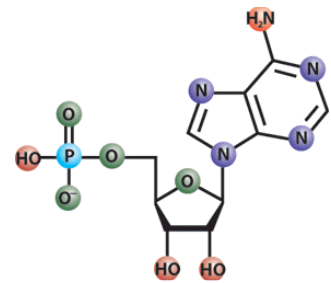
- a. It brings instructions from DNA in the cell nucleus to the cytoplasm.
- b. It clamps onto messenger RNA and uses its information to assemble amino acids.
- c. It transports amino acids to the ribosomes to be assembled into proteins.
- d. It creates another molecule of DNA through replication.

3. Which of the following **correctly** shows a **complementary base pair** of **nitrogenous bases** in a **DNA** molecule?

- a. adenine- guanine
- b. guanine- cytosine
- c. cytosine- adenine
- d. guanine- thymine

4. **DNA** is a polymer which is made up of subunits called **nucleotides**. Nucleotides have **three** basic parts. Which of these is **not** a nucleotide component?

- a. deoxyribose sugar
- b. phosphate group
- c. ribose sugar
- d. nitrogenous base



5. A nitrogenous base is an important component of the **nucleotide** making up DNA. Which of the following **correctly** lists the **four possible nitrogenous bases** in **DNA**?

- a. adenine, guanine, cytosine, uracil
- b. leucine, proline, tyrosine, phenylalanine
- c. glutamine, proline, tyrosine, phenylalanine
- d. adenine, guanine, cytosine, thymine

6. **Translation** is crucial to the **process of making proteins**. Which statement **best** describes what **takes place** during **translation**?

- a. An RNA copy of a DNA strand is made.
- b. Information in mRNA is converted into a sequence of amino acids in a protein.
- c. A copy of chromosomal DNA is created.
- d. Instructions from DNA in the nucleus are brought to the cytoplasm.

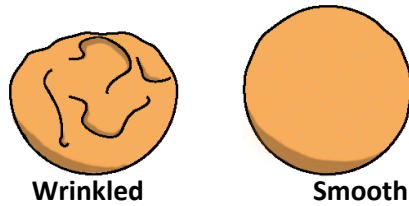
7. In order for DNA instructions to move from the nucleus to the ribosomes in the cytoplasm of a cell, an **RNA copy of a DNA strand must be made**. This **process**, which takes place in the **cell nucleus**, is called-

- a. translation
- b. DNA replication
- c. mutation
- d. transcription

8. John has **one recessive allele** for blue eyes (**b**) and **one dominant allele** for brown eyes (**B**). Amy also has **one recessive allele** for blue eyes and **one dominant allele** for brown eyes. What **phenotype** is an **offspring** of John and Amy **most likely** to express?

- a. Bb
- b. BB
- c. blue eyes
- d. brown eyes

Gregor Johann Mendel was an Austrian monk who is considered to be the father of genetics. In the 1850's Mendel began doing experiments on pea plants. In one experiment Mendel took one pea plant with smooth seeds and crossed it with another pea plant with wrinkled seeds. Then he looked at the offspring from this cross. He found that all of the offspring produced only smooth seeds. In his experiments, Mendel was careful to use only pure-breeding strains of peas.

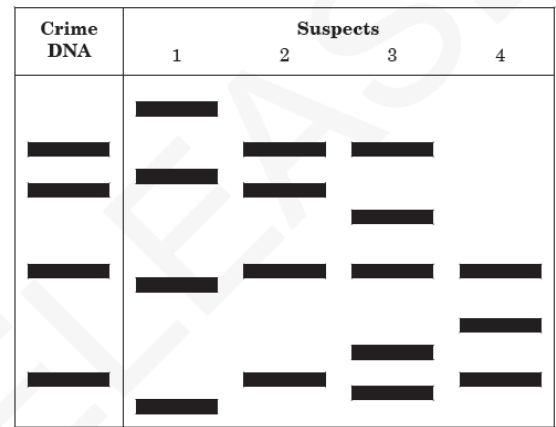


9. Refer to the information above. Which statement is **true** about **pure strains**?
- a. Pure-breeding strains arise from self-pollination.
 - b. Pure-breeding strains do not produce pollen.
 - c. Pure-breeding strains produce seed faster than non-pure plants.
 - d. Pure-breeding strains are easier to cross-pollinate.
10. Refer to the information above. Which statement is **true** about **pure strains**?
- a. Pure-breeding strains grow more quickly than regular plants.
 - b. Pure-breeding strains have traits that skip generations.
 - c. Pure-breeding strains allowed Mendel to uncover the law of genetics.
 - d. Pure-breeding strains are hybrids.
11. Refer to the information above. Why did the offspring of Mendel's cross **all have smooth seeds**?
- a. The wrinkled trait showed incomplete dominance.
 - b. The smooth trait was dominant.
 - c. The wrinkled trait was lost by spontaneous mutation.
 - d. The offspring did not contain the gene for the wrinkled trait.
12. Refer to the description above. After doing the initial cross with smooth and wrinkled peas, Mendel then took the **offspring (all smooth)** and **crossed them with each other**. If Mendel looked at **1000 seeds** in the next generation, approximately how **many seeds would you expect to show each trait**?
- a. 500 smooth seeds, 500 wrinkled seeds
 - b. 750 smooth seeds, 250 wrinkled seeds
 - c. 1000 smooth seeds, 0 wrinkled seeds
 - d. 1000 wrinkled seeds, 0 smooth seeds
13. Bill grows two varieties of corn in his garden. One variety produces large ears of corn and one makes small ears of corn. When Bill crosses the **two plants** the **resulting** ears of corn are **medium in size**. Which statement **best** explains **Bill's result**?
- a. The corn underwent a spontaneous mutation.
 - b. Ear size is a trait that shows incomplete dominance.
 - c. Ear size is controlled by the environment.
 - d. Ear size is not genetically controlled.
14. What process produces **many variations** in **phenotypes**?
- a. independent assortment
 - b. asexual reproduction
 - c. regeneration
 - d. cloning

15. This diagram represents samples of **DNA** that were cut with a restriction enzyme during DNA **fingerprinting** in a crime lab.

Which **technique** was used to produce these bands?

- cloning
- gel electrophoresis
- gene splicing
- genetic engineering



16. This chart represents amino acids that are coded from different combinations of mRNA codons.

Codons in mRNA									
First Base	Second Base								Third Base
	U		C		A		G		
	UUU	Phenylalanine	UCU	Serine	UAU	Tyrosine	UGU	Cysteine	U
U	UUC	Phenylalanine	UCC	Serine	UAC	Tyrosine	UGC	Cysteine	C
	UUA	Leucine	UCA	Serine	UAA	Stop	UGA	Stop	A
	UUG	Leucine	UCG	Serine	UAG	Stop	UGG	Tryptophan	G
	CUU	Leucine	CCU	Proline	CAU	Histidine	CGU	Arginine	U
C	CUC	Leucine	CCC	Proline	CAC	Histidine	CGC	Arginine	C
	CUA	Leucine	CCA	Proline	CAA	Glutamine	CGA	Arginine	A
	CUG	Leucine	CCG	Proline	CAG	Glutamine	CGG	Arginine	G
	AUU	Isoleucine	ACU	Threonine	AAU	Asparagine	AGU	Serine	U
A	AUC	Isoleucine	ACC	Threonine	AAC	Asparagine	AGC	Serine	C
	AUA	Isoleucine	ACA	Threonine	AAA	Lysine	AGA	Arginine	A
	AUG	Methionine or start	ACG	Threonine	AAG	Lysine	AGG	Arginine	G
	GUU	Valine	GCU	Alanine	GAU	Aspartic Acid	GGU	Glycine	U
G	GUC	Valine	GCC	Alanine	GAC	Aspartic Acid	GGC	Glycine	C
	GUA	Valine	GCA	Alanine	GAA	Glutamic Acid	GGA	Glycine	A
	GUG	Valine	GCG	Alanine	GAG	Glutamic Acid	GGG	Glycine	G

Which **amino acid sequence** can be coded from the **DNA sequence CAG TAG CGA**?

- Valine- Isoleucine- Glycine
- Valine- Aspartic Acid- Alanine
- Valine- Isoleucine- Alanine
- Valine- Phenylalanine- Alanine

(Hint: match the DNA sequence above with the following RNA sequence: GUC AUC GCU then use codon chart)

17. Refer to the Codon chart above. A strand of **DNA** with the sequence **AAC AAG CCC** undergoes a **mutation**, and the **first A is changed to a C**. How will this mutation affect the **amino acid sequence**?

- One amino acid will change.
- Two amino acids will change.
- All of the amino acids will change.
- The amino acids will remain the same.

18. **One** of the parents of a child has **phenylketonuria** (PKU), which is caused by recessive alleles. The **other parent does not** have the PKU alleles. What is the **chance** that the couple will have a **child** with phenylketonuria?

- a. 0% b. 50% c. 75% d. 100%

(Hint: both parents would have to be recessive for child to have PKU because it is caused by recessive alleles)

19. A scientist treats a cell with a chemical that **destroys the ribosomes**. As a result, which **cell process** will be **stopped**?

- a. osmosis b. photosynthesis c. protein synthesis d. respiration

20. **Hitchhiker's thumb** (H) is **dominant** to **no hitchhiker's thumb** (h). A woman who does not have **hitchhiker's thumb** marries a man who is **heterozygous** for hitchhiker's thumb. What is the **probable genotypic ratio** of their children?

- a. 0% Hh : 100% hh
b. 50% Hh : 50% hh
c. 75% Hh : 25% hh
d. 100% Hh : 0% hh

	h h	
H	Hh	Hh
h	hh	hh

21. A **sugar**, a **phosphate group**, and a **nitrogen base** form the building blocks of which **organic compound**?

- a. carbohydrates
b. lipids
c. nucleic acids
d. proteins

22. A genetic counselor is examining a **karyotype** from a patient when an **extra copy** of chromosome 13 is noticed. This condition is referred to as

- a. trisomy
b. diploidy
c. triploidy
d. monosomy

***Continue to the next page**

SURFIN' THROUGH STAAR

Session 4: Genetics & Heredity

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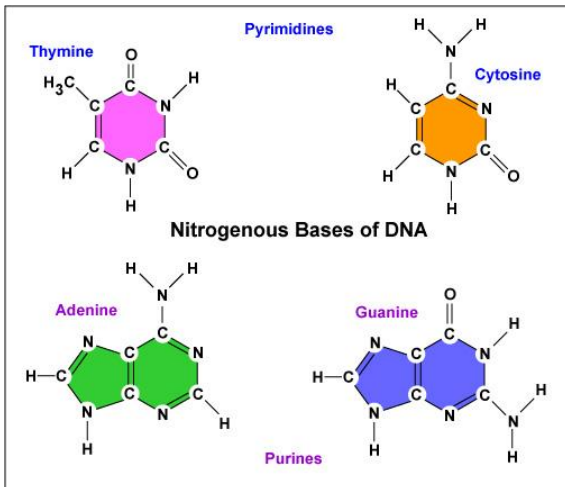
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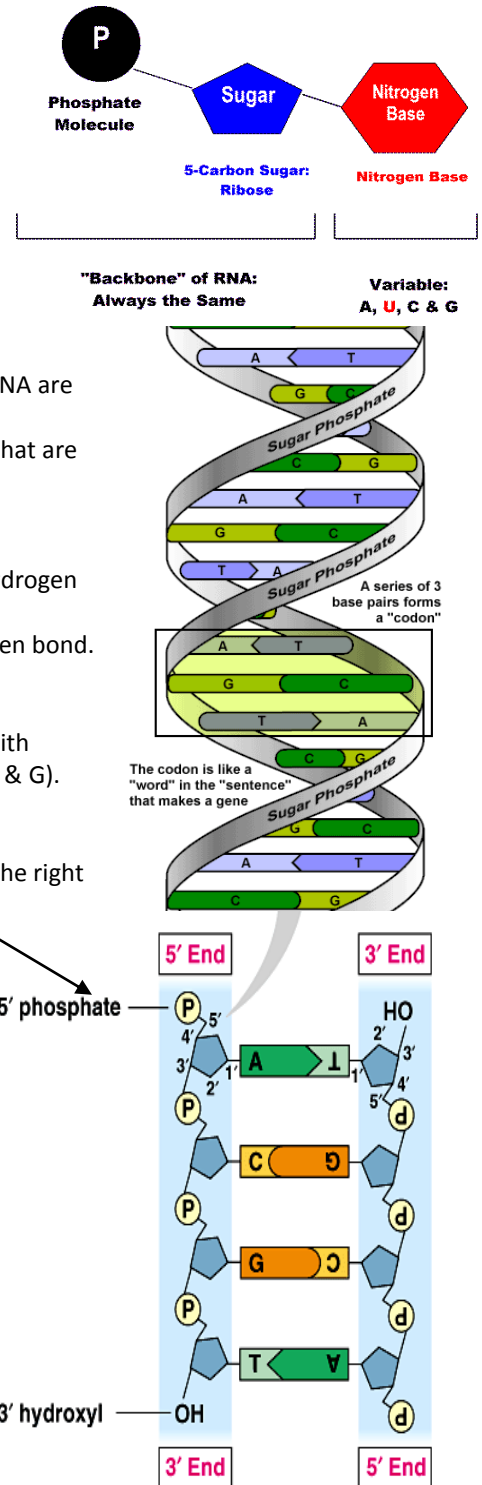
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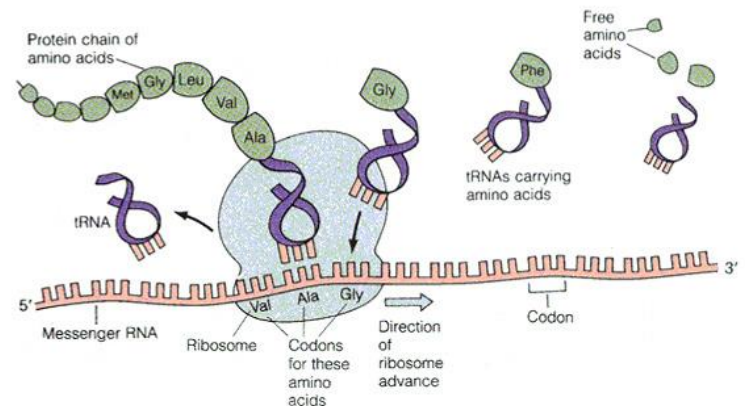
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T	TT	Tt
t	Tt	tt

In this cross, the resulting offspring ratio is 1:2:1 with one being homozygous dominant, two being heterozygous and one being homozygous recessive.

Dihybrid Crosses

- A cross that involves **two** pairs of **contrasting** traits

(di = two, hybrid = cross).

- In these crosses, alleles must be independently sorted and then listed for the cross.
- *For example: A cross between two heterozygous guinea pigs (SsBb x SsBb):*

SsBb x SsBb

	SB	Sb	sB	sb
SB	SSBB	SSBb	SsBB	SsBb
Sb	SSBb	SSbb	SsBb	Ssbb
sB	SsBB	Ssbb	ssBB	ssBb

S = short
s = long
B = black
b =

sb

SSBb	SSbb	ssBb	Ssbb
------	------	------	------

The offspring that result from the cross of these two heterozygous guinea pigs have **four** different phenotypes:

9/16 = short, black hair

3/16 = short, black hair

9:3:3:1 ratio

3/16 = long, black hair

1/16 = long, brown hair

1. This chart shows the results of several crosses with white-feathered chickens and dark-feathered chickens.

Cross	Parental Feather Colors	Offspring Feather Colors
1	White x White	100% White
2	White x White	75% White, 25% Dark
3	White x Dark	50% White, 50% Dark
4	Dark x Dark	100% Dark

Which cross would be represented as **Aa x aa**, where **(A)** represents a **dominant allele** and **(a)** represents a **recessive allele**?

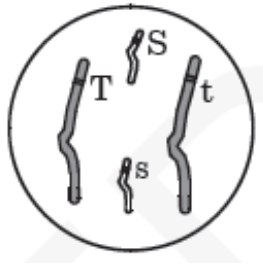
a. Cross 1

b. Cross 2

c. Cross 3

d. Cross 4

2. This diagram shows a diploid cell with two pairs of homologous chromosomes.



Due to **independent assortment**, what is the possible genetic make-up of **gametes** produced by this organism?

a. SsTt

b. SS, Tt

c. S, s, T, t

d. ST, St, sT, st

3. Which **genetic abnormality** can be identified through **karyotyping**?

a. point mutation

b. recessive allele

c. extra chromosome

d. sex-linked allele

4. During **DNA replication**, which of the following segments would be **complementary** to the original **DNA segment of CCTAAT**?

a. CGATTA

b. GGUTTU

c. GGATTA

d. GGAUUA

5. What type of **RNA** is responsible for **bringing amino acids to the ribosome** for **protein synthesis**?

a. messenger RNA

b. transfer RNA

c. ribosomal RNA

d. mitochondrial RNA

6. To determine the **molecular sequence of a gene for a protein**, which molecule should be analyzed?

- a. tRNA b. ATP c. DNA d. rRNA

7. If a portion of a **DNA** strand has the base sequence **TACGCA**, what will be the **base sequence of the mRNA** strand transcribed?

- a. TACGCA b. UACGCA c. AUGCGU d. ATGCGT

8. The chart to the right matches messenger RNA codons with amino acids.

Messenger RNA Codons

glycine	leucine	alanine	serine
GGU, GGC, GGA, GGG	UUA, UUG, CUU, CUC, CUA, CUG	GCU, GCC, GCA, GCG	UCU, UCC, UCA, UCG, AGC, AGU

A **DNA strand** has the codon **TCA**. According to the chart, the **corresponding messenger RNA** codes for which of the following **amino acids**?

- a. glycine
b. leucine
c. alanine
d. serine

9. In a genetics laboratory, **two heterozygous tall plants are crossed**. If **tall is dominant over short**, what are the expected **phenotypic** results?

- a. 100% tall
b. 75% tall, 25% short
c. 50% tall, 50% short
d. 25% tall, 75% short

	T	t	
T	TT	Tt	Tt- tall
t	Tt	tt	tt- short

10. When viewing a **karyotype** to **detect genetic disorders**, which of the following would be a **concern**?

- a. different chromosomes of different lengths
b. two X chromosomes
c. twenty-three pairs of chromosomes
d. three chromosomes in any one set

11. **Color blindness** is a **sex-linked recessive** trait. A mother with **normal color vision** and a **color blind father** have a **color blind daughter**. Which of the following statements is **correct**?

- a. All of their daughters will be color blind.
b. The mother is a carrier of the color blindness gene.
c. All of their sons will have normal color vision.
d. All of their sons will be color blind.

	X ^b	Y
X ^B	X ^B X ^b	X ^B Y
X ^b	X ^b X ^b	X ^b Y

(Hint: Daughter is color blind so she must be X^bX^b as color blindness is a **sex-linked recessive** trait. That means she gets one X from mom and one from dad. Dad is color blind so his only X is X^b- all he can pass on to his daughters is the infected X with color blindness. If daughter is X^bX^b as she is color blind, one infected X came from dad, other must have come from mom. Mom has normal vision so she can't be X^bX^b, therefore she is heter X^BX^b.)

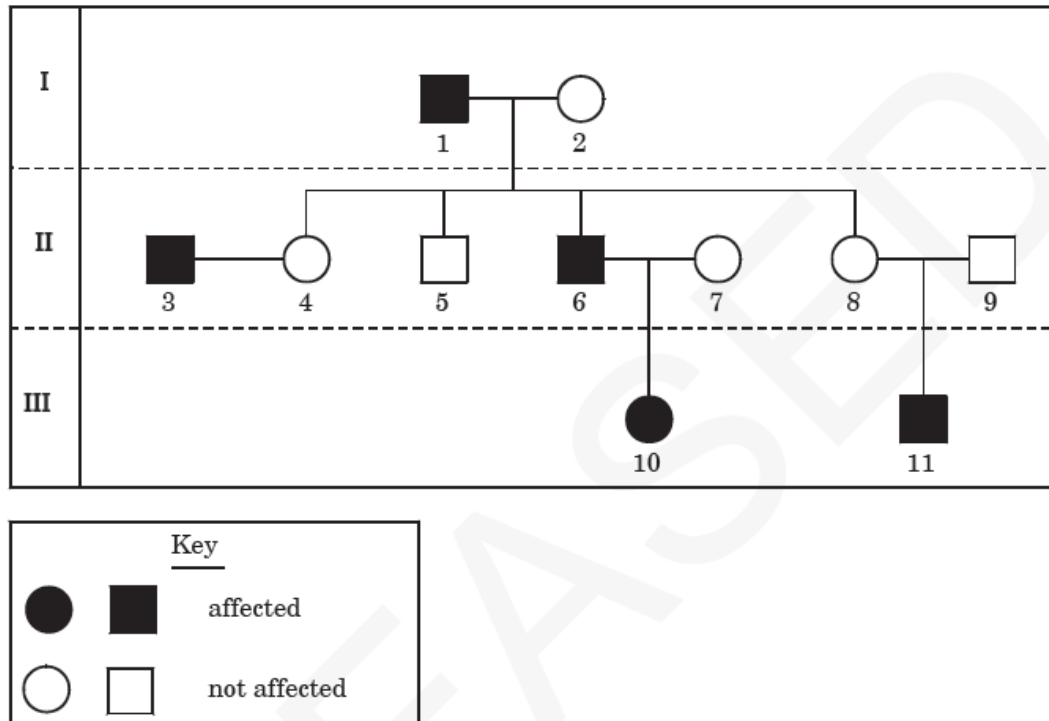
12. After performing **amniocentesis**, which analysis is most often used to determine the **chromosomal condition** of a developing fetus?

- a. blood type
b. DNA sequence
c. genetic marker
d. karyotype

13. **Albinism** is a **genetic mutation** that results in some animals being born **without the enzyme** that produces the pigment for skin and eye color. Which of the following best explains this **mutation**?

- The DNA failed to replicate.
- The deoxyribose sugar became separated from the DNA.
- The genetic code change caused the wrong protein to form.
- The RNA necessary to produce proteins was not present.

14. This diagram shows a pedigree for a **recessive genetic disorder**.



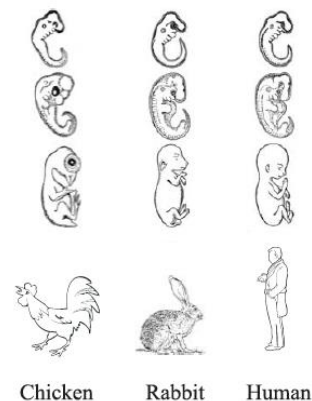
What is the **genotype** of individual 6?

- $X^H X^H$
- $X^H X^h$
- $X^H Y$
- $X^h Y$

15. The figure to the right shows **embryonic stages** of **three different kinds** of organisms.

What does the figure suggest about these organisms?

- They underwent similar mutations.
- They share the same acquired traits.
- They originated in the same location.
- They show similar embryonic development.



16. How do the **functions** of DNA and RNA **differ**?

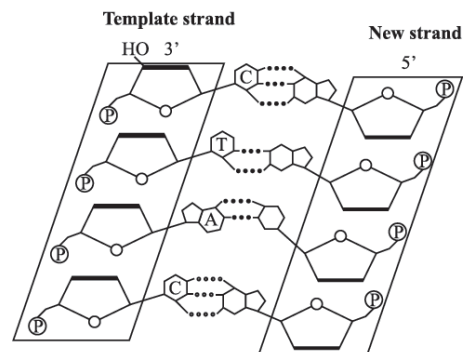
- DNA directs protein transport, while RNA aids in energy production.
- DNA aids in energy production, while RNA directs protein transport.
- DNA stores genetic information, while RNA relays genetic information for protein synthesis.
- DNA relays genetic information for protein synthesis, while RNA stores genetic information.

17. One way in which a **point mutation** and a **deletion mutation** are **different** is that
- a point mutation is always harmful, and a deletion mutation is never harmful
 - a point mutation is a physical change, and a deletion mutation is a chemical change
 - a point mutation always results in a frameshift mutation, while a deletion mutation never results in a frameshift mutation
 - a point mutation only results in a change in a single nucleotide base, while a deletion mutation can result in a change in multiple nucleotide bases

18. The illustration below shows a step in **DNA replication**.

Starting at the **top**, which list shows the **identity of the bases** of the **new strand**?

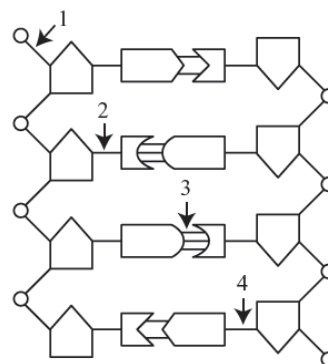
- A, G, T, A
- G, A, T, G
- G, A, U, G
- A, G, U, A



19. The graphic below represents a segment of DNA.

Which **bond must be broken** if DNA replication is to occur?

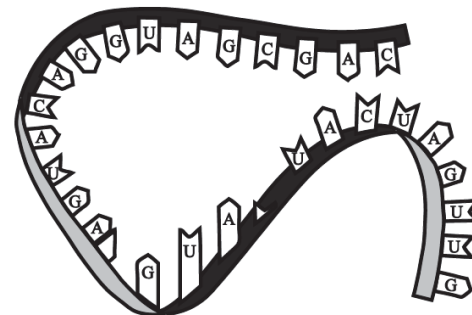
- 1
- 2
- 3
- 4



20. The figure to the right shows genetic material.

What information confirms that this is an **RNA** molecule?

- The molecule contains adenine.
- The molecule is single-stranded.
- The molecule has hydrogen bonds.
- The molecule has a sugar-phosphate backbone.



21. The figure to the right shows an **RNA** molecule found within the cell.

What does the **letter U** represent in this nucleotide?

- ribose sugar
- nitrogen base
- phosphate group
- deoxyribose sugar



22. What is the **role of hydrogen bonds** in the structure of **DNA**?

- to code for proteins
- to synthesize proteins
- to separate the strands
- to connect the base pairs

Leap Frog Plants, Animals/Systems & Ecology

Background Information:

Are **plants** multicellular or unicellular? multicellular Prokaryotic or eukaryotic? Eukaryotic

List the **plant divisions** (phyla) in order from simple to complex?

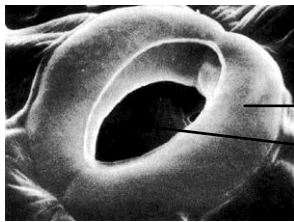
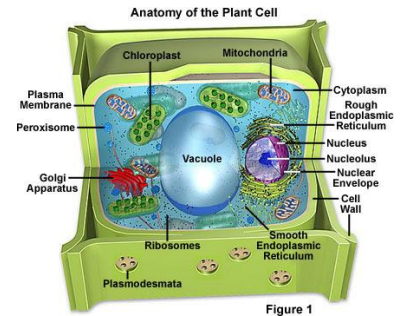
- Bryophytes (simplest)
- Seedless Vascular Plants
- Gymnosperms
- Angiosperms (most complex)

How are the 2 classes of **angiosperms distinguished**? by their number of seed leaves (cotyledons)

Tissues that are vessels in terrestrial plants (plants on land) are called? Vascular tissues

Which vascular tissue transports **water**? Xylem **Food**? Phloem

Which process in plants requires the energy in sunlight? photosynthesis



- Identify the structure labeled A. guard cells
- What is the function of A? open/close stoma
- Identify the structure labeled B. stoma
- What is the function of B? CO₂ in/O₂ out and regulates water

How does **xylem** also support the plant? It has thick cell wa

How can you tell the **age of a tree**? Tree rings

What else can be explained by this feature? Disasters, fire, amount of rainfall

What is the **protective covering** of a seed? seed coat-keeps from drying out

What parts make up a **seed**? What is the seed for?

Parts of the seed: endosperm (food supply), embryo, seed coat (keeps from drying out)

Function: reproduction/germination

How have seeds become **adapted** to be "spread" for germination?

wings for wind pollination, sticky to attach to animals, in fruit for animal dispersion

What are **functions of a fruit** (purposes)? dispersal of seeds, seed protection, and source of food; not for pollination

Which part of the plant (specifically) **absorbs water**? Root hairs

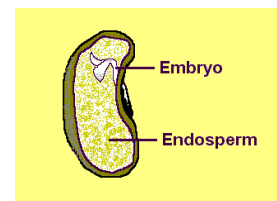
When plants respond to a stimulus, this is a **tropism**. Name the type of tropism when plants respond to **sunlight**?

phototropism **Gravity**? gravitropism – pulls roots downward

Carnivorous plants (like a venus fly-trap) live in areas with poor soil. Which specific **nutrient** is obtained

when the insect is digested? nitrogen

Photoperiodism is a response to plants flowering to periods of light and dark. Give an example of a **short-day plant** (plants that need fewer hours of light to bloom). Poinsettia



Give an example of a **long-day plant** (plants that need more hours of light to bloom)- Spinach, Summer time flowers- sunflower, daisy, etc. Plants are classified by short/long day... not night!

A drug in tobacco that might be a **natural insecticide** protecting the tobacco plants is what? nicotine

Why do cacti have **leaves that are shrunk** in size? reduce the amount of water loss

Why do cacti have **extensive shallow root systems**? to soak up rainfall (water) quickly

A stem **swells** and stores water. How is this a helpful **adaptation**?

Able to survive long, dry periods of time

Can we live **without** plants? No! Without plants we wouldn't be here!

The diagram to the right is called a **cladogram**.

Which type of plant is the **common ancestor** to **all** of the plants on the figure to the right?

Green algae

Did vascular tissue or seeds evolve **first** on the figure to the right? vascular tissue

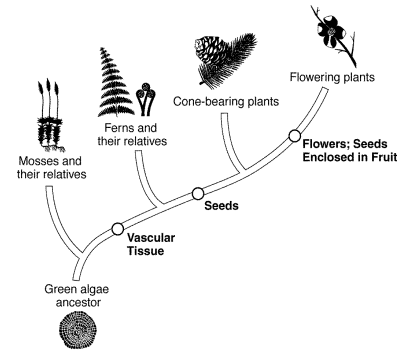
Some **seeds have wings**? Why is this a helpful **adaptation**? The wings allow them to be carried in the wind for dispersion.

Why do flowers have **brightly colored petals**? to attract pollinators such as insects or small animals

How many **seed leaves** do **monocots** have? 1 seed leaf (cotyledon) **Dicots**? 2 seed leaves (cotyledons)

Describe the **veins** in **monocots**. parallel veins

Describe the **veins** in **dicots**. branching or net-like veins



Biological Processes & Systems:

If white blood cells attack any of your body cells, what type of **disease** (category) would that be? Autoimmune disease

Which system is involved with the **removal of urea** from cells **creating urine**? Excretory system

Which system is involved with **making feces**? Digestive system

Why does **oxygen** from the lungs move into the bloodstream? (biological process) **concentration gradient**- moves from high to low concentration without energy- ex: urea absorption

Which organ **releases hormones** to control **glucose levels** in the blood? What is the hormone released? Pancreas- releases insulin

What effect does **adrenaline** (hormone) have on your body? When is it released? "fight-or-flight"- **Increases heart rate**, increases blood

vessel dilation, increasing breathing rate

What is the **autonomic nervous system**? What are some functions it controls? Works automatically (autonomic)- functions: body temperature (ex: shiver in cold), blood sugar level

Which **system** is involved when you experience an "**allergy attack**"? sneeze, itchy, watery eyes-immune system

How do fish "**hear**"? they have lateral lines How do fish **control the depth they swim**? They have a swim bladder

During respiration, which **gas is taken into our body**? O₂ Which **gas is removed & exhaled**? CO₂

During digestion, what is the main function of the **small intestine**? Digestion and absorption of food

During digestion, what is the main function of the **large intestine**? Removes water and makes feces

What type of cell **carries impulses to and from the brain and spinal cord**? Neurons

What are **voluntary** muscles? Give an example. You can control them: skeletal (striated= striped) ex: whistling a song

What are **involuntary** muscles? Give an example. Work by themselves: your heart, stomach, smooth muscles (intestines)

What causes the disease, **diabetes**? Blood sugar levels are too high, can't control them

What do **arteries** do? Carry oxygenated blood **away** from the heart

What do **veins** do? Carry deoxygenated blood **to** the heart

What do **capillaries** do? Smallest vessels- deliver oxygen and nutrients to individual cells

What is the function for **red blood cells**? Why is the red-blood cell its shape (like a donut)? Carry oxygen- shape: allows them to hold maximum amount of oxygen

Why are **cells different shapes** (or appear different)? Their shape is related to their function

What is the function of the **air sacs** (alveoli) in the lungs? Pick up oxygen from lungs and carry to capillaries

What are the functions of **white blood cells**? Defense, fight pathogens, part of immune system

Which **organ removes metabolic wastes from the blood**? Your kidneys

List the **sensory organs**. Eyes, ears, tongue, skin and nose

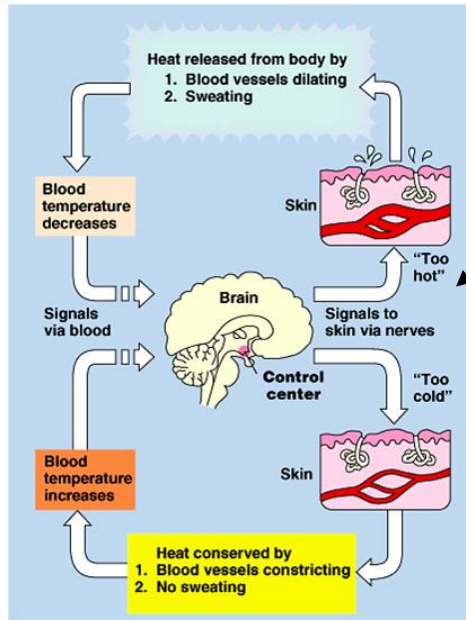
What triggers the "**flight-or-fight**" response? Release of hormones and the activation of the sympathetic nervous system

Motor neurons look similar in appearance in all animals; do they perform similar **functions** in all animals? They do perform similar functions in different animals!

Do **all of our systems** work together? Or independently? All of our systems work together! Negative feedback is a mechanism of how our bodies maintain homeostasis when conditions are out of a "normal range". Body temperature, blood sugar levels, pH, and production of urea from cell metabolic activities are examples.

If the body stopped producing new Beta cells, what would the expected outcome be?

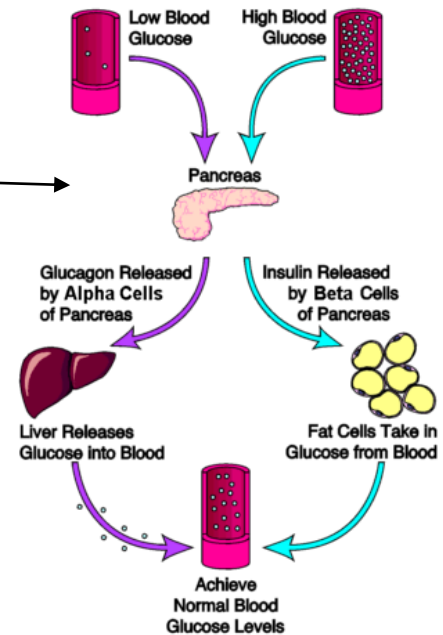
- The pancreas would no longer release glucagon
- High blood glucose levels would continue to become normal
- Insulin would no longer be released**
- Alpha cells would become beta cells



(b) Control of body temperature

You have just ran a marathon (26.2 miles) and your body is trying to reach homeostasis. Which of the following statements is true?

- Your blood vessels will constrict to conserve heat
- Your blood vessels will dilate to release body heat**
- Your body's control center will shut down
- Your brain will tell your body no to sweat



Ecology:

List some **limiting factors** that would affect a **plant** (such as a corn plant) population. Light, carbon dioxide concentration, temperature, nutrients in soil, water

List some **limiting factors** that affect an animal such as a **field mouse**. Food source, oxygen, temperature, mates available, predators preying on mice

Which organisms need **nitrogen**? What is **nitrogen** needed for? **ALL** organisms need N_2 , it is used for making proteins and other biomolecules

How can **nitrogen** be **returned to soil**? What is this **process** called? Bacteria convert N_2 in air to Nitrate (NO_3^-) for plants; called nitrogen fixation- a **major role**; N_2 can also be returned to soil from urine, feces and chemical fertilizers.

What is **mutualism**? List an example of this symbiotic relationship.

Mutualism – a relationship in which two organisms interact and **both benefit**. Example: a flower and a butterfly – flowers provide food, butterfly pollinates the flower

What is **parasitism**? List an example of this symbiotic relationship.

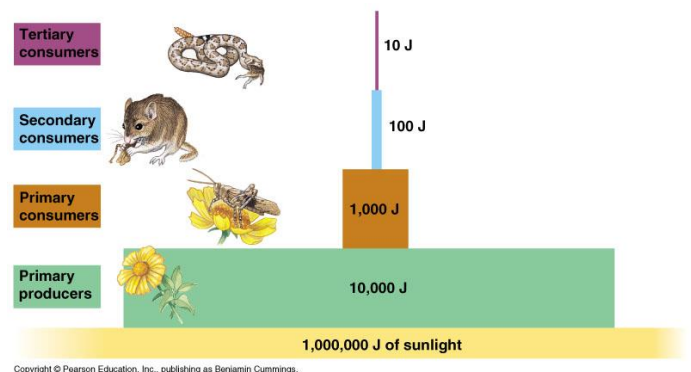
Parasitism – when one organism lives on or in another and obtains part or all of its nutritional needs from its host. Example: Ticks feed on animals, can transmit disease to host.

What is **commensalism**? List an example of this symbiotic relationship.

Commensalism – a relationship in which one species benefits and one is not helped or harmed. Example: Cattle egrets (birds) are found in fields where cows/horses move through grass feeding, making insects move up out of the grass, and the egret then eats insects- benefits. No benefit or harm for cows.

How can **grass** (a ground cover) **protect soil**? The roots on grass spread out and hold the topsoil in place.

What happens to the **total energy available** from one **trophic level** to the next? Why? The energy level **decreases** from one trophic level to the next. The organism in the lower trophic level uses some of the energy it received (for metabolic activities) and releases



the rest as heat. (*Remember that is why there are **many more** organisms at the lowest level- producer, fewer at the primary consumer (herbivore) and much less at the secondary consumer (carnivore).

How are animal populations affected by **volcanic activity**? What type of **succession** is shown by volcanic activity? How do you know?

Animals move out or are killed during volcano so the populations decrease.

Volcanoes are an example of primary succession; the lava flows form rock.

Over time, the rock will be broken into soil, then plant and animal life returns.

What type of **succession follows a forest fire**? What is a **benefit** to forests after a fire? Forest fires are an example of secondary

succession (soil remains- not rock). Plants (trees) are burned, which return nutrients to the soil. Some pine trees only have their cones open and release their seeds after the high heat a forest fire.

What happens to the **animal population after a forest fire**? After a forest fire, the animal population decreases immediately. Animals move out of the area or are "caught" in the fire.

After **damage to an ecosystem** (fire, volcanoes, floods, etc); how does the **damaged ecosystem begin restoration**? After fire – pine trees release their seeds into the "newly amended" soil and forest begin to grow again. After volcanoes, lichens grow on the rock, breaking down into soils, then plants grow.

If a lake is covered by an overgrowth of algae, what could be the effects on the **living organism (biotic factors)**? What could be

effects on the **abiotic** (nonliving factors)? **Biotic factors**: that result due to an overgrowth of algae (which is a producer) is that there would be an increase of herbivorous fish, then more carnivorous fish. **Abiotic factors**: affected are there would be an increase of oxygen (more photosynthesis), and the water temperature would decrease due the inability of light penetrating the surface of the water (to warm it).

In a **food web** or an **ecological pyramid**, which organism is on the **first level**? **Producers** (photoautotroph or chemoautotroph) are always on the first level. It is at the bottom of a pyramid (largest base) so that it can support the rest of the food web.

In a **food web**, at which **level are carnivores** found? **Carnivores** are found on the secondary consumer (3rd trophic level), tertiary or quaternary consumer (4th/5th trophic level). In the food web, carnivores only consume other heterotrophs. * Remember carnivores are the predator, so there are fewer of them. There has to be more prey to sustain their population. The populations of both are "kept in check".

In a **food web**, **organisms that feed on other organisms** are called? Heterotrophs or consumers

Detritovores which **feed on dead animals**, such as a vulture, can also be called a? Scavenger

Organisms that **use energy** (from light or chemical compounds) are called? Autotrophs or producers

How have plants that **live in poor soil** conditions managed to be **successful**? The soil in these areas produces thick growth due to the rapid rate of nutrient recycling from dead tree logs, leaves, etc. The rate of decomposition partly accelerated to the warm, wet areas. With the **increasing** number of humans, what affect does this have on the **natural resources**? As the human population increases, the natural resources available decreases.

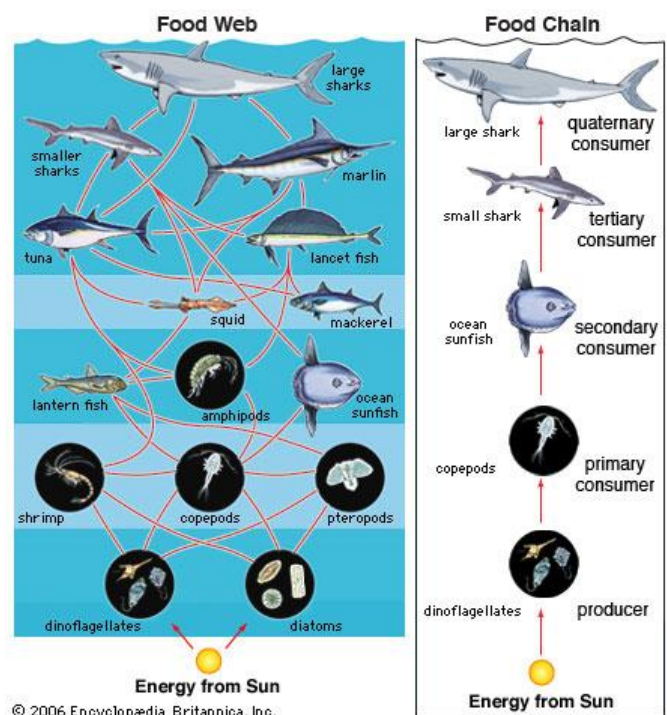
What is a **predator**? List an example. Why are predators **important** in a food web? Predators are animals that eat other animals.

Examples include wolves and hawks. One function of a predator is that they maintain the number of prey (which for the most part are herbivores). If the predator moves out or dies, the prey population increases, eating the plant population.

What is a **prey**? List an example. Why are prey **important** in a food web? Prey are animals that tend to be herbivores. Examples are mice and deer. Prey provide food, which is a source of energy for predators.

What is the role of **fungi** (such as mushrooms, bracket fungi) & lichens (algae & fungus) to an ecosystem?

Fungi and lichens are decomposers. They break down complex compounds into smaller ones that can be absorbed by other organisms.



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What specifically do **lichens** that live on rocks do for an ecosystem?
Lichens play a very important role – they break down rocks into soil, so that plants and other organisms can move into the ecosystem.

Practice Questions:

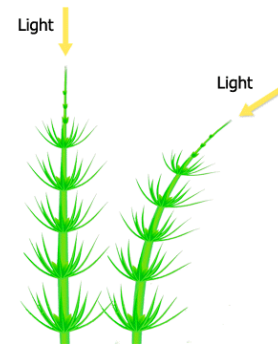
1. Celia steps off the sidewalk without looking into the street, and narrowly misses being hit by a car. Her heart beats faster, her breathing becomes more rapid, her skin gets cold and clammy, and she begins to tremble. Which of the following triggers this fight-or-flight response in Celia?

Examples of Physical Fight-or-Flight Responses
Muscles tense
Blood pressure increases
Digestion slows or stops entirely
Breathing and heart rates increase
Pupils dilate

- a. the shutdown of the active transport system which moves ions into and out of the cells
- b. the failure of neurons to conduct impulses quickly enough
- c. the release of hormones and the activation of the sympathetic nervous system
- d. fluid movement in the cochlea resulting in bending of hair cells

2. Plants grow and position their roots, stems, and leaves in response to a variety of environmental stimuli. These responses are called tropisms. Which of these refers to the growth response of a plant towards light?

- a. gravitropism
- b. thigmotropism
- c. nastic movement
- d. phototropism



Nitrogen (N) is used and reused by various organisms and processes as it cycles through the environment.

3. Study the statement above. Which of the following statements about the nitrogen cycle is **false**?

- a. Plants use nitrogen to make proteins and other molecules.
- b. Nitrogen-fixing bacteria play a minor role in the nitrogen cycle.
- c. Urine from animals returns nitrogen to the soil.
- d. Decomposers release nitrogen compounds into the soil.

Forest fires change ecosystems in many ways. Some changes are immediately apparent, while others are not.

4. Refer to the information above. How are **animal populations** affected by **fires**?

- a. Animal populations increase immediately after a fire.
- b. Animal populations decrease immediately after a fire.
- c. Animal populations are not affected by forest fires.
- d. Animal populations show a dramatic increase, then decrease immediately after a fire.

Lava flowing from an erupting volcano destroys everything in its path. New land is formed, but it is barren, supporting no organisms.



5. Refer to the information above. How are **animal populations** affected by **volcanic activity**?

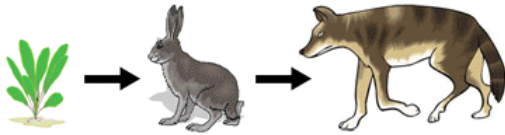
- a. Animal populations decrease after volcanic activity, but reestablish over time.
- b. Animals never return to an area affect by volcanic activity.
- c. Animal populations are not affected by volcanic activity.
- d. Animal populations are only slightly affected by volcanic activity.

Organisms within food webs are interdependent and often compete for resources.

6. Read the statement given above. Organisms that use **light energy stored in chemical compounds** to make energy-rich compounds are known as-

- a. heterotrophs
- b. autotrophs
- c. scavengers
- d. decomposers

7. The coyote feeds on jackrabbits, which feed on plants.

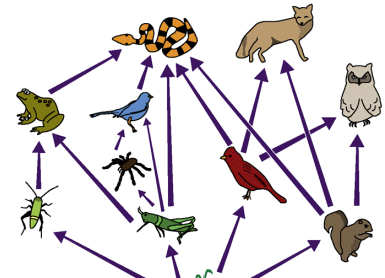


Which of these best describes the **jackrabbit** in this desert community food web?

- a. The jackrabbit is an autotroph.
- b. The jackrabbit is a producer.
- c. The jackrabbit is prey for the coyote.
- d. The jackrabbit is a carnivore.

8. The diagram below shows a food web made up of a variety of organisms involved in different feeding relationships. Which term best describes the **role of crickets in the food web** shown?

- a. Crickets are predators of frogs.
- b. Crickets are prey for spiders and snakes.
- c. Crickets are a second-order consumer of spiders.
- d. Crickets are producers of energy.



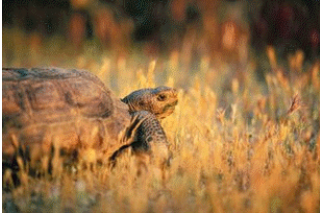
9. The pods from honey mesquite trees are a food source for beetles.

Which of these **best** describes the honey mesquite trees in this desert community food web?

- a. The honey mesquite tree is an omnivore.
- b. The honey mesquite tree is a predator of beetles.
- c. The honey mesquite tree is a consumer.
- d. The honey mesquite tree is a producer.



10. The desert tortoise feeds on prickly pear cactus and other plants.

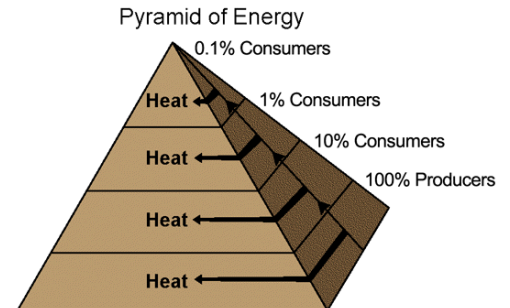


Which of these best describes the **desert tortoise** in this desert community food web?

- a. The desert tortoise is an herbivore.
- b. The desert tortoise is a producer.
- c. The desert tortoise is a predator.
- d. The desert tortoise is a carnivore.

11. The diagram shows a pyramid of energy, with producers at the bottom and higher order consumers occupying successively higher levels. As energy is transferred from producers to first-order, second-order, and higher-order consumers, a large amount of energy is converted to thermal energy and given off as heat. Which statement is **true**?

- a. More useful energy is available to higher-order consumers than to first-order consumers.
- b. The amount of useful energy is no different at different levels of the pyramid.
- c. The amount of useful energy increases at each successively higher level in the pyramid.
- d. Less useful energy is available to higher-order consumers than to first-order consumers.



12. The prickly-pear cactus shown in the figure above has a **leaf adaptation** that

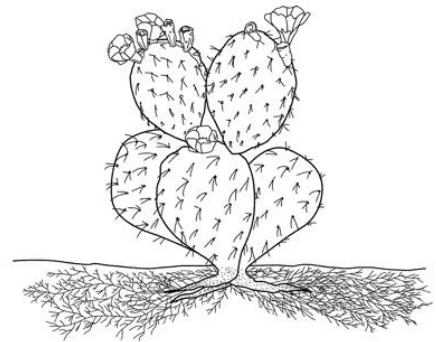
- a. pumps out salt
- b. reduces water loss
- c. produces thick, green stems
- d. produces seeds when it rains

13. How is the cactus in the figure above **adapted to soak up rare rainfall quickly**?

- a. It has thin, sharp spines.
- b. It has stems that shrivel when it rains.
- c. It has wide stems that catch rainwater.
- d. It has an extensive shallow root system.

14. How is the cactus in the figure above **adapted** to survive **long dry** periods?

- a. Its stems swell and store water.
- b. It leaves drop off when it gets dry.
- c. Its root system holds water for later use.
- d. It remains dormant when there is no rain.



15. The crab *Lybia tessellate* carries a pair of sea anemones on its claws. The crab uses the sea anemone's stinging tentacles as protection and the sea anemone obtains small food particles released by the crab as it feeds. Which type of symbiotic relationship does this **best** illustrate?

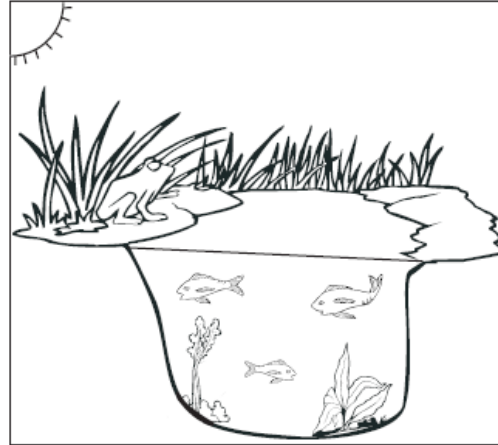
- a. commensalism
- b. mutualism
- c. parasitism
- d. predation

16. What is the main **difference** between **primary succession** and **secondary succession**?

- a. Primary succession happens slowly, and secondary succession happens rapidly.
- b. Small plants grow first during primary succession, while large trees grow first during secondary succession.
- c. Primary succession occurs after a natural disaster, and secondary succession occurs before a natural disaster.
- d. Primary succession is the colonization of new sites, and secondary succession is colonization of previously inhabited sites.

17. An example of a **biotic factor** in the ecosystem shown to the right is

- a. the Sun
- b. the soil
- c. the water
- d. the plants



18. The **symbiotic relationship** between a **tick and the dog it is biting** is called

- a. predation
- b. parasitism
- c. mutualism
- d. commensalism

19. A **person sweating** on a hot day would most likely be an example of what biological process?

- a. digestion
- b. respiration
- c. homeostasis
- d. gametogenesis

20. Why do **leaves** tend to be **flat**?

- a. so that water can easily be absorbed and carried to the rest of the plant
- b. so that sunlight can easily penetrate to the leaf's photosynthetic tissues
- c. so that nutrients can easily enter the plant and be used for structure and support.
- d. so that plants can easily find balance due to the symmetrical nature of their branches

21. Which figure shows an organism with **radial symmetry**?

a.



b.



c.



d.



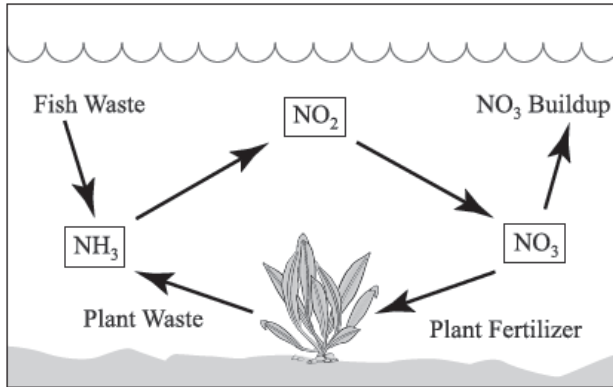
22. Moss often grows on trees. The tree is not affected, while the moss has the nutrients it needs to grow. What type of **symbiotic relationship** is this?

- a. predatory
- b. parasitism
- c. mutualism
- d. commensalism

23. Which **best** describes the interaction between **autotrophs** and **heterotrophs**?

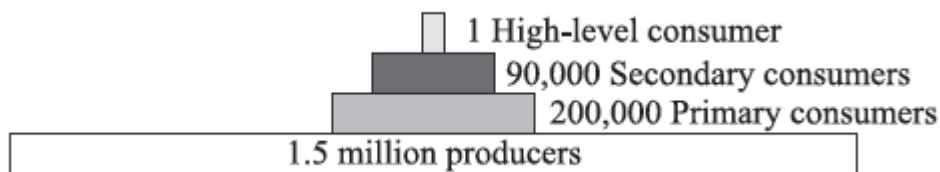
- a. One competes with the other for access to sunlight and soil.
- b. One decomposes the other to release nutrients back into the soil.
- c. One helps produce the other in a mutually beneficial relationship.
- d. One consumes the other to use energy that originally came from the sun.

24. The diagram to the below of an aquatic ecosystem represents what elemental cycle on Earth?



- a. water
- b. carbon
- c. nitrogen
- d. phosphorus

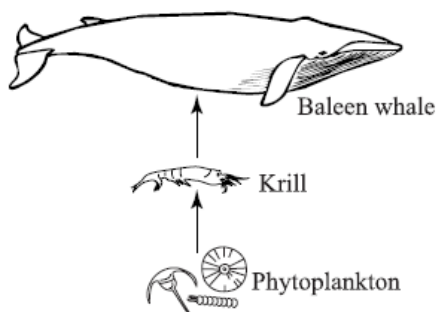
25. The figure below shows the number of plants and animals necessary to support life of one high-level consumer in a temperate grassland biome.



The figure represents the **flow of energy** through-

- a. different trophic levels in most ecosystems
- b. soil, plants, and animals during the nitrogen cycle
- c. different organisms within a single level of most food webs
- d. the atmosphere, land, and bodies of water during the water cycle

26. Which organism in the aquatic food web to the right **gets energy directly from the Sun**?



- a. krill
- b. baleen whale
- c. phytoplankton
- d. both krill and the baleen whale

27. Which **two systems** work together to make sure that **oxygen reaches the blood stream** and **carbon dioxide is removed** from the bloodstream?

- a. digestive and circulatory
- b. circulatory and excretory
- c. respiratory and circulatory
- d. respiratory and endocrine

Evolution, Classification & Microorganisms

Background Information:

Theory- a well-supported testable explanation of phenomena that have occurred in the natural world

Evolution- change over time; modern organisms have descended from ancient organisms.

Darwin's Theory of Evolution: An adaptation is a trait that helps an organism be more suited to its environment

Darwin decided adaptations develop over time

Natural selection- organisms with traits well suited to their environment survive and reproduce at a greater rate than less well-adapted organisms in the same environment

Long-term survival of any species of organisms is possible only if the organisms can reproduce successfully

Organisms most fit to reproduce are selected by environment which results in adaptation of the population

Fitness- ability of an individual to survive and reproduce in its environment

Natural selection is also called "survival of the fittest"

Conditions for natural selection include:

- A. Genetic variations exist among members of a population
- B. Many more individuals are produced each generation than will

survive

- C. Some individuals are better adapted so they survive and reproduce
- D. Members of a population compete for food, space, mates etc.

Common Descent- All species- living and extinct- were derived from common ancestors;

Darwin called this "Descent with modification"

Anatomical Evidence of Evolution: Organisms have anatomical similarities when they are closely related because of common descent

1. **Homologous Structures**- in different organisms are inherited from a common ancestor have similar structures (but different function)

EX: vertebrate forelimbs contain the same sets of bones organized in similar ways, despite their dissimilar functions

2. **Analogous Structures**- are inherited from different ancestors and have come to resemble each other because they serve a similar function

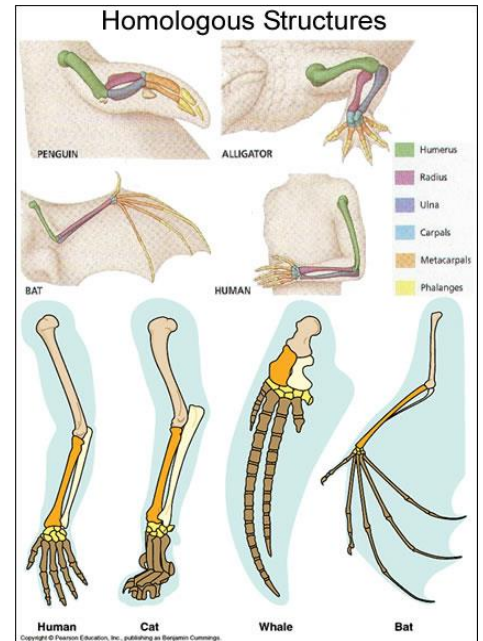
EX: Bat wings vs. butterfly wings- both for flight but they are structurally different

3. **Vestigial Structures**- are remains of a structure that have reduced in size because they no longer serve an important function

EX: Humans have a tailbone but no tail

EX: Hip/leg bones in pythons and whales, appendix in humans

4. **Similarities in embryology**- the early stages of embryo development in vertebrates show many similarities.



Patterns of Evolution:

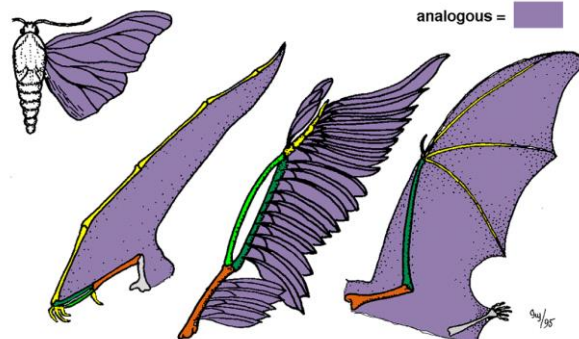
1. **Adaptive Radiation**: A single species or small group of species has evolved, through natural selection and other processes, into diverse forms that live in different ways

2. **Convergent Evolution**: Unrelated organisms come to resemble one another; Start out with different "raw material" for natural selections; Face similar environmental demands; Natural selection molds similar traits

3. **Coevolution**- two species evolve in response to changes in each other over time; Organisms closely connected to one another by ecological interactions evolve together; EX: Flowers and pollinators

Endosymbiosis: Most biologists think that mitochondria and chloroplasts were once prokaryotes that formed a partnership with another cell; They contain their own DNA and ribosomes and they reproduce independently of the cells they are in

Analogous Structures:



Taxonomy: The science of naming and classifying organisms is called **taxonomy**.

History of Taxonomy: Aristotle (384-322 B.C.) developed the first widely accepted classification system; He grouped plants and animals into basic categories according to their structural similarities

Binomial Nomenclature: created by Linnaeus: two-word naming system- genus (first word) and species (second word)

Levels of Classification: We have eight levels of classification today. **D.K.P.C.O.F.G.S.**

Domain	Dear
Kingdom	King
Phylum	Phillip
Class	Came
Order	Over
Family	For
Genus	Great
Species	Spaghetti

Evolutionary History:

Classification based on similarities often reflects an organism's phylogeny (evolutionary history).

Similarities that arise due to convergent evolution are called analogous characters

Cladistics is a method of analysis that reconstructs phylogenies by inferring relationships based on shared characters.

There are two types of characters that are used in cladistics

Ancestral Characters - evolved in a common ancestor of both groups

Derived Characters - evolved in an ancestor of one group, but not the other

Biologists use branching diagrams called cladograms to group organisms as well as to separate them.

The Three Domains

1. **Bacteria:** Contains a single Kingdom (Eubacteria)
2. **Archaea:** Contains a single Kingdom (Archaeobacteria)
3. **Eukarya:** Contains 4 diverse Kingdoms (Protista, Fungi, Plantae, and Animalia)

The 4 Ways Organisms are put into a Domain

1. Cell Type: Prokaryotic cells or Eukaryotic cells
2. Cell Walls: Absent or Present
3. Body Type: Unicellular or Multicellular bodies
4. Nutrition: Autotrophic or Heterotrophic

The Six Kingdoms:

1. Eubacteria

Cell Wall: Eubacteria have cell walls containing peptidoglycan

Gene Translation Apparatus: Their DNA polymerase and ribosomal protein are different than Archaeobacteria and Eukaryotes
They can be harmful pathogens useful soil, intestinal, or food bacteria; or even producers!

2. Archaeobacteria

Cell Wall and Cell Membrane: Cell Walls do not contain peptidoglycan and their lipids are very different from eubacteria and eukaryotes.

Gene Structure and Translation: Their gene structure and translation process are similar to eukaryotes.

Kinds of Archaeobacteria

Methanogens - Live deep within the mud & are poisoned by oxygen... they make methane gas as a waste product.

Extremophiles - Live in extreme environments

Thermophiles - live in very hot places

Halophiles - live in very salty lakes

Domain Eukarya (contains 4 kingdoms)

Highly organized cell interior: The organelles and nucleus allow for specialized function within each cell

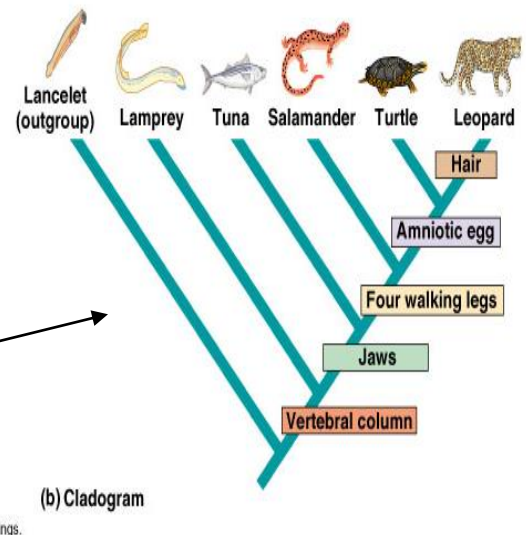
Multicellularity: Not all eukaryotes are multicellular, however, all eukaryotic kingdoms have at least a few multicellular members

Sexual Reproduction: Although genetic exchange happens in bacteria, eukaryotes undergo meiosis & more regulated sexual reproduction

3. **Protista:** "Animal-like" and "Plant-like" organisms most are unicellular BUT a few are multicellular (like kelp); Some make their own food, others do not; They have individuals with similarities to many of the other kingdoms

4. **Fungi:** Cells walls made with chitin; Most are multicellular BUT some are unicellular; ALL Heterotrophic; Examples: Yeasts & mushrooms

5. **Plantae:** Cell walls made with cellulose; ALL are multicellular; ALL are heterotrophic; Nonvascular plants like mosses all the



way to daisies and oak trees!

6. Animalia: NO CELL WALLS EVER; ALL multicellular, ALL heterotrophic; from rotifers & earthworms to people

Microorganisms:

Bacteria: ALL PROKARYOTES- do NOT have a nucleus

Two kingdoms: Eubacteria and Archaeobacteria

How they are identified: shape, chemical nature of their cell walls, how they move, and how they obtain energy

Shapes: **bacilli**- rod shaped bacteria; **cocci**- spherical (round) and **spirilla**- spiral or corkscrew shaped

Importance of Bacteria- bacteria are vital to maintaining the living world

Some bacteria are producers; produce food through photosynthesis (1st link in food chains)

Others are decomposers; they break down nutrients in dead matter and recycle

Nitrogen fixation – bacteria convert nitrogen gas in air to a form plants can use.

Bacteria live in root nodules in legume plants (beans)

Human Uses of Bacteria- our bodies are covered in bacteria, some harmful, many are not

E. Coli bacteria in our intestines produce vitamins that our body cannot make. Example of a symbiotic relationship.

Use bacteria for making food – cheese and yogurt

Archaeobacteria are used for purifying water (sewage, oil spills)

Bacterial Diseases in Humans:

Bacteria produce disease in 2 ways:

Damage cells & tissues Ex: strep throat, tuberculosis, bubonic plague

Produce toxins Ex: salmonella, botulism

Preventing Bacterial Diseases:

Vaccine - weakened form of bacteria that stimulate the immune system to produce antibodies against the disease.

Antibiotics - compounds that stop bacterial growth. Antibiotics work only on BACTERIAL diseases.

Viruses: particles of nucleic acid (DNA or RNA), proteins, and in some cases, lipids; NOT made of cells; cannot live independently outside of a host, all they do is replicate; a typical virus is composed of a core of DNA or RNA surrounded by a protein coat

Structure: capsid- a virus's protein coat that helps virus enter host cell

Bacteriophage- virus that infects a bacterium

Lytic Cycle Viral Infection- viral replication cycle in which a virus takes over a host cell's genetic material and uses the host cell's structures and energy to replicate until the host cell bursts, killing it

Lysogenic Cycle Viral Infection- viral replication cycle in which a virus's nucleic acid is integrated into a host cell's chromosome; the host cell is not killed until the lytic cycle is activated

Retroviruses: Contain RNA as their nucleic acid (genetic information), instead of DNA

Called retroviruses because genetic information is copied backwards, from RNA to DNA

Reverse transcriptase- enzyme carried in the capsid of a retrovirus that helps produce viral DNA from viral RNA

The DNA is then integrated into the host cell's chromosome

Examples include: HIV, some cancers, hepatitis are caused by retroviruses

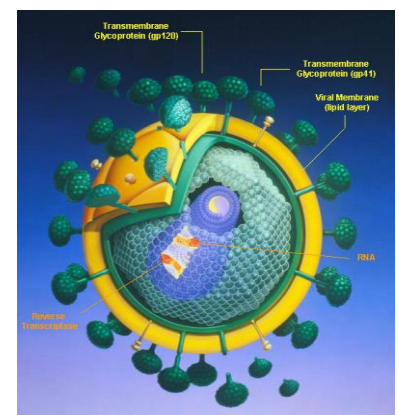
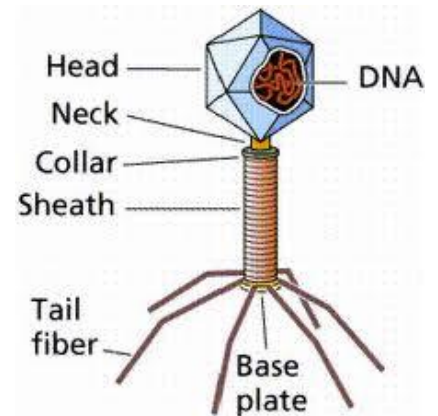
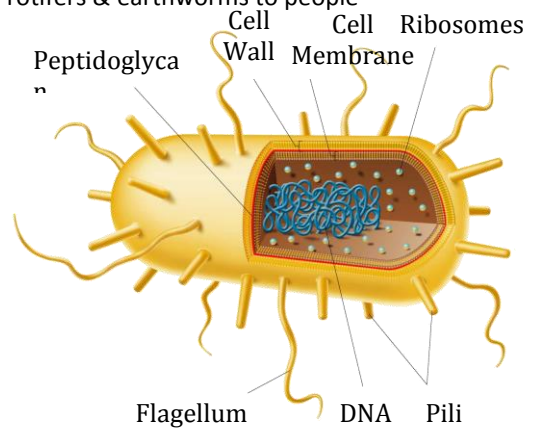
HIV Virus: Infects helper T cells in the immune system.

HIV can incubate for years, then it will be activated.

AIDS = acquired immunodeficiency syndrome, infected persons cannot fight off other diseases.

Prions: are proteins that cause infections; no nucleic acid to carry genetic info

Viroids are single-stranded RNA molecules that have no capsid (protein coat)



Practice Questions:

1. Structural adaptations help organisms survive in various environments. Which of these is **not** an example of a **structural adaptation**?

- a. The harmless syrphid fly resembles the yellow jacket in coloring and body shape.
- b. The leaf frog's coloring and shape make camouflage on the forest floor possible.
- c. Mole-rats have large teeth and claws which help them dig tunnels and escape predators.
- d. A lizard finds a shady spot to escape the sun's heat.

2. Penicillin is widely used to kill bacteria which cause disease. However, this drug **does not affect as many species of bacteria today** as it did when it was first discovered. Which statement describing this situation is **false**?

- a. Thousands of years were required for bacteria to become resistant to penicillin.
- b. The ability of bacteria to resist penicillin varies within a population.
- c. Bacteria which are resistant to penicillin will survive exposure to the drug.
- d. Bacteria which are resistant to penicillin will produce penicillin-resistant offspring.

3. Which of the following statements about **mutations** is **false**?

- a. Environmental factors including radiation and chemicals can cause mutations to occur.
- b. Enzymes in cells can fix mutations by replacing incorrect nucleotides with correct ones.
- c. All mutations are harmful to both the organism and the species to which it belongs.
- d. Cancer is one result of DNA mutation.

4. Within a fish species, variations exist in color, size, and the speed at which individuals can swim. Which variation would be least likely to be passed on to future generations of the species?

- a. swimming speed which is less than that of predators
- b. color of markings which aid camouflage
- c. size which enables hiding among small rocks and in rock crevices
- d. reproduction by laying extremely large numbers of eggs



5. A bear produces two offspring. One of the cubs is smaller than normal and has difficulty digesting food. Which statement comparing the two cubs is **false**?

- a. The larger bear cub is more likely to survive to reproductive age.
- b. The smaller bear cub is less likely to pass its genes on to another generation.
- c. The larger bear is better adapted for survival in its environment.
- d. Both bear cubs are equally likely to pass their genes on to the next generation.

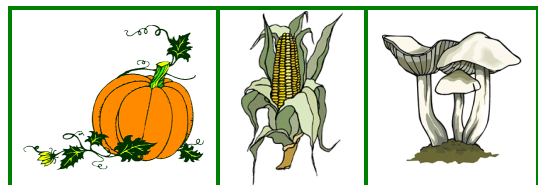


6. Which of these statements about **natural selection** is **true**?

- a. Organisms which survive to reproduce can pass favorable variations on to offspring.
- b. Natural selection works on individuals, rather than a population of organisms.
- c. All organisms within a species are genetically identical.
- d. Offspring can inherit traits of an organism which that organism develops during its life.

7. What is one reason that **pumpkins** are **more closely** related to **corn plants** than to edible mushrooms?

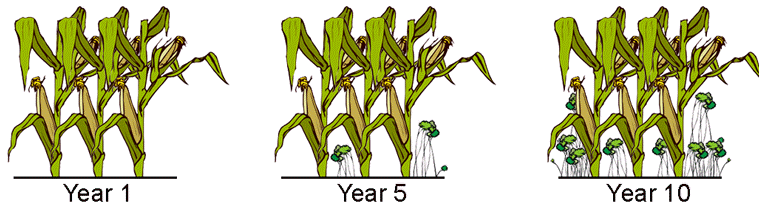
- a. Pumpkins and corn grow more slowly than mushrooms.
- b. Pumpkins and corn need less moisture than mushrooms.
- c. Pumpkins and corn taste different than mushrooms.
- d. Pumpkins and corn both make their own food.



8. Living organisms are classified into kingdoms based on their structure and shared characteristics. In what kingdom would a scientist classify an organism that is made up of **eukaryotic cells**, is **multicellular**, and is a **consumer**?

- a. Protista
- b. Archaea
- c. Plantae
- d. Animalia

9. Heidi Takashi is a farmer who grows corn. About 10 years ago, Ms. Takashi began spraying her fields with **herbicide**, a chemical that kills plants, to kill weeds in the corn field. For a few years the herbicide killed nearly all of the weeds in Ms. Takashi's corn field. One year, Ms. Takashi noticed that some weeds were growing even after being sprayed with herbicide. The next year, even more weeds were still alive after herbicide-spraying. Based on what you know about how organisms adapt to their environment, what is the **most likely reason** to explain the results of Ms. Takashi's use of herbicide?



- The weeds underwent a mutation which led to a resistance to herbicide.
- The weeds were new species of weeds.
- The herbicide was still effective on Ms. Takashi's weeds.
- The herbicide underwent a chemical change.

10. At one time, scientists believed all organisms belonged to either the plant kingdom or the animal kingdom. Today some scientists classify organisms into one of six kingdoms: plant, animal, fungus, protist, eubacteria, and archaeobacteria. Which of these **characteristics** helps **determine the kingdom** to which an organism belongs?

Kingdoms of Living Things	
Kingdom	Number of Cells
Archaeobacteria	Single-celled
Eubacteria	Single-celled
Protista	Single-celled and multi-celled
Plantae	Single-celled and multi-celled
Fungi	Multi-celled
Animalia	Multi-celled

- where the organism lives
- the size of the organism
- whether the organism can photosynthesize
- whether the organism has a cell membrane

11. Which kind of evidence led scientists to suspect that **species** may **change over time**?

- fossils of marine organisms that were found buried in the sides of mountains
- a recent theory stating that new organisms can only come from older organisms
- experiments in which plants were crossbred to produce offspring with traits from each parent
- sequential layers of fossils that have the remains of the most modern-looking organisms in the top layers

12. What is a **dichotomous key**?

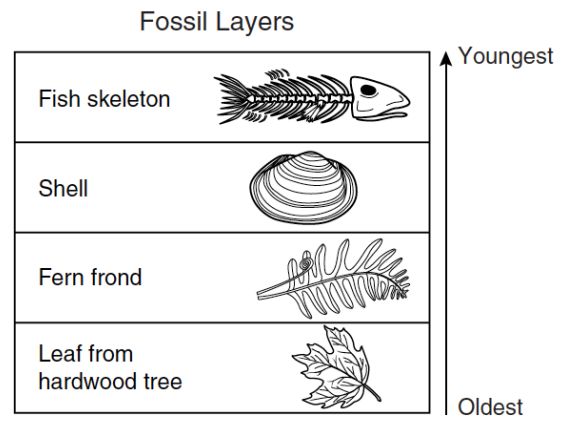
- A tool that allows a scientist to categorize organisms that only have two legs
- A tool use to identify species by giving a series of choices that lead to the name
- A chart that helps classify organisms using DNA samples and electrophoresis
- A chart with pictures of organisms that help to categorize them by height and width

13. *Durio grandiflorus* is a plant species that produces edible fruits. Which of these **species MOST likely produces similar fruits**?

- Rosa gallica*
- Durio dulcis*
- Rosa grandiflora*
- Magnolia grandiflora*

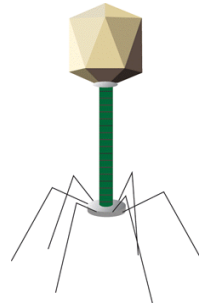
14. During a severe drought a dry lake was explored for fossils. The diagram below represents the fossils uncovered and the layers they were in. According to this information, this area was once a—

- a. forest that was replaced by a freshwater lake
- b. freshwater lake that was replaced by a desert
- c. saltwater sea that was replaced by a forest
- d. freshwater lake that was replaced by a forest



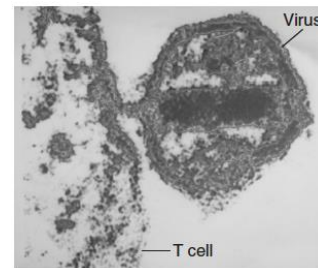
15. Many scientists classify viruses as non-living things. Which of these best describes why a virus might be classified as non-living?

- a. It has no genetic material of its own.
- b. It reproduces only when it is inside a cell.
- c. It can take control of a cell and change its normal activities.
- d. Its effects on an organism are always harmful.



16. The photograph to the right shows a virus attacking a human T cell (immune cell). Which disease could result if many **T cells are destroyed** in this manner?

- a. AIDS
- b. Tuberculosis
- c. Chicken pox
- d. Multiple sclerosis



17. A virus has been approved for use as a food additive because it attacks and kills bacteria harmful to humans. The **virus kills the bacteria** by doing which of the following?

- a. ingesting the bacteria
- b. injecting its own genetic material into the bacteria**
- c. absorbing the oxygen that the bacteria need for respiration
- d. producing toxins that prevent the bacteria from reproducing

18. **Viruses** that contain **RNA** as their genetic information are

- a. prophages
- b. bacteriophages
- d. retroviruses**
- d. capsids

19. If a flu virus infects a person, which of the following will **MOST** likely occur inside the person?

- a. Deformed bone and skin cells will appear
- b. The pH of the bloodstream will change slightly
- c. The number of viruses will increase dramatically
- d. Body cells will temporarily stop undergoing mitosis

20. How does a **virus** differ from a **cell**?

- a. Viruses are much larger than the largest cells
- b. A virus cannot copy itself unless it is inside a living cell
- c. Cells make people sick, but viruses heal them
- d. A virus can make copies of itself before invading a body

21. How does using **killed or weakened bacteria** in an **immunization** help the body prevent infections?

- a. Antibodies are formed that fight those types of bacteria
- b. The body develops a fever that kills beneficial bacteria
- c. Bacterial reproductive cycles are disrupted
- d. Bacteria-fighting viruses are activated

22. What is the basic structure of a **virus**?

- a. DNA or RNA surrounded by a protein coat
- b. a capsid surrounded by a protein coat
- c. a tail sheath surrounded by tail fibers
- d. a tiny cell surrounded by a cell wall

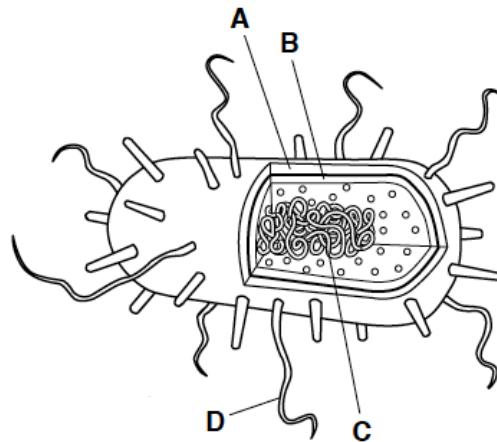
Refer to the figure to the right to answers 23 and 24.

23. The structure labeled **C** in the figure above is—

- a. DNA
- b. an organelle
- c. the nucleus
- d. a high-energy sugar

24. The structure labeled **D** in the figure above is—

- a. DNA
- b. pilus
- c. flagella
- d. cilia



25. Some **antibiotics** cause patients to exhibit digestive side effects. These side effects are most often the result of—

- a. bacteria being killed in the digestive tract
- b. the antibiotics being converted into stomach acids
- c. too much water being drawn into the digestive tract
- d. the stomach wall being torn