Biology SOL Review Packet

I. Scientific Investigation:
   A. Steps to the Scientific Method

1. **Make observations/Do research:** to determine what problem you want to address
2. **Develop a Research Question:** what specifically do you want to determine?
3. **Develop a hypothesis:** based on research from a variety of sources
   a. **scientific journals:** are the best place to locate *current* findings on the newest technologies
   b. **encyclopedias:** are a good place to find information on extinct species or historical theories
   c. **state/local agencies:** can help with local policies or local research (example: can help research the effects of pesticides on the squirrel population)
4. **Conduct a Controlled Experiment:** testing the hypothesis and collecting data and observations
5. **Interpret and Analyze Data:** using tables and graphs
6. **Draw Conclusions:** including improvements for future experiments
7. **Communicate Results:** so others can build on the experiment

**B. Terms:** Word Bank: experiment, variables, hypothesis, constants, control, independent variable, dependent variable

1. **Hypothesis** - is an educated guess/prediction; usually in “IF...THEN” form.
2. **Variables** - are the factors that are measured in an experiment.
3. **Independent Variable** - is the variable that you purposely change...variable “I” change.
4. **Dependent Variable** - is the variable that changes as a result of changing the IV.
5. **Control** - is the baseline measurement that you compare your data to.
6. **Constants** - the thing(s) that are purposely kept the same in the experiment.
7. **Experiment** - is a structured way to test a hypothesis.
C. Scientific Tools - Identify the tool used for each of the following tasks: Word Bank: beaker, graduated cylinder, balance, light microscope, electron microscope

1. Balance - used for measuring mass
2. Electron Microscope - used for examining extremely small specimens
3. Light Microscope - used for examining small specimens, was used to discover cells
4. Graduated Cylinder - used for measuring precise volumes of liquids
5. Beaker - less accurate tool for measuring volume

D. Microscope – Fill in the names of the parts of the microscope. Word bank: objective lens, ocular lens, diaphragm, fine focus, course focus, stage, barrel, base, stage clips, lamp, arm, revolving nosepiece

Total Magnification
Ocular Lens x
Objective Lens

Example:
Ocular – 10x
Objective – 100x
Total = 10 x 100 = 1,000

1. Course Focus - used to make BIG changes in focus
2. Diaphragm - adjusts the amount of light
3. Objective Lens - changes the magnification
4. Stage Clip - holds down the slide
5. Ocular Lens - what you look through

6. Draw a picture demonstrating how to properly put on a coverslip to avoid bubbles.
II. Characteristics of Living Things

A. List the 7 Themes of Biology: Word Bank: cells, metabolism, homeostasis, reproduce, heredity, evolution, interdependence

1. **Cells** - smallest unit of all life
2. **Metabolism** - get and use energy in order to carry out life functions
3. **Interdependence** - organisms rely on each other to survive
4. **Reproduce** - either asexually or sexually

5. **Homeostasis** - maintain a constant internal environment, e.g. body temperature
6. **Heredity** - pass on traits to offspring
7. **Evolution** - populations of organisms change over time

B. Biological terms in order from smallest to largest

Cell → tissue → organ → organ system → organism → population → species → community → ecosystem → biosphere

1. **Cell** - the smallest unit of life
2. **Tissue** - a group of cells that carry out a similar function
3. **Organ** - a group of tissues that carry out a specialized function in the body
4. **Organ System** - a group of organs that work together to perform body functions
5. **Organism** - a single living thing
6. **Population** - a group of organisms of the same species that live in the same area and can interbreed
7. **Species** - a group of organisms that look similar and can produce fertile offspring
8. **Community** - a group of different species that live in the same habitat and interact with one another
9. **Ecosystem** - a community of organisms and their non-living environment
10. **Biosphere** - all of the world and its atmosphere that support life
III. Life at the Molecular Level

A. Inorganic Compounds—(Typically DO NOT contain carbon)

1. Water: Word Bank: hydrogen bonding, floats, acids, body temperature, capillary action, water, polar, 7, 4, 14, 0. cohesion, solvent, adhesion, bases, high heat capacity, homeostasis, surface tension)

a. Water molecules have an unevenly distributed charge, this means that the molecule is ____________.

b. **Hydrogen bonding** is the attraction between the positive end of one water molecule and the negative end of another water molecule.

c. Many of the unique properties of water are caused by hydrogen bonding

   ~ **Capillary action** ____________ is the movement of water up thin tubes, due to **cohesion** ____________ which means that water molecules ‘stick’ to each other and **adhesion** ____________ which means that water molecules can ‘stick’ to other substances.

   ~ The property that helps bugs stand on water is called **surface tension** ____________.

   ~ Water expands when it freezes which makes ice ____________.

   ~ Water has a **high heat capacity** ____________, which means it takes a lot of energy to raise or lower its temperature. This is important because it helps organisms maintain **homeostasis** ____________ by keeping a constant **body temperature** ____________.

d. Because water is a polar molecule, it is called the universal ____________ which means that it can dissolve many substances.

e. Cells are mostly ____________, therefore much of your entire body is made of water.

   ~ **The pH scale** is from 0-14. **Acids** ____________ range 0-6. **Bases** ____________ range 8-14. A neutral solution has a pH of ____________.

2. The Water Cycle: Fill in the blanks with letters from the diagram.

   a. water falls to the ground in the form of **precipitation** (letter ____________)

   b. it percolates through the soil to make **ground water** (letter ____________)

![Diagram of the water cycle](image)
c. water that doesn’t go into the ground is called run off (letter E)
d. water is taken into plants through the roots by capillary action
e. transpiration is the process of releasing water vapor into the atmosphere from plant leaves. (letter F)
f. evaporation puts water from oceans and lakes into the atmosphere. (letter A)
g. water in the atmosphere forms droplets in clouds by condensation. (letter G)

3. The Carbon Dioxide/Oxygen Cycle: Word Bank: heterotrophs, CO2, water, O2, glucose, chloroplasts, mitochondria, photosynthesis, chemical, respiration, autotrophs, solar

   a. Autotrophs use organelles called chloroplasts in their leaves to collect solar energy.
   b. Photosynthesis occurs so plants can make glucose to use for energy
   c. photosynthesis converts solar energy into chemical energy.
   d. photosynthesis uses CO2, water and solar energy to form glucose & O2.

   e. animals can not make their own food therefore they are called heterotrophs.
   f. all organisms use organelles called mitochondria to perform a process called respiration which breaks down food molecules to produce ATP for energy.
   g. respiration uses O2 and glucose to produce water and CO2 (i.e. ATP!)
   h. the gas made by respiration is CO2; the gas taken in by photosynthesis is CO2.
   i. the gas taken in by respiration is O2; the gas produced by photosynthesis is O2.
B. Organic Compounds: There are 4 (number) different organic compounds. All organic molecules contain carbon and are necessary for life!!!

1. Carbohydrates Word Bank: monosaccharides, built, glucose, broken down

   a. Carbohydrates are built to store energy in plants and are broken down to be used as cellular energy to accomplish the characteristics of life.
   
   b. Monosaccharides are the building blocks of carbohydrates, example glucose

2. Lipids Word Bank: fat, cuticle, oil, store, wax, insulate

   a. lipids are organic compounds that include include fat, oil, and wax.

   b. lipids are used to store energy in animals

   c. leaves have a protective lipid layer called the cuticle that prevents water loss.

   d. lipids like those in whale blubber and human fat help insulate organisms, protecting them and keeping them warm

3. Proteins: Word Bank: unchanged, amino acids, active sites, peptide, enzymes, speed up, substrate

   a. Proteins are made up of amino acids joined together by peptide bonds.

   b. Enzymes are a special group of proteins that speed up reactions.

   c. Enzymes have active sites with specific shapes that allow them to interact with only one type of substrate.

   d. Enzymes are unchanged during reactions.

   e. Circle the substrates. Box in the enzyme AFTER the reaction. Draw a Triangle around the products.

   ![Enzyme-substrate complex diagram]
4. **Nucleic Acids:** *Word Bank:* adenine, cytosine, guanine, thymine, hydrogen bond, uracil, replication, sugar, ribose, Watson & Crick, nucleotides, Rosalind Franklin, double helix, genetic, deoxyribose, phosphate, DNA, RNA, nitrogen base

a. The two types of nucleic acids are **DNA** and **RNA**.

b. The building block of a nucleic acid is a **nucleotide**, which is made of a **sugar**, a **phosphate**, and a **nitrogen base**.

c. **DNA** is common to all living things and it stores genetic information.

d. In DNA, **adenine** bonds with **thymine** and **guanine** bonds with **cytosine**.

e. The nitrogen bases are held together by **hydrogen bond**.

f. The shape of a DNA molecule is a **double helix**, discovered by **Watson & Crick**.

g. **Rosalind Franklin** took X-ray photographs of DNA that helped determine DNA's structure.

h. **Replication** is a process that makes an exact copy of DNA.

i. The sugar in DNA is **deoxyribose**, but the sugar in RNA is **ribose**.

j. In DNA, adenine bonds with **thymine**, but in RNA it bonds with **uracil**.

k. **RNA** is single stranded, and **DNA** is double stranded.

l. **DNA** is copied by **RNA** which becomes the pattern for making proteins.

m. **Genetic** engineering involves inserting foreign DNA into host DNA to make recombinant DNA.
IV. Life at the Cellular Level

A. The Parts of the Cell Theory

1. Cells are the basic unit of structure and function of life.
2. All living things are composed of cells.
3. All cells come from pre-existing cells.

B. Development of the Cell Theory Word Bank: Hooke, Leeuwenhoek, Schleiden, Schwann, Virchow

1. Leeuwenhoek - first to observe living microorganisms through a microscope
2. Hooke - observed cork and named cells
3. Schleiden - studied plant cells
4. Schwann - studied animal cells
5. Virchow - concluded that all cells come from pre-existing cells

C. Types of Cells Word Bank: prokaryotes, eukaryotes, both

1. Eukaryotes - have a nucleus
2. Eukaryotes - have organelles
3. Prokaryotes - includes the kingdom Eubacteria and Archaebacteria
4. Prokaryotes - do not have organelles (mini-organs)
5. Eukaryotes - includes Protists, Fungi, Plants, and Animals
6. Both - have DNA, (HINT: ALL kingdoms have this in common)
7. Eukaryotes - go through mitosis
8. Prokaryotes - go through binary fission
9. Both - have ribosomes to synthesize (make) proteins

![Cell Diagram](image)
D. Cellular Organelles: Word Bank: nucleus, mitochondria, vacuole, ribosomes, golgi
body or apparatus, endoplasmic reticulum, nucleolus, centriole, cell wall, cytoplasm, chloroplast, lysosomes, cell membrane

1. **Nucleus** - command center of the cell; DNA in the form of chromosomes is here
2. **Nucleolus** - small organelle in the nucleus that makes ribosomes
3. **Ribosomes** - the site of protein synthesis in prokaryotes and eukaryotes
4. **Endoplasmic Reticulum** - transport system of the cell
5. **Golgi** - collects, packages, and distributes proteins
6. **Vacuole** - storage tank of the cell
7. **Mitochondria** - organelle that conducts ‘respiration’ for the cell
8. **Mitochondria** - the powerhouse of the cell
9. **Mitochondria** - organelle that conducts ‘photosynthesis’ for plant cells
10. **Mitochondria** - assists in cell division in animal cells only
11. **Mitochondria** - the jelly-like material in which organelles float inside a cell
12. **Mitochondria** - made of cellulose (plants) or chitin (fungi); boundary outside of the cell membrane in some cells
13. **Cell Membrane** - encloses cell, controls what gets into and out of the cell
14. **Cell Membrane** - numerous in heart muscle cells because of need for energy
15. **Cell Membrane** - numerous cells that produces large quantities of proteins

E. Differences between plant and animal cells (complete the table)

<table>
<thead>
<tr>
<th></th>
<th>Plant (A)</th>
<th>Animal (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shape</strong></td>
<td>Square</td>
<td>Round</td>
</tr>
<tr>
<td><strong>Unique Parts</strong></td>
<td>Cell wall</td>
<td>Chloroplast</td>
</tr>
</tbody>
</table>
F. The Fluid Mosaic Model and Movement through the Cell Membrane: Word Bank: diffusion, proteins, cell membrane, active transport, endocytosis, exocytosis, phospholipids, energy, low, high, carbohydrates, water, facilitated diffusion, pinocytosis, osmosis, phagocytosis

1. The cell membrane is composed of phospholipids, proteins, and carbohydrates.

2. The Fluid Mosaic Model describes the cell membrane.

3. Passive transport is also called diffusion and it doesn't require energy.

4. Passive transport moves molecules move from areas of high to low concentration.

5. Facilitated diffusion - diffusion where carrier proteins help molecules across the membrane.

6. Osmosis is a type of diffusion involving only the movement of water molecules.

7. The type of transport that requires energy is active transport.

8. The movement that requires energy moves molecules from low to high concentrations.

9. Active transport that moves substances into the cell is called endocytosis.

10. Moving solid particles into the cell is called phagocytosis.

11. Moving liquids into the cell is called pinocytosis.

12. Active transport that moves substances out of the cell is called exocytosis.

13. Molecules are transported across the cell membrane by carrier proteins.
V. Cell Division

A. Mitosis (Word Bank: nucleus, replicated, interphase, prophase, metaphase, anaphase, telophase, cytokinesis, centromere, chromatids, chromatin, centrioles, spindle fibers, plate, furrow)

1. A chromosome is made of two identical parts called chromatids.
2. The parts of a chromosome are held together by a centromere.
3. Only animal cells have centrioles to help with chromosome movement.
4. During **anaphase** sister chromatids are separated at the centromere and are pulled to opposite ends of the cell.
5. DNA is replicated during interphase so each cell will have the same information.
6. Chromosomes line up along the equator of the cell in **metaphase**.
7. Loose or uncoiled chromosomes are actually DNA in the form of chromatin.
8. During **anaphase** spindle fibers shorten which pulls chromosomes to the poles.
9. After the nucleus divides, **cytokinesis** occurs: the division of the cytoplasm.
10. In plant cells only, a cell plate forms during cytokinesis.
11. In animal cells only, a cell furrow forms during cytokinesis.
12. Spindle fibers are attached to chromosomes at the centromere.
13. **Prophase** - chromosomes become visible
14. **Telophase** - nuclear membrane forms around each chromosome set
15. **Prophase** - nuclear membrane begins to disappear
16. **Cytokinesis** - two daughter cells are formed

17. Label each phase of mitosis in the diagram at the right.
B. Meiosis Word Bank: gametes, 1, the same, 46, 23, eggs, sperm, zygote, homologous, diploid, half, 2, haploid, prophase, fertilization,

1. Meiosis is a type of cell division that makes sex cells or ________ gametes ________.

2. The two types of sex cells are __________ sperm ________ and __________ eggs ________.

3. Mitosis consists of __________ 1 __________ division(s), while meiosis consists of __________ 2 __________ division(s).

4. Mitosis makes cells with the same number of chromosomes as the parent cell, but meiosis produces cells with ________ half ________ the number of chromosomes as the parent cell.

5. A human's body cells have ________ 46 ________ chromosomes; sex cells or gametes have ________ 23 ________.

6. For every chromosome your mother gave you, there is a ________ homologous ________ chromosome from your father with information regarding the same trait(s).

7. When a cell has a full complement of homologous chromosomes from each parent (2 complete sets of chromosomes), the cell is said to be ________ diploid ________.

8. Sex cells have only ONE set of chromosomes, they are called ________ haploid ________.

9. When an egg and a sperm combine during ________ fertilization ________, the ________ zygote ________ that is formed has the normal diploid number of chromosomes.

10. ________ Homologous ________ chromosomes exchange information during ________ prophase ________, which adds to diversity. ("crossing over")

C. Making Proteins Word Bank: translation, diffusion, transcription, proteins, mRNA, amino acid, DNA, peptide, tRNA, codon, nitrogen bases, cytoplasm, ribosome, nucleus, anticodon

1. Almost everything in a living organism is made of or made by ________ proteins ________.

2. The process of protein synthesis is consist of ________ transcription ________ and ________ translation ________.

3. During ________ transcription ________, the genetic code is copied from ________ DNA ________ to ________ RNA ________.
4. Because DNA can't leave the _______ nucleus _______, the message is carried out to the ________ cytoplasm ______ by ________ RNA ________.

5. Once the message from DNA is copied, the _____ RNA _____ leaves the nucleus and travels to a ______ ribosome ______ in the ______ cytoplasm ________.

6. A sequence of 3 bases on mRNA is called a(n) _______ codon _______, but 3 bases on a tRNA molecule are called a(n) _______ anti-codon ________.

7. Each codon is matched with an _______ anti-codon ______ and the _______ tRNA ______ transfers the _______ amino acid ______ to the ribosome.

8. Each _______ amino acid ______ is linked together by _______ peptide ______ bonds to form _______ proteins ________.

9. Another name actually making proteins is _______ translation ________.

10. The sequence of _______ nitrogen bases ______ on _______ DNA ______ carry the genetic code.

**D. Transcription and Translation:** Use a codon chart to transcribe and translate the following DNA sequence: GGCCATTTCCATTGAGC

1. mRNA _______ CCUUUAAGCUAAACUCU ________

2. amino acids _______ (need chart to answer) ________

3. This protein is made of _______ 10 ______ amino acids. (give the number of amino acids)
**E. DNA Technology:** Word Bank: DNA sequence, genes, fingerprinting, identical, fraternal, collaborative, same

1. DNA **fingerprinting** is used to identity crime suspects (such as murder and rape).

2. Using gel electrophoresis, scientists can determine an individual’s DNA fingerprint.
   No two people have the **same** fingerprint, except for **identical** twins.

3. Human Genome project is considered a **collaborative** effort because 13 countries worked on it.

4. The objective of the Human Genome Project was to understand the human **DNA sequence**.

5. Scientists wanted to determine the sequence of bases to ultimately find the **genes** responsible for certain diseases and human traits.

**VI. Genetics**

**A. Vocabulary** Word Bank: phenotype, gene, heredity, genetics, genome, recessive, dominant, Gregor Mendel, trait, genotype, alleles, homozygous, heterozygous

1. **Homozygous** - two **different** alleles, a hybrid (TT)

2. **Heredity** - is the passing of characteristics from parent to offspring

3. **Genotype** - is the **type** of **genes** or alleles present in an organism's genome

4. **Dominant** - form of gene that always shows even in the presence of recessive allele.

5. **Genome** - all of the genes in an organism

6. **Allele** - are different forms of the same gene (ex: tall vs. short)

7. **Homozygous** - two alleles of the **same** form that make up a genotype, pure breed (TT or tt)

8. **Gregor Mendel** is the Father of Modern Genetics

9. **recessive** - form of a gene **only** expressed in a homozygous state

10. **trait** - is an inherited characteristic

11. **phenotype** - is an organism’s **physical** appearance

12. **genetics** - is the study of heredity

13. **gene** - is a segment of DNA located on a chromosome that codes for a particular protein
B. Mendelian Genetics: Word Bank: monohybrid, dihybrid, independent assortment, segregation, Punnett square, P, F1, F2, incomplete dominance, codominance, sex-linked traits

1. **Punnett squares** - table used to diagram the probability of getting certain genotypes

2. A **monohybrid** cross looks at only one trait

3. A **dihybrid** cross looks at two traits at a time

4. The first generation of a 'cross' is the **P** or parental generation

5. The offspring of the **F1** generation is the F1 generation

6. The offspring of the **F2** generation is the F2 generation

7. The Law of **independent assortment** states that each gene is inherited separately from others if they are on different chromosomes

8. The Law of **segregation** states the 2 alleles for each trait separate as gametes form

9. **Incomplete dominance** is blending of traits; red flowers + white flowers = pink

10. **Codominance** - both alleles are expressed equally, as in blood typing (A+B = AB)

11. **Sex-linked traits** - controlled by genes on sex chromosomes and are often more common in males than in females; colorblindness, hemophilia

C. Mutations—there are 2 major types 'gene' and 'chromosomal'

1. **Gene Mutations** Word Bank: gene, point, frameshift, mutagens, UV light, chemicals

   a. A **gene** mutation is a change in one or more nucleotide bases of DNA.

   b. Mutations are caused by **mutagens** like **UV light** or **chemicals**

   c. A **point** mutation is when 1 nucleotide base in DNA is changed

   d. A **frameshift** mutation occurs if 1 or more nucleotides in DNA are added or deleted; this causes the codon sequence to be shifted.

   ~ if the original DNA is ATAACGCCTATT...

   ~ then the number of codons is 4

   ~ then the mRNA sequence would be UAUAAGC67A1MAA

15
~ if the original DNA were replicated and the "G" was deleted...
~ then the DNA sequence would be AIAACGCTATT
~ then the number of complete codons would be 3
~ then the mRNA sequence would be UAUAUGGGAUAA

~ if the original DNA is replicated and "C" was added to the beginning...
~ then the DNA sequence would be CATAACGCTATT
~ then the number of complete codons would be 4
~ then the mRNA sequence would be GUUAUGGGAUAA

2. Chromosomal Mutations Word Bank: duplication, inversion, insertion, deletion, translocation, nondisjunction, polyploidy, haploid, triploid, diploid, chromosomal

a. A ___________________ mutation occurs if there is a change in the number or structure of a single chromosome or whole sets of chromosomes
b. ___________________ - chromosomes don't separate during meiosis
c. ___________________ - chromosome pieces are moved onto another chromosome
d. ___________________ - chromosome segment is inserted in reverse order
e. ___________________ - a segment of a chromosome is repeated
f. ___________________ - segment of a chromosome is removed
g. ___________________ - segment of chromosome is inserted into another chromosome
h. ___________________ - whole extra sets of chromosomes in the same cell
i. In plants and animals, sex cells are ___________________ which means that they have half the number of chromosomes that a body cell has
j. ___________________ - a cell with 2 sets of chromosomes (1 from mother; 1 from father)
k. ___________________ - a cell with 3 sets of chromosomes

Types of mutation

Deletion

Duplication

Inversion

Translocation

Insertion
D. Genetic Disorders: Word Bank: 21st, karyotype, trisomy, chromosomes, Monosomy

1. Only a [karyotype] detects mutations affecting the number of [chromosomes].


3. [Trisomy] occurs when there is an extra copy of a chromosome in a diploid cell.

4. Turner Syndrome is caused by only having one sex chromosome, one X pair. This condition is called a [monosomy].

VII. Taxonomy- is the naming and organization of organisms developed by Carolus Linneaus, based on structural similarities.

A. Classification: Complete the table by arranging the terms largest (1) to smallest (8) (use these terms: Domain, Genus, Kingdom, Species, Phylum, Class, Family, Order).

<table>
<thead>
<tr>
<th>Classification Level</th>
<th>Trick to Remember</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Domain</td>
<td>Dear</td>
</tr>
<tr>
<td>2. Kingdom</td>
<td>King</td>
</tr>
<tr>
<td>3. Phylum</td>
<td>Phillip</td>
</tr>
<tr>
<td>4. Class</td>
<td>Came</td>
</tr>
<tr>
<td>5. Order</td>
<td>Over</td>
</tr>
<tr>
<td>6. Family</td>
<td>For</td>
</tr>
<tr>
<td>7. Genus</td>
<td>Good</td>
</tr>
<tr>
<td>8. Species</td>
<td>Spaghetti</td>
</tr>
</tbody>
</table>
B. Naming Organisms: Word Bank: genus, Linneaus, species, different, the same, binomial nomenclature, kingdom

1. **Binomial nomenclature**, or '2 name naming' was developed by **Linneaus**

2. An organism's scientific name is made of its **genus** then its **species**

3. If 2 organisms are in the same genus, they must be in the **same** family

4. *Clostridium tetani* and *Clostridium botulinum* are two types of bacteria from the Eubacteria **kingdom**. They are in **different** species, but they are in the **same** genus

5. The **Class** of Mammals includes organisms such as rabbits and elephants which are in the **same** Phylum but **different** Species

6. Only organisms that **interbreed** and produce **fertile offspring** are in the **same** species.

   **Giraffe** –
   Scientific Name =
   **Giraffa camelopardalis** (genus) (species)

C. Kingdoms (complete the chart using the terms: eukaryotic, unicellular, multicellular, autotroph, heterotroph, prokaryotic)

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Cell Type</th>
<th>Cell Structure</th>
<th>Number of Cells</th>
<th>Nutrition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eubacteria</td>
<td>P</td>
<td>Cell wall (Peptidoglycan)</td>
<td>Uni</td>
<td>Autotroph or heterotroph</td>
<td>All common bacteria</td>
</tr>
<tr>
<td>Archeabacteria</td>
<td>P</td>
<td>Cell wall</td>
<td>Unicellular</td>
<td>Autotroph or heterotroph</td>
<td>Extremophiles</td>
</tr>
<tr>
<td>Protista</td>
<td>E</td>
<td>Eukaryotic</td>
<td>Uni or Multicellular</td>
<td>Autotroph or Heterotroph</td>
<td>Ameoba, Paramecium</td>
</tr>
<tr>
<td>Fungi</td>
<td>E</td>
<td>Cell wall (chitin)</td>
<td>Uni or Multicellular</td>
<td>Heterotroph</td>
<td>Mushrooms, yeast</td>
</tr>
<tr>
<td>Plantae</td>
<td>E</td>
<td>Cell Wall (cellulose)</td>
<td>Multicellular</td>
<td>Autotroph</td>
<td>Grass, Flowers</td>
</tr>
<tr>
<td>Animalia</td>
<td>E</td>
<td>No cell wall</td>
<td>Multicellular</td>
<td>Heterotroph</td>
<td>Cats, Jellyfish</td>
</tr>
</tbody>
</table>
VIII. Evolution - the theory that there is a gradual change in characteristics over time.

A. Origin of Life – Scientists Hypotheses
1. Disproving Spontaneous Generation (Word Bank: air, sealed, open, bacteria, gauze, spontaneously)
a. Through the early 1800s, people believed organisms could _spontaneously_ develop, an idea know as spontaneous generation.

b. In 1668, many believed maggots spontaneous generated from rotting meat. Francis Redi’s experiment disproved this by experimenting with meat in _open_ jars, _sealed_ jars and jars covered with _gauze_.

c. It was also believed that bacteria spontaneous generated in broth. Lazzaro Spallanzani removed the _life_ from a flask, _boiled_ the broth and sealed the flask. No bacteria generated without exposure to the air.

d. Some people still supported spontaneous generation but thought that air was a _life_ force, necessary for it to occur.

e. In 1859, Louis Pasteur completely disproved spontaneous generation by using a special flask that allow _air_ in but captured bacteria before it could get to the broth. No _bacteria_ grew in the flask after boiling = no spontaneous generation.
2. **First Life** *(Word Bank: eukaryotes, prokaryotic, variety, self-replicating, organic, photosynthesis, oxygen)*
   
a. Earth's atmosphere had to be very hot and with little oxygen for the first __organic__ molecules to first form.
   
b. Organic molecules clumped together for form __self-replicating__ structures that later evolved into cells.
   
c. **Prokaryotic** cells were the first to evolve.
   
d. When cells gained the ability to do __photosynthesize__, they used up carbon dioxide and put more __oxygen__ into the atmosphere.
   
e. With more oxygen in the atmosphere, a wider __variety__ of organisms evolved on land.

6. Some cells engulfed each other leading to the formation of more complex cells that we now call __eukaryotes__.

**B. Early Theorists**

1. **Lamarck** *(Word Bank: Inheritance of Acquired Traits, Law of Use and Disuse)*
   
a. **Law of use and disuse** - if you don't use it, you lose it.
   
b. Lamarck believed that giraffe's long necks were a result of being stretched because they were trying to reach tall trees, and the one's who didn't stretch died out.
   
c. **Inheritance of acquired characteristics** - was his belief that if a characteristic occurs and is beneficial to an organism's survival, then it will be passed on; ex. if a toe gets cut off and it's helpful, then that trait gets passed on to offspring.
   
d. **No evidence** to support this theory so it was **thrown out**.
2. **Charles Darwin** Word Bank: The Origin of Species, finches, Galapagos Islands, Natural Selection
   
a. **Natural selection** - only the organisms that are best suited to their environments will survive

b. The **Galapagos Islands** were a cluster of islands that had different food sources. Because of this, the **finches** had different beaks to help eat the food.

c. **The Origin of Species** was his book that compiled his evidence for evolution

**C. Rates of Evolution** Word Bank: gradualism, punctuated equilibrium

1. **Gradualism** - organisms evolve as a result of small adaptive changes over time

2. **Punctuated Equilibrium** - short periods of rapid change followed by long periods of little or no change.

**D. Evidence of Common Ancestry** (appendix, younger, older, homologous structures, fish, vestigial organs, common ancestors, rabbits, DNA sequence, absolute, relative, gorillas, embryology)

1. **Homologous Structures**: a bat's wing, whale's flipper, and human arm have the same number, type, and arrangement of bones; considered to have a common evolutionary origin.

2. The presence of the same number & type of bones in the wing of a bat and the arm and hand of a human suggests that a bat and a human must share **common ancestors**
3. **DNA sequence** - similar amino acid sequences in proteins of horses and humans provides evidence of similar origin, this is the most specific way to compare organisms.

4. The fact that the DNA of humans and that of monkey species are 99% similar suggests that they probably share common ancestors.

5. The most specific way to provide evidence of common ancestry is by using DNA sequence.

6. **Embryology** - embryos of different organisms (chicken, human, rabbit) look similar at certain early stages, which means the same genes are working at those times.

7. Use the diagram to the right, the embryological development of the stages in the green box suggest that rabbits and gorillas are more closely related because they look alike.

8. **Veinial structures** - are structures that have no apparent use; the appendix in humans may be a remnant of a digestive organ still found in other organisms and the pelvis and femur in a whale may be remnants of when whale ancestors had legs.

9. According to relative dating of fossils: the deeper under ground the fossil is, the older it is.

10. **Absolute** dating uses radioactive isotopes to determine an estimated age for fossils.

IX. **Ecology** - the study of organisms and their interactions with the environment

   A. **Ecological Succession** desert, rain forest, deciduous, coniferous, tundra, ocean, grassland, freshwater, climax community, primary succession)

   1. **Ecological succession** is the sequential replacement of one ecological community with another. Succession is complete when a stable, climax community is established.
10. __________ biomes have little vegetation. The few plants that can survive here have shallow root systems that collect rain water as soon as it falls.

11. ________________ trees have thin needle-like leaves instead of broad leaves with a lot of surface area.

12. ________________ trees have broad leaves that change color and fall off in the fall.

13. In VA, most of the trees lose their leaves in the fall. The biome is a
   ________________ forest.

C. Ecology Vocab: Word Bank: consumer, autotrophic, biotic, abiotic, increase, decrease, species, carnivore, omnivore, herbivore, scavengers, decomposers, producer, population, heterotrophic, community, energy, ecosystem, biosphere

1. A ___________ is an organism at the beginning of a food chain; produce their own food

2. Organisms, like plants, that can make their own food are _____________.

3. Organisms that feed off of other organisms are _____________.

4. A ___________ is an organism that eats producers or other organisms for energy.

5. A nonliving part of the environment is a(n) ____________ factor.

6. A living part of the environment is a(n) ____________ factor.

7. A consumer that eats only producers is called a(n) ____________.

8. A consumer that eats both plants and animals is called a(n) ____________.

9. A ___________ is a group of organisms that can interbreed and produce fertile offspring.

10. Many populations of different organisms living together is a(n) _____________.

11. A group of individuals of a species that lives together and interbreeds is a(n) _____________.

12. The community of organisms in an area including abiotic factors is a(n) _____________.

13. The Earth represents a(n) _____________.

14. ____________ is transferred through an ecosystem by eating or consuming food.

15. ____________ eat things that are already dead (ex. vulture)
16. **Decomposer** break down decaying organisms and nutrients are put back into the soil by bacteria and fungi like mushrooms.

17. [A hunter ---- a fox ---- a rabbit ---- grass or plants] In food webs or food chains, the arrow ALWAYS points to the direction that **energy** flows.

18. [A hunter ---- a fox ---- a rabbit ---- grass] In this food chain, the rabbit is a **herbivore**, the fox is a **carnivore**, and the grass is a **producer**.

19. [A hunter ---- a fox ---- a rabbit ---- grass] In this example, if the rabbit population increased, then the fox population would probably **increase**.

**D. Relationships:** Word Bank: commensalism, mutualism, parasitism, symbiosis, predation, water, sunlight, extinction, limiting factors, competition for food, pollution, disease, climate

1. **parasitism** - one organism is harmed while the other benefits
2. **mutualism** - both organisms benefit
3. **mutualism** - buffalo and a bird that picks insects off the buffalo
4. **symbiosis** - organisms living together

6. Some wasps inject eggs into other organism. As the eggs develop into larvae, they use the host for nutrients. The host dies as the wasp larvae develop. When one organism benefits and the other is harmed the relationship is called **parasitism**.

7. Anemones release poisonous chemicals from their tentacles that paralyze prey. Clown fish are not affected by the poison & find protection from predators by living near anemones. This is called **commensalism** because the fish don’t harm or benefit the anemone.

8. Things that limit the size of populations are called **limiting factors**.

9. On the rain forest floor, a limiting factor for plants would be availability of **water**.

10. In the desert, a limiting factor for both plants and animals would be availability of **water**.

11. Hunting is encouraged for deer populations because they live in such close proximity to each other that **disease** is a limiting factor.

12. Only 3,000 manatee *Trichechus manatus* are left, and most of them are in the ocean around Florida. Because there is little genetic diversity, a disease that reduces fertility might cause **extinction**.