

Providence High School
Summer Biology Packet
(Covering Science Content Standards)

To the Student:

You're expected to read this handout in its entirety, visit and review contents of websites provided and research and understand the major concepts listed below. Besides the resources provided you are expected to explore other sites which further your understanding of the basic concepts of biology. You will have multiple quizzes/tests on these concepts during the first two weeks of school. These assessments will be an accurate measure of your effort and work completed over the summer.

Focus on Life Science

Cell Biology

1. All living organisms are composed of cells, from just one (unicellular) to many trillions (multicellular), whose details usually are visible only through a microscope (magnification and resolution). As a basis for understanding this concept:
 - a. Students know cells function (list functions or **characteristics of living things**) similarly in all living organisms.
 - b. Students know the characteristics (**cell structure and all organelles**) that distinguish plant cells from animal cells, including chloroplasts and cell walls.
 - c. Students know the nucleus is the repository for genetic (**DNA/ chromosomes**) information in plant and animal cells.
 - d. Students know that **mitochondria** liberate energy for the work that cells do and that **chloroplasts** capture sunlight energy for photosynthesis (these two are energy related organelles)
 - e. Students know cells divide to increase their numbers through a process of **mitosis**, which results in two daughter cells with identical sets of chromosomes. Organisms that carry **sexual reproduction** also show **meiosis** which helps form gametes or sex cells
 - f. Students know that as multicellular organisms develop, their cells **differentiate** (include the concept of stem cells)
 - g. **Prokaryotes** are simple cells that evolved into **eukaryotes** (must include similarities and differences between the two types)

Genetics

2. A typical cell of any organism contains genetic instructions (DNA/chromosomes) that specify its traits. Those **traits** (ex. height, color, shape, etc.) may be modified by environmental influences. As a basis for understanding this concept:
 - a. Students know the differences between the **life cycles** and reproduction methods of sexual and asexual organisms.
 - b. Students know sexual reproduction produces offspring that inherit half their genes from each parent.
 - c. Students know an inherited trait can be determined by one or more **genes**.
 - d. Students know plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or **alleles**) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.
 - e. Students know **DNA (deoxyribonucleic acid)** is the genetic material of living organisms and is located in the chromosomes of each cell.

Evolution

3. Biological evolution accounts for the diversity of **species** developed through gradual processes over many generations. As a basis for understanding this concept:
 1. Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.
 2. Students know the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.
 3. Students know how independent lines of evidence from geology, fossils, and comparative anatomy provide the bases for the theory of evolution.
 4. Students know how to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics and how to expand the diagram to include fossil organisms.
 5. Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.
4. Evidence from rocks allows us to understand the **evolution** of life on Earth. As a basis for understanding this concept:
 - a. Students know Earth processes today are similar to those that occurred in the past and slow geologic processes have large cumulative effects over long periods of time.
 - b. Students know the history of life on Earth has been disrupted by major catastrophic events (ex. volcanic eruptions, asteroids)

- c. Students know that the rock cycle includes the formation of new sediment and rocks. Rocks are often found in layers, with the oldest generally on the bottom.
- d. Students know that evidence from **geologic layers and radioactive dating** indicates Earth is approximately **4.6 billion years old** and that life on this planet has existed for more than **3 billion years**.
- e. Students know **fossils** provide evidence of how life and environmental conditions have changed.
- f. Students know how movements of Earth's continental and oceanic plates through time, with associated changes in **climate** and geographic connections, have affected the past and present distribution (**communities and biomes**) of organisms.
- g. Students know how to explain significant developments and extinctions of plant and animal life on the **geologic time scale**.

Investigation and Experimentation

- 4. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:
 - a. Plan and conduct a scientific investigation to **test a hypothesis. Below are steps of a Scientific method (can include variations)**
 - 1. Define the problem
 - 2. Suggest an answer
 - 3. Experiment
 - 4. Solve the problem
 - 5. Draw conclusions
 - b. Scientific conclusions lead to formulation of **theories** (explanations of how) and **laws/principles** (*many* experiments and observations)- **understand the difference between hypothesis and theory**
 - c. Communicating Results (Research Paper or Article)
 - <http://www.columbia.edu/cu/biology/ug/research/paper.html>
 - d. Evaluate the accuracy and reproducibility of **data**.
 - e. Distinguish between **variables and controls** in a(n) test/experiment
 - f. Recognize the slope of the linear graph as the constant in the relationship $y = kx$ and apply this principle in interpreting graphs constructed from data.

- g. **Construct appropriate graphs** (using Microsoft Spreadsheet/Excel) from data and develop **quantitative** statements about the relationships between variables.
- h. Understand the difference between **quantitative and qualitative** measurements
- i. **Metric System and Units of measurements with prefixes (ex. units of mass, distance, volume such as meter, liter, gram and prefixes such as kilo, centi, milli, micro, nano, angstrom, pico, femto.)**
- j. Apply simple mathematic relationships to determine a missing quantity in a mathematic expression, given the two remaining terms (including **speed = distance/time, density = mass/volume, force = pressure × area, volume = area × height**).
- k. Distinguish between linear and nonlinear relationships on a graph of data.
- l. Students know how to calculate the density of substances (regular and irregular solids and liquids) from measurements of mass and volume.

Structure of Matter

- 5. Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept:
 - a. **Students know the structure of the atom and know it is composed of protons, neutrons, and electrons.**
 - b. Students know that compounds are formed by combining two or more different elements and that compounds have properties that are different from their constituent elements.
 - c. Students know atoms and molecules form solids by building up repeating patterns, such as the crystal structure of NaCl or long-chain polymers.
 - d. Students know the states of matter (solid, liquid, gas) depend on molecular motion.
 - e. Students know that in solids the atoms are closely locked in position and can only vibrate; in liquids the atoms and molecules are more loosely connected and can collide with and move past one another; and in gases the atoms and molecules are free to move independently, colliding frequently.
 - f. Students know how to use the periodic table to identify elements in simple compounds.

Reactions (Connections of Biology and Chemistry)

- 6. Chemical reactions are processes in which atoms are rearranged into different combinations of molecules. As a basis for understanding this concept:
 - a. Students know reactant atoms and molecules interact to form products with different chemical properties.

- b. Students know the idea of atoms explains the conservation of matter: In chemical reactions the number of atoms stays the same no matter how they are arranged, so their total mass stays the same.
- c. Students know chemical reactions usually liberate heat or absorb heat.
- d. Students know physical processes include freezing and boiling, in which a material changes form with no chemical reaction.
- e. Students know how to determine whether a solution is acidic, basic, or neutral.

Chemistry of Living Systems (Biochemistry/Life Sciences)

- 7. Principles of chemistry underlie the functioning of biological systems. As a basis for understanding this concept:
 - a. Students know that carbon, because of its ability to combine in many ways with itself and other elements, has a central role in the chemistry of living organisms.
 - b. Students know that living organisms are made of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.
 - c. Students know that living organisms have many different kinds of molecules, including small ones, such as water and salt, and very large ones, such as carbohydrates, fats, proteins, and DNA.

Periodic Table (Fundamentals of Chemistry)

- 8. The organization of the periodic table is based on the properties of the elements and reflects the structure of atoms. As a basis for understanding this concept:
 - a. Students know how to identify regions corresponding to metals, nonmetals, and inert gases.
 - b. Students know each element has a specific number of protons in the nucleus (the atomic number) and each isotope of the element has a different but specific number of neutrons in the nucleus.
 - c. Students know substances can be classified by their properties, including their melting temperature, density, hardness, and thermal and electrical conductivity.

RESOURCES

Sites to Visit and Review (Sections listed where applicable)

URL: <http://www.biology4kids.com/index.html>

URL: <http://www.explorebiology.com/regentsbiology/notes/>

- The Scientific Method
- Chemistry of Life
- Cells are the Foundation of Life
- Enzymes and Metabolism (Chemistry)

URL: <http://www.saburchill.com/IBbiology/chapters01/001.html>

- Biochemistry
- Cells

URL: <http://www.pbs.org/topics/science-nature/biology-chemistry/>

- Videos in Biology and Chemistry (connections)

URL: <http://nhscience.lonestar.edu/biol/biolint.htm>

• Basic Chemistry	• Biochemistry	• Cell Structure	• Mitosis/Meiosis
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URL: <http://www.wiley.com/legacy/college/boyer/0470003790/animations/animations.htm>

- Amino acid Game
- Cell Structure
- Cellular Transport
- DNA Replication
- Enzyme Specificity
- Protein Synthesis

URL:

http://www.biocourse.com/mhhe/bcc/life_sciences/cell_biology.xsp?text=disciplines:000009&start=0&quant=10

- Use the Tab for Cell Biology and Explore by subtopics

URL: <http://www.execulink.com/~ekimmel/gr11.htm> (ZEROBIO)

- Cellular Functions
 - Worksheets
 - Quizzes and Games

<http://www.biology.arizona.edu/>

- Biochemistry
- Cell Biology