BIOLOGY CURRICULUM MAP

QUARTER ONE: The Chemistry of Life
Standard 1.1 Recognize that biological organisms are composed primarily of very few elements. The six most common are C, H, N, O, P, S.

Assessments:
1) Carbon atoms in organic molecules most commonly bond to atoms of H, O, and…
   a) Calcium
   b) Magnesium
   c) Nitrogen
   d) Sodium

2) List the 6 most common elements found in living things.

3) Draw the atomic structures of the elements C, H, N, O, P, S

4) Explain why Carbon is so important and the basis for organic molecules.

Concepts:
- Biology is the study of life, which is based on organic molecules
- atom, proton, neutron, electron, nucleus (Note the nucleus of an atom is not the same as the nucleus of a cell), electron energy levels
- periodic table, atomic #, atomic mass, isotopes,
- atoms vs. compounds
- atoms vs. molecules
- types of bonding (ionic and covalent)
- the importance of Carbon in living things (forms strong stable covalent bonds with many different elements)

Activities:
- Drawing diagrams of atoms
- Building simple molecular models (water, methane, ethane, etc)
- Adopt an Element Project

Resources:
- Textbook

Standard 1.2 Describe the basic molecular structures and primary functions of the four major categories of organic molecules (carbohydrates, lipids, proteins, and nucleic acids).

Assessments:
1) Aquatic birds secrete waxy organic substances that repel water to coat their feathers. These waxy substances would be mainly composed of
   A) Lipids
   B) Proteins
C) Carbohydrates  
D) Nucleic Acids

2) A substance has the general formula CH₂O. Which type of organic molecule would it be?  
   A) Protein  
   B) Nucleic Acid  
   C) Carbohydrate  
   D) Lipid

3) Identify the monomer of proteins.  
   A) Nucleotides  B) fatty acids  C) Monosaccharides  D) Amino acids

4) Which of the following is a primary function of carbohydrates?  
   A) Storage of energy  
   B) Transmission of genetic material  
   C) Acceleration of chemical reactions  
   D) Transport of molecules across membranes

Concepts:  
- Students should know that macromolecules are large molecules consisting of many smaller units (monomers) joined together  
- Dehydration synthesis vs. hydrolysis  
- Carbohydrates (sugars and starches)  
  - energy storage  
  - monomer is monosaccharide (glucose, galactose, fructose)  
  - contain elements CHO in the ratio of 1:2:1  
- Proteins (also called polypeptides)  
  - build and repair cells  
  - function in movement  
  - hormonal communication  
  - enzymes  
  - elements C,H,O, N, S  
  - monomer = amino acids  
  - amino acids are joined together by peptide bonds  
- Lipids  
  - elements C,H,O  
  - long term energy storage  
  - protection  
  - insulation  
  - repair of cell membrane  
  - polymer of glycerol and fatty acids  
  - Cholesterol as a lipid (HDL vs. LDL)  
  - Saturated vs. unsaturated (monounsaturated and polyunsaturated)  
- Nucleic Acids  
- Elements C,H,O,N,P  
- Monomer = nucleotide (sugar, phosphate, nitrogen base)
- Store hereditary information
- DNA and RNA are examples

**Activities**
- Examining food labels for the macromolecules and comparing calories produced through metabolism of each type of macromolecule.
- Building Molecular Models Lab
- Testing Foods for macromolecules (Biuret test for proteins, Benedict’s test for monosaccharides, Iodine test for carbohydrates, brown bag test for fats)
- Macromolecule Brochure Activity
- Vocabulary Card Game: Macromolecules Rummy

**Resources:** Textbook, Online

**Standard 1.3** Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify factors, such as pH and temperature, which have an effect on enzymes.

**Assessment:**
1) In Siamese cats, an enzyme determines fur color. On cooler places of the body, the enzyme causes darker fur. On warmer places, the enzyme does not function. Which of the following best explains how temperature affects this enzyme?
   A) Cooler temperatures denature the enzyme
   B) Cooler temperatures cause more enzyme production
   C) The enzyme is active in a specific temperature range
   D) Heat allows the enzyme to break down white pigment

2) Explain why a fever can be so dangerous in terms of enzyme activity.

3) Without enzymes it could take years to digest a simple meal. Explain why enzymes are so crucial to digestion.

4) Draw a diagram of the Lock and Key Theory of Enzymes. Label the enzyme, substrate, enzyme-substrate complex, active site. Be sure to explain your diagram and state whether or not the enzyme is changed after its interaction with the substrate.

5) Explain why ingestion of a chemical that drops blood pH would be so harmful.

6) What effect does an enzyme have on the activation energy of a biochemical reaction:
   A) increases it
   B) maintains it
   C) lowers it
Concepts:
- Proteins often function as enzymes
- Enzymes are catalysts
- Enzymes of ten end in –ase
- What pH is and its importance in living things
- pH scale (acid, base, or neutral)
- Lock and Key Theory of enzyme-substrate interaction
- Extremes of temperature and pH can denature enzymes-Most enzymes work only in a specific ph/temperature range
- Enzymes speed up chemical reactions by lowering the activation energy

Activities:
- Lactase enzyme lab
- Lock and Key Model Activity
- Enzyme activity lab (ph and temperature effects)

Resources:
- Textbook
- Lactase Lab Resource: www.learnnc.org/lessons

Standard: 2.1 Relate cell parts/organelles(plasma membrane, nuclear envelope, nucleus, nucleolus, cytoplasm, mitochondrion, endoplasmic reticulum, Golgi apparatus, lysosome, ribosome, vacuole, cell wall, chloroplast, cytoskeleton, centriole, cilium, flagellum, pseudopod) to their functions. Explain the role of cell membranes as a highly selective barrier (diffusion, osmosis, facilitated diffusion, and active transport).

Assessments:
1) A student observes a rectangular shaped cell with a cell wall and a large central vacuole. This cell most likely came from
   a) an animal
   b) an archaeabacterium
   c) a fungus
   d) a plant

2) Some cells such as human nerve cells and muscle cells contain many more mitochondria than do other cells, such as skin cells. Why do some cells have more mitochondria than others?
   a) The cells use more energy
   b) The cells store more nutrients
   c) The cells degrade more proteins
   d) The cells divide more frequently.

3) Many animals have internal or external skeletons that provide support and structure. Which of the following plays a similar role in plants?
   a) cell membranes
b) cell walls
c) chloroplast
d) cytoplasm

4) Which of the following best describes the function of the Golgi apparatus?
   a) To release energy from ATP
   b) To deliver proteins to other locations in the cell
   c) To collect amino acids for use in protein synthesis
   d) To send messages about cell requirements to the nucleus

5) Which of the following best describes the movement of molecules in osmosis
   a) Sugar molecules will move from high concentration to low concentration
   b) Water molecules will move from high concentration to low concentration
   c) Sugar molecules will move from low concentration to high concentration
   d) Water molecules will move from low concentration to high concentration.

4) I spray perfume at the front of the room and eventually the students in the back can
   smell it. The movement of the molecules is known as
   a) Kinetic entropy
   b) diffusion
   c) osmosis
   d) transpiration

Concepts:
- All living things share basic characteristics like being composed of cells, reproducing,
  obtaining and using energy, growing and developing, having genetic material, have a
  metabolism, respond to the environment
- Cell parts and their functions
- Why cells need to be small (Surface area vs. volume)
- Diffusion vs. osmosis (A special case of diffusion)
- Passive transport (Including facilitated diffusion involving a helper molecule) vs. active
  transport (requiring ATP)
- Structure of the cell membrane (as a semi-permeable phospholipid bilayer)

Activities:
- Cell analogy poster and essay
- Cell Diagram activity (Labeling, coloring, identifying parts and functions)
- Microscope Lab (how to use it: The letter “e”, depth of focus with thread, measurement
  , plant cells vs. animal cells with elodea vs. cheek cells lab)
- Diffusion Lab (Ex. Starch and Iodine plastic baggie)
- Osmosis Lab: (Ex. Cucumber and Salt, Raisin in water)

Resources:
  - Textbook
  - Cells video (HHS library)
  - Cells alive.com

Standard 2.2 Compare and contrast, at the cellular level, prokaryotes and
  eukaryotes (general structures and degrees of complexity).
**Assessments:**

1) A single prokaryotic cell can divide several times in an hour. Few eukaryotic cells can divide as quickly. Which of the following best explains this difference?
   - a) Eukaryotic cells are smaller than prokaryotic cells.
   - b) Eukaryotic cells have less DNA than prokaryotic cells.
   - c) Eukaryotic cells have more cell walls than prokaryotic cells.
   - d) Eukaryotic cells are more structurally complex than prokaryotic cells.

2) Which of the following is an example of a prokaryotic organism?
   - a) bacterium
   - b) celery
   - c) horse
   - d) mushroom

3) Explain the primary differences between prokaryotes and eukaryotes and give an example of an organism of each type.

**Concepts:**
- The membrane bound nucleus is an important distinction between prokaryotes (Before nucleus) and eukaryotes (True nucleus).
- Life most likely originated with prokaryotic bacteria.
- Human are eukaryotic.
- Prokaryotes are only found in Kingdoms Archaebacteria and Eubacteria. All other kingdoms are eukaryotic.

**Activities:**
- Examine various cell types with the microscope and compare complexity of bacterial cells vs. eukaryotic cells.

**Resources:**
- Text
- Online: “Let’s get small” www.microbeworld.org/resources/
- “Mega Multiples of Microbes” www.microbeworld.org/resources

**Standard 2.3** Use cellular evidence (such as cell structure, cell number, and cell reproduction) and modes of nutrition to describe six kingdoms (Archabacteria, Eubacteria, Protista, Fungi, Plantae, Animalia).

**Assessments:**

1) Which of the following distinguishes Fungi from the other eukaryotic kingdoms?
   - a) Fungi are unicellular
   - b) Fungi reproduce sexually
   - c) Fungi obtain nutrients by absorption
   - d) Fungi make food through photosynthesis
2) Four students attempted to make a classification table. Which student’s classification table is correct?

<table>
<thead>
<tr>
<th></th>
<th>Plants</th>
<th>Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 1</td>
<td>Eukaryotic cells</td>
<td>Prokaryotic cells</td>
</tr>
<tr>
<td>Student 2</td>
<td>Multicellular</td>
<td>Unicellular</td>
</tr>
<tr>
<td>Student 3</td>
<td>Cells with cell walls</td>
<td>No cell walls</td>
</tr>
<tr>
<td>Student 4</td>
<td>Heterotrophic by absorption</td>
<td>Heterotrophic by ingestion</td>
</tr>
</tbody>
</table>

a) Student 1  
b) Student 2  
c) Student 3  
d) Student 4

**Concepts:** Kingdoms of Life Comparison Chart (see email attachment from Karen)

**Activities:**
- Dichotomous Key
- Microscope Lab: Comparing organisms from each kingdom and identifying what Kingdom an organism is in
- Compare/Contrast Kingdoms Chart
- Kingdom Identification Game

**Resources:** Text

**QUARTER TWO: CELL BIOLOGY CONTINUED**

**Standard 2.4** Identify the reactants, products, and basic purposes of photosynthesis and cellular respiration in the cells of photosynthetic organisms.

**Assessments:**

1) The natural cycling of oxygen between organism and their environment is most directly accomplished through which of the following pairs of processes?
   a) fermentation and oxidation  
   b) transpiration and evaporation  
   c) precipitation and condensation  
   d) photosynthesis and respiration

2) A mutation that prevents a maple tree from taking gases from the air would most directly affect which process?
   a) reproduction  
   b) photosynthesis  
   c) water uptake  
   d) DNA replication

3) In which of the following ways are photosynthesis and cellular respiration alike?
   a) Both produce glucose.  
   b) Both consume carbon dioxide.  
   c) Both take place in chloroplasts.  
   d) Both involve energy transformations.
3) In one step of the carbon cycle a person exhales a molecule of carbon dioxide into the atmosphere. Which of the following is most likely the next to happen to the carbon in this molecule?
   a) It may be used as part of a sugar in a plant
   b) It may become part of a protein in an animal.
   c) It may be consumed as a fossil fuel is burned
   d) It may be decomposed into carbon and oxygen by a bacterium.

4) Which of the following occurs during photosynthesis?
   a) Carbon dioxide is used to produce water
   b) Carbon dioxide is absorbed by mitochondria
   c) Carbon dioxide and water are converted to carbohydrates.
   d) Carbon dioxide and water are combined into carbonic acid.

5) Cyanide is a powerful poison which inhibits an enzyme in mitochondria. The poison would affect the production of which molecule?
   a) ATP
   b) glucose
   c) oxygen
   d) RNA

Concepts:
- Recognize the reactants and products of photosynthesis
- Identify examples of photosynthetic organisms such as plants
- Recognize the importance of chlorophyll and chloroplasts and why leaves change color in autumn
- Light Dependent Reactions gather energy from sunlight into a usable form
- Dark Reactions (Calvin Cycle) use the energy of ATP to make sugar
- Structure of a leaf
- How carbon fixation occurs and chemiosmosis
- Recognize reactants and products of cellular respiration
- The role of the mitochondrion in cellular respiration
- Glycolysis is the breakdown of glucose anaerobically occurring in the cytoplasm
- The importance of the Krebs Cycle and the electron transport chain (Aerobic respiration)
- Lactic acid fermentation vs. alcoholic fermentation
- The reason why we breathe oxygen is so that the electron transport chain can make ATP
- Photosynthesis and cellular respiration are inter-dependent (Carbon-Oxygen Cycles)

Resources:
- Text
- Biologycorner.com
Standard 2.5 Explain the important role that ATP serves in metabolism.

Assessments:
1) The molecule ATP is composed of elements found in organic molecules. Which of these is one of these elements?
   a) aluminum
   b) calcium
   c) phosphorus
   d) tin

2) The energy in ATP comes from
   a) breaking the bonds of the phosphate group
   b) forming bonds with the phosphate group
   c) adding adenosine
   d) osmosis

Concepts:
- Composition of ATP
  \[\text{AMP} + P = \text{ADP}\]
  \[\text{ADP} + P = \text{ATP}\]
- Removal of a phosphate group from ATP provides energy for cellular use
- Energy is stored in chemical bonds: Breaking a bond releases energy.
- ATP is produced in the mitochondrion
- Plants have both chloroplasts to undergo photosynthesis and mitochondria to make ATP.

Activities:
- Comparing ATP to a rechargeable battery
- Worksheets on ATP

Resources:
- Text

Standard 2.6 Describe the cell cycle and the process of mitosis. Explain the role of mitosis in the formation of new cells, and its importance in maintaining chromosome number during asexual reproduction.

Assessments:
1) What cellular process is directly responsible for the regeneration of a starfish arm?
   a) meiosis
   b) mitosis
   c) transcription
   d) respiration

2) Identify a diagrammatic picture as either mitosis or meiosis and which phase the cell is in.
3) Explain 3 differences between mitosis and meiosis.
Concepts:
- Stages of the cell cycle (G1, S, G2, M)
- Cyclin as a cell cycle regulator
- Cancer is a general name for uncontrolled cell growth
- Causes of cancer
- Stages of Mitosis (Prophase, Metaphase, Anaphase, Telophase)
- Differences between Plant and Animal Cell Mitosis
- Prokaryotic cell division: Binary fission (Compare to eukaryotic cell division)
- Diploid vs. haploid cells
- Cytokinesis

Activities:
- Mitosis Microscope Lab (white fish blastula vs. onion root tips)
- Mitosis Flip Book activity
- Cell Cycle game online

Resources:
- cellsalive.com
  http://nobelprize.org/medicine/educational/2001/index.html
  (cell cycle game)
- Understanding cancer-NIH
- Text