**Unit 3 – Chemistry of Life**

**MCAS Frameworks:** This unit addresses the following MA State Frameworks in Biology:

1.1 Recognize that biological organisms are composed primarily of very few elements. The six most common

are C, H, N, O, P, and S.

1.2 Describe the basic molecular structures and primary functions of the four major categories of organic

molecules (carbohydrates, lipids, proteins, nucleic acids).

1.3 Explain the role of enzymes as catalysts that lower the activation energy of biochemical reactions. Identify

factors, such as pH and temperature, that have an effect on enzymes.

2.5 Explain the important role that ATP serves in metabolism.

3.1 Describe the basic structure (double helix, sugar/phosphate backbone, linked by complementary nucleotide

pairs) of DNA, and describe its function in genetic inheritance.

4.1 Explain generally how the digestive system (mouth, pharynx, esophagus, stomach, small and large

intestines, rectum) converts macromolecules from food into smaller molecules that can be used by cells for

energy and for repair and growth.

SIS1. Make observations, raise questions, and formulate hypotheses.

SIS2. Design and conduct scientific investigations.

SIS3. Analyze and interpret results of scientific investigations.

SIS4. Communicate and apply the results of scientific investigations.

**Big Ideas**

1. All life processes are based on the properties and reactions of elements that make up molecules.

2. Cellular processes are constrained by the laws of thermodynamics.

3. The structure of molecules enables their functions.

4. Metabolism is based on the transfer of energy from molecules.

**Essential Questions**

1. How does our understanding of chemical principles help us explain the structures and processes that make life

possible?

**Unit 3 Objectives - Chemistry of Life**

**Reading:** Text Chapters 2, 38-1, 38-2.

**Objectives:** Upon completion of this unit, you should be able to:

*Topic 1: The Nature of Matter and Bonding (Chapter 2-1)*

1. Describe and diagram the structure of an atom, including: protons, neutrons, electrons, and their charges.
2. Explain the relationships among atoms, molecules, elements, and compounds.
3. Define element and list the six elements most abundant in living organisms.
4. Define and provide examples of isotopes and radioisotopes.
5. Describe the differences between ionic bonds and covalent bonds, including differences in strength, and provide examples of each.

*Topic 2: Properties of Water and pH (Chapter 2-2)*

1. Diagram the structure of a water molecule.
2. Explain the properties of water: cohesion, adhesion, surface tension.
3. Explain why water molecules are polar and how this helps hydrogen bonds form.
4. Describe the differences between solutions and suspensions.
5. Compare acidic and basic solutions in terms of their H+ ions and OH- ion concentrations.

*Topic 3: Organic macromolecules AKA Carbon Compounds (Chapter 2-3)*

1. Explain what an organic compound is and why they are important for life.
2. Define and relate the terms macromolecule, polymer, monomer, and polymerization (not in book, look up on your own).
3. Identify and diagram the 4 groups of carbon compounds found in living things.
4. Define and relate the terms: carbohydrate, monosaccharide, disaccharide, and polysaccharide.
5. Define and relate the terms: lipid, phospholipid, and cholesterol.
6. Explain the difference in structure between unsaturated and saturated lipids and explain why eating one type is better for your health than the eating the other.
7. Define and relate the terms: nucleic acids, nucleotides, DNA, RNA
8. Define and relate the terms: protein, amino acid, polypeptide, and peptide bond.
9. Describe the four levels of organization of a protein.

*Topic 4: Chemical Reactions and Enzymes (Chapter 2-4)*

1. Explain the different parts of a chemical equation – determine which parts of the equation are the reactants and which are the products.
2. Explain how chemical reactions affect chemical bonds in reactions.
3. Define and relate the terms: activation energy, catalyst, enzyme, substrate.
4. Describe some ways that structure is important for function of a protein.
5. Describe how energy changes affect how easily a chemical reaction will occur.
6. Explain how and why enzymes can be affected by factors such as temperature and pH.

*Topic 5: Human Digestion (Chapter 38-1, 38-2)*

26. Define nutrient, calorie and digestion.

27. List the six nutrients needed by the body.

28. Review the functions of carbohydrates, lipids, and proteins in light of human nutrition.

29. Explain (in general terms) the function of minerals and vitamins.

30. Describe how proteins, lipids and carbohydrates are digested.

31. Describe the differences between chemical and mechanical digestion.

32. Outline the process of digestion from start to finish.

**Key Terms/Concepts**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Atom | Suspension | Chemical reaction | | Amylase |
| Nucleus | pH scale | Reactant | | Pepsin |
| Electron | Acid | Product | | Esophagus |
| Element | Base | Activation energy | | Peristalsis |
| Isotope | Monomer | Catalyst | | Stomach |
| Compound | Polymer | Enzyme | | Chyme |
| Ionic bond | Carbohydrate | Substrate | | Small intestine |
| Ion | Monosaccharide | Calorie | | Pancreas |
| Molecule | Polysaccharide | Digestion | | Liver |
| Cohesion | Lipid | Vitamin | | Villus |
| Adhesion | Nucleic Acid | Mineral | | Large intestine |
| Mixture | Nucleotide |  | | Chemical digestion |
| Solution | Ribonucleic Acid (RNA) | |  | Mechanical digestion |
| Solute | Deoxyribonucleic acid (DNA) | |  |  |
| Solvent | Protein | Primary (1º) structure | | Secondary (2 º) structure |
|  | Amino acid | Tertiary (3 º) structure | | Quarternary (4 º) structure |

**Assessment Evidence**

Projects: McMush Lab, Enzyme inquiry lab, Model building

Assessments: Unit quiz 1-19, Unit test

**Learning Plan Period 5**

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| **Day** | **In Class Topic** | **Homework** |
| Mon 11/7  B day | No class |  |
| Tues 11/8  C day | Intro unit  Topic 1: Basic chemistry refresher (objectives 1-5) | Obj 6-8 |
| Wed 11/9  D day | Topic 2: Water chemistry | Obj 9-11 |
| Thur 11/10  E day | Topic 2: pH scale - Acids & Bases | Obj 12-15 |
| Friday 11/11 | Veteran’s Day |  |
| Mon 11/14  F day | Topic 3: Intro to biochemistry  Carbohydrates | Obj 16-19 |
| Tues 11/15  A day | Topic 3: Lipids | Obj 20-22 |
| Wed 11/16  B day | No class |  |
| Thur 11/17  C day | Topic 3: Proteins | Obj 23-25 |
| Fri 11/18  D day | Topic 3: Molecular Models | Study for quiz on Objectives 1-19 |
| Mon 11/21  E day | **Quiz Objectives 1-19**  Finish models | Obj 26-29 |
| Tues 11/22  F day | McMush lab | Complete lab questions |
| Wed 11/23-  Sun 11/27 | Thanksgiving vacation |  |
| Mon 11/28  A day | Topic 4: Enzymes | Obj 30-32 |
| Tue 11/29  B day | No class |  |
| Wed 11/30  C day | Topic 5: Digestion | TBA |
| Thur 12/1  D day | Topic 5: Digestion | Read/prep lab |
| Fri 12/2  E day | Set up enzyme lab | Lab due: Friday 12/9 |
| Mon 12/5  F day | Enzyme inquiry lab | Study for test |
| Tues 12/6  A day | Review | Study for test |
| Wed 12/7  B day | No class |  |
| Thur 12/8  C day | **Test Unit 3** | Obj 1-5 Unit 4 |

**Assessment Evidence**

Projects: McMush Lab, Enzyme inquiry lab, Model building

Assessments: Unit quiz 1-19, Unit test

**Learning Plan Period 6**

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| **Day** | **In Class Topic** | **Homework** |
| Mon 11/7  B day | Intro unit  Topic 1: Basic chemistry refresher (objectives 1-5) | Obj 6-8 |
| Tues 11/8  C day | Topic 2: Water chemistry | Obj 9-11 |
| Wed 11/9  D day | Topic 2: pH scale - Acids & Bases | Obj 12-15 |
| Thur 11/10  E day | Topic 3: Intro to biochemistry  Carbohydrates | Obj 16-19 |
| Friday 11/11 | Veteran’s Day |  |
| Mon 11/14  F day | Topic 3: Lipids | Obj 20-22 |
| Tues 11/15  A day | No class |  |
| Wed 11/16  B day | Topic 3: Proteins | Study for quiz |
| Thur 11/17  C day | Topic 3: Molecular Models | Study for quiz on Objectives 1-19 |
| Fri 11/18  D day | Quiz Objectives 1-19  Finish models | Obj 23-25 |
| Mon 11/21  E day | McMush lab | Complete lab questions |
| Tues 11/22  F day | Discuss McMush lab | Obj 26-29 |
| Wed 11/23-  Sun 11/27 | Thanksgiving vacation |  |
| Mon 11/28  A day | No class |  |
| Tue 11/29  B day | Topic 4: Enzymes | Obj 30-32 |
| Wed 11/30  C day | Topic 5: Digestion | Read/prep lab |
| Thur 12/1  D day | Set up enzyme lab | TBA |
| Fri 12/2  E day | Enzyme inquiry lab | Lab due: Friday 12/9 |
| Mon 12/5  F day | Discuss lab  Topic 5: Digestion | Study for test |
| Tues 12/6  A day | No class |  |
| Wed 12/7  B day | Review | Study for test |
| Thur 12/8  C day | **Test Unit 3** | Obj 1-5 Unit 4 |