The Molecules of Life Poster

The **Molecules of Life** poster complements the **Molecules of Life Modeling Kit©** and serves as your on-the-wall reference throughout the year. The key concept for your students to understand is:

Small molecules (monomers) join to form larger macromolecules essential for life.

Additional Points:

- The Molecules of Life poster presents ***multiple representations*** of these small molecules of life, including:
    1. Chemical structures
    2. 2D stamped-foam representations used in the Molecules of Life kit
    3. Computer-generated images of the 3D structures
- While **dehydration synthesis** is not shown on the poster, (it is covered in the modeling kit), it is important for students to understand enzymes catalyze the process for each monomer-to-macromolecule synthesis

Specific Teaching Points for each of the four **Molecules of Life** follow.

Proteins

- Proteins (polypeptides) perform essential functions within cells including:
- Acting as enzymes that catalyze chemical reactions
- Providing structural support (intracellular matrix) within cells
- Regulating cellular processes
- Signaling via peptide hormones
- Ribosomes synthesize proteins by linking amino acids together in a specific sequence encoded in mRNA
- Some proteins, like hemoglobin, are globular and exist in the ***hydrophilic cytoplasm*** of the cell. Others, like aquaporin, are embedded in the ***hydrophobic membrane*** that surrounds the cell

*For more modeling and information on amino acids and proteins see the **Amino Acid Starter Kit©** (middle school, high school, and college), and **Protein Structure Modeling Kit©**(high school and college), Teacher resources, student handouts or a slide deck are available.*

Carbohydrates

- Carbohydrates Serve as Fuel – that metabolizes to generate energy
    - Glucose is a simple sugar (carbohydrate) that metabolizes to produce energy for cells
    - Monomers of glucose link together to form glycogen – a storage form of glucose
- Carbohydrates play an important role in cell-cell communication.
    - Carbohydrates (simple sugars) link together in complex structures to modify proteins that embed in the cell membrane

DNA

- The sequence of nucleotides in DNA encodes the sequence of amino acids in proteins.
    - Adenine, thymine, guanine, and cytosine are the four nucleotide monomers that link together to form double-stranded DNA.
    - Adenine forms hydrogen bonds with thymine, and guanine forms hydrogen bonds with cytosine in double-stranded DNA.
- In a eukaryotic cell, DNA exists in the:
    - Nucleus, where the cell's DNA genome is stored – until its code is transcribed and mRNA carries the code – to ribosomes in the endoplasmic reticulum where it is translated into amino acids
    - Mitochondria and Chloroplast organelles, which were once were free-living prokaryotes that gradually, over time, became part of eukaryotic cells, yet still retain remnants of their prokaryotic genomes

*For more DNA modeling and information see **Dynamic DNA Kit©** and **Flow of Genetic Information Kit©** (high school and college), or the **DNA Starter Kit** (middle school). Teacher resources and student handouts are available.*

Membranes

- Phospholipids spontaneously assemble into membranes
    - Phospholipids are amphipathic – composed of hydrophobic fatty acid tails and a hydrophilic phosphate head group.
    - Unlike the other molecules of life, phospholipids are not joined together by covalent bonds to form the membrane
    - Hydrophobic interactions between the fatty acid tails of the phospholipids stabilize the membrane
    - Membranes function as a hydrophobic barrier between the inside of a cell and the extracellular environment.

- Proteins embed in membranes, including
  - Transmembrane channel proteins
  - Peripheral proteins
  - Receptor
  - Glycolipids – long strands of sugar molecules

For more modeling and information on membranes, please see the ***Mosaic Membrane Mighty Model©*** *and its slide deck,* ***Modeling Biological Membranes*** *and the* ***Phospholipid & Membrane Transport Kit©,*** *with its teacher guide and student handouts. Both are suitable for high school and college.*

Next Generation Science Standards

Science and Engineering Practices	Cross Cutting Concepts	Disciplinary Core Ideas
Developing and Using Models	Scale, Proportion and Quantity	HS-LS1.A
Constructing Explanations and Designing Solutions	Structure and Function	HS-LS1-2