Chemistry for Health Science - Unit 3 - Pharmaceuticals

Unit Focus

Students will investigate chemical structures and general properties of carbohydrates, lipids, proteins, and the relevance of nucleic acids as they seek to understand the natural polymers in the human body and how they function to maintain health. Students will explore the properties of medications with regard to how the structure of medicinal compounds relates to their functionality. Emphasis will be on the application of carbohydrates to medicinal drug choice (chirality of drugs), the role of lipids in cell membranes (statins and the biochemistry of cholesterol), and how enzymes regulate body processes. Students will have a culminating experience in which they will act as a pharmaceutical representative as they teach others about the specifics of a pharmaceutical drug.

Stage 1: Desired Results - Key Understandings

Standard(s)

Next Generation Science Standards (DCI)
Science: 10

- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy. *PS1.9.B1*

NGSS/NSTA Science & Engineering Practices
NGSS Science & Engineering Practices: 9-12

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. *SE.9-12.3.2*
- Select appropriate tools to collect, record, analyze, and evaluate data. *SE.9-12.3.4*

Transfer

T1 Create models to explore complex systems, show mastery of key science concepts, and/or develop solutions through creation of a product open to testing and redesign.
T2 Analyze qualitative and quantitative data to interpret patterns, draw conclusions, and/or make predictions.

Meaning

Understanding(s)

U1 Carbohydrates, lipids, proteins, and nucleic acids are the four macromolecules essential for life's processes.
U2 Bodies break down food through a series of chemical reactions. The products of these reactions are then used for structures and processes in the body.
U3 Many pharmaceutical medications are chiral compounds.
Can the statement below be made into an understanding?
About more than half of the drugs currently in use are chiral compounds and near 90% of the last ones are marketed as racemates consisting of an equimolar mixture of two enantiomers.
U4 An understanding of macromolecules and their 3D structure enables structure based design of pharmaceuticals so that the pharmaceuticals complement receptor macromolecules in the body, resulting in several advantages to the patient, including increased therapeutic effect, reduced side effects, and highly specific release mechanisms.

Essential Question(s)

Q1 What are the important natural polymers in the human body and what are their functions?
Q2 How do cells obtain energy from their environment?
Q3 Why is chirality important in biological systems and medications?
Q4 How does understanding of the role of macromolecules in the human body impact the selection of medication when treating conditions?

Stage 1: Desired Results - Key Understandings

	Acquisition of Knowledge and Skill	
	Knowledge	**Skill(s)**
• Make directional hypotheses that specify what happens to a dependent variable when an independent variable is manipulated. *SE.9-12.3.5* • Make a quantitative and/or qualitative claim regarding the relationship between dependent and independent variables. *SE.9-12.6.1* • Apply scientific reasoning, theory, and/or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion. *SE.9-12.6.4* **Student Growth and Development 21st Century Capacities Matrix** **Madison Public Schools Profile of a Graduate** *Critical Thinking* • Analyzing: Examining information/data/evidence from multiple sources to identify possible underlying assumptions, patterns, and relationships in order to make inferences. (POG.1.2) *Collaboration/Communication* • Collective Intelligence: Working respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. (POG.3.1)	**K1** ATP is the energy storage molecule. **K2** Carbohydrates are metabolized through glycolysis, the Kreb's cycle, and electron transport chain. **K3** Lipids are metabolized through oxidation. **K4** Proteins are metabolized through the urea cycle, which is related to genetic diseases and metabolic disorders. **K5** When pharmaceuticals complement receptor macromolecules in the body, there are several advantages to the patient, including increased therapeutic effect, reduced side effects, and highly specific release mechanisms.	**S1** Determine the root cause and manifestations of a disease, from a molecular perspective, and how the disease can be treated. **S2** Analyze a variety of medicinal compounds to understand how their structure relates to their functionality in the human body. **S3** Explain how pharmaceutical drugs are synthesized and marketed based on their structure and function.