

## NGSS Connections

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### Crucial Concentration

High School

**Performance Expectations:** Students' ability to complete the following performance expectation(s) will be supported by participation in this activity.

**HS-LS1-1:** Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential function of life through systems of specialized cells.

**HS-PS1-2:** Construct and revise an explanation for outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

**HS-PS1-7:** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

Dimension	NGSS Code or citation	Corresponding student task in activity
<b>Disciplinary Core Idea</b>	LS1.A: Structure and Function <ul style="list-style-type: none"> <li>Systems of specialized cells within organisms help them perform the essential functions of life.</li> </ul>	In the macromolecules pre-lab activity, students will consider and explore the role of macromolecules (including proteins) in the cell and the body.
	PS1.B Structures and Properties of Matter <ul style="list-style-type: none"> <li>The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.</li> </ul>	Students will use the results of a chemical reaction (Lowry Assay) to determine the absorbance values of known quantities of protein. They will then use Beer's law to calculate the concentration of sports drinks for which they have absorbance values.
<b>Practice</b>	Planning and Carrying out Investigations <ul style="list-style-type: none"> <li>Conduct an investigation and/or evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation.</li> </ul>	Students will conduct an investigation to determine which of three sports drinks has the most protein.
	Construct an explanation <ul style="list-style-type: none"> <li>Construct an explanation using models or representations.</li> </ul>	Students will make a claim as to which sports drink contains the most protein and use data from their investigation as evidence to support their claim. They

	<ul style="list-style-type: none"> <li>Construct a scientific explanation based on valid and reliable evidence obtained from sources (including students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.</li> </ul>	will provide scientific reasoning to connect their evidence to their claims.
<b>Crosscutting Concept</b>	<p>Patterns</p> <ul style="list-style-type: none"> <li>Use mathematical representations to identify certain patterns.</li> </ul>	<p>Students will observe the patterns of color change in their samples after performing the Lowry Assay.</p> <p>Students will plot their data on a graph, and use Beer's Law to determine concentration of unknown proteins.</p>
	<p>Cause and Effect</p> <ul style="list-style-type: none"> <li>Students suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems.</li> <li>Students will use cause and effect relationships to predict phenomena in natural or designed systems.</li> </ul>	<p>Students will explore how specific chemical reactions cause color changes based on protein concentration.</p> <p>Students will use empirical evidence based on cause and effect of specific chemical reactions to make claims about the amount of protein in sports drinks.</p>
	<p>Energy and Matter</p> <ul style="list-style-type: none"> <li>Energy cannot be created or destroyed. It only moves between one place and other, place, between object and/or field, or between systems.</li> </ul>	Students will use chemical reactions to quantify the concentration of a colorless protein.

### Nature of Science

Scientific Knowledge is Based on Empirical Evidence

- Science knowledge is based upon logical and conceptual connections between evidence and explanations.

Scientific Models, Laws, Mechanisms and Theories Explain Natural Phenomena

- Theories and laws provide explanations in science, but theories do not with time become laws or facts.
- Laws are statements or descriptions of the relationships among observable phenomena.

Scientific Knowledge Assumes an Order and Consistency in Natural Systems

- Science assumes the universe is a vast single system in which basic laws are consistent.

### Connections to Common Core State Standards

English Language Arts/Literacy

Mathematics

RST.9-10.3  
 RST.9-10.4  
 RST.9-10.7  
 RST.11-12.3  
 RST.11-12.4  
 RST.11-12.7  
 W.9-10.1  
 W.9-10.2

HSF.IF.B.5  
 PRACTICE.MP3  
 PRACTICE.MP4  
 PRACTICE.MP5  
 PRACTICE.MP6

**Advanced Placement Standards: Chemistry**

<b>Standard</b>	<b>Associated Activity in Activity</b>
<p>Enduring Understanding 1.D. Atoms are so small that they are difficult to study directly; atomic models are constructed to explain experimental data on collections of atoms.</p> <p>Essential Knowledge 1.D.3.c: The amount of light absorbed by a solution can be used to determine the concentration of the absorbing molecules in that solution, via the Beer-Lambert Law.</p>	<p>Students will use perform a Lowry Assay on protein samples of known and unknown concentrations. They will use a colorimeter to measure the amount of light being absorbed in each sample and use Beer-Lambert Law to calculate the concentration of protein in the unknown samples.</p>
<p>Science Practice 2: The student can use mathematics appropriately.</p>	<p>Students will use Beer's law to determine the concentration of the unknown sports drinks.</p>
<p>Science Practice 5: The student can perform data analysis and evaluation of evidence.</p>	<p>Students will look for patterns and relationships in the data and evaluate that data to answer the question of which sport drink has the highest concentration of protein.</p>
<p>Science Practice 6: The student can work with scientific explanations and theories.</p>	<p>Students will construct a scientific argument to support their claims about which sport drink has the highest concentration of protein. The argument will include evidence and scientific reasoning.</p>