JS002: Foundations in Science: Energy and Matter

Course Description

Foundations in Science: Energy and Matter is a year-long seminar style course that introduces students to the concepts that provide the foundation for physics, chemistry, and biology. Students will explore the ideas that are common to all natural sciences, focusing on energy and matter, and examine these core ideas from the perspective of each discipline. Students will use an inquiry-based approach with an emphasis on acquiring the background knowledge and perspective to develop research problems. Through exploration of the central themes of the course, students will additionally become familiar with the basic principles of scientific reasoning. The primary goal of the course is to provide students with a well-informed introduction to science that prevents common misconceptions and that prepares students for high-school and AP-level laboratory sciences.

Learning Objectives

Through the successful completion of the Foundations in Science: Energy and Matter course, students will:

- have a thorough understanding of energy and matter,
- be able to define and describe energy and matter from the perspective of physics, chemistry, and biology,
- have an appreciation for the relationship between the disciplines of natural science,
- be able to identify interesting scientific questions through observation of the natural world and possess some of the tools and skills necessary to answer those questions,
- be prepared for high-school level science courses.

Course Schedule

In this course, students will engage in a hands-on exploration of ten items (light, rockets, symmetry, water, soap, air, eggs, electricity, sound, and heat) from the perspective of physics in the fall, chemistry in the winter, and biology in the spring. In the process, students will gain a solid foundation for inquiry within and across physics, chemistry, and biology.

Key Assignments

Each semester, the final letter grade will be determined through the following types of assignments:

- **Experiment Write-Up**: Each week students will submit their lab notebook corresponding to the week’s lab work as well as complete additional short answer questions.
- **Quiz**: Each week, at the end of the second discussion, students will complete a brief, multiple-choice quiz on the topics of the week.
- **Midterm and Final Exams**: There will be a comprehensive, written, proctored midterm and final exam each semester.
- **Class Participation**: Students are expected to participate in in-class discussions and be part of an active learning environment. This portion of the grade will be determined based on attendance and regular participation in the discussion including and answering questions using Learning Catalytics during class meetings.
Sample Assignments

An example of an assignment trio in Foundations in Science is the experiments with light. From the perspective of physics, we experimentally determine the speed of light using chocolate in a microwave oven. Later in the year, as chemists, we model the way in which atoms and molecules in the atmosphere interact with light by scattering it. Finally, we experiment with the ways in which light interacts with living things by growing plants under different colors of light filters. After completing this trio of experiments and comparing results in discussion, Foundations in Science students are able to answer questions such as "What kind of energy does an electromagnetic wave possess? What can it do?" "Why does a home-made spectroscope pointed at a yellow computer monitor show red and green lines?" "Why is the sky blue?" "How do sodium atoms in the atmosphere of the sun interact with the sun's radiation?" "Why and how is the color of light important to the growth of plants?"