Liquid Crystals: The Fourth State of Matter

Concepts:

States of matter, liquid crystals, nanotechnology, diffraction

Use the following recommendations to increase and/or decrease the challenge difficulty for your students.

Short-on-time Inquiry Lab:

In this experiment students will investigate liquid crystals and observe how different ratios of the same chemicals can produce liquid crystals with sensitivity over different temperature ranges. They will examine their assigned mixture with light and dark backgrounds to see how the color of the crystals change. They will also observe how the colors change under white light while being heated.

Guided Inquiry Lab:

This lab builds on the previous lab by having the students further explore the properties of their liquid crystals. In this version groups will have two mixtures to observe and test. Along with the light reflection and transmission experiments from the short version, students will also determine the temperature range of their liquid crystal mixtures.

Open Inquiry Lab:

For this version, students are given two vials of liquid crystals to evaluate. While the preparation is laid out for them, each group must design an experiment to evaluate the properties of their liquid crystals. They are given some criteria to help guide them, but they must decide the best approach to observe the absorption and transmission of light, along with determining the range of their liquid crystals.

Advanced Inquiry Lab:

The first three parts of this lab are the same as the guided version. Each group is assigned one liquid crystal mixture and must evaluate its properties. The last part of this lab has groups working together to create their own aquarium temperature strip. They must confer with other groups to determine which vial numbers correspond to which temperature ranges. They must create a temperature strip with an uninterrupted range.

Outcomes:

Liquid crystals are an odd substance. They go from a white power to an opalescent shimmery liquid when heated. The colors appear differently when they are on a white versus black background and when looked at with white light. Liquid crystals as temperature strips work best on a black background. When heated, the red color indicates the lower edge of the temperature range. Green is the middle, and blue is the top of the temperature range. When the ratio favors the cholesteryl oleyl carbonate, the temperature range is low. When the ratio favors cholesteryl pelargonate, the temperature range is higher.

Associated Phenomena:

Product Design

Standards

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and carrying out investigations Analyzing and interpreting data Constructing explanations and designing solutions Obtaining, evaluating and communicating information	HS-PS1.A: Structure and Properties of Matter HS-PS2.D: Types of Interaction HS-PS1.D: Chemical Reactions HS-ETS1.C: Optimizing the Design Solution	Patterns Structure and Function Stability and Change of Systems

Performance Expectations

HS-PS1-3: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.