

Measurement of the Length of a Fatty Acid Molecule

Experiment Overview

It is often difficult to find laboratory activities which provide students with hands-on experience and data relating directly phenomena at the atomic or molecular level. This experiment is extremely easy to carry out, even for multiple labs for large cohorts of students, but still provides some direct data relating to the behaviour of single molecules of oleic acid. Analysis of the data requires students to;

- theorize about how individual molecules are behaving when added to water
- apply an understanding of the polar nature of water molecules and how this affects the way it interacts with non-polar molecules
- apply an understanding of how amphipathic molecules, in particular, behave in water.
- apply this understanding to how phospholipids behave in water leading to the formation of a bilayer.
- Develop and use skills in computations involving dilutions, area, volume, units of measurement, and exponents.

The last point is quite important in that the decline in quantitative skills in students of science is becoming widely recognized. See, for example, the Quantitative Skills in Science project [<http://www.qsinscience.com.au/>] Building a basic level of skills is becoming a serious problem for foundational course in all areas of science.

Learning Experience

This experiment provides students with an experience that extends their understanding in several areas. Within this context its main aim is to provide a basis for discussing the chemical basis of the phospholipid bilayer and its basis in the interactions between the lipid molecules and water. It also provides much needed practice in carrying out computations in scientific experiments, an area where many students lack confidence. It also emphasises the links between chemistry and biology, which is important since many are also enrolled in a Chemistry course, although not always willingly.

The reason for submitting this laboratory exercise is that it is one of my favourite student activities, not only because it is rather neat to be able to estimate the size of an individual molecule with such simple equipment but for its pedagogic power; it's relevance to so many conceptual areas of understanding.

Aims and Objectives

The experiment aims to provide a link between the chemical and physical properties of fatty acids and water and the formation of lipid layers in watery environments.

Students will

- Understand how some physical properties, particularly polarity, of fatty acids relate to how they behave in water, and relate this to the structure of the phospholipid bilayer.
- Carry out a simple experiment applying the physical behaviour of water to approximate the dimension of a fatty acid molecule
- Apply their understanding of these interactions to carry out appropriate computations to calculate the average carbon-carbon bond length in a biomolecule.
- Understand that there are strong links between fundamental ideas in chemistry and biological systems.

Level of Experiment

First year Biology

Keyword Descriptions of the Experiment

Domain

Biomolecules, Cell Membrane

Specific Descriptors

Behaviour of fatty acids in water

Course Context

Students are covering the section on cell chemistry, biomolecules and membrane structure. This includes some understanding of polarity of water molecules and the amphipathic nature of some lipids, including phospholipids.

/span>

Prerequisite Knowledge and Skills

Assumed knowledge and skills include a capacity to carry out computations involving dilutions and the calculation of volume. Students also need to handle exponents in calculations.

Time Required to Complete

Prior to Lab: 15 minutes

In Laboratory: 15 minutes

After Laboratory: 15 minutes

Experiment History

I have conducted this experiment over the last 20 years in senior secondary science classes, and this protocol is quite well known in both chemistry and physics teaching. Its origin is not known.

The particular worksheet used in this exercise is from David A. Katz's www.chymist.com website (2004).

Comments

This laboratory exercise can be used within many contexts. It can provide a focus on diverse conceptual areas, from atomic structure to the structure of the lipid bilayer.

References

Katz, D A. (2004) Downloaded from <http://www.chymist.com/size%20fatty%20acid.pdf>