Kaleidoscope of Milk (The polarity of molecules)

Target audience: grades 6-12

Background and Notes:

Covalent and lonic Bonding can be predicted from an electronegativity table. Molecular geometry can be determined by drawing electron dot models. Molecular geometry determines Polarity and subsequent Intermolecular forces.

This activity relates molecular motion to polarity and nonpolarity of molecules. Milk consists of polar (sugars and salts) and nonpolar (fats and lipids) components. Detergents have polar and nonpolar regions to their molecules, therefore the constant attractions and repulsions between the different regions and types of molecules results in the motion (kinetic energy) that subsequently ensues.

Knowledge and skills:

- Students should be able to relate concepts of molecular geometry to the polarity of molecules.
- Students should be able to connect molecular motion to the attractions and repulsions of differently polar molecules.

Fundamental understanding:

• Potential energy is stored in molecules and can be translated into kinetic energy due to polarity differences between molecules.

Essential Question:

• How does polarity relate to molecular motion i.e. kinetic energy?

National standard:

• National content standard B, students should develop an understanding of the structure of atoms and the structure and properties of matter. Students should understand the motions and forces with Interactions of energy and matter.

State standard(s):

• 1.02 and 1.07 Objectives for North Carolina Standard Course of Study Objective: Bond Polarity and molecular polarity, including intermolecular forces in order to explain polarity

Hypothesis: Molecules of same and different polarities will repel and attract each other resulting in observable motions.

Safety Precautions: Food dyes may stain clothing and hands.

Materials:

• Equipment:

- 1. Used clean aluminum pie plates (one per 2 students)
- 2. Toothpicks (1 box/ group of 4 students)
- 3. Small 500 ml beakers or small paper or plastic cups to hold a dab of detergent (one per 2 students)

• Reagents:

- 1. Milk (whole mild containing more fats works best)
- 2. Set of 4 food dyes (1 box/ group of 4 students)
- 3. Dish-washing detergent or shampoo (a small dab into small beaker- one per 2 students)

Procedure:

- 1. Pour enough milk into pie plate to cover the entire surface about 1/4 inch deep.
- 2. Add one drop of each different color food dye to each quadrant of milk in the pie plate, careful not to mix.
- 3. With single toothpick, add a small amount of detergent into the center of the pie plate containing milk. Hold the toothpick still and wait to see what happens?

Results:

- 1. Draw a picture before and after adding the detergent.
- 2. Describe what happened after adding the detergent.

Conclusion:

- 1. Restate the hypothesis.
- 2. What is the molecular basis for your observation?
- 3. What types of molecules are in milk?
- 4. What types of molecules are in detergents?
- 5. What types of molecules are in food dyes?
- 6. What do you think is the shape of the molecules in this activity?
- 7. How would you change or improve this activity/experiment?
- 8. What would you do next in another investigation?

References and Resources:

Chemistry book containing information about bonding, molecular geometry, polarity, and dipoles

Teacher Notes:

Set Up each lab station:

- 1. 2 small beakers with a dab of detergent
 - 2. 2 pie plates
 - 3. 1 box of 4 food dyes
 - 4. 1 box of toothpicks
 - 5. Approximately 1/2 cup milk per 2 students usually one gallon is enough for one class of 26 students