THE UNIVERSITY OF TEXAS AT AUSTIN
College of Natural Sciences

Chemical Engineering Station

Lesson created by: UTeach Outreach
Date of Lesson: Fall 2014
Description of Students: Small groups or an event table
Length of Lesson: 20 - 30 minutes
Source of Lesson:
http://en.wikipedia.org/wiki/Chemical_engineering
http://mrsec.umd.edu/News/Details/MarylandDay/SillyPuttyInfo.pdf
http://chemistrytwig.com/2011/05/19/are-chemistry-and-chemical-engineering-the-same-thing/
http://www.ceb.cam.ac.uk/exemplarch2002/mcp21/chemistry.html
http://rchemistry.wikispaces.com/file/view/lipid-bilayer-structure.jpeg/335928822/410x254/lipid-bilayer-structure.jpeg

TEKS addressed
4.5A measure, compare, and contrast physical properties of matter, including size, mass, volume, states (solid, liquid, gas), temperature, magnetism, and the ability to sink or float;
4.5C compare and contrast a variety of mixtures and solutions such as rocks in sand, sand in water, or sugar in water.

I. Objectives

Students will be able to:

1. Distinguish between hydrophilic and hydrophobic substances
2. Identify and distinguish substances based on physical properties
3. Develop a better understanding of Chemical Engineers

II. Background Information

Background Information for Slime

How does Silly Putty work?

Silly Putty is a polymer made from silicone oil and boric acid. A polymer is a chain of molecules that areall tangled up. Silly Putty has flexible molecules that, when smooched by fingers, slide over each other and cause the material to flow. Therefore, Silly Putty is considered an elastomer. An elastomer springs back to its original shape after being twisted, pulled, or compressed. Besides silly putty, an example of an elastomer is a rubber band or a car tire.

The liquid latex (Elmer's glue) that you are using in this experiment contains small globules of hydrocarbons suspended in water. The silly putty is formed by joining the globules using sodium borate (borax, a cross-linker). Very weak intermolecular bonds that provide flexibility around the bond and rotation about the chains of the cross-linked polymer hold the silly putty together.

Silly Putty is a viscoelastic liquid. It acts primarily as a viscous liquid, though it can have properties of an elastic solid, too. There are covalent bonds within the polymer, but hydrogen bonds between the molecules. The hydrogen bonds can be readily broken. When small amounts of stress are slowly applied to the putty, only a few of the bonds are broken. Under these condition, the putty flows. When more stress is applied quickly, many bonds are broken, causing the putty to tear

III. Resources, materials, and supplies

- Water
- Clear vial with water and yellow oil
- Newspaper
- Borax
- Elmer's glue
- Zipper-lock baggies
- Small plastic cups
- Vials
- Small plastic spoons
- Paper towels

IV. Advanced Preparation

- Prepare the borax solution before students arrive:
    - Measure ½ cup of warm water into a cup and add a teaspoon of Borax powder, stir
    - Measure out 10 ml of the borax solution and put them into vials for each student
- Have the small plastic cups already filled $1/8^{th}$ deep with glue for each student
- Pre-make one baggie of slime
- Lay out newspaper at each station

V. Possible Misconceptions

- **Chemical Engineers and Chemists are the same.** Chemists study molecules and chemical reactions which lets them create new substances of and what is needed to produce them. Chemical engineers take a chemist's findings and design machines to produce them on a commercial scale

VI. Vocabulary/ Definition

For Outreach Students:

- **Hydrophobic:** the physical property of a molecule that is repelled from a mass of water
- **Hydrophilic**: a molecule that is attracted to, and tends to be dissolved by, water.

For elementary level:

- **Hydrophobic:** substances that does not mix with water. "water-hating"
- **Hydrophilic:** substances that mix with water. "water-loving"

VII. Safety Considerations: no safety considerations needed

VIII. Question of the Day

What roles do Chemical Engineers play in our society?

Five-E Organization

ENGAGEMENT (2-3 MIN)		**Time: 3-4 minutes**
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
Safety is very important so don't taste anything this experiment, make sure to follow directions, and ask questions if needed. **Show hydrophobic and hydrophilic diagram.** *This show a diagram of a substance with hydrophilic and hydrophobic properties. Hydrophobic means that it doesn't mix with water. Hydrophilic means that it will mix with water.* **Have students repeat 'hydrophobic' and 'hydrophilic' back to you** **Hold up vial with oil and water.**	What kind of property would you say oil has? So what region on the diagram would you find oil?	Hydrophobic [point to] hydrophobic

EXPLANATION		**Time: 5 minutes**
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
Chemical engineers are essential part of our society. But sometimes there is confusion between chemists and chemical engineers. Chemists study molecules and chemical reactions which lets them create new substances and find out what is needed to produce them. *However, chemists are not equipped to design machines to produce chemicals on a commercial scale. This is where engineers come in. They are able to take a chemist's findings and mass produce machines based on them.* *So looking at our oil mixture, a*		

chemist would have to know the chemical reaction between hydrophobic and hydrophilic substances and an engineer would find a way use that it in society, such as making slime. *Today, we are going to be chemical engineers: we are going to create our own silly putty.* **Pass out cups of glue, borax vials, and spoons.** *I am passing out a cup that contains some glue. We are going to add some food coloring to our glue to give your slime some color.* **Have students pick any color food coloring and add 1-2 drops into their cups.** *Now I want you to pick up your vial of solution, unscrew the cap slowly and pour it into your cup. Now pick up your spoons and start stirring!* **When the students are done, hand each of them a bag that they can label and put their slime into.**		

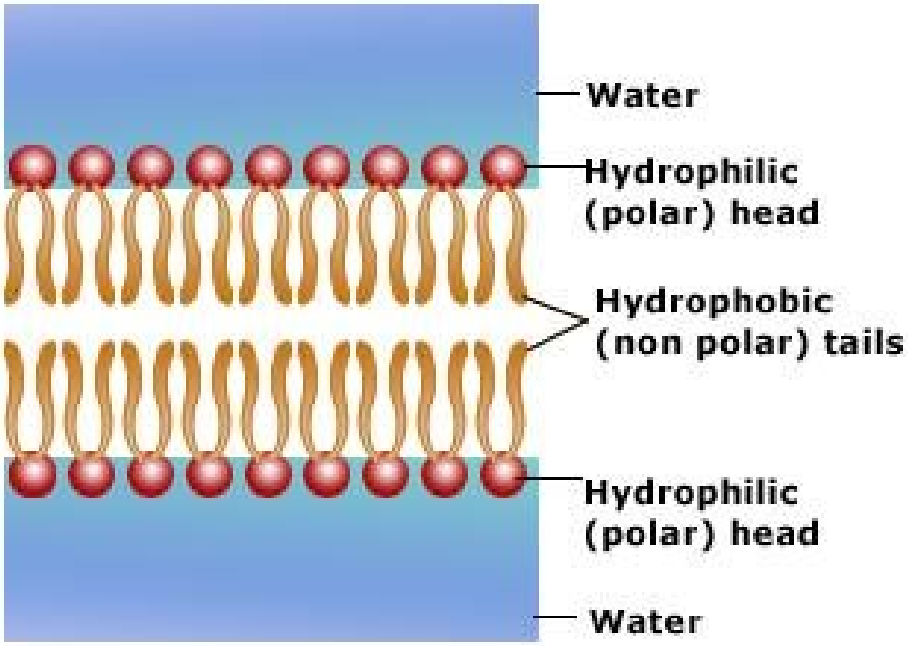
ELABORATION		**Time: 5-10 minutes**
What the Teacher Will Do	**Probing Questions**	**Student Responses** **Potential Misconceptions**
*There are two groups of chemical engineers: chemical **process** engineers, who design, make and operate machinery; and chemical **product** engineers who develop new or adapted substances for products such as food and beverages, cosmetics, cleaners, and pharmaceutical ingredients.* **Have students say product engineer and process engineer**	Which kind of engineer do you think you were today?	Product engineer

ELABORATION		Time: 5-10 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
Correct! We were product engineers today because we used existing material to make new ones.	What products did we make today? What did we use to make our product?	We made slime! Glue, borax solution , food coloring, etc

EVALUATION		Time: 5-10 minutes
What the Teacher Will Do	**Probing Questions**	**Student Responses Potential Misconceptions**
	What kind of properties does oil in water exhibit?	Hydrophobic
	What are the two types of chemical engineers?	Process and product
	If I am cooking spaghetti and I put olive oil in by pot of water, what would happen?	The water and oil would not mix
	What are some materials used in this station that are due to our chemical engineers?	Many responses

Question of the day:

What roles do Chemical Engineers play in our society?


Water
Hydrophilic
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Water