Students assigned to Unit 2 in the cooking lab will complete this part of the assignment:

Observe and Analyze Data from Lab

- Upload the results from the "Observe and Analyze" assignment given to you by Dr. CK in this assignment box (hint: you can scan it as a pdf file or take a photo of it with a tablet/phone (make sure I can see it and read your writing!) and upload it)

Critically Think Summary Instructions:

- At the top of your paper, include the following: the names of the recipes prepared during lab and the names of the members of your "kitchen unit".
- Copy the questions below into a word document, answer them, and then upload the document with your answers in this assignment box.
- Formatting requirements for the Critically Think Summary: 2-3 pages. 1" margins. 1.5" spacing. 11 point font.

Questions to answer for the Critically Think Summary:

1. Describe the chemical changes that occurred to turn the salad dressing into an emulsion once it was mixed.
2. Which salad dressing held together the longest? Using the scientific principles learned in class, explain why this occurred (think about the ingredients used or not used in the recipe, tools used to mix the dressings).
3. Describe how each group member contributed to the Critically Think assignment.

Additional Notes:

- After I grade your uploaded submission, you will have 3 days to improve the document and resubmit it. I will review it and give you the final approval to post it on the discussion forum.
- Once you have your final grade, upload the questions and answers for questions #1 and #2 in the discussion form for your classmates to read and reflect on your summary.

Student Response:

1.Describe the chemical changes that occurred to turn the salad dressing into an emulsion once it was mixed.

The basic ingredients in a salad dressing involve oil and vinegar. However, different preparation methods and additions to this mixture can yield dramatically different results in an end product. Oil and water form what is known as an emulsion. An emulsion can be defined as a liquid being dispersed into another liquid in which it is usually incapable of being mixed. Water, consisting of polar, hydrophilic molecules are repelled by the nonpolar molecules found in oil. In a salad dressing, the two phases of the emulsion, being the dispersed phase and continuous phase, are kept apart by surface tension, and the boundary between them being the interface. In order for these phases to mix more readily, the surface tension needs to be lowered. Mixing an emulsion plays a huge roll in its stability, furthermore, the addition of shearing power provides increasing degrees of stability. A higher shearing power increases the emulsion’s capacity to resist separation.

When adding the vinegar and oil together, the particles in the dispersed phase which in this case is oil, collide to form large droplets and the phases remain separate. In order for the two phases to combine, certain external factors come into play. Without the addition of an emulsifier, mixing and providing shearing power to the phases can allow for them to create temporary and semi-permanent emulsions. Mixing in general will allow for the dispersed molecules to be broken apart from the large droplet and form smaller droplets that are then more dispersed in the continuous phase. When mixing with a whisk, the amount of shear power is strong enough to break the fat particles into smaller pieces creating a temporary emulsion. In a temporary emulsion, the solution is very unstable and will separate within a short amount of time. In this emulsion, dispersed particles will again form large droplets on top of the vinegar. With more shearing power through the use of a blender, the fat particles become much smaller and further dispersed in the continuous phase. With smaller fat particles throughout the continuous phase, the emulsion is much more stable and can resist separation for a longer period of time than an emulsion mixed using a whisk. It will take a longer time for the small particles to reform into larger droplets, but eventually over the course of hours, the solution will become separated.

The stability of emulsions is determined by the shearing power as mentioned above, but can become further stabilized by the addition of emulsifying agents and stabilizers. As previously stated, lowering the surface tension between the dispersed and continuous phases allows for a semi-permanent or permanent emulsion to be created. The addition of a stabilizer adds viscosity to the solution and decreases the tendency for the emulsion to separate. A stabilizer such as honey will allow for a thicker and more viscous dressing to be created once mixed with a high shearing power and increase the amount of time that the emulsion remains in that state. Although a stabilizer alone will not create a permanent emulsion, the addition of an emulsifier will. An emulsifier contains both polar and nonpolar molecules, that once added to the solution will form bonds with other emulsifier molecules to create a stable film that disturbs the interface between the phases. This film resists the dispersed phase from forming together because they are surrounded by the stable film from the emulsifier. The dispersed particles are able to collide with one another without coalescing.

2. *Which salad dressing held together the longest? Using the scientific principles learned in class, explain why this occurred (think about the ingredients used or not used in the recipe, tools used to mix the dressings).*

Out of the three dressings we prepared, the dressing that contained the addition of mustard and honey, and was mixed through blending held together the longest. This dressing was able to hold together the longest because it was prepared with specific ingredients, and was combined with a high shearing power (blender).

The ingredients that contributed to the stability of the dressing were mustard and honey. Mustard, in emulsions, will act as a natural emulsifier. An emulsifier works to link fat and water particles together. Emulsifiers can be found as amino acid chains, or as phospholipids. The chemical components found in mustard are what allows it to be an emulsifier for mixtures like the dressing we created in class. The mustard seed contains a great amount of mucilage, a thick gluey substance that many plants produce. When mixed in fat, the chemicals found in mucilage will surround fat particles in an emulsion, allowing these molecules to mesh better with water molecules in the solution. Aside from its flavorful taste, mustard's emulsifying properties is why it is often added to homemade and commercial salad dressings.

The honey added to the dressing was acting as a stabilizer to the emulsion. A stabilizer prevents the breakdown of emulsions by getting in the way of the dispersed phase. The dispersed phase in terms of our dressing was the oil. Stabilizers are large molecules that are water-soluble, therefore, typically added to the continuous phase. The continuous phase in terms of our dressing was the vinegar, as it consists of water. Stabilizers, like honey, use their molecular composition and thickness to block fat molecules from coming back together. Stabilizers are also able to add viscosity to the emulsion. Adding viscosity creates a thicker continuous phase, which allows for a delay in potential joining of the dispersed phase. The increased viscosity is also able to keep the fat particles in solution relatively small, making it hard for them to come back together as well. Because the shearing power is increased with velocity, the emulsion is able to stay together even longer.

Last, while preparing the third dressing, we used a blender to mix our ingredients, which was able to increase the shearing power greatly in the emulsion. The shearing power is the mechanism that is going to break the dispersed phase into particles. The smaller the particles, the better and more stable the emulsion will be. When we used a whisk for the first dressing, we had a lower shearing power, and our dispersed phase particles were a lot larger. Because the molecules were a lot larger, they are able to come together more easily. We were able to notice this when our salad dressing separated in a short amount of time. When we used the blender for the second dressing (without mustard and honey), the shearing power was the factor that contributed to the increased stability of the vinaigrette. We noticed this dressing stay together a lot longer than the whisked dressing. In the third dressing, we blended the dressing again, and added an emulsifier and stabilizer. With the blender, we were able to break the dispersed phase into smaller parts, preventing the breaking of the emulsion. Both the blender and added ingredients were what helped make the third dressing the most stable of the three.