Lecture Notes

Eggs are delicious, protein-packed, and can be used in every meal of the day. We're going to focus on two subjects: protein coagulation and heat with agitation vs. protein coagulation and heat with emulsion and temperature control. I'll review hard boiled, meringue, hollandaise, and poached egg variations.

In our Chocolate Chip Cookie (heat) video and our Ricotta (acid) video we discussed protein coagulation using heat and acid, but let's talk a bit more about proteins.

Proteins are made of long chains of amino acids, the building blocks of proteins. The proteins in an egg white are globular proteins, which means that the long protein molecule is twisted and folded and curled up into a more or less spherical shape, like a ball of yarn. A variety of weak chemical bonds keep the protein curled up tight as it drifts placidly in the water that surrounds it. Through the application of heat, we are able to denature the protein and unravel that ball of yarn.

Hard Boiled

Step one: Cover eggs with cold water in a saucepan. You'll want the eggs to have about 1/2 an inch of water over the top.

Step two: Heat the pan on high heat to bring the water up to a boil. Remember water boils at 212 degrees. We're going to add a teaspoon of vinegar just in case a shell cracks and 1/2 teaspoon of salt to help prevent cracking. This is an excellent illustration of carry-over cooking. We aren't applying additional heat, but our food is still cooking!

Step three: Turn off the heat and let sit for 6-16 minutes. Since we are going to use these in a salad, I'm going to go for 6 minutes, but if I was making deviled eggs, or egg salad, I'd go with the full 16.

Step four: Strain the eggs and change the water out for ice water. I like peeling eggs under running water. If you are cooking a bunch of eggs in advance, keep them covered in the refrigerator for up to 5 days.

Now let's discuss what is going on…

When you apply heat, you agitate those placidly drifting egg-white proteins, bouncing them around. They slam into the surrounding water molecules; they bash into each other. All this bashing about breaks the weak bonds that kept the protein curled up. The egg proteins uncurl and bump into other proteins that have also uncurled. New chemical bonds form—but rather than binding the protein to itself, these bonds connect one protein to another.

After enough of this bashing and bonding, the solitary egg proteins are solitary no longer. They've formed a network of interconnected proteins. The water in which the proteins once floated is captured and held in the protein web. If you leave the eggs at a high temperature too long, too many bonds form and the egg white is rubbery.

Meringue

When you beat raw egg whites to make a meringue, you incorporate air bubbles into the water-protein solution. Adding air bubbles to egg whites denatures (or unfolds) those egg proteins just as much as heating them.

I mentioned amino acids earlier, let's get into that a little more… some amino acids are hydrophilic, or water-loving. Other amino acids are repelled by water, meaning they're hydrophobic, or water-fearing.

Egg-white proteins contain both hydrophilic and hydrophobic amino acids. When the protein is curled up, the hydrophobic amino acids are packed in the center away from the water and the hydrophilic ones are on the outside closer to the water. (Kind of like the ball of yarn is wearing a raincoat)

When an egg protein is up against an air bubble, part of that protein is exposed to air and part is still in water. The protein uncurls so that its water-loving parts can be immersed in the water—and its water-fearing parts can stick into the air. Once the proteins uncurl, they bond with each other—just as they did when heated—creating a network that can hold the air bubbles in place.

With the addition of sugar, we get very stable air bubbles that will now allow us to hold a variety of shapes, whether we decide to cook the meringue or not.

Hollandaise

We've previously discussed emulsions when we discussed the Creaming Method and chocolate chip cookies and the natural state of milk. When making hollandaise sauce we will be creating our own emulsion.

- 4 eggs, separated
- 100g butter - melt and put into a container with a spout
- Put the bowl of yolks over a bain-marie (double boiler), gently simmering.
- Add 1 tablespoon of lemon juice and 1 teaspoon dried mustard then whisk.
- Gradually add small splashes of butter, whisking well after each addition.
- If you see your hollandaise start to separate, drop in an ice cube and keep whisking.
- Once all the butter is incorporated, you'll have a smooth thick sauce. You can thin it with a little white wine vinegar, if needed.

Most food emulsions are known as the oil-in-water type, which means that fat is dispersed through water. To help aid in creating an emulsion, we're going to use two emulsifying agents. Mustard and egg yolks. Egg yolk contains a number of emulsifiers, which is why egg yolks are so important in making foods such as hollandaise and mayonnaise.

Many proteins in egg yolk can act as emulsifiers because they have some amino acids that repel water and some amino acids that attract water. Mix egg proteins thoroughly with oil and water, and one part of the protein will stick to the water and another part will stick to the oil. Egg yolks also contain lecithin which is commonly added to products to help with emulsification, like mayonnaise.

Bonus: Poached Eggs

Step one: Bring a large pot of water to a boil. You'll need at least 4 inches of water.

Step two: Use the freshest eggs possible. While waiting for the water to boil, crack an egg into a small fine mesh sieve over a bowl. Swirl the egg in the sieve until all the liquid egg whites have been removed. Then, place the egg in a ramekin.

Step three: Stir the vinegar into the water and create a vortex. Add the egg to the middle of the vortex and cook the egg for 3 minutes.

Step four: Remove the egg with a slotted spoon and dab it on a paper towel to remove any excess water. Serve immediately.

Sample meals with eggs

- Mediterranean Salad Bowl with Soft boiled egg:
    - swww.eggs.ca/recipes/mediterranean-salad-bowl
- Crispy meringue kisses with ganache
- Pavlova
- Eggs benedict and Avocado toast
- Asparagus

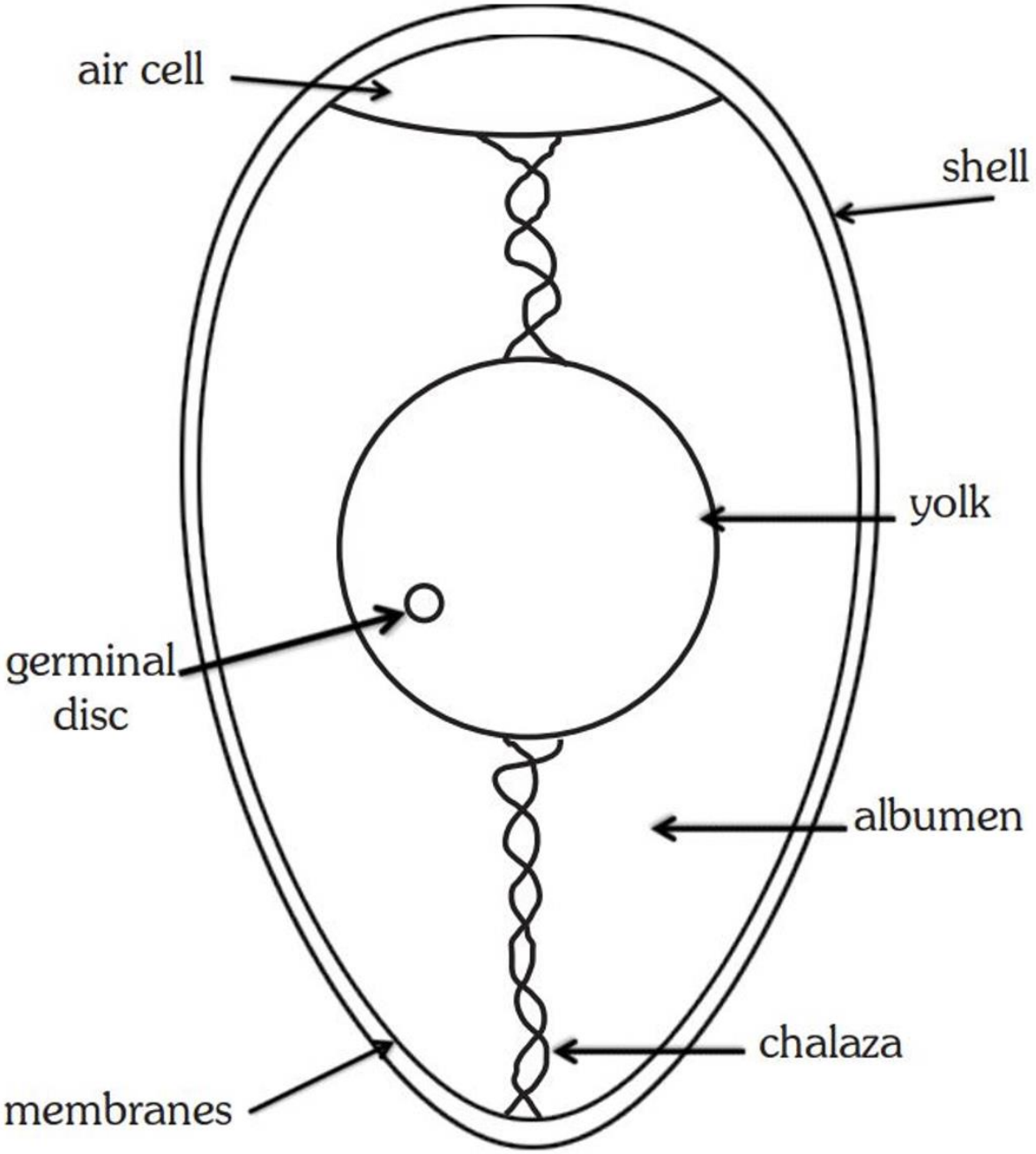
Props Needed

- Assorted salad plates
- Pretty tea towels
- Glass of orange juice
- 2 Cake stands
- Medium-size bowl for salad

Ingredients needed:

- 6 hard boiled eggs
- 6 poached eggs
- Chervil
- Chives
- Avocado
- Salt and Pepper
- Butter
- English muffin
- Whole grain bread
- Asparagus
- Assorted berries
- Lemon curd
- Radishes

Diagram: Parts of an Egg



Culinary Objectives Students will be able to:

- Take temperature of foods at various stages; understand that specific temperature thresholds can have dramatic effects on food.
- Understand basic cheesemaking process: coagulation of curds and separation of curds from whey.
- Describe textures of foods, distinguish between textures they find appealing or unappealing, how to avoid “rubbery” eggs, desired texture of hollandaise.
- Understand that differently prepared foods can be combined to create new combinations of flavor and texture.

Discuss the Big 4:

- Fat
- Salt
- Acid
- Heat

MOTHER SAUCES (web source: www.thesavory.com)

Tomato Sauce —

BASE: Tomato

SECONDARY SAUCES: Spanish, Creole

COMMON USES: pasta

Bechamel (bay-shah-mel) Sauce—

BASE: Milk

SECONDARY SAUCES: Cream, mornay, nantua

COMMON USES: croque madame

Veloute (veh-loo-tay) Sauce—

BASE: White stock

SECONDARY SAUCES: vin blanc, normandy

COMMON USES: roasted chicken and potatoes

Espagnole (ehs-pah-nyol) Sauce—

BASE: Brown stock

SECONDARY SAUCES: demi-glace, bordelaise, madeira

COMMON USES: roasted leg of lamp

Hollandaise (hol-uhn-deayz) SAUCE—

BASE: Egg yolk and butter

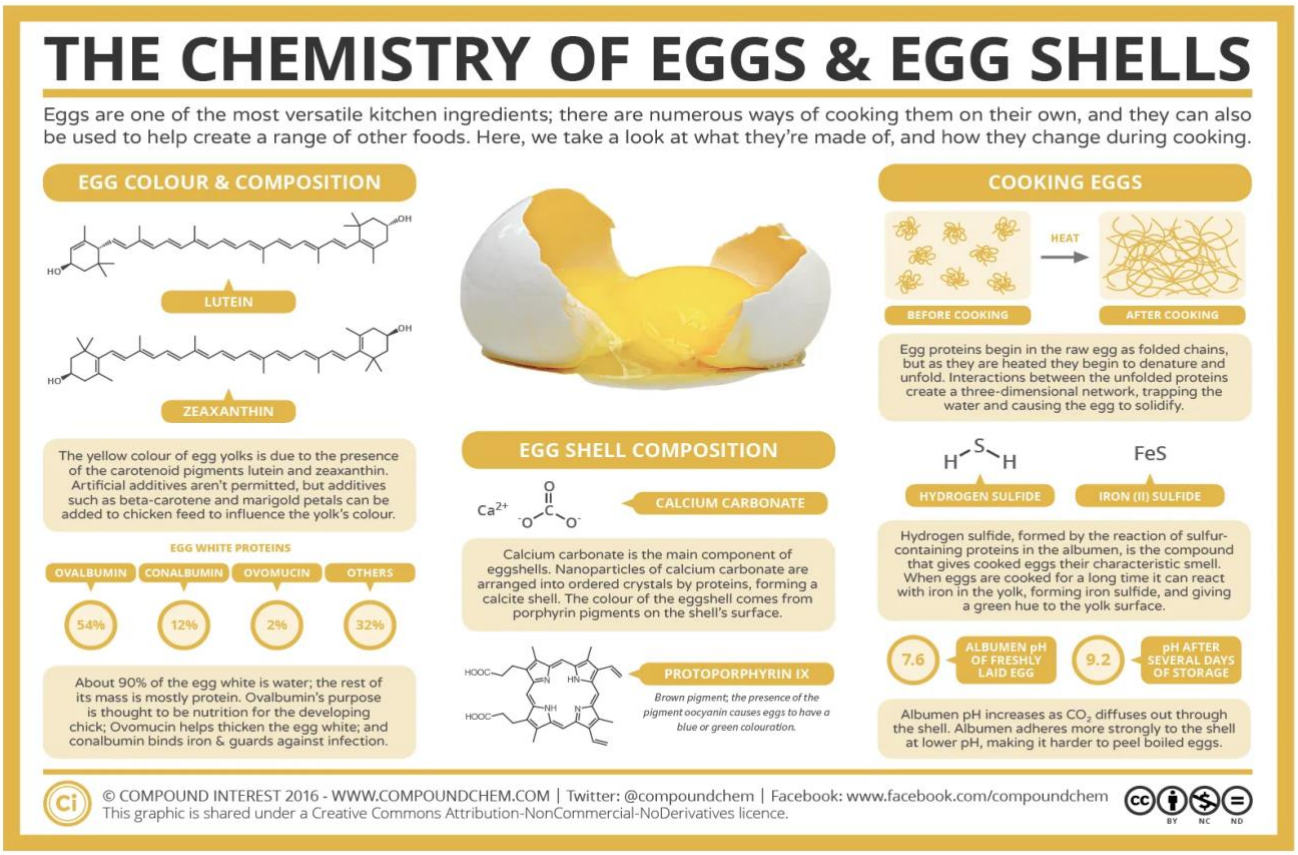
SECONDARY SAUCES: bearnaise, mousseline

COMMON USES: eggs benedict

The Chemistry of Eggs and Egg Shells

The following graphic is a visual aid to illustrate the composition of eggs and egg shells.

SOURCE: www.compound.com



The Scientific Method

Step 1: Ask a Question

Step 2: Research

Step 3: Formulate Hypothesis

Step 4: Test With an Experiment

Step 5: Analyze Your Results

Step 6: If your hypothesis is “true” then you may report your results. If your hypothesis is “false” then you should think about it and go back to step three.

NOTE: The following worksheet is specifically for junior high and/or high school students. Individual teachers will assign points/credit at their discretion. The addition of pictures is vital to maximizing the academic value of this assignment. Please be as thorough as possible with each step.

Title

(Centered, clearly written, concise)

I. Background Information:

State the important concepts and definitions you need in order to complete the lab.

II. Purpose:

Make a statement of purpose or describe what you will investigate.

III. Hypothesis:

An educated guess about what you think the results of the experiment will be. (This is often an if-then statement. For example, if the balloon is inflated, then it will have more mass than the uninflated balloon.)

IV. Materials:

List all equipment and materials, including specific quantities. Remember to include safety equipment like gloves, aprons, or goggles when necessary. Please arrange your equipment and take a picture.

V. Procedure:

Make a list of the steps in the experiment. You may need to draw a labeled diagram of the apparatus or set-up.

VI. Data/Observations:

1. Qualitative Data: observations (Please include pictures of your observations.)
2. Quantitative Data: numbers/amounts, often listed in a table (Please include pictures of your observations.)

VI. Conclusion:

In paragraph form, restate your purpose and hypothesis and explain how you completed the lab. Evaluate your hypothesis based on your data and state whether or not it was correct. Mention any possible sources of error or things that may have had an effect on the accuracy of your experiment. Explain what you learned and the conclusion you came to in your own words. Culinary students should also include a taste evaluation. Make sure you include all those culinary descriptors: chewy, crispy, cakey, bitter, acidic, sour, well balanced, metallic, burnt, salty, gooey, “butterscotchy”, caramelized.

Remember, if you followed the Procedure and your experiment did not turn out according to your Hypothesis, this is not failure, it just means you need to take a second (or third, or forth) look at your hypothesis.

EXAMPLE— Chocolate Chip Cookie Experiment**:**

I. Background Information:

There was a Chef demo covering the creaming method, the function of each ingredient in the recipe, and the necessary equipment needed.

Creaming method: the process of creaming room temperature fat and sugar to create air pockets within a baked product to assist during leavening. Additionally, once eggs are added, the creaming method involves making an emulsion of the fat (and sugar) and the moisture in the eggs. Lastly, the dry ingredients are added to limit gluten formation.

Leavening: a substance used in dough or batter to make it rise. Examples include Chemical: baking soda and baking powder, Natural: yeast and Physical: steam.

Emulsion: An emulsion is a mixture of two or more liquids that are normally immiscible (not mixable or able to blend).

Gluten: a substance present in cereal grains, especially wheat, that is responsible for the elastic texture of dough. Gluten forms when water combines with flour and coaxes the two wheat proteins glutenin and gliadin to combine and form gluten.

II. Purpose:

Since baking soda needs acid in order to activate, I would like to test the original recipe and substitute baking powder to evaluate the final outcome.

III. Hypothesis:

If baking powder is used in the place of baking soda, then there will be no effect on the finished cookie.

IV. Materials:

See recipe, scale, rubber spatula, parchment paper, sheet pan, portion scoop.

V. Procedure:

Pull butter and eggs from the refrigerator to warm up to room temperature, 1 hour prior to making cookies. In a mixing bowl, with a paddle attachment, cream butter and sugar together until light and fluffy. Emulsify eggs into sugar and butter mixture, one at a time. In a separate bowl, combine dry ingredients and whisk to combine. Incorporate dry ingredients into wet ingredients and mix just until combined. Stir in vanilla and baking chips by hand.

VI. Data and Observations

Qualitative Data: observations (Please include pictures of your observations.)

The cookie dough looked just as expected, but the hypothesis specifically relates to baking.
The cookies did not have as much spread as anticipated, and were thicker by 1/8 inch.

Quantitative Data: numbers and amounts, often listed in a table. Include photos of your observations, when possible.

CONTROL RECIPE:

Creaming of butter and sugar: 5 minutes
Emulsification – eggs: 1 minute
Leavening Agent: Baking Soda
Cookie size: 2 oz. scoop
Baking Time: 10 minutes
Temperature: 350 Degrees

CONTROL RECIPE OBSERVATIONS:

Raw cookie dough diameter
Raw cookie dough height
Baked cookie diameter
Raw cookie dough height

TEST RECIPE:

Creaming of butter and sugar: 5 minutes
Emulsification – eggs: 1 minute
Leavening Agent: Baking Powder
Cookie size: 2 oz. scoop
Baking Time: 10 minutes
Temperature: 350 Degrees

TEST RECIPE OBSERVATIONS:

Raw cookie dough diameter:
Raw cookie dough height:
Baked cookie diameter:
Raw cookie dough height:

VI. Conclusion:

My original hypothesis was that the substitution of baking soda with baking powder would not make a difference. My original hypothesis postulated that since baking powder already has acid in it, it would not need the acid from the brown sugar, thus, would not make any difference in baking. My unexpected outcome was that the cookie had less spread, but surprisingly the baking chips were more visible. Additionally, there was a significantly lighter color to the test recipe cookies over the control recipe. The flavor was very similar to the control recipe, but the texture was more cakey, where the control recipe had a thinner, more chewy texture, but was crispy around the edges.

EXPERIMENT WORKSHEET

Purpose. I wonder …

Hypotheses: I think …

Materials:

Procedure:

Results:

Conclusion: I learned that …