Food Project 2008

What is it?	A project that involves research, action, fun, and food.
When is it due?	Wednesday, May 7. Meet in Mr. Wangerin's room and come early to set up.
What's the deal?	You find a recipe, do some chemical and mathematical analysis of it, make the food and a poster describing it, bring the food and poster, eat the food.

Background: Aside from living, cooking is the most purely chemical activity we engage in. Consider cookies: the ingredients, the tastes, the smells, the calories, the gas you might cook them with, the drink with which you wash them down -- they're all chemicals. And cooking, like chemistry, is also about measuring, ratios, and experimenting with ingredients. It's all chemistry baby.

Chemistry is sometimes divided into two sections: inorganic and organic chemistry. Most of the chemicals we work with are inorganic (not containing carbon) and this course is sometimes called "Inorganic Chemistry." We study a couple of inorganic things that actually have carbon, such as carbon dioxide and carbonates, but we are largely concerned with metals, oxides, chlorides, nitrates, etc.

We will study organic chemistry this month. This area includes carbon compounds: nearly 6 million different ones! Organic compounds are usually larger and more complex than inorganic ones. The group includes hydrocarbons, alcohols, ethers, carbohydrates, proteins, fats, nucleic acids, and more. From this list you can see that sometimes we can think of "organic" as being things that originate from living plants and animals. (In the grocery store the word "organic" has a different, and somewhat misleading use.)

You are going to have to find the chemical names and formulas for the ingredients in your recipe. Inorganic compounds are fairly easy (salt = $NaCl$, baking soda = $NaHCO_3$). Organic ingredients, I warn you now, are immensely complicated – THEY ARE CELLS OR PRODUCTS OF CELLS. There are hundreds of compounds in a chicken egg and dozens in a chocolate chip. You have to focus on the 2 or 3 most important components of such ingredients. SIMPLIFY! With milk you might find the 3 most important components (water, lactose, calcium) and ignore things that are there in small amounts. You may need to find formulas for some things in a chemical dictionary or on the internet. Finally, your chemical analysis of ingredients should reflect our class work on organic molecules (proteins, carbohydrates, and fats especially). The organic part will be difficult – you have to be creative and fight the urge to ask me ridiculous questions like "What's the formula of a banana?" I might say something stupid like "equal parts Barium Nitrogen And Sodium."

Suggested steps:

1. Periods 1 and 2 have breakfast type foods; 3 and 4 have lunch type foods; 6 has desserts.
2. Think about what you'd like to share. Think of something tasty that has a small number of ingredients and is relatively easy to prepare and transport. Ethnic food or foods that are traditional in your family are welcome!
3. Find the recipe. Write down the ingredients and amounts, convert amounts to the metric system, translate the ingredients to chemical formulas and moles and find the number of calories that each ingredient provides. See Table 1 with flour as an example:

Name of ingredient	Amount as stated in recipe	Mass in g or volume in mL	Best formula for ingredient & molar mass	Number of moles	Number of calories
(as in recipe)	(exactly as in recipe)	(use conversion tables. You can convert vol → mass if you want to)	(see advice in Background above)		
Flour	1 cup	137 g	$(C_6H_{12}O_6)_{1000}$ 180,000g/mol	.00076	495 kcal

4. Continue to work with your ingredient. Determine if it's inorganic or organic, and what group of organic compounds it belongs to. Find out where it's grown or manufactured, and the cost per pound. See Table 2 with flour as an example:

Name of ingredient	General type of chemical	Comes from	Cost per pound
(common name)	(inorganic or organic, and if organic then specify the type as much as possible)	(do your best to find out – is it grown in Yakima? Guatemala? Turkey?)	(get this from the store. You may have to do some conversions)
Flour	Organic – carbohydrate, polysaccharide	Eastern Washington – says so on the package	$1.36

Cooking details: You must make something. Not your Dad, not your Mom, not your Grandma. You need to clean up after yourself too. I encourage you to work with one other person (maximum of 2 in a group) because it's more fun and you can share the tasks.

Some help:

- I will have a cup of sugar and flour, a tsp of salt and baking soda, and an egg in the lab. You can weigh them here. You can bring in other things to weigh if you can't determine the weight at home.
- Assume that all liquid ingredients (such as oil or vanilla or milk) have a density of 1.0 g/cm^3 and 1.0 cm^3 = 1.0 mL so therefore 1.0 mL = 1.0 g. We've used this logic many times this year.
- There is a good chemical dictionary in Room 2 for finding chemical formulas.

Here are the presentation details:

1) You will make a beautiful poster that has:
   a) a copy of the original recipe
   b) tables like those above
   c) your written commentary (see #2) about the experience
   d) any other relevant or artistic stuff. You will place this poster next to your plate of food so people can see what they're eating.
2) The written commentary: answers (typed, one-half page each) to these questions:
   a. Can different dishes be made out of the same ingredients that you used? Explain and use examples.
   b. Do some/all ingredients go through chemical changes as they cook? What are these changes and how do they affect the taste/texture/nature of the food?
   c. Why do some of the ingredients defy our attempts to reduce them to simple formulas? Which ones did you have trouble with? How did you solve the "complexity problem" with organic ingredients?
   d. What other chemical things were happening in your kitchen? What was your % yield? Any sources of error? Any combustion reactions? Heat energy involved anywhere?
   e. How do you feel about reducing food to formulas? Is cooking really chemistry or is it art? Did your recipe work? Was it an experiment? Did you have any fun?

Extra credit: Arrange with me to bring a drink other than water. Follow the same procedure for the drink: ingredients, formulas, masses, moles. This is easier for drinks – they're less complicated. But the process – names, moles, poster – will be the same. Some students will be encouraged to bring their work to share at the May 8 Family Night.