

NOTE: The following are not allowed to be turned in as the tasks for the Chemical Change Video Assignment.

- **Browning of apples or other fruits**
- **Lighting of match sticks**
- **Burning of natural gas or propane gas or butane gas or their mixtures without their use for cooking**
- **Burning of camp fuels**
- **Burning of paper**
- **Burning of charcoals or barbeque fire starter chips**
- **Burning of cigarettes or other tobacco products**
- **Burning of alcoholic beverages**
- **Burning of rubbing alcohol or petrol (gasoline) or petroleum products**
- **Burning of wood**
- **Burning of Plastic**
- **Burning of foam**
- **Burning of cotton or yarns or fabrics**
- **Burning of moth balls**
- **Burning of incense sticks**
- **Burning of candle**
- **Farting**
- **Belching**

Also please note that boiling or freezing water is a physical change. Similarly, Bubbling Lava Lamp is a Physical Change, not a Chemical Change.

Your task for this assignment should be complex enough that it exhibits the following physical changes that indicate a change in composition which accompanies a chemical change. At least eight of these 10 changes need to be present and explained in your video.

1. *Color generation*
2. *Glow or spark generation*
3. *Heat changes*
4. *Volume change*
5. *Textural changes*
6. *Water absorption*
7. *Water release*
8. *Gas generation*
9. *Smell generation*
10. *Noise generation*

Task Description, Rubric, and Exemplars

Create a video of a chemical change taking place in the kitchen or in the home's environment - video done along with parents or adult sibling - commentary (voice over) given by the student explaining why it is a chemical change providing details of the reactants, products, reaction conditions, and the balanced chemical equation along with phases, and the evidences of chemical change through indicators of a chemical change. The video can be up to 10 minutes but needs to be concise and precise and should have been edited accordingly.

Home Environment (5 pts); Adult Partner throughout the process, participating in the lab and speaking/responding (15 pts); Commentary is given by student (5 pts), explanation of why a chemical change given by conversation between the parent and the student (10 pts); Reaction Conditions (15 pts); Balanced Chemical Equation with phases (15 points); Evidence of Chemical Change through indicators (15 pts) Details on the qualities of Reactants (10 pts). Details on the qualities of products (10 pts).

Exemplars:

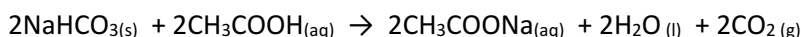
<https://drive.google.com/file/d/0B7an485n3QWVZVY2X1Z6WE9GSkk/view?usp=sharing>

<https://drive.google.com/file/d/0BwNZguaSmyVHdXgzSjdoWkI1RDg/view?usp=sharing>

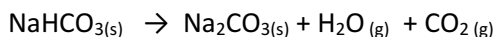
Resources for Common Chemical Reactions in Cooking Food

Some Resources for chemical reactions in the kitchen are given here. Please research further for other chemical reactions.

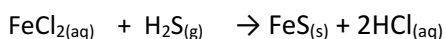
Reaction between Baking Soda and Vinegar



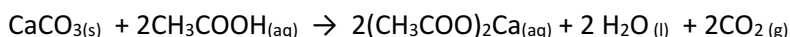
Chemical Reaction in baking with baking soda or baking powder



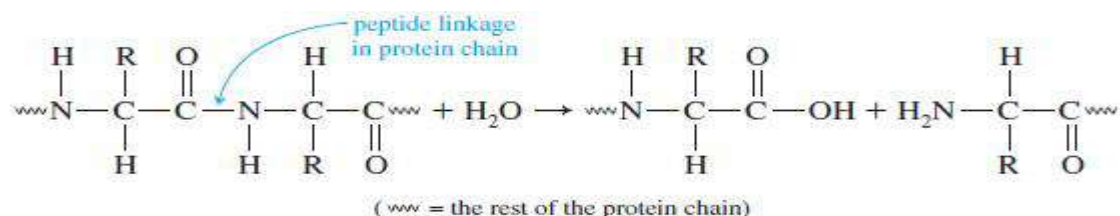
Chemical Reaction between White and Yolk of the Egg



Chemical Equation for the Reaction between Egg Shell and Vinegar

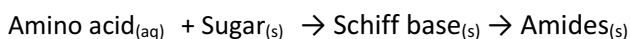


Chemical Equation for Denaturing of Proteins

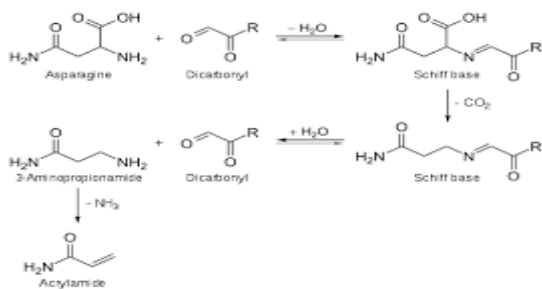


Chemical Equation of the Maillard Reaction

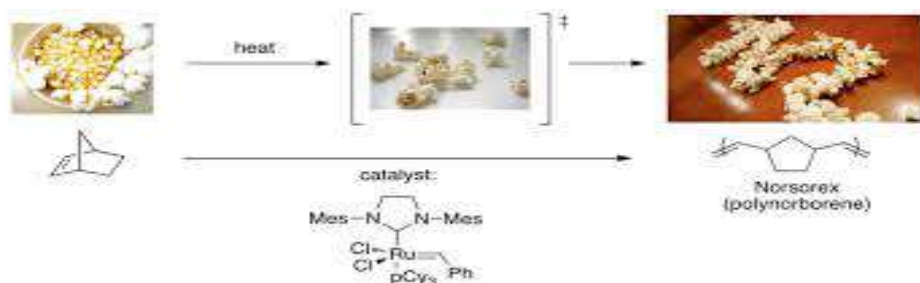
General Reaction



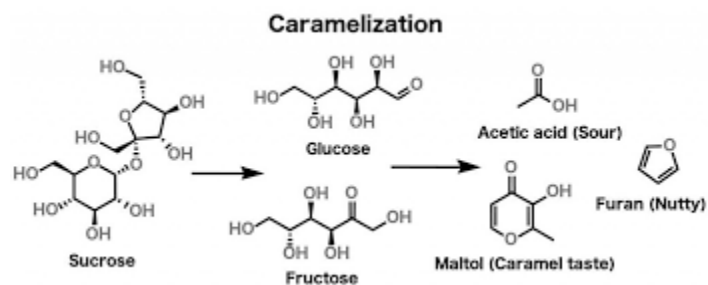
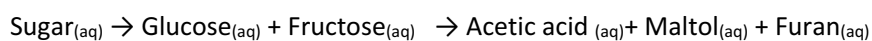
Maillard Reaction with specific formulas



Chemical Equations in the Popping of Popcorn



Chemical Equation for Caramelization



Cooking Chemistry

<https://www.haikudeck.com/cooking-chemistry-science-and-technology-presentation-0TaQPzWIBf>

Chemistry of cooking

<https://www.slideshare.net/Chemrcwss/c24-the-chemistry-of-cooking>

Chemistry of bread making

<http://www.compoundchem.com/2016/01/13/bread/>

Chemistry and Craft of Making Bread

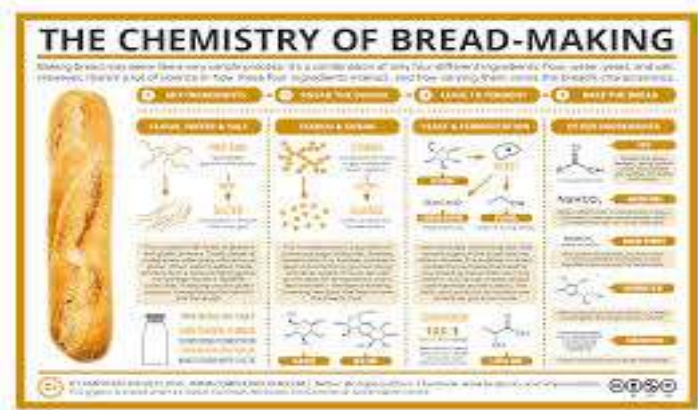
<https://www.dailymotion.com/video/x4a5ayh>

Science of Bread

<https://www.youtube.com/watch?v=JthJR3pWkUo>

Poster on Bread making

<https://www.compoundchem.com/2016/01/13/bread/>



Poster on Aroma of Fresh Baked Bread

<https://www.compoundchem.com/2016/01/20/bread-aroma/>

Aroma Chemistry
THE AROMA OF FRESH-BAKED BREAD

WHAT CREATES BREAD'S AROMA?

INGREDIENTS **FERMENTATION** **BAKING**

The compounds that help to generate baked bread's aroma are influenced by the ingredients of the bread, and also by compounds generated during the fermentation process. Caramelisation and non-enzymatic Maillard reactions during baking help produce characteristic aroma compounds.

A SELECTION OF SIGNIFICANT AROMA COMPOUNDS FROM BAKED BREAD

- MALTOL**: Both formed from D-fructose. Well known contributors to bread and bread crust flavour and aroma.
- ISOMALTOL**: Both formed from D-fructose. Well known contributors to bread and bread crust flavour and aroma.
- 2-ACETYL-1-PYRROLINE**: Key odorant in wheat-bread crust, responsible for cracker-like properties.
- 2-ACETYLTETRAHYDROPYRIDINE**: Also a significant crust odorant. It and 2-acetyl-1-pyrroline are both have low odour thresholds.
- (E)-2-NONENAL**: Amongst the key odorants of bread crust; also found in the crust. Weirdly enough, these are also key odorants of cucumber.
- 3-METHYLBUTANAL**: 3-methylbutanal (malty), found in the crust, has a significantly higher value in the crust of rye breads, as does methional (also a key odorant in the crumb). Diacetyl adds buttery notes.
- METHIONAL**: 3-methylbutanal (malty), found in the crust, has a significantly higher value in the crust of rye breads, as does methional (also a key odorant in the crumb). Diacetyl adds buttery notes.

IN SHORT

No one compound conjures up the smell of baked bread; instead a mixture of compounds are responsible. 2-acetyl-1-pyrroline is a significant contributor to the crust aroma.

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Cookies

<https://sciencemadefun.net/blog/cookie-chemistry/>

Chemistry of Baking Cookies

<https://www.thoughtco.com/chemistry-baking-cookies-4140220>

Cookie-Baking Chemistry

<https://www.npr.org/sections/thesalt/2013/12/03/248347009/cookie-baking-chemistry-how-to-engineer-your-perfect-sweet-treat>

Brownie Science

<https://foodcrumbles.com/chemistry-brownie-science-recipe/>

Pancake

<https://www.wired.com/2012/07/pancakes-served-with-a-side-of-science/>

Cake


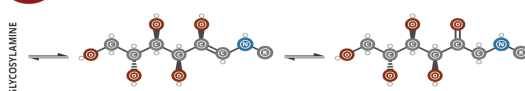

<http://www.dispatch.com/content/stories/science/2013/11/24/1-cakeschemistry.html>

Chemistry of Baking

A guide to the Maillard Reaction (From Discover Magazine Blogs)









A GUIDE TO THE MAILLARD REACTION

The Maillard reaction occurs during cooking, and it is responsible for the non-enzymatic browning of foods when cooked. It actually consists of a number of reactions, and can occur at room temperature, but is optimal between 140-165°C. The Maillard reaction occurs in three stages, detailed here.

- 1** The carbonyl group on a sugar reacts with a protein or amino acid's amino group, producing an N-substituted glycosylamine.

SUGAR (GLUCOSE) + AMINO GROUP → GLYCOSYLAMINE (+ WATER)
- 2** The glycosylamine compound generated in the first step isomerises, by undergoing Amadori rearrangement, to give a ketosamine.

GLYCOSYLAMINE → 1,2-ENAMINOL → AMADORI COMPOUND
- 3** The ketosamine can react in a number of ways to produce a range of different products, which themselves can react further.

FSSION PRODUCTS REDUCTONES HYDROXYMETHYLFURFURAL

Classes of Maillard Reaction Products

The Maillard reaction produces hundreds of products; a small subset of these contribute to flavour and aroma, some groups of which are described below. Melanoidins are also formed, brown, polymeric substances which contribute to the colouration of many cooked foods.

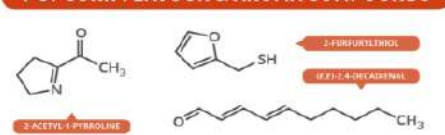
 PYRAZINES cooked roasted toasted	 PYRROLES cereal-like nutty	 ALKYLPYRIDINES bitter burnt astringent	 ACYLPYRIDINES cracker-like cereal
 FURANONES sweet caramel burnt	 FURANS meaty burnt caramel-like	 OXAZOLES green nutty sweet	 THIOPHENES meaty roasted

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Chemistry of Popcorns from <http://www.compoundchem.com/2017/01/19/popcorn/>


THE CHEMISTRY OF POPCORN

POPCORN FLAVOUR & AROMA COMPOUNDS



2-ACETYL-1-PYRROLINE 2-FURFURYLTHIOL (E,E)-2,4-DECAADIENAL


Many aroma compounds are given off by freshly prepared popcorn. Some of the most significant are 2-acetyl-1-pyrroline (which is a contributor to the roasty, popcorn-like aroma), (E,E)-2,4-decadienal (which has a fatty, fried aroma) and 2-furfurylthiol (which in isolation has a roasted coffee-like aroma). A range of other pyrazine, pyridine, and phenol compounds also contribute to flavour and aroma.



2,3-BUTANEDIONE 2,3-PENTANEDIONE

Flavourings added to popcorn can also contribute to the aroma. For example, butter-flavoured popcorn can include the compounds 2,3-butanedione (diacetyl) or 2,3-pentanedione. These compounds can cause respiratory problems in workers that inhale them while manufacturing the flavourings – the condition they can cause is known as 'popcorn lung'.

WHAT MAKES POPCORN POP?



14% H₂O → HEAT 180°C

The content of popcorn kernels is about 14% water. When the kernels are heated, this turns into water vapour at water's boiling point. However, it is trapped by the kernel's shell until the pressure builds up enough to crack through. The 'pop' is due to the escape of this pressurised water vapour, rather than the cracking of the kernel's shell. The molten starch bursts through the shell then rapidly cools, giving popcorn its fluffy appearance.

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Popcorn popping

<http://poppingcornpigakuri.blogspot.com/2017/06/popping-corn-physical-or-chemical-change.html>

Egg and its Chemical Composition

http://uoqasim.edu.iq/e_Learning/lec_file/The%20eggs%20and%20its%20chemical%20composition%2006.pdf

Chemistry of Egg White

<https://www.giapo.com/the-chemistry-of-egg-whites/>

Chemistry of Lipids in Egg Yolk

https://www.jstage.jst.go.jp/article/jsnfs1949/24/6/24_6_317/_article

Why do egg yolks turn green?

Chemistry of Egg and Egg Shells from <http://www.compoundchem.com/2016/03/26/eggs/>

Why do eggs turn white when we boil them?

<https://recipes.howstuffworks.com/menus/question616.htm>

Eggs, Change, and Osmosis

<https://www.labroots.com/videos/1685/the-chemistry-behind-egg-shell-vinegar-experiment>

Reaction of Egg with Vinegar

Why add vinegar to dye eggs?

<https://www.sciencefriday.com/educational-resources/eggs-to-dye-for/>

An Exciting Egg Experiment

<https://williambiolabreports.wordpress.com/2014/11/07/an-egg-citing-egg-speriment-by-william-h-vince-f-and-nolan-d/>

Egg Facts

<https://gemperle.com/egg-nutrition-facts/egg-facts/>

Reaction between Egg and Vinegar

<https://www.labroots.com/videos/1685/the-chemistry-behind-egg-shell-vinegar-experiment>

Equation for reaction between baking soda and vinegar

<https://www.thoughtco.com/equation-for-the-reaction-of-baking-soda-and-vinegar-604043>

Baking soda & lemon juice reaction

<http://sites.jmu.edu/chemdemo/2011/06/14/lemon-fizz/>

Egg and Vinegar reaction

<http://www.kidzone.ws/science/egg.htm>

Equation for Egg Shells and Vinegar reaction

<https://van.physics.illinois.edu/qa/listing.php?id=461>

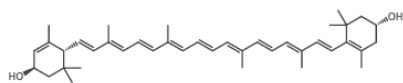
Science of Eggs

<https://www.exploratorium.edu/cooking/eggs/eggscience.html>

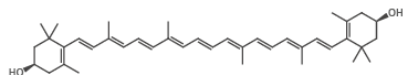
THE CHEMISTRY OF EGGS & EGG SHELLS

Eggs are one of the most versatile kitchen ingredients; there are numerous ways of cooking them on their own, and they can also be used to help create a range of other foods. Here, we take a look at what they're made of, and how they change during cooking.

EGG COLOUR & COMPOSITION



LUTEIN



ZEAXANTHIN

The yellow colour of egg yolks is due to the presence of the carotenoid pigments lutein and zeaxanthin. Artificial additives aren't permitted, but additives such as beta-carotene and marigold petals can be added to chicken feed to influence the yolk's colour.

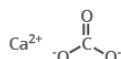
EGG WHITE PROTEINS



About 90% of the egg white is water; the rest of its mass is mostly protein. Ovalbumin's purpose is thought to be nutrition for the developing chick; Ovomucin helps thicken the egg white; and conalbumin binds iron & guards against infection.

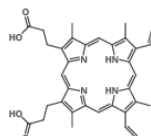


EGG SHELL COMPOSITION



CALCIUM CARBONATE

Calcium carbonate is the main component of eggshells. Nanoparticles of calcium carbonate are arranged into ordered crystals by proteins, forming a calcite shell. The colour of the eggshell comes from porphyrin pigments on the shell's surface.



PROTOPORPHYRIN IX

Brown pigment; the presence of the pigment oocyanin causes eggs to have a blue or green colouration.

COOKING EGGS



BEFORE COOKING

AFTER COOKING

Egg proteins begin in the raw egg as folded chains, but as they are heated they begin to denature and unfold. Interactions between the unfolded proteins create a three-dimensional network, trapping the water and causing the egg to solidify.



HYDROGEN SULFIDE



IRON (II) SULFIDE

Hydrogen sulfide, formed by the reaction of sulfur-containing proteins in the albumen, is the compound that gives cooked eggs their characteristic smell. When eggs are cooked for a long time it can react with iron in the yolk, forming iron sulfide, and giving a green hue to the yolk surface.

7.6

ALBUMEN pH OF FRESHLY LAID EGG

9.2

pH AFTER SEVERAL DAYS OF STORAGE

Albumen pH increases as CO₂ diffuses out through the shell. Albumen adheres more strongly to the shell at lower pH, making it harder to peel boiled eggs.

