

The Development of a High School Synthesis of Aspirin

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- CHE 498
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Outline

- High school Considerations
- Research Objectives
- Why Aspirin?
- My research
- Synthesis of Salicylic acid
- Synthesis of Acetylsalicylic Acid
- Experimental Results
- Green Aspects

High school Considerations

- Time Limit.
- Equipment.
- Limited resources.

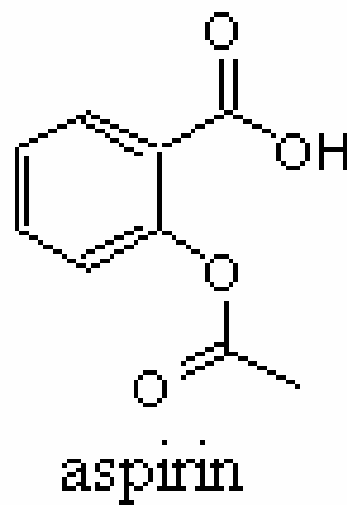
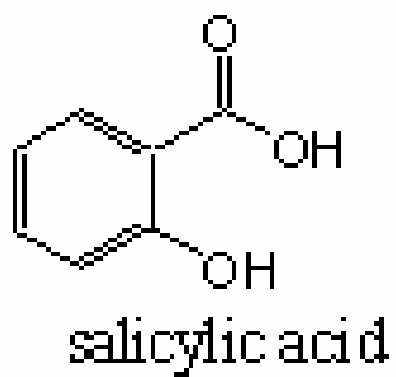
Research Objectives

- Refine the lab procedures of the synthesis of salicylic acid and acetylsalicylic acid.
- Incorporate some explanation of key concepts.

Why Aspirin?

- Why make it in the high school?
- What can you teach?

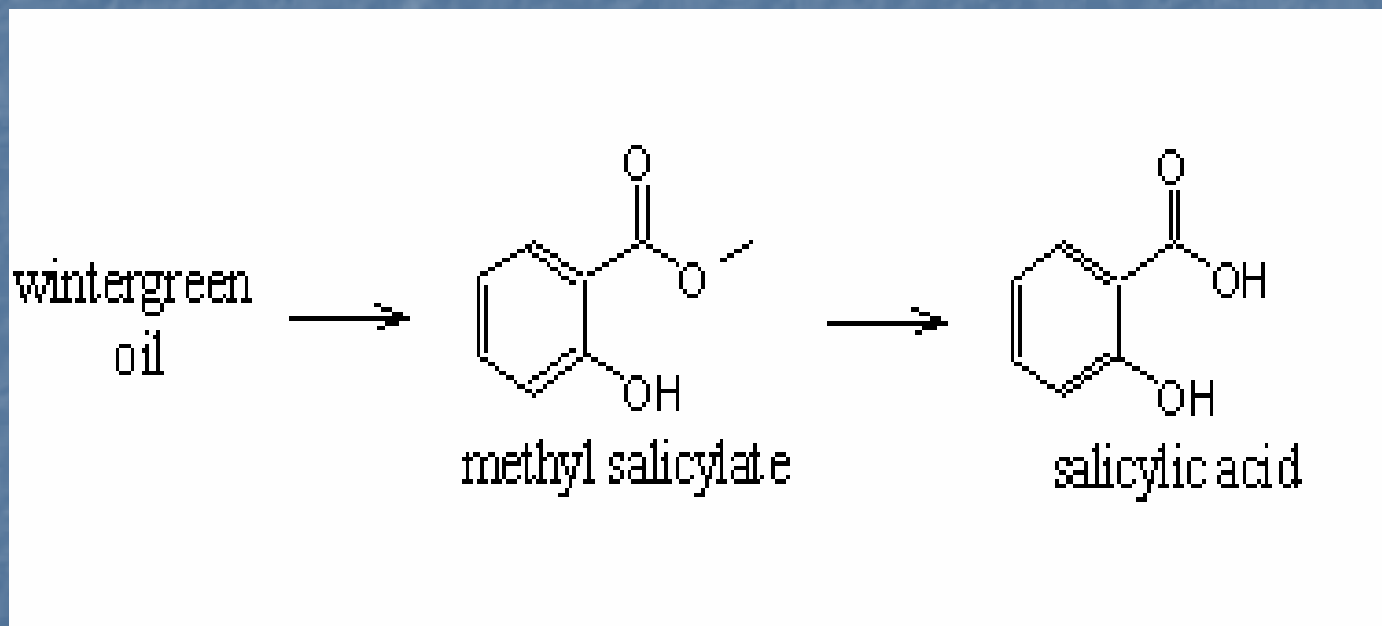
Synthesis



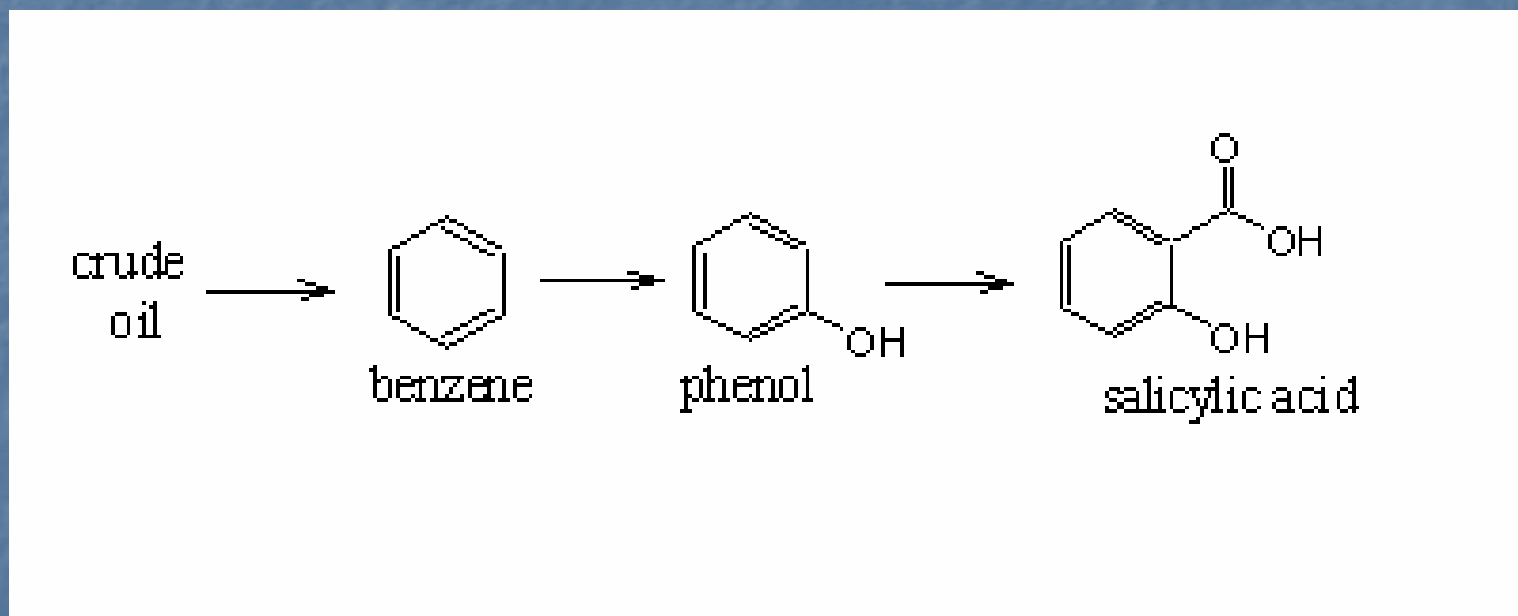
Synthesis of Salicylic Acid

- Methyl Salicylate Found in plants, mainly in wintergreen leaves.
- Because it can be grown it is considered a renewable resource.
- It can be made into Salicylic Acid.

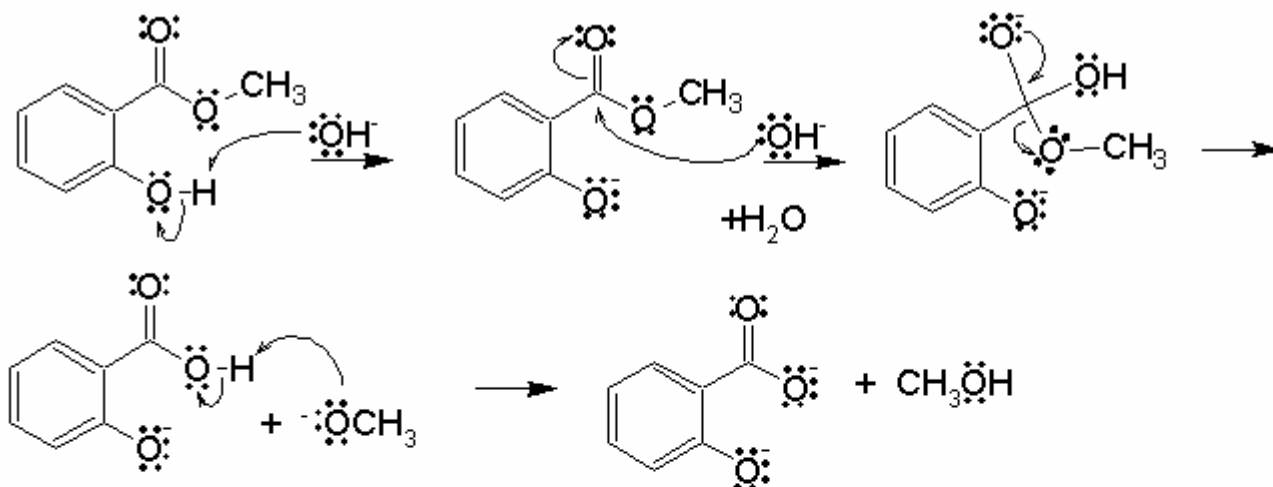
Experimental Synthesis of Salicylic Acid



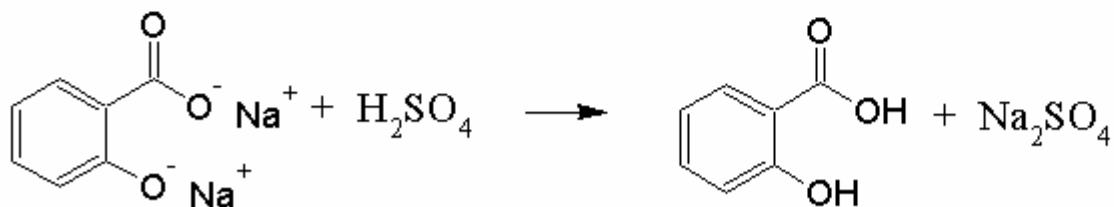
Commercial Synthesis of Salicylic Acid



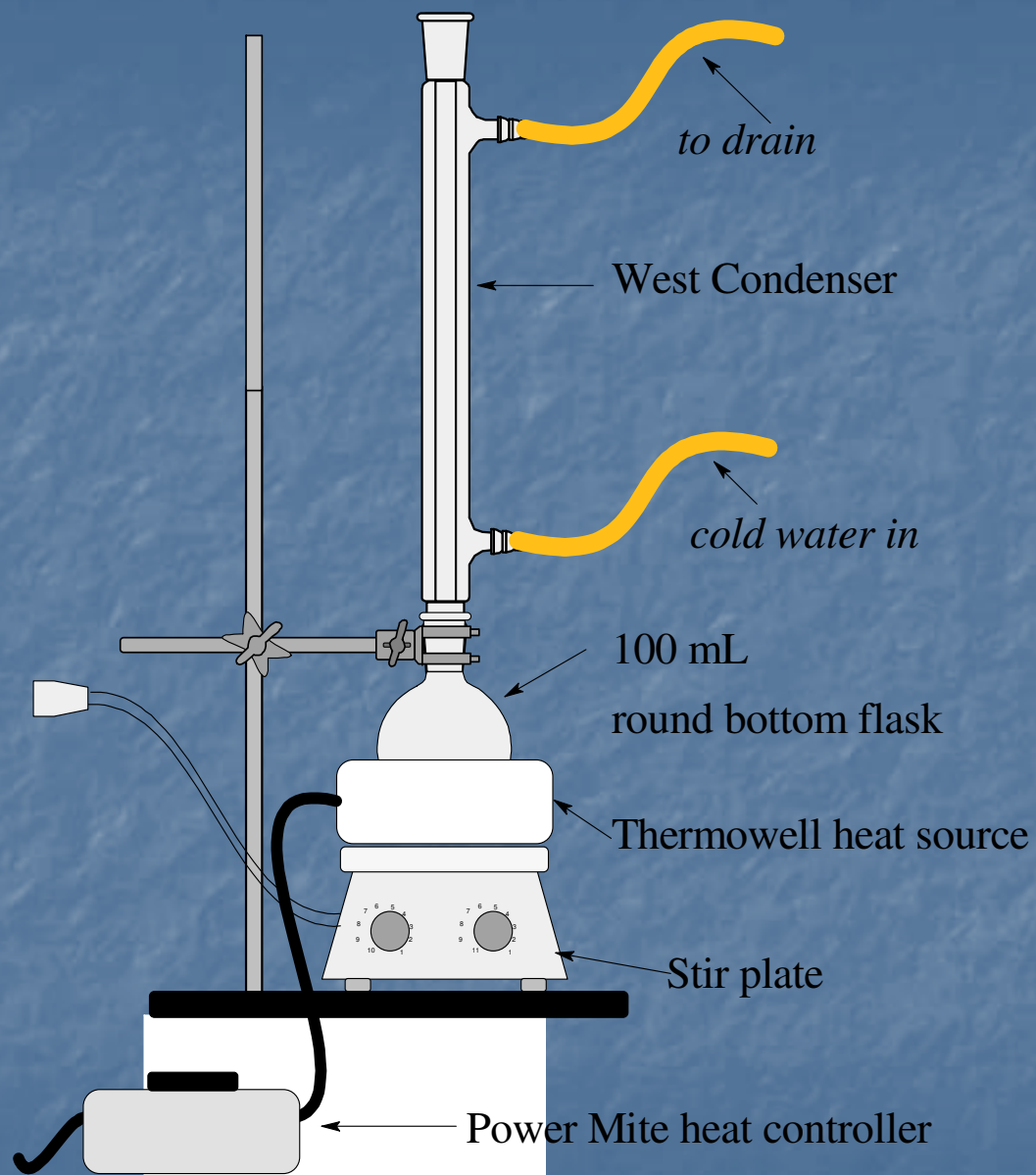
Mechanism for Experimental Synthesis of Salicylic Acid



Mechanism for the reaction of methyl salicylate with sodium hydroxide



Acidification of disodium salicylate to yield salicylic acid



Reflux Apparatus

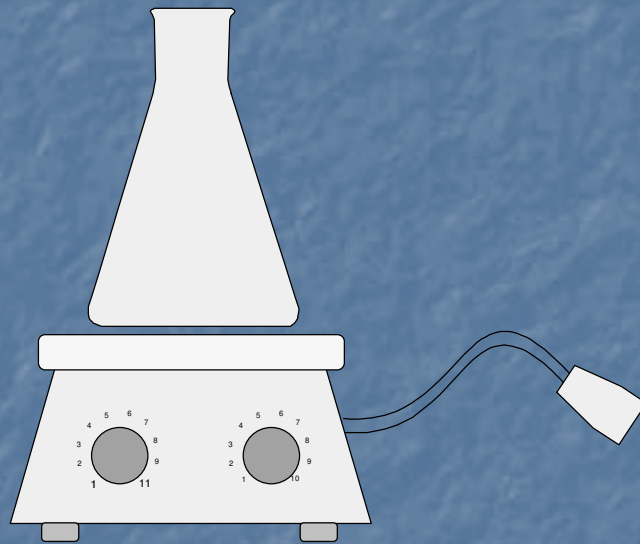
Experimental Procedure

- 1:2 molar ratio mixture of methyl salicylate and Sodium Hydroxide.
- Heated.
- Cooled.
- Sulfuric Acid Added.
- Ice Bath.
- Collected Salicylic acid by vacuum filtration.

Experimental Variable

- Time
 - Cooling.
 - Heating.
 - Aparatus.

High School Apparatus



Optimized Lab Results

- Percent Yield Range = 76 – 90.
- Average Percent Yield = 87%.
- Experimental time = ~40 min.

Purification of Salicylic Acid

- Salicylic acid dissolves in hot water.
- When cooling, like molecules align with like molecules.
- A crystal lattice forms and it precipitates out of the liquid.

Supplement Information

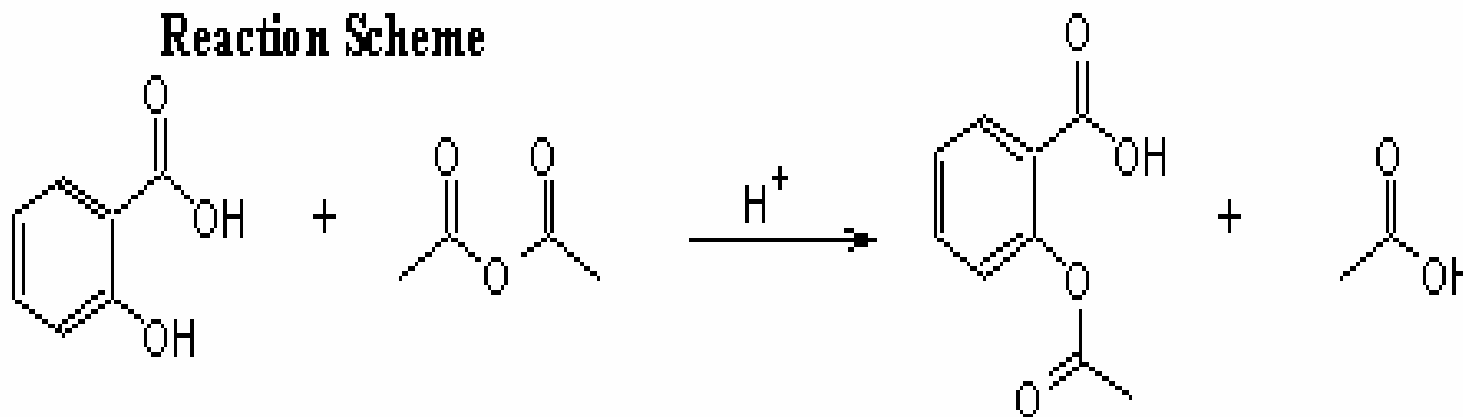
- During the last 20 minutes of the Synthesis of Salicylic Acid lab, the teacher can talk about:
 - Solubility
 - The purpose of recrystallization
 - Acid Base Chemistry
 - Exothermic Processes

Background on Aspirin

- German chemist known as Felix Hoffman had motivation to find a pain reliever for his father that had arthritis.
- His work led to the development of the synthesis of aspirin.
- Bayer patented it, and is now the worlds largest used pain reliever.

Synthesis of Aspirin

Reaction Scheme



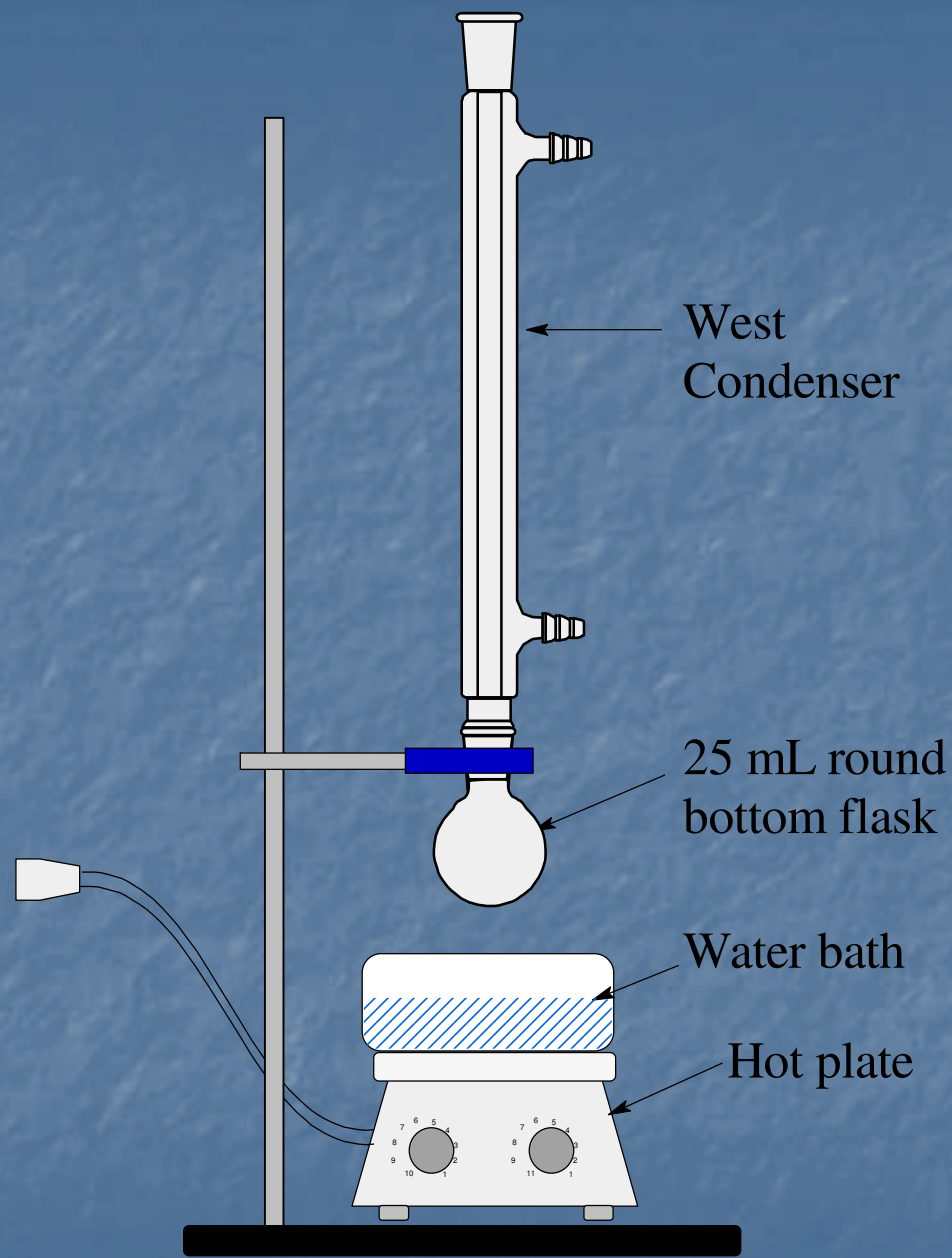


Figure 1. Reaction Apparatus

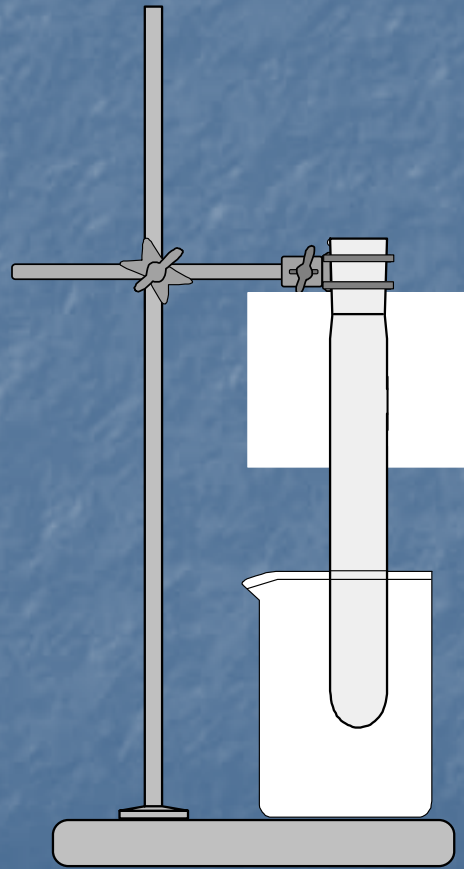
Experimental Procedure

- 1:3/1:2 molar ratio mix of purified Salicylic acid and acetic anhydride
- 3 drops of catalytic 85% phosphoric acid
- Heated
- Added Water
- Cooled in ice bath and collected by vacuum filtration

Experimental Variable

- Time
 - Ice Bath.
 - Apparatus.

High School Apparatus



Optimized Lab Results

- Percent yield range = 67-75%.
- Average Percent Yield = 71%.
- Experimental time = 1 Hour.

Conclusion

- In both experiments, yields were at or above average.
- A significant amount of time was cut out of both experiments.
- Experiments were able to be done in glassware available to highschool labs.

Acknowledgements

- Thanks to:
 - Dr. Lecher.
 - CHE 498 group for their support.

Sources Sited

- <http://www.earlham.edu/~chem/chem111f03/labs/Experiment%2011.pdf>
- <https://camsap.marian.edu:1445/cmSPDocuments.asp?CourseDocumentID=5053>
- <https://camsap.marian.edu:1445/cmSPDocuments.asp?CourseDocumentID=5305>