

## Lab 2: Developing and Testing a Hypothesis

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### Objectives

By the end of this laboratory, you should have developed the skills to do the following:

- Develop a testable hypothesis.
- Formulate a new hypothesis based on experimental results.

### Recommended Resources

- Handout ~ Topic 4: Writing an Organic Chemistry Lab Report  
[http://www.csub.edu/chemistry/organic/manual/Topic4\\_Report.pdf](http://www.csub.edu/chemistry/organic/manual/Topic4_Report.pdf)
- Handout ~ Topic 7: Using a Pasteur Pipet  
[http://www.csub.edu/chemistry/organic/manual/Topic7\\_Pipet.pdf](http://www.csub.edu/chemistry/organic/manual/Topic7_Pipet.pdf)

### Background

A hypothesis is an educated guess regarding the outcome of an experiment. A good hypothesis is one that is testable and that can be modified and improved based on the outcome of experimental results. In organic chemistry lab, you will often be expected to develop a hypothesis, and test that hypothesis during your experiment.

This exercise will assist you in developing a hypothesis testable hypothesis. You will attempt to identify which organic compounds ferric chloride ( $\text{FeCl}_3$ ) reacts with. First, you will react ferric chloride with each of three compounds. In this experiment, an intense color change as compared to the control will indicate a reaction with ferric chloride (a scientific control contains all aspects of the experiment except for the variable...in this case, your control will contain water, ethanol, and ferric chloride, but no organic compound). Based on your results, you will develop an initial (or working) hypothesis. Then, you will test additional compounds as need to confirm or refute that hypothesis. Your goal is develop a hypothesis that is consistent with all of the available data by the end of the lab period.

### Lab Notebook Preparation

Before coming to lab, the following items must be in your lab notebook:

1. Title of the experiment & date the experiment is to be performed
2. Structures of the seven compounds you will be testing
3. Functional groups present in each compound
4. Hazards of and appropriate precautions for the safe handling of hydrochloric acid

## 5. References

### Directions

1. Add 0.5 mL of water and 0.5 mL of 95% ethanol to each of eight, clean test tubes.
2. Number the test tubes 1-8.
3. To the first test tube, add one drop of methyl salicylate.
4. To the second test tube, add about 10 mg of salicylic acid.
5. To the third test tube, add about 10 mg of aspirin.
6. To the fourth test tube, add about 10 mg of acetaminophen.
7. To the fifth test tube, add about 10 mg of phenacetin.
8. To the sixth test tube, add about 10 mg of menthol.
9. To the seventh test tube, add one drop of benzyl alcohol
10. Add two drops of 2.5% ferric chloride solution to test tube number eight (your control).
11. Add two drops of 2.5%  $\text{FeCl}_3$  to each of the first three test tubes. Comparing the contents of these test tubes to the control, and record your observations. Formulate an initial hypothesis as to which compounds ferric chloride reacts with based in your results.
12. Add two drops of 2.5%  $\text{FeCl}_3$  to the fourth test tube. Again, compare your results to the control, and record your observations. Do the results support your original hypothesis? If not, formulate a new hypothesis that accounts for all of the results.
13. Add two drops of 2.5%  $\text{FeCl}_3$  to the fifth test tube. Again, compare your results to the control, and record your observations. Do the results support your current hypothesis? If not, formulate a new hypothesis that accounts for all of the results.
14. Add two drops of 2.5%  $\text{FeCl}_3$  to the sixth test tube. Again, compare your results to the control, and record your observations. Do the results support your current hypothesis? If not, formulate a new hypothesis that accounts for all of the results.
15. Add two drops of 2.5%  $\text{FeCl}_3$  to the seventh test tube. Again, compare your results to the control, and record your observations. Do the results support your current hypothesis? If not, formulate a final hypothesis that accounts for all of the results.

### Reporting your Results

Write your report according to the guidelines described in "Topic 4: Writing an Organic Chemistry Lab Report". Work with your team of 4-5 on this report.

### References & Additional Resources

1. Lehman, J. W. *Operational Organic Chemistry: A Problem-Solving Approach to the Laboratory Course*, 3rd ed.; Prentice Hall: Upper Saddle River, NJ, 1999; pp 476-477.