# THE CHEM R & E PROJECT

Mr. Lodal  Mr. Pham  Mr. Street  Ms. Piper

---

**Calvin and Hobbes**  Bill Watterson

Here's an interesting article. The top five gum brands are compared in terms of flavor retention, elasticity, bubble capacity and chewing rebound.

The computer graph shows the results, compensating for various saliva qualities. If you know your pH, this really helps you choose the proper gum for your chewing style.

What kind of nut would care about all this?

Everyone! This is hard data! It lets you quantify your enjoyment.

I thought fun was supposed to be fun. Well, I prefer to trust the experts.

---

<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Team Number</th>
<th>Student Name</th>
</tr>
</thead>
</table>
# Chemistry/R&E Project Sequence

For the Class of 2018

<table>
<thead>
<tr>
<th>Week</th>
<th>Emphasis</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Journal Submissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **2-Mar**: Introduction
- **16-Mar**: Research
- **23-Mar**: Proposal DUE
- **30-Mar**: Start STELLA & Experiments
- **6-Apr**: Spring Break 2015
- **13-Apr**: PARCCAM Testing
- **20-Apr**: Data Sharing
- **27-Apr**: Finish Data Collection
- **4-May**: Data Analysis Check Point
- **11-May**: Written Report Due
- **18-May**: Memorial Day
- **1-Jun**: Project Deadline
- **8-Jun**: Finals 1-2, Finals 3-4, Finals 5/6-7, Finals 8-9 & Magnet Picnic
- **15-Jun**: Summer Vacation

*Draft: 3/3/15*

*Subject to Change*
The CHEM - R & E Project

Objective:
Students will apply the scientific method in developing a research experiment that tests a chemical or physical property of a material. The data collected will be used to explain the chemistry of the subjects researched on the molecular level.

Organization:
Teams of three or four students will be formed and assigned by the teacher. There are 8 specific areas for student Investigations & experiments. Students will be expected to divide up the work of this project equitably between group members.

Overview of Project Requirements:

Project Research: Conduct a literature search to be able to: answer interview topic questions, conduct a safety analysis of your experiment, complete the research article questions, and to prepare the annotated bibliography. Your research will be also be used to write up in the background science section of your paper.

Lab Journal: Each team will need to prepare a single journal. Team members will rotate journal-recording responsibility. There will be periodic checks

Written Work: The following are written aspect of the project. These will receive team grades. Written Proposal, Experimental Design Brief (EDB), Background Science Paper and Final written report. Each team will prepare a scientific and engineering abstract of their project.

Experiment: Design an experiment to scientifically explain the occurrence. Acquire materials, instruments and apparatus to perform the experiment. Conduct repeated trials of the experiment and collect data. 12 separate data sets would be ideal!

Project demonstration: Demonstrate a trial of the experiment where data is collected and recorded in the presence of your teachers.

Analysis: Analyze the data using tools such as, box & whisker plots, graphs, tables, illustrations and pictures. The data must be analyzed to explain the chemistry of the subjects researched. Data from other blocks needs to be compared in the final presentation.

Inventor Design: Each team member will draw with Inventor, some element of the experimental setup and turn in an isometric drawing of their part. Parts will be compiled in an assembly file and an isometric will be printed. An Inventor graphic of your isometric needs be included in the final presentation.

Formal Presentation: Present the scope of the entire project in a professional presentation. Your goal is to explain the chemistry of your experiment at the molecular level.
Topic Research

Objective:
The purpose of this phase of the project is to expand your knowledge of your topic. This will add the necessary depth you need to complete this project. You will need information from this work for the first team interviews, writing the background science section of the paper and explaining the chemistry of your topic in the final presentation.

Procedure:
We will have class media sessions for introduction to science databases and general search techniques. Each team member will need to find sources related to the topic and record all the citation information needed for the bibliographical reference. Record these in your journal. Branch out (HaHa) from the school library and go to your local library, also consider a visit to a university chemistry library. In searching for specific resources allot plenty of time.

Keywords:
Develop a list of keywords for your research searches. These could be related to the subject, title or technical terms. This list will help you in doing an on-line computer search.

Research Assignment #1: Interview Questions and Terms
Each individual separate person on your team will be responsible for turning in the topic terms and questions. The person on the team with the journal will record their work in the journal. Everyone on the team must be knowledgeable about your topic!

Research Assignment #2: Annotated Bibliography
Each team member will prepare an annotated bibliography of the sources they individually researched. An annotated bibliography gives an account of the research that you have done on your given topic. An annotated bibliography is similar to a simple bibliography in that it is an alphabetical list of research sources. However, in addition to bibliographic data, an annotated bibliography provides a concise summary of each source, including content information that you would use in your written report, and some assessment of its value or relevance.

Research Assignment #3: Outline
Develop an initial outline of your topic. The outline will serve as a guide for areas to search the literature on this topic. The keywords and outline must be recorded in your journal. The outline will serve as section headings of your background science paper. You may not find articles that are exactly related to your project.
Experimental Topics

**Topic 1:**
*Heat of Neutralization - The Strong versus the Weak:
*The heats of neutralization for mixtures of strong and weak acids with strong and weak bases will be determined and compared. A calorimeter must be designed and used to measure molar heat of neutralization for selected substances. Results will be analyzed and compared using Hess' Law.

**Topic 2:**
*Energy in food - Which one of these foods would you guess has the most energy?*
This project will study the amount of energy in nuts, potato chips, and pastas.

**Topic 3:**
*Exploring rate of reaction by using a “clock” reaction.*
This is the hydrogen peroxide/ potassium iodide ‘clock’ reaction. A solution hydrogen peroxide is mixed with one containing potassium iodide, starch and sodium thiosulfate. After a few seconds the colorless mixture suddenly turns dark blue. This is one of a number of reactions loosely called the iodine clock. Students will examine the effect of reactant concentrations and temperatures on the rate of changing color. From the data, students will be able to determine the rate expression.

**Topic 4:**
*Buffer Capacity:*
Students will compare the capacity of two buffers, i.e. determine how much acid or base it will take to “break” the buffer. Students will make both of the buffer systems.

**Topic 5:**
*Calcium as a Nutritional Supplement:*
The mass and percent composition calcium in three common nutritional supplements will be determined and compared with the label information. The calcium supplements will be provided and students will analyze them for calcium ion concentration using gravimetric analysis or titration. The results will be compared to the contents listed on the label.

**Topic 6:**
*Paper Chromatography: chlorophylls, carotenes, and anthocyanins*
What mixes of alcohol and water are needed to get the best chromatography results when comparing the chemical makeup of several different types of common leaves?

**Topic 7:**
*Vitamin C as a natural supplement.*
Find the mass percent composition of vitamin C in three common brands of orange juice.

**Topic 8:**
*Gas Laws: Do all gases at STP have a volume of 22.4 L?*
Compare several different gases and design an apparatus to find the volume of a given amount of these gases at STP

**Topic 9:**
*Copper concentration in a solution – How many ways to find blue?*
A comparison of the effectiveness and relative accuracy of different methods of finding the copper(II) ion concentration will provide you with a challenging and wide-ranging investigation: Redox, titration, gravimetric analysis, or electrochemical cells. You will determine the best method to determine the concentration of cupric solution.

**Topic 10:**
*Find the cheapest way to plate copper on materials*
Electroplating is an economically important process, often used to reduce corrosion or improve the appearance of objects. During electroplating a thin layer of a desirable metal is deposit Students will collaborate to determine the best method to determine the time and amount to plate a good quality of copper on a material.
CHEM R&E JOURNAL

A journal is a permanent record of daily activities for a student actively participating in any science course or science activity. Each student in Chem R&E project will take turns keeping a daily journal. The journal will be collected and graded on a regular basis.

1. Each new entry will start with a record of date and time in the right hand margin. The 3 underlined sections headings should be written and completed for each day R&E is scheduled after the project is introduced.

2. Each entry will have a Synopsis section. This consists of one to two sentences explaining the day’s activities. This is an easy reference tool for was completed on that day.

3. The next entry will be a Activities section. Describe detailed information about the work of the team and related data will be included as well as thoughts, conclusions and recommendations.

4. Team projects require a detailed account of the individual’s Log and a concise account of all team members’ work and the time each team member spent on their part of the project

5. At the end of each work session, record the time and compute the total time spent on the activity in the margin of the journal.

6. The journal should be kept up to date so that it could be collected at any time.

7. Any bound book such as a composition book is acceptable as a journal. NO spiral bound notebooks.

8. All pages of the laboratory notebook should be numbered in the upper outside corner of the page. Be sure you number well ahead of entries.

9. The first 3 pages should be reserved for a Table of Contents.

10. All entries should be in non-erasable blue or black ink. All errors are corrected by a single- line cross out

11. Under no circumstances should pages be torn from the journal and no loose papers should be stored in the journal.

12. Records should be kept in handwriting unless special problems exist. The student should consult the teacher and accommodations will be made.

13. Copies of important handouts, printouts, letters, etc. may be added by carefully using paste, tape etc. Paste this handout in the inside front cover of the journal.

14. When the book is filled, start a new book, but do not throw away the old one. It remains a record of the work completed.
Experimental Design Brief

Your EDB should be between 2 pages. Set reasonable margins and 12 point, Arial or Geneva. Include the left margin subheadings and spacing demonstrated in this model. No exceptions will be made. Your R and E teacher will grade this assignment.

Engineering Problem statement
Your chemistry problem restated with an engineering focus. Consider what your team needs to do to collect the experimental data? Do you need to build anything? How will you control your experiment?

Core chemistry
What is the essential chemistry of your topic? (Chemicals, equations, reactions)

Data Analysis
Describe the data to be collected? What are your independent and dependant variables? How will you analyze your data? What types of graphs might be appropriate?

Graph variables and show units

How do you propose to quantify this data? (Methods, instrumentation) List any special material and equipment you will need.
CHEMISTRY PROPOSAL

Your chemistry proposal may not be more than 3 pages. Set reasonable margins and 12 point text. Follow the centering and spacing demonstrated in this model. No exceptions will be made. This will be graded by your science teacher.

TITLE
(Do not use the words “A proposal to …”; be concise and to the point)

PROBLEM
Introduction: What has been done, What is known and why are you doing it now? A good way to start this is with the words, “The purpose of this…”

SCIENTIFIC METHODS
List no more than 13 steps. Be concise! Each step should only be 1-2 sentences. Do not bullet or number the steps. Indent the second line of each statement, just like we have done here. The result will be similar to the format of your bibliography.

HYPOTHESIS
What do you think will take place? What relationships do you expect? Justify your hypothesis, remember, your group has been interviewed to determine if your project is scientifically valid.

DATA, INTERPRETATION, AND TREATMENT
This is a prediction of how the data will be handled. Expected challenges and what to do about them. Independent variables - the property that changes or can be changed and that is believed to affect the dependent variable.

Dependent variables - the property believed to be changed by the independent variable.

Control – how you will

Include quantities to be used and expected order of the magnitude of the measurements. Do not forget to use proper units and watch out for significant figures.

Submit the tables (blank except for the top row and first column) and the boxplots (blank except for label on the axes) that you expect to create after the device is tested. This section will be expanded after your data has been collected into the Analysis and Conclusions section of the report.
BACKGROUND SCIENCE SECTION

Review of Literature

The background science section of the paper is a review of published literature, background science, and other related research about your topic. This section is an expansion of the introduction part of your proposal. Use your outline, annotated bibliography, and proposal to develop this section. This section should be approximately 2-3 pages in length. Material that comes from a specific source and is not common knowledge must be referenced according to the APA format.

Subheadings:
Subheadings are required to break down the paper into assignable individual sections. Use your outline topics, these might include history of topic, chemicals involved, experimental results from past experiments, chemistry stuff, etc.

Resources
http://www.library.cornell.edu/newhelp/res_strategy/citing/apa.html
http://www.noodletools.com/

APA citation style refers to the rules and conventions established by the American Psychological Association for documenting sources used in a research paper. APA style requires two elements for citing outside sources: Reference Citations in Text and a Reference List. Together these elements identify and credit the sources consulted in the paper and allow others to access or retrieve this material.

Examples:
Works by a Single Author

The last name of the author and the year of publication are inserted in the text at the appropriate point.
In a recent study of reaction times (Walker, 2000)

If the name of the author or the date appear as part of the narrative cite only missing information in parentheses.
Walker (2000) compared reaction times
In 2000 Walker compared reaction times

Reference List

Journal Article, one author

Article in an Internet-only journal
GUIDELINES FOR PREPARING THE CHEM R&E PROJECT REPORT

The purpose of the final report is to provide any educated reader with a complete picture of your project. The final report must be a stand-alone document, i.e. you cannot assume that because you already wrote it in the proposal (or anywhere else) there is no need to write it again in the project report.

Please use the following format:

Title page: Name of project; name of authors, date, and block letter (A,B,C, or D) and Team #

Introduction: Provide the reader with background information about your project and explain the underlying scientific principles. If applicable, refer to research papers that helped you understand the science. Make sure you cite your sources (and include a list of sources cited in the appendix).

Also, include your original hypothesis and justify it in detail (“because the literature says so” is not going to cut it!!). While we all know that the purpose of this experiment was to teach you about carrying out research, do provide some information why this kind of research in general is important.

Materials: List all chemicals (including concentrations) and equipment required for your experiment.

Procedure: Describe in detail how you carried out the experiment(s). Include information about instrument calibration, etc., if applicable. Give enough detail that somebody else could take your procedure and reproduce your experiment. If you made any changes to the proposed design, you MUST state a) what change was made and b) why the change was made.

Data Analysis: Start by clearly stating what type of data you collected (these are your primary data), as well as how you used them to calculate your final result. Show all formulas you used. Make sure you show how often you repeated the experiment to produce comparable data (sets). Organize your data into tables, graphs, etc, as appropriate, and show your boxplot(s) (don't forget to title all tables/ graphs, etc and label them, not forgetting the units, either!). The actual primary data should be included in the appendix.

Problems encountered: What problems did you come across and how did you overcome them. What improvements could be made? If you were not able to repeat your experiment 10 – 12 times please describe in detail why you were unable to fulfill this requirement. Please be constructive - this is not meant to be a whine-session!

Discussion: Discuss what your results mean and whether you feel they make sense. Make sure to comment on your hypothesis and whether your results confirm or refute it. Discuss why or why not. Use your background knowledge regarding your project to explain why your data may have turned out differently from what you expected. Could a systematic error explain any discrepancies? Anything else that you now recognize went wrong? If so, what happened? If need be, reformulate your hypothesis, justifying the revision by what you have learned from the experiment. Also discuss the quality of your data in terms of precision and accuracy. At this point, also compare your data with the data sets from the other three blocks. Are they comparable? Do the combined results (i.e. from all four blocks) agree with your hypothesis?

Appendices: Primary data
List of sources cited
Other (any information that you feel is important to the project but does not fit into the categories given above)

In all sections: include whatever else you feel may be relevant to describing and explaining your project. The report should be 5 to 8 pages (excluding: title page and appendices) and should be 12 point type, line spacing 1.5, and 1” margins.
CHEM R&E Oral Presentation

Introduction
These guidelines are designed to provide you with the information necessary to make a textbook-perfect oral presentation. In your presentation, you must, both mentally and in your appearance, assume the role of prominent professionals making a presentation on a very important topic to an audience of other professionals (businessmen/women, engineers, scientists, etc.).

Content: Remember the overriding objective of this project in making your presentation:

Students will apply the scientific method in developing a research experiment that tests a chemical or physical property of a material. The data collected will be used to explain the chemistry of the subjects researched on the molecular level.

In addition, the presentation of a research paper is also about sharing the research process and soliciting input. Your written paper will serve as the outline for what needs to be conveyed in this presentation. In presenting the background science of your topic be sure to include a keyword visual. You should look over the sample rubric provided below. Each team is responsible for a minimum of 15 minutes of presentation plus the demonstration. The demonstration may be at the end or during your talk.

Present initial data collected (not in a big table) > Treatment/calculations > Analysis > Conclusions

The use of visuals: A modern presentation is not complete unless it includes effective graphic communication. For this presentation you develop a PowerPoint presentation. Each slide that you show needs to be explained, not just shown, it takes time for the audience to understand what you are showing. All presentations (for all groups) are due on the day the first presentations start, and will be turned in to Mr. Templin’s Hand_In folder.

The use of note cards: Each student should have note cards. Do not read the notes - use them as a reminder of where you are in the presentation and as a prompt as to what comes next. Notes should consist of key words and phrases; they should be PRINTED double size, skipping 2 lines between concepts (also, “bullet” each concept to help students keep them separated in their minds). Number the cards to help keep them organized. The cards will be collected at the end of your presentation. Suggested size is 5” x 8” cards. Full sheets of paper are not allowed.

Do not use a podium: Students tend to hide behind it and lean on it. If you can master speaking without a podium, then public speaking should never present a problem. This also applies for speaking from behind desks and computers

Physical Appearance:

Dress: This is a FORMAL presentation. How would someone from the business world dress when making a formal presentation? Males - suit/sport coat, dress shirt with tie, dress shoes (no "sneakers"), etc. Females - business suit or dress or skirt/blouse, dress shoes, etc.

Posture: Stand erect, feet together, hands by the side or both hands holding note cards low and in front. Look at the audience, looking about the room, making eye contact. It helps some students to look just above the heads of those in the audience instead of making eye contact. Always try to face the audience, and do not move around without purpose. Do not shift back and forth, sway, or rock.

Speaking: Know, but don't memorize, your topic. Speak in a clear, steady voice. Make certain all in the audience can hear. Pronounce the words properly and use proper grammar. Do not use slang. Assume that
the audience is intelligent and knowledgeable.

!!! Practice !!!  !!! Practice !!!

In this group presentation each member of the group must have an equal spoken part. Some may also be needed to hold props, coordinate visuals, operate equipment, and/or demonstrate what the presenter of the moment is discussing - in the ideal situation, the one talking should not be holding things up, changing transparencies, activating the slide projector, etc.; but instead, the speaker should be discussing what another is holding, doing, activating. The speaker may need to use a pointer and, along with any helpers, must remember not to stand between the audience and the visual aids/props. Remember, do not turn away from the audience when making use of visual aids and/or props.

!!! Practice !!!  !!! Practice !!!

**Sample Presentation Rubric:** Content, Each speaker, and Presentation

| Attention getting introduction |
| Background and importance of project |
| Presentation follows written requirements |
| Analysis of data |
| Demonstration of device |
| Conclusions |

| Knowledge of topic |
| Professionalism & attire |
| Enthusiasm during presentation |
| Effective communication |
| Effective use of visuals |
| Audience rapport |

| Effective & readable visuals. Keywords & Data |
| Effective use of information during talk |
| Presentation ordered and understandable |
| Concluding remarks |
| Questions solicited during session |

This entire presentation should be "choreographed" and well rehearsed. And did we mention…  !!! PRACTICE !!!
Presentation Essential Elements

Project Timing
Overall time allowed is 30-45 minutes, depending if 2 or 3 teams scheduled per day

Load files
Setup experiment
Present (15-20 minutes)
Questions and feedback

What do you need to cover:

- What did you do?
  - The Problem
  - Hypothesis and justification
  - Background of experiment - Core chemistry
  - Set up your experiment and describe your methods. You do not need to heat anything but if you used a hot plate it should be in the set-up.
  - Why did you choose to do it this way

- What did you get
  - Present your data in a clear organized fashion. Spend enough time with this section, do not rush through! Explain each of your graphs and box plots; do not just show a slide and expect the audience to make sense of it.
  - How did your project’s results compare with the other blocks

- What do you think about it?
  - What are your conclusions? Do you accept or refute your initial hypothesis.
  - What problems did you overcome

Speaking
1. Your teachers would like to hear leadership in your voice. You are the experts! We would also simply like to hear your words! Do not be a “Low Talker”
2. Share the speaking roles equally

PowerPoint
- Do not use sounds or other distracting bells and whistles.
- Do not try to put a whole page of text on a slide. Some of your teachers wear glasses and will be sitting in the back of the room – they need big text!
- Check your presentation content before you start to make sure all your elements work. on the presentation computer.