<table>
<thead>
<tr>
<th>Week of:</th>
<th>LAB EXERCISE (Pre-lab Quiz)</th>
<th>PRE-LAB ASSIGNMENT</th>
<th>POST-LAB ASSIGNMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 31</td>
<td><strong>Topic 1:</strong> Introduction (Syllabus &amp; Safety); Process of Scientific Inquiry (Q1)</td>
<td>Read Syllabus and Hand out</td>
<td>Finish Writing Assignment (Due next week)</td>
</tr>
<tr>
<td>Sept 7</td>
<td><strong>Topic 2:</strong> Kirby Bauer Experiment Writing Ethics; Searching for Scientific Literature; (Q2)</td>
<td>Bring laptops to this lab. <strong>MONDAY LAB MEETS ON FRIDAY SEPT 4</strong></td>
<td>Individual Mini-report due in three weeks</td>
</tr>
<tr>
<td>Sept 14</td>
<td><strong>Topic 3:</strong> Making Graphs with Excel (Q3); Mini-report format</td>
<td>Turn in Excel HW; Bring laptops to this lab.</td>
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</tr>
<tr>
<td>Sept 21</td>
<td><strong>Topic 4:</strong> Pipetting and Plating E. coli and Rifampicin Experiment (Q4)</td>
<td>Read Handout and Answer Questions</td>
<td>Group Mini-report due in 4 weeks</td>
</tr>
<tr>
<td>Sept 28</td>
<td><strong>Topic 5:</strong> Data Analysis/Brainstorming Preparing Powerpoint slides (Q5)</td>
<td>Individual Mini-report due; Read Mini-Report Guidelines Bring laptops to this lab.</td>
<td>Read “Art of Writing Science” (questions about this article will be on quiz this week)</td>
</tr>
<tr>
<td>Oct 5</td>
<td><strong>Topic 6:</strong> Group Power Point on proposal (Q6)</td>
<td></td>
<td>Detailed protocol required before you leave the lab</td>
</tr>
<tr>
<td>Oct 12</td>
<td>FALL BREAK – NO LABS THIS WEEK</td>
<td></td>
<td>Group Mini report due next week</td>
</tr>
<tr>
<td>Oct 19</td>
<td><strong>Topic 7:</strong> Data collection/experiments, developing individual mini report and (Q7)</td>
<td>Turn in group mini report</td>
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<tr>
<td>Oct 26</td>
<td><strong>Topic 8</strong>: Experiments (Q8)</td>
<td></td>
<td>Final group poster (due at beginning of Lab 11)</td>
</tr>
<tr>
<td>Nov 2</td>
<td><strong>Topic 9:</strong> Microscopes, Prokaryotes and Protists (Q9)</td>
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<tr>
<td>Nov 9</td>
<td><strong>Topic 10:</strong> Protists, Fungi and Animals (Q10)</td>
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<tr>
<td>Nov 16</td>
<td><strong>Topic 11:</strong> Student poster presentations of data obtained from E.coli experiments or labs 8*</td>
<td>Posters and Presentations due (email text of poster to your instructor 2 days before the presentation date)</td>
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<tr>
<td>Nov 23</td>
<td>THANKSGIVING BREAK – NO LABS THIS WEEK</td>
<td></td>
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<tr>
<td>Dec 1</td>
<td>FALL BIOLOGY RESEARCH SHOWCASE</td>
<td>DURING ACTIVITY PERIOD 12:30-2:00pm</td>
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</tr>
</tbody>
</table>
Textbook: No Textbooks are required for the lab. However, most labs will have handouts posted on Blackboard. You are responsible for downloading, printing, reading and studying the handouts BEFORE lab. You are also required to bring the handouts to the correct laboratory as seen in schedule above.


Description and goals of this course: This course will introduce students to the four major themes of our curriculum: ecosystems, organisms, cells and molecules. Practicum in scientific methodology, critical thinking, reading and writing, focusing on analysis of scientific literature through discussion, team based learning and invited research presentations.

Outcome 1: Students will be able to apply the tenets of the scientific method in both descriptive and quantitative analyses.
Outcome 2: Students will develop critical reading and thinking skills through reading and discussions of scientific literature.
Outcome 3: Students will be able to explain and discuss the latest cutting edge research in the field of biology and articulate an opinion about its relevance and impact to society.
Outcome 4: Students will develop their oral communication skills through in-class presentations and class discussion.
Outcome 5: Students will be able to apply an ethical approach to the practice of the scientific method.

Attendance and Assignments:

YOU MUST ATTEND EACH LABORATORY. If you have an emergency that requires you to miss a laboratory, you must notify your instructor immediately. You should call his or her office, as well as email him/her, before class begins and discuss the possibility of attending another lab section (if the other instructor agrees). You will be working in groups in the laboratory and this will be difficult for your group and the groups in the other lab sections. If the instructor does not hear from you before class, you relinquish the right to make up the laboratory. The instructor can deduct 25 points from your overall total points for every lab that is missed.

You must turn in assignments on time. Reports, homework and laboratory assignments are due at the beginning of each class period. All work handed in after the beginning of class will be levied a 20% penalty. Each additional day that the work is late will add an additional 20% penalty.

Read the assigned lab material and prepare for your quizzes. You will have a quiz at the beginning of most labs.

Scholastic Ethics:
Each student is expected to do his/her own work. Should you turn in work that is paraphrased from a colleague, or plagiarized from any source, you will be given a zero (0) for that portion of the course. The professor reserves the right to report the student to the Academic Dishonesty Committee, and he/she may be withdrawn from the course. When you work within your lab groups, you are still expected to do your own work and not represent the work of others as your own. Please note: allowing others to copy from your work also constitutes cheating.

Activities and Grading:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Points</th>
<th>Due Date</th>
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<tbody>
<tr>
<td>Quizzes (10 total, 15 pts each, lowest quiz grade will be dropped)</td>
<td>135</td>
<td>Beginning of most labs</td>
</tr>
<tr>
<td>HW Lab 1 (Proposal)</td>
<td>20</td>
<td>Beginning of Lab 2</td>
</tr>
<tr>
<td>Lab 3 Pre-lab homework (Excel)</td>
<td>20</td>
<td>Beginning of Lab 3</td>
</tr>
<tr>
<td>Lab 4 Pre-lab Homework (E.coli experiment questions)</td>
<td>20</td>
<td>Beginning of Lab 4</td>
</tr>
<tr>
<td>Individual Mini-Report</td>
<td>50</td>
<td>Beginning of Lab 5</td>
</tr>
<tr>
<td>Proposal Presentation AND Detailed Protocol</td>
<td>20</td>
<td>Beginning of Lab 6</td>
</tr>
<tr>
<td>Group Mini-Report</td>
<td>50</td>
<td>Beginning of Lab 7</td>
</tr>
<tr>
<td>Protist Tree</td>
<td>10</td>
<td>End of Lab 9</td>
</tr>
<tr>
<td>Mini-Trees</td>
<td>20</td>
<td>End of Lab 10</td>
</tr>
<tr>
<td>Poster and Presentation</td>
<td>150</td>
<td>Beginning of Lab 11</td>
</tr>
<tr>
<td>Peer Evaluation</td>
<td>25</td>
<td>End of Lab 11</td>
</tr>
<tr>
<td>Total</td>
<td>565</td>
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</table>
To calculate your grade at any time, add up the total number of points you have received and divide by the total number of possible points at that time, then multiply the result by 100 for a percentage. Your total percentage will be assigned a grade as follows:

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<th>D+</th>
<th>C-</th>
<th>C</th>
<th>C+</th>
<th>B-</th>
<th>B</th>
<th>B+</th>
<th>A-</th>
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<td></td>
<td>&lt;59</td>
<td>59-66</td>
<td>67-68</td>
<td>69-71</td>
<td>72-76</td>
<td>77-78</td>
<td>79-81</td>
<td>82-86</td>
<td>87-88</td>
<td>89-91</td>
<td>92-100</td>
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</table>

Please note the following policy from the UST Handbook: 6.2.14c. “Semester grades are mailed to the student by the Registrar’s Office. Grades are not to be posted, even with a coded listing, by individual instructors, who are not to communicate final grades to the students either orally or in writing.”

**Cell phones, beepers, pagers, and other electronic noisemakers:**
These devices are extremely disruptive during a class period. Please DO NOT USE THEM DURING CLASS. If you must bring them, make sure to turn them off before class begins. If you are texting, blogging, tweeting or facebooking, or your device rings during class time, the instructor reserves the right to remove you and/or your device from the classroom, and retain it for 3 days.

Attached are a series of appendices that will provide you with valuable information on lab safety (pages 4-6), writing mini-reports (pages 7-10) and posters (pages 11-14) and proper citing (pages 15-16).
In case of emergency, notify your instructor and campus security (713-525-3888)
If directed, call 911.

Other contacts to be used only in case of emergency:
Lab Coordinator, Building Safety Captain – Debra Rollo 713-831-7811
Building Safety Captain – Albert Ribes, Rosemarie Rosell (713) 525-3166

General Information:

- Completely read the assigned lab exercise or experiment BEFORE entering the lab.
- Teaching assistants are employees of the University and must be treated with the same level of respect as any other staff or faculty member.
- The consumption of food or drink in lab is PROHIBITED. All food items must remain OUTSIDE of the lab during class time. NO EXCEPTIONS. This includes chewing gum.
- Putting on makeup or contacts is not allowed in lab. Please do this before coming to class.
- Closed-toe shoes must be worn at all times. Open-toed shoes are not permitted. You will be asked to leave the lab if you arrive in sandals, flip flops, or shoes that do not adequately cover your feet. Wear lab-suitable clothing.
- If you are allergic or sensitive to any material used in lab, notify the instructor immediately. The Biology Dept. provides nitrile gloves for laboratory use.
- Never work in the laboratory alone, except with instructor permission. Access to the laboratory is limited at the discretion of the instructor and lab coordinator, especially during non-classroom times.
- No materials, reagents or instruments are to be removed from the lab, except by the instructor.

Lab Safety:

- All accidents, even the most minor, should be reported to the instructor, TA, or lab coordinator IMMEDIATELY.
- In case of fire, there is an evacuation route at both ends of the lab - take the route that takes you away from flames. (See attached floor plan). There is also a fire extinguisher in the lab. Only use if the fire has small risk of spreading and if usage does not put you in danger. Please leave the lab in a prompt but calm manner if a fire occurs, while alerting those around you that there is a fire in the building. Fire alarms are located near the entrances to Anderson Hall.
- There are shower and eye wash stations in all labs (see attached floor plan). If you 'think' you need to use a wash station, especially when your eyes are involved, then you do.
- There is a first aid kit for minor injuries located in the lab (see attached floor plan).
- Be careful not to touch hot glass - glass cools slowly. Use hot pads provided by instructor.
- Never leave a flame or hot plate unattended.
- Eye protection is provided and is to be worn when working with caustic liquids, especially acids or bases.
- Gloves should be worn when working with preserved specimens, bacteria, buffers, or caustic liquids. Remove gloves BEFORE LEAVING.
- NEVER use your mouth to pipette solutions.
- Keep hands away from face and mouth while in lab.
- Wash your hands after lab, especially if you have been working with bacteria or chemicals.
- Horseplay and practical jokes can be dangerous and are not permitted.
- Keep all extra books and materials such as jackets stored away from your bench top.
- Dumb questions are not nearly as dangerous as dumb mistakes - please ask!!!!
Waste Disposal:

- You **MUST** clean your lab bench before leaving the laboratory for the safety of the students in the following labs. This includes washing your glass wear, wiping down your lab bench, and properly disposing of any waste generated.
- Disposable sharp objects such as scalpels, needles, or razor blades must be disposed of in a proper sharps container which will be provided to you if necessary.
- Broken or chipped glassware should be disposed of in the broken glassware disposal boxes. If in doubt, ask a professor or TA what you should do BEFORE you use it.
- Do not dispose of anything down the sink unless you have permission to do so by the instructor. Most chemicals **CANNOT** go down the sink and must be disposed of in a chemical or biohazard waste container.
- Biohazardous waste must be disposed of in a biohazard bag. DO NOT throw away biohazardous materials in the trashcan.
- Chemical spills should be cleaned according to the nature of the liquid. Notify the instructor of spills, especially if they involve acids, bases or caustic solutions.
- MSDS (material safety data sheets) are provided in an addendum to this safety information. Please reference the MSDS for chemicals you are working with in the lab so that you are aware of any potential hazards.

Please acquaint yourself with the following waste disposal and chemical hazard signs:

![Sharps container for proper sharps disposal.](image1)

![Glass disposal box for broken glassware.](image2)
Universal biohazard symbol that indicates biohazardous waste. Do not discard non-hazardous waste in these containers.

http://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&docid=OSTX6P0KHA0OyM&tbm=ufE6iRKUWzrLIM&ved=0CAUQjRw&url=http%3A%2F%2Fsafety.ag.utk.edu%2Fsafetyplan%2F10chemweb%2Fnpfadamin.htm&ei=1XobUsHmH4GK2gWfm4EI&bvm=bv.51156542,d.b2I&psig=AFQjCNEYXyxdvFATwU9mvd4DeKd09Gh

NFPA Ratings that you may see on lab chemicals and solutions.
GUIDELINES FOR WRITING MINI-REPORTS

For some labs you will be handing in a one page Mini-Report. It must include the following sections: Title, Introduction, Methods, Results, Discussion (or Conclusion), and Literature Cited. Additional information and hints are provided for each section (see italicized text).

1. Title: Here you will state the main findings: What were the results of your work? The title should be specific and allow the reader to know exactly what you are investigating. Underneath the title, you should write the last names of all the members of your lab team (followed by the initial of the first name), the name of your instructor (last name, first initial and typed in bold text), lab section, and date. If you are the author of an individual report, your name should be listed first and must be underlined, followed by the names of your group members.
   Example: Photosynthesis is impaired when plants are given UV light.
   Carrasco, M., Jones, P., Smith, H., Vu, T., Rosell, R. Lab Section LA: 09/15/09

   • Write a descriptive title. Be specific. For example “Choosing the best mouthwash” or “Which concentration kills more bacteria?” are vague titles as they fail to describe what substances you used, what ‘best’ means, how many different solutions or chemicals were tested, or what bacterial strains were used to conduct the experiment. A better title would be “The most effective mouthwash at killing S. aureus is Crest”.
   • Writing the names of all your group members (and spelling them correctly) shows respect. Whether you are handing in an individual or group mini report, all the names of your research colleagues must be there. This shows good work ethics.

2. Introduction: The introduction includes background information, the rationale and your hypothesis. The background information should be detailed enough so that the reviewer will understand what you are doing and why it should be done. For example, if your experiment involves enzymatic reactions and temperature, you should describe enzymes, how they work, what can affect their function. Then, explain the consequences of changing the environmental conditions of the reaction and focus on the specific effects of temperature. Your introduction should be approximately 6 sentences in length, so you will need to convey this information as succinctly as possible. Cite your information sources within the text by putting the last name of the first author and year of publication in parentheses, for example (Perez, 1996). In the last 2-3 sentences of your introduction, state your rationale and hypothesis, which should portray the relationship you expect to find between the independent and dependent variables.
   • You should also make use of relevant primary literature and avoid making your introduction sound like an encyclopedia entry by providing information that is relevant and as specific as possible to your subject.
   • Have a rationale for your hypothesis. The rationale (reason you are doing this specific experiment) and hypothesis will state the relationship between your dependent and independent variables. Your rationale must be clearly stated and express the reasons why you pose your hypothesis in the first place. It should also be grounded on observations or background research using the scientific literature. The rationale is usually written in 1-2 sentences after the background information and before the hypothesis in the introduction section.

3. Methods: In this section you will briefly describe how you conducted your experiment. In paragraph form, describe the experimental procedures performed to obtain your data. Use the past tense. You must be specific (give exact measurements, volumes, times, etc.), but at the same time, be brief and only include details that are necessary if someone else would wish to replicate the experiment. Remember to indicate the number of
replicates and the control(s) you used. If you refer to your lab handout in this section, remember to cite your handout and mention any deviations or changes from the original procedure.

- How you labeled your samples and the number of tubes you used are pieces of information that are not crucial for another researcher to be able to repeat the experiment. Write only what another person would need to know if someone wanted to replicate your experiment. Mention the number of trials conducted (which usually is three). Use your technical vocabulary and avoid using personal pronouns; for example, say “paper discs soaked in the three test solutions were placed on bacterial lawns of E. coli” instead of “we used three paper circles for each solution, wet them and then put them on one of the quadrants of a petri dish that had E. coli smeared all over”. Describe what you used as your control.

4. Results: This section should contain at least one paragraph (no more than 5 sentences) describing your most significant findings followed by a graph (or table) that shows your data. Always refer to your table or graph in the text by citing it at the end of the sentence, or using parentheses, for example: “see Figure 1”, or “see Table 3 below”, or “(Figure 2)”. Remember your figures must have descriptive legends below them, and tables are to be identified with titles at the top. Never include raw data. Do not begin your sentences with “Figure 2 shows”. Keep in mind you must describe the data, not the figure.

- Describe all your results in the Results section. If there is anything particular about your standard deviation, mention it here. Mention exact values, as sometimes they cannot be estimated by observing the graph. For example, “Dr. Tichenor’s mouthwash had the highest zone of inhibition (19.5 mm ± 0.5) followed by...” Please remember that all numbers smaller than 1 should have a zero before the decimal point. Always use relevant units when mentioning data points and be consistent with significant figures.
- The graph (table or figure) should be presented AFTER the written description of your results. Understanding which are your dependent and independent variables allows you to decide which one goes on each axis, and if you should use a column(bar) or line graph. DO NOT graph your raw data. DO graph your averages. Be critical (smart) about your error bars. Remember that tables have a title (above the table), and figures and graphs have a legend (detailed short paragraph under the graph or figure). Your title or legend must be descriptive and should not include the results of your experiment.

5. Discussion (or Conclusion): In your first sentence, state if the data supports your hypothesis or not. Then, interpret your results relative to the background information. Do not repeat what you stated in the ‘Results’ section; instead explain what the results mean. Compare your findings to those published in the scientific literature. These may support (or not) your findings. For example, if you were testing salt concentration and its relationship to product formation in an enzymatic reaction, you should search publications where the authors describe the effects of different salt concentrations on the enzymatic activity of similar enzymes. This should be the longest section of your report and you may use up to 12 sentences for your data interpretation.
- Begin this section by stating if your data support your hypothesis (or not). Since it is a short format, you do not need to restate the hypothesis. The main point of your discussion is to explain why you obtained the data you did. What is the underlying mechanism? Why is product A better than product B? Do not repeat your results in this section. Discuss your findings in the light of the findings of others who have conducted similar experiments and remember to cite those primary references correctly. Because of the space limitation, please refrain from explaining what could have gone wrong or where your research could go in the future.

6. Literature Cited: List the references and the sources you cited in your text following the author-year format. Include a list of your references at the end of your document. You must use the proper format for in-text citations and references which is described in detail on pages 10-11 of this syllabus. In the literature cited section of your report, include all authors’ last names and initials, year of publication, and full title of the paper, article or book. For journal articles, you must list the journal name (abbreviated form is fine), volume,
issue number (if available), and inclusive pages. Books must be identified by publisher, place of publication, and inclusive pages. Please refer to Pechenik’s “A Short Guide to Writing about Biology”, Chapter 5, for more information on how to cite your references correctly.

- **At minimum, you should have three references:** one for your background information and two for your discussion. At least two of those, typically the ones you use in your discussion, should be primary references from peer-reviewed journals. In many cases, your textbook will be useful for the background information. If you do not include at least two primary references, the highest grade you can make in this section is a D. Keep in mind that opinion articles, encyclopedias and Wikipedia are not considered sources of scientific information.

**Miscellaneous Directions for your Mini-report:**

- Always follow the verbal and written instructions provided by your instructor. Make notes so you don’t forget.
- Use Arial text (size 11). The Literature cited may be presented in a smaller font if extra space is required (size 9). Margins: 2 cm (or 1 inch) on every side.
- The maximum length of your mini-report is **ONE page**.
- If you are using scientific names of organisms, you **must** use the appropriate binomial nomenclature and italicize the text. For example, *Caenorhabditis elegans* or *C. elegans*.
- Make sure the font type, font size, margins, and maximum extension (1 page) of your document are correct. If you do not have strong writing skills, take your work to the Writing Center and get help.
- Be cohesive. If your title reads “Effect of mouthwash alcohol concentration on *E. coli* growth”, you are stating your dependent (growth) and independent (alcohol concentration) variables. Your hypothesis should reflect that you expect these variables to interact. Your graph must have ‘Diameter of growth inhibition’ on the y-axis and ‘Alcohol concentration’ on the x-axis, along with the corresponding units for these measurements or calculations in parentheses. Since concentration is a continuous variable, you should have a line graph. This is what it means to be cohesive. Your narrative and research of the literature should also relate directly to these general themes.
- Keep in mind that scientific writing is conventional, only uses established abbreviations and should be clear, concise and accurate. In addition, scientific writing uses formal language, **avoids quotations**, and is objective. Write with your audience in mind (college freshman level). For more information on characteristics of scientific writing, please see following document: <http://skills.library.leeds.ac.uk/uploads/Writing%20for%20Science%20Subjects747.pdf>.

The grading rubric that will be used to grade your mini reports is provided on the following page.
<table>
<thead>
<tr>
<th>CONTENT (50 pts)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Title (3 pts)</td>
<td>Descriptive, well written, contains conclusion of the work, succinct (2)</td>
<td>Descriptive, includes conclusion of the work, not succinct (1.5)</td>
<td>Accurate, does not encompass the conclusion, &quot;effect of&quot; title (1)</td>
<td>Generally describes the work but is vague or poorly written (1.5)</td>
<td>Poorly written, does not describe the experiment or absent (0)</td>
<td></td>
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<tr>
<td>Names of group members</td>
<td>Properly formatted (1)</td>
<td>Present, but improperly formatted (0.5)</td>
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<td>Absent (0)</td>
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<tr>
<td>2. Introduction (11 pts)</td>
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<tr>
<td>Background information</td>
<td>Succinctly explains the system and introduces the question being studied (6)</td>
<td>Relevant details are present, includes extraneous information but well written (5)</td>
<td>Extraneous or missing information, misspellings, improper grammar or flow, issues with organization (4)</td>
<td>Missing information, poor grammar, flow and organization (3)</td>
<td>Inaccurate, poor grammar, spelling and organization (0)</td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>Provides clear explanation for hypothesis, well written, supported by literature (2.5)</td>
<td>Details are present, well written, includes extraneous information (2)</td>
<td>Missing information or not properly supported with literature (1.5)</td>
<td>Missing information, poor grammar and organization (1)</td>
<td>Not present, inaccurate, poor grammar, spelling and organization (0)</td>
<td></td>
</tr>
<tr>
<td>Hypothesis</td>
<td>Well written, succinct and testable (2.5)</td>
<td>Testable, slight issues with wording (2)</td>
<td>Testable, but poorly worded (1.5)</td>
<td>Not testable and difficult to identify in the text (1)</td>
<td>Unclear or not present (0)</td>
<td></td>
</tr>
<tr>
<td>3. Methods (7 pts)</td>
<td>Methods well written with excellent organization (5)</td>
<td>General problems with organization, missing details (3.5)</td>
<td>Unorganized and missing several important steps or details (2.5)</td>
<td>Poorly written, with partial sentences, missing information (1.5)</td>
<td>Not present, unclear or inaccurate (0)</td>
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<tr>
<td>Experimental design paragraph</td>
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<tr>
<td>Variables</td>
<td>Correctly identified and stated (3)</td>
<td>Missing information (0.5)</td>
<td>Unidentified (0)</td>
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<tr>
<td># of replicates</td>
<td>Stated (1)</td>
<td>Missing (0)</td>
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<td>4. Results (12 pts)</td>
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<tr>
<td>Description of results</td>
<td>Clearly explains the experimental results, well written, references figures in the text (5)</td>
<td>Too much/little detail, but accurately describes the results (4)</td>
<td>Issues with grammar and spelling, a list of data without accompanying prose (3)</td>
<td>Poorly written, slightly inaccurate (2)</td>
<td>Not present, inaccurate, a list of raw data (1-0)</td>
<td></td>
</tr>
<tr>
<td>Figures</td>
<td>Correct type, error bars and legend/title accurate, controls present, well labeled and organized (7)</td>
<td>All components present, slight issues with wording, figure layout or error bar presentation (5.6)</td>
<td>Some components and labels missing (4.9)</td>
<td>Wrong type of figure, missing components, inaccurate (4.2)</td>
<td>Poorly organized, inaccurate, components missing, unreadable (3.5-0)</td>
<td></td>
</tr>
<tr>
<td>5. Conclusion (12 pts)</td>
<td>Present, well-written, accurate (2)</td>
<td>Present, poorly written (1)</td>
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<td></td>
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<tr>
<td>Does the data support the hypothesis?</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Interpretation of results</td>
<td>Accurate, well supported by the data, logically presented (6)</td>
<td>Slight issues with wording or grammar, but accurate and logically sound (5)</td>
<td>Issues with logic, but generally supported by data (4)</td>
<td>Poor logic, not supported by results (3)</td>
<td>Poorly written, no logical flow and not supported by results, absent (2.0)</td>
<td></td>
</tr>
<tr>
<td>Comparison with previously published information</td>
<td>Clearly and succinctly written, compared to relevant literature (4)</td>
<td>Slight issues with wording/grammar, accurate and relevant information (3.5)</td>
<td>Some information is not relevant or is missing, issues with wording and grammar (2.5)</td>
<td>Mostly irrelevant information, issues with grammar and spelling, poor logical flow (2)</td>
<td>Mising, no relevant information, poor grammar and spelling (1-0)</td>
<td></td>
</tr>
<tr>
<td>6. Literature cited in text and reference section (5 pts)</td>
<td>Proper and consistent formatting throughout (3)</td>
<td>Some errors in formatting (2.4)</td>
<td>Mixture of proper and improper formatting (2.1)</td>
<td>Mostly improper formatting (1.8)</td>
<td>Missing/improper format (1.5-0)</td>
<td></td>
</tr>
<tr>
<td>Formatting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citation quality/quantity</td>
<td>&gt;3 relevant primary literature (2)</td>
<td>&gt;2 relevant primary literature (1.5)</td>
<td>&gt;1 relevant primary literature (1)</td>
<td>1 relevant primary literature (0.5)</td>
<td>Poor quality, not relevant, missing (0)</td>
<td></td>
</tr>
</tbody>
</table>

HOW TO LOSE POINTS: AUTOMATIC 5 POINT DEDUCTION FOR EACH OF THE FOLLOWING:

1. Restate results in Discussion
2. Use Wikipedia/online dictionaries in Literature Cited
3. Report is more than one page
4. Using raw data in Results
5. Using direct quotes from any source (reference material)
HOW TO MAKE A POSTER PRESENTATION OF SCIENTIFIC EXPERIMENTS

I. A GREAT POSTER IS

- Readable—text and ideas should flow easily
- Use bullet points to decrease overall amount of text while preserving content
- Legible—use larger fonts so text can be seen from far away (24-32 point is usually large enough for text—titles should be bold and larger than 40 pt)
- Well organized—make it easy for the reader to follow where you are going
- Succinct—use as few words as possible to get your message across
- Neat and visually attractive

II. ELEMENTS THAT YOU MUST INCLUDE

- Title: centered with authors directly underneath and LAB SECTION in very large font in top right corner!
- Introduction: make sure to include hypothesis
- Methods: short & concise—can use a table, flow chart or bulleted list
- Results:
  - Must have written summary of most important data.
  - Must reference Figures [with error bars] & Tables—use Fig.# or Table # at end of sentence in parentheses
- Discussion: Interpretation
- Literature Cited

III. DESIGNING THE POSTER ELEMENTS

- Use a computer with word processing and Excel. DO NOT WRITE OUT BY HAND!!
- Print out your final elements on nice paper or with a color printer if available.
- If you want to use photographs or pictures, feel free as long as they are applicable to the subject of the poster and well labeled. Each picture or photograph MUST have a descriptive legend below it and each should be referenced somewhere in the text (Introduction, Methods, Results, or Discussion)

IV. TO BEGIN

A. Decide what the main message is: keep it short—use the active voice.
B. Measure the space you have
   - Lay out the space physically as well as drawing it on paper
   - Make the elements of the poster flexible so you can move parts of it around
C. Lay out the elements crudely
   - Before you make the final elements of the poster, take pieces of paper that are the right size and see if you can make them all fit

V. POSTER LAYOUT SUGGESTIONS

A. How to arrange poster elements and text
   1. Put the most important message in the center top position (title in largest font with your names in font just a bit smaller, lab section in large font)
   2. Flow of information
      - Start flow of poster in top left
      - Can then flow information in two ways:
      - Down to bottom left and then up to top right and then down to bottom right (information in vertical rows across the poster board)
      - OR across on the top to the right and then start on bottom left and go to right along bottom of poster
   3. Space is important in a poster—leave some—gives reader visual pauses to think
   4. Watch the spatial arrangement of your text—use various sized fonts to bring home most important points

B. PRACTICAL MATTERS: Making a poster takes time—don’t leave this until the last minute or you will not get it done

C. FONTS
   - Use highlighting with text format (e.g., use bold for important terms)
• use tabs or bullets to indent and set text apart
• use center justification for element titles (Introduction)

D. COLOR: color adds dimension to your poster. Ways to add color:
• use colored construction paper to back your text on plain paper--this adds a border that highlights the information in that panel
• can use colored yarn to visually link poster elements
• add contrast by adding light color to the backgrounds of your figures or using white lettering on a colored background (if you have a color printer)
• GLITTER IS NOT ALLOWED!!! NO GLITTER ON ANY PART OF POSTER!!! It makes a mess and does not add to the overall appearance of your poster.

VI. FINAL CHECK BEFORE YOU ASSEMBLE THE POSTER
Have someone that has not been working on the poster read the text and look for misspellings or confusing statements. Make the changes before you actually attach your elements to the poster or color background.

VII. POSTER ASSEMBLY
➢ Keep your hands and work surface clean while assembling everything onto the butcher paper.
➢ To attach elements to the butcher paper, use glue sticks or spray mount (be careful with this because it can get on the front of your papers and stain if you are not careful).
➢ Scotch tape will not hold the papers onto the butcher paper in Houston humidity.
➢ You don’t want to walk into lecture class the morning after you have put your poster up and find all of the pieces on the floor!!!!

LIST OF MATERIALS NEEDED
➢ Individual poster elements (all text, charts, tables and graphs) printed out on nice paper or final drafts of any hand drawings. Have two of each in case you make a goof while gluing.
➢ Butcher paper—provided by your lab instructor! (Do not go to Kinkos for printing—poster will not be accepted by instructor)
➢ Colored paper or construction paper
➢ Adhesive—glue sticks or spray mount
➢ Sharp Razor blade (we will supply if you need one)
➢ Straight edge—ruler
➢ Soft pencil and good eraser (to mark where you want your elements to be on the butcher paper and then erase the marks)
➢ Large clean surface to work on

SECTIONS
Your poster should have the same elements as a mini report (title, introduction, methods, results, discussion/conclusion, literature cited)

The grading rubric for the poster and for the peer and group evaluations are provided on the next few pages.

This is adapted from "How to make a great poster" by Dina F. Mandoli. Use the internet to peruse any other information that is available, for example, here are a few good websites:
http://www.ncsu.edu/project/posters/NewSite/index.html#Note0
http://www.tc.umn.edu/~schne006/tutorials/poster_design/

The rubric for the poster is provided on the following page. Please review it prior to creating the poster.
<table>
<thead>
<tr>
<th>Title (6 pts)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Descriptive, well-written, contains conclusion of the work, succinct (5)</td>
<td>Descriptive, includes conclusion of the work, not succinct (4)</td>
<td>Accurate, does not encompass the conclusion, &quot;effect of&quot; title (3.5)</td>
<td>Generally describes the work but is vague or poorly written (3)</td>
<td>Poorly written, does not describe the experiment or absent (2.5-0)</td>
</tr>
<tr>
<td>Names of group members</td>
<td>Properly formatted (1)</td>
<td>Present, but improperly formatted (0.5)</td>
<td></td>
<td></td>
<td>Absent (0)</td>
</tr>
</tbody>
</table>

2. Introduction (20 pts)

| Background information | Succinctly explains the system and introduces the question being studied (10) | Relevant details are present, includes extraneous information but well written (8) | Extraneous or missing information, misspellings, improper grammar or flow, issues with organization (7) | Missing information, poor grammar, flow and organization (6) | Inaccurate, poor grammar, spelling and organization (5-0) |
| Rationale | Provides clear explanation for hypothesis, well written, supported by literature (5) | Details are present, well written, includes extraneous information (4) | Missing information or not properly supported with literature (3.5) | Missing information, poor grammar and organization (3) | Not present, inaccurate, poor grammar, spelling and organization (2.5-0) |
| Hypothesis | Well written, succinct and testable (5) | Testable, slight issues with wording (4) | Testable, but poorly worded (3.5) | Not testable and difficult to identify in the text (3) | Unclear or not present (2.5-0) |

3. Methods (10 pts)

| Experimental design paragraph | Methods well written with excellent organization (8) | General problems with organization, missing details (6.4) | Unorganized and missing several important steps or details (5.6) | Poorly written, with partial sentences, missing information (4.8) | Not present, unclear or inaccurate (4.0) |
| Variables | Correctly identified and stated (1) |  |  | Missing information (0.5) | Unidentified (0) |
| # of replicates | Stated (1) |  |  |  | Missing (0) |

4. Results (18 pts)

| Description of results | Clearly explains the experimental results, well written, references figures in the text (7) | Too much/little detail, but accurately describes the results (5.6) | Issues with grammar and spelling, a list of data without accompanying prose (4.9) | Poorly written, slightly inaccurate (4.2) | Not present, inaccurate, a list of raw data (3.5-0) |
| Figures | Correct type, error bars and legend/title accurate, controls present, well labeled and organized (11) | All components present, slight issues with wording, figure layout or error bar presentation (8.8) | Some components and labels missing (7.7) | Wrong type of figure, missing components, inaccurate (6.6) | Poorly organized, inaccurate, components missing, unreadable (5.5-0) |

5. Conclusion (19 pts)

| Does the data support the hypothesis? | Present, well-written, accurate (2) | Present, poorly written (1) |  |  | Inaccurate based upon data presented (0) |
| Interpretation of results | Accurate, well supported by the data, logically presented (12) | Slight issues with wording or grammar, but accurate and logically sound (9.6) | Issues with logic, but generally supported by data (8.4) | Poor logic, not supported by results (7.2) | Poorly written, no logical flow and not supported by results, absent (6-0) |
| Comparison with previously published information | Clearly and succinctly written, compared to relevant literature (5) | Slight issues with wording/grammar, accurate and relevant information (4) | Some information is not relevant or is missing, issues with wording and grammar (3.5) | Mostly irrelevant information, issues with grammar and spelling, poor logical flow (3) | Missing, no relevant information, poor grammar and spelling (2.5-0) |

6. Literature cited in text and reference section (7 pts)

| Formatting | Proper and consistent formatting throughout (4) | Some errors in formatting (3.2) | Mixture of proper and improper formatting (2.8) | Mostly improper formatting (2.4) | Missing/Improper format (2.0) |
| Citation quality/quantity | >3 relevant primary literature (3) | >2 relevant primary literature (2.4) | >1 relevant primary literature (2.1) | 1 relevant primary literature (1.8) | Poor quality, not relevant, missing (1.5-0) |

**APPEARANCE (40 pts)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Excellent - Clear, neat and well organized</th>
<th>Good - Well done, room for improvement</th>
<th>Average - Acceptable</th>
<th>Below Average - Needs improvement</th>
<th>Poor - Unclear and/or poorly organized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readability: font size, highlighting, use of color</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Organization of elements (neat poster format)</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Figures: clear, appropriate and helpful</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Writing: grammar, style, clarity</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Overall attractiveness of poster</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

**APPEARANCE SCORE / 40**

**TOTAL SCORE / 120**
### PEER POSTER EVALUATION: each group must evaluate all other posters in the class

**Poster Title:**

**Authors:**

**Reviewers’ names:**

<table>
<thead>
<tr>
<th>SCIENTIFIC QUALITY OF POSTER (10 pts)</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of introduction (background info, rationale, hypothesis)</td>
<td>( \begin{array}{c} A \ \ 3 \ \ 2.5 \ \ 2 \ \ 1.5 \ \ 0 \ B \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Description of methods</td>
<td>( \begin{array}{c} A \ \ 2 \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ B \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Clarity of data presentation (results)</td>
<td>( \begin{array}{c} A \ \ 2 \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ B \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Discussion and conclusion (clear, logical)</td>
<td>( \begin{array}{c} A \ \ 3 \ \ 2.5 \ \ 2 \ \ 1.5 \ \ 0 \ B \ \ 2 \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPEARANCE OF POSTER (10 pts)</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readability: font size, highlighting, use of color</td>
<td>( \begin{array}{c} A \ \ 2 \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ B \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Organization of elements (neat poster format)</td>
<td>( \begin{array}{c} A \ \ 2 \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ B \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Figures: clear, appropriate and helpful</td>
<td>( \begin{array}{c} A \ \ 2 \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ B \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Writing: grammar, style, clarity</td>
<td>( \begin{array}{c} A \ \ 2 \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ B \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Overall attractiveness of poster</td>
<td>( \begin{array}{c} A \ \ 2 \ \ 1.5 \ \ 1 \ \ 0.5 \ \ 0 \ B \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
</tbody>
</table>

**TOTAL (20 pts)**

### INSTRUCTOR EVALUATION OF GROUP PRESENTATION

**Poster Title:**

**Student’s name:**

**Group:**

<table>
<thead>
<tr>
<th>CONTENT (10 pts)</th>
<th>Possible Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student is well prepared and shows clear understanding of the topic</td>
<td>( \begin{array}{c} A \ \ 4 \ \ 3 \ \ 2 \ \ 1 \ \ 0 \ B \ \ 3 \ \ 2.5 \ \ 2 \ \ 1 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Student participates equally and is in attuned to the flow of the presentation</td>
<td>( \begin{array}{c} A \ \ 3 \ \ 2.5 \ \ 2 \ \ 1 \ \ 0 \ B \ \ 2 \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
<tr>
<td>Student has clear articulation and exhibits confidence. Volume is appropriate and student maintains eye contact.</td>
<td>( \begin{array}{c} A \ \ 3 \ \ 2.5 \ \ 2 \ \ 1 \ \ 0 \ B \ \ 2 \ \ 1 \ \ 0.5 \ \ 0 \ \ 0 \end{array} )</td>
</tr>
</tbody>
</table>
REFERENCE FORMAT (Adapted from Pechenik, 2007*)

All statements of fact and opinion require support. When you write a paper, you do not ‘make things up’. You read about them and collect the relevant information. At the end of your manuscript OR LAB REPORT you must list the books, research articles and Web Sites you consulted. Here are some basic guidelines:

1. **Cite by author and year of publication**
   It does not matter if your source is a book, a scientific journal or the Internet, you must always cite the publication using the authors last name, and the year of publication.
   
   **Example:**
   A variety of organic molecules are commonly used to maintain or adjust the osmotic concentration of intracellular fluids (Hochachka and Somero, 1984; Schmidt-Nielsen, 1990).

2. **Consider the number of authors**
   When you have two authors write both their names. When more than 3 authors have collaborated on a single publication, use ‘et al’, which is the abbreviation for *et alii*, meaning ‘and others’. Since it is in Latin, it should be italicized.
   
   **Example:**
   A mutation is defined as any change occurring in the nitrogenous base sequence of DNA (Tortora *et al*, 1982).

3. **Same author, same year**
   If by chance you have two (or more) papers published by the same person in a single year, you can distinguish them by using a letter.
   
   **Example:**
   Asmodeus and Li, 1998a / Asmodeus and Li, 1998b

4. **Cite only those sources you have actually read**

5. **Listing references**
   List references in alphabetical order and then chronologically. Spell out only the last names of the authors; initials are used for first and middle names. All authors must be included. Journal names are usually abbreviated.

**IN THE ‘LITERATURE CITED’ SECTION OF YOUR REPORT, THIS IS HOW YOU WILL IDENTIFY YOUR REFERENCES:**

**A. Citing Book references:**
Last Name 1, F., Last Name 2, F. Year. *Name of the book (italicized)*, Edition Number. Publisher, City, State, pages (when specific section is used).

**Examples:**


**B. Citing a Laboratory Manual or Handbook:**
Last Name 1, F., Last Name 2, F. Year. *Name of the handbook (italicized)*. Publisher or School, Edition Number, City, State, pages (when specific section is used).

**Examples:**

C. Citing a Scientific Journal:
Last Name 1, F., Last Name 2, F. Year. Title of the article. *Abbreviated name of Journal*. Volume (number/issue): pages.

Examples:


Note: If you are citing an electronic journal you should add ‘e’ before the page number.

D. Citing a Website (NO dictionaries, wikipedia or encyclopedias):
Last Name 1, F. Name of the article [Internet]. City, state: Name of the Website; year of publication [citation date]. Available from <write the full URL>

Examples: