

## BIOL/CHEM/PHYS 4700 Research Methods for Secondary Science Instruction

COURSE SYLLABUS Spring 2016

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UNT endeavors to offer students a high-quality education and to provide a supportive environment to help you learn and grow. As faculty members, we are committed to helping you be successful as a student. **Here's how to succeed at UNT: (1) Show up; (2) Find support; (3) Get advised; (4) Be prepared; (5) Get involved; and (6) Stay focused.** You are encouraged to access the following website: <https://success.unt.edu>. The site contains multiple student resource links and short videos with student messages.

### Course Description:

In this course, students are provided opportunities and tools to solve scientific problems in a laboratory setting, are made aware of how scientists communicate with each other through peer-reviewed scientific literature, and gain understanding of how scientists develop new knowledge and insights that are shared with the scientific community and, ultimately, their future students. This course also provides content knowledge and experiences concerning all aspects of managing the high school science laboratory. Discussion of techniques used to successfully accomplish scientific inquiry in the laboratory or in the field, experimental design & set-up, effective use of current technology, proper data analysis, laboratory & field safety, and high school laboratory design & management are included in the course.

### Prerequisites:

Completion of freshman and sophomore science courses required for teacher certification and consent of department. EDSE 3500 and EDSE 4000 are *highly* recommended.

### Instructional Emphasis

**Research Methods for Secondary Science Instruction** is a two-pronged course that is primarily laboratory-based. This course is steeped in inquiry through research and practical teaching techniques that require the student to take on three different roles throughout the course: scientist, science teacher, and science student. Technology that is used in laboratory situations, both in research and in secondary schools, is used throughout the course. Safety is of utmost importance to a scientist and a science teacher, therefore, much time is spent learning safe practices for inside and outside the science laboratory.

Research Methods students design experiments to answer scientific questions and to reduce systematic and random errors. They incorporate relevant statistics to interpret experimental results and deal with sampling errors. They present their scientific research orally and in writing. Writing is a significant component of the course, and the written reports students produce are evaluated as examples of scientific writing.

Research Methods students also develop relevant laboratory management skills, technology expertise, and classroom management techniques that are needed in the secondary science classroom. The emphasis is on inquiry techniques and science process skills that are used to develop effective habits of mind from a scientific and consumer perspective and that are used to develop 21<sup>st</sup> century skills in secondary students. State standards are also emphasized, particularly the TEKS and CCRS.

The combination of **Research Methods for Secondary Science Instruction** and **Perspectives on Mathematics and Science** provides prospective science and mathematics teachers with an in-depth understanding of how the scientific

enterprise works. Students embed their understanding of the nature of science and mathematics into their project-based instruction curriculum unit.

### Core Components

- The course is taught by an instructional team with a broad mix of scientific expertise and instructional expertise.
- The course is primarily a laboratory course where students develop and practice skills that are fundamental to the scientific enterprise.
- The course is organized around one independent inquiry that TNT students design and carry out.
- The course requires a substantial amount of writing. Components of the inquiry will be individually evaluated based on scientific writing standards and feedback provided before the entire written inquiry report is submitted at the end of the semester.
- The course emphasizes the development of skills that are directly applicable in teaching secondary science (e.g. use of equipment, preparation of lab materials, safety issues, use of technology)

### Course Objectives, State and National Standards:

<b>OBJECTIVES:</b> <i>Upon completion of this course, students will be able to...</i>	<b>Texas PPR EC-12 Standards:</b>	<b>NSTA Standards for Science Teacher Preparation</b>
Pose scientific questions and create experiments to answer these questions	9D	1d
Find, read, and critique research articles in a field of scientific study.	9C	
Design experiments to reduce systematic and random errors and provide for proper data analysis	9D	1d, 1e
Implement current technology using probes and computers to gather and analyze data	3E, 9A, 9B, 9F	5d
Practice laboratory safety, understand how and why chemical storage in the secondary environments works, state the purpose of and correctly use safety tools in a laboratory setting.	5F, 9B, 13A, 13B	5f, 9b, 9c, 9d
Explain why safety is crucial in all laboratory investigation settings. Explain the legal and ethical responsibilities of science teachers.	5F, 5G, 9B, 13A, 13B	9a
Use statistics to interpret results of experiments.	9D	
Design a safe, functional, and efficient science laboratory.	5F, 9B, 13A, 13B	9a-d
Write and review scientific papers.	3B, 3G, 8D, 9G	5e, 8a
Give both oral and poster presentations of scientific research.	3D, 9E	

### Course Materials:

Required: Collins, J.W. (2010). *Texas Safety Standards: Kindergarten through Grade 12, A Guide to Laws, Rules, Regulations, and Safety Procedures for Classroom, Laboratory, and Field Investigations*, 4th Ed. Charles. A Dana Center: Austin, TX.

Optional: Marder, M.P. (2011). *Research Methods for Science*, Cambridge University Press: New York. ISBN 978-0-521-14584-8.

### Attendance

Attendance and punctuality are expected in this course. Daily roll will be taken and you will be responsible for signing the attendance sheet each class period. Tardies and absences will count toward final grade reduction. **Three tardies = 1 absence; 3 absences = 1 letter grade lowered; 4 absences = 2 letter grades lowered; 5 absences = 3 letter grades lowered; 6 or more absences = failure in the class.**

## Grading:

Item	Due Date	Points
Reading Assignments (13)	Throughout the semester – see below for details	12 @ 2 pts each = 26 pts
Statistics Assignments (3)	Throughout the semester – see below for details	3 @ 2 pts each = 6 pts
Three topics, questions for research, and journal article	1/24/16	3
Research proposal	1/31/16	3
Flinn Safety Certification	2/7/16	10
Experimental design & data analysis plan	2/7/16, 2/13/16	3
Literature review	2/9/16	3
Canned Tech Lab with Write-Up	2/14/16	20
Canned Tech Lab Reflection and Discussion Board Feedback	3/2/16, 3/6/16	2
Presentation of initial experimental results	3/21/16	5
Data analysis	4/12/16	3
Demonstration with Write-Up	4/10/16	10
Demonstration Reflection and Discussion Board Feedback	4/15/16, 4/17/16	2
Conclusions	4/20/16	3
Rough draft of Research Paper	4/26/16	5
Poster presentation	5/4/16	5
Final Research paper	5/10/16	20
Final presentation	5/9/16	5
<b>TOTAL POINTS</b>		<b>132</b>

### Grading Scale (Percentage of total points earned)

90 – 100% = A

80 – 89 % = B

70 – 79% = C

60 – 69% = D

0 – 59% = F

*Things that can seriously impact grades and are often over-looked: absences, class behavior, inappropriate use of technology, tardiness, poor participation, missing assignment deadlines, neglecting small assignments.*

## Course Requirements and Expectations

- Much of what is done in class requires work to be done by you beforehand, especially when discussing different aspects of your research project. It is your responsibility to be fully prepared with all required materials ready to participate in the activities as outlined below. Failure to be fully prepared with all required materials will result in an unexcused absence for you, since you will not be able to participate in class.
- Some course topics will be covered only in class. You must be present to receive credit for these activities.
- Drafts of all writing assignments (components of your final research paper) will be graded and feedback provided based on the Research Paper Rubric. All draft write-ups will receive extensive notation from your instructor. Final drafts will have fewer (if any) comments.
- The research project must be closely related to your major.
- Development of instructional materials in the course is expected and such materials will be shared with classmates in a spirit of collegiality.
- Research Methods is a substantial writing course. Therefore, your writing assignments will be evaluated both on CONTENT and QUALITY of written expression. Conventional use of English language and conventions of scientific writing will be followed. There are no formal examinations. It is typical for your final inquiry paper to run about 15 to 20 tightly edited pages.
- This course is lab-intensive. When you are provided work time for your research project, you should spend the time on the research project. There is always writing to revise, data to analyze, or experimentation to do. **NO OTHER CLASS' WORK IS PERMITTED DURING CLASS TIME.**

## Assignments

- All assignments are submitted on BlackBoard Learn.
- All assignments are due by midnight of the day the assignment is due. Midnight is defined as being between 11:59 p.m. and 12:00 a.m.
- **No late assignments will be accepted.**
- If you have to miss an in-class assignment due to unforeseen circumstances, let your instructor know ahead of time (Dr. Lopes for physics majors, Dr. Sherman for chemistry majors and Dr. Thompson for biology majors). If you let the instructor know in advance, you will be allowed to make the assignment up. Failure to attend and communicate will result in an automatic zero for the assignment.

## Academic Dishonesty

Students caught cheating or plagiarizing will receive a "0" for that particular assignment or exam [or specify alternative sanction, such as course failure]. Additionally, the incident will be reported to the Dean of Students, who may impose further penalty. According to the UNT catalog, the term "cheating" includes, but is not limited to: a. use of any unauthorized assistance in taking quizzes, tests, or examinations; b. dependence upon the aid of sources beyond those authorized by the instructor in writing papers, preparing reports, solving problems, or carrying out other assignments; c. the acquisition, without permission, of tests or other academic material belonging to a faculty or staff member of the university; d. dual submission of a paper or project, or resubmission of a paper or project to a different class without express permission from the instructor(s); or e. any other act designed to give a student an unfair advantage. The term "plagiarism" includes, but is not limited to: a. the knowing or negligent use by paraphrase or direct quotation of the published or unpublished work of another person without full and clear acknowledgment; and b. the knowing or negligent unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials.

## Acceptable Student Behavior

Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The university's expectations for student conduct apply to all instructional forums, including university and electronic classroom, labs, discussion groups, field trips, etc. The Code of Student Conduct can be found at <http://deanofstudents.unt.edu>. Persistent misbehavior of any kind will result in serious consideration for removal from the TNT program by a committee composed of the instructor, a director of the program, the program advisor, and another TNT faculty member.

### **Course Safety Statement**

Students in BIOL/CHEM/PHYS 4700 are required to use proper safety procedures and guidelines. While working in laboratory sessions, students are expected and required to identify and use property safety guidelines in all activities requiring lifting, climbing, walking on slippery surfaces, using equipment and tools, handling chemical solutions and hot and cold products. Failure to follow safety protocols is considered unacceptable student behavior, and appropriate consequences may be applied including verbal warnings, removal from lab, and/or referral to Dean of Students. Persistent refusal to follow safety protocols could result in removal from the TNT program as described above.

Students should be aware that the University of North Texas is not liable for injuries incurred while students are participating in class activities. All students are encouraged to secure adequate insurance coverage in the event of accidental injury. Students who do not have insurance coverage should consider obtaining Student Health Insurance for this insurance program. Brochures for this insurance are available in the UNT Health and Wellness Center on campus. Students who are injured during class activities may seek medical attention at the UNT Health and Wellness Center at rates that are reduced compared to other medical facilities. If you have an insurance plan other than Student Health Insurance at UNT, please be sure that your plan covers treatment at this facility. If you choose not to go to the UNT Health and Wellness Center, you may be transported to an emergency room at a local hospital. You are responsible for expenses incurred there.

### **Americans With Disabilities Act:**

The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with an accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information, see the Office of Disability Accommodation website at <http://disability.unt.edu> . You may also contact them by phone at (940) 565-4323.

### **\*SPOT (Student Perceptions of Teaching)**

Student feedback is important and an essential part of participation of this course. The Student Perceptions of Teaching (SPOT) is a requirement for all organized classes at UNT. This short survey will be made available towards the end of the semester to provide you with an opportunity to evaluate how this course is taught.

***This course syllabus is intended to be a guide and may be amended at any time.***

**Course Overview (subject to change – Watch BlackBoard for announcements.)**

<p style="text-align: center;"><b>Week 1</b> <b>January 20</b></p> <p style="text-align: center;"><b>Introduction, Safety, and Research</b></p>	<ul style="list-style-type: none"> <li>• Welcome Back! Introductions. What did you do over the break (Paired Interview). Pre-Assessment for RM Study.</li> <li>• Syllabus – expectations of students for this semester</li> <li>• Safety – Flinn course</li> <li>• Set up login to course</li> <li>• Watch video on safety incident with demo. What could have been done differently? What are our responsibilities as teachers? Students write answers to questions then discuss with table group. Share with whole class.</li> <li>• Think-Pair-Share – What is science? What is research? Discuss with class. Instructor writes down response on the board</li> <li>• What are your goals for this course? Write 2-3. How will you accomplish this? (broad ideas OK).</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading</b>– Sherman Chapters 1 and 2 – assignment due by midnight on 1/24/16</li> <li>2) <b>Research Project</b> – Identify 3 potential topics for research, write questions for each, and locate one journal article for each potential topic – due 1/24/16.</li> <li>4) <b>Flinn Safety Course</b>- Go to <a href="http://labsafety.flinnsci.com/CertificateCourseSelection.aspx?CourseCode=HS">http://labsafety.flinnsci.com/CertificateCourseSelection.aspx?CourseCode=HS</a> . Create a login and get started on the safety course. Due 2/7/16.</li> </ol>
<p style="text-align: center;"><b>Week 2</b> <b>January 25</b></p> <p style="text-align: center;"><b>Research Design</b></p>	<ul style="list-style-type: none"> <li>• Prepare for Gallery Walk of research ideas</li> <li>• Seilman’s research – students read high school research report and evaluate the research in terms of ethics, safety, validity. Evaluate the report in terms of quality of writing and quality of content. What grade would you give this student? How does this apply to you as a researcher? Discuss afterwards</li> <li>• Reading Discussion – Sherman Chapters 1 &amp; 2</li> <li>• Gallery Walk: research topics and questions. Students will evaluate 3 sets of topics and questions.</li> <li>• Lecture: Designing experiments and writing research proposals</li> <li>• Student Individual work: make a decision regarding your research topic and research question. Revise question appropriately and write a hypothesis that answers the question.</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading</b> Sherman Chapter 3 – due 1/26</li> <li>2) <b>Research Project</b> – Research Proposal due 1/31/16. Bring a hard copy to consultation session on 2/1/16.</li> <li>3) <b>Research Project</b> – Find one research article related to your research topic and question, print out a hard copy and bring to class on 1/27/16.</li> <li>4) <b>Flinn Safety Course</b>- Go to <a href="http://labsafety.flinnsci.com/CertificateCourseSelection.aspx?CourseCode=HS">http://labsafety.flinnsci.com/CertificateCourseSelection.aspx?CourseCode=HS</a> . Create a login and get started on the safety course. Due 2/7/16.</li> </ol>
<p style="text-align: center;"><b>January 27</b></p> <p style="text-align: center;"><b>The Literature Search</b></p>	<ul style="list-style-type: none"> <li>• Reading Discussion – Sherman, Ch 3</li> <li>• Science librarian for UNT provides instruction about online databases, scientific journals, and how to use search strings (Boolean) properly – best databases and journal sources for work. Students work through searching examples with librarian</li> <li>• Students search for 3 research articles about their topic. Librarian and instructors help students.</li> <li>• Instructor discusses other sources – textbooks, personal interviews, lab books, etc. Ties in the literature search to the design of their experiment. Instructor discusses how to read and critique research articles.</li> <li>• Students complete lit review question sheet for article brought to class. This is beginning of annotated bibliography and</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading</b> Texas Safety Standards: Ch 1, 4, 7 – assignment due by midnight on 1/31/16</li> <li>2) <b>Research Project</b> – Research Proposal due 1/31/16. Bring a hard copy to consultation session on 2/1/16.</li> <li>3) <b>Flinn Safety Course</b> – due 2/7/16. (Be sure that you are logged into the course as you work!)</li> </ol>

	literature review	
<p><b>Week 3</b> <b>February 1</b></p> <p><b>Proposal Consultations</b></p>	<ul style="list-style-type: none"> <li>• Reading Discussion: TX Safety Standards Ch 1, 4, 7</li> <li>• Think-pair-share: What constitutes a good experimental design?</li> <li>• Discussion about experimental design: controls and variables, independent vs. dependent variable; null and alternate hypotheses; what data/measurements/scale are appropriate for quantitative research; planning the experimental process</li> <li>• Students define their independent and dependent variables to answer their research question, identify controls for experiment, write null and alternate hypotheses, determine the data and measurements for their research, and sketch out a plan for experiment (done after each section of the discussion)</li> <li>• Proposal consultations – divided up by major; largest major (Biology) divided up so Biology instructor not overwhelmed</li> <li>• Students write experimental procedures (continuation of guided practice) while waiting or after consultation</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading Asst:</b> Texas Safety Standards Ch 2 &amp; 3 – due 2/2/16</li> <li>2) <b>Reading Asst:</b> Sherman Chapter 4 – due 2/2/16</li> <li>3) <b>Research Project</b> – Prepare proposal presentation for class on 2/3/15</li> <li>4) <b>Flinn Safety Certification Course</b> -- finish all units and their assessments. Submit copy of certificate(s) to Assignment Portal by 2/7/16.</li> <li>5) <b>Research Project</b> – Write up experimental design – due 2/7/16.</li> </ol>
<p><b>Week 4</b> <b>February 3</b></p> <p><b>Proposal Presentations</b></p>	<ul style="list-style-type: none"> <li>• Research proposal presentations – individual presentations (2-3 minutes long, max) followed by 2 minutes of Q&amp;A for each</li> <li>• Reading Discussion of Sherman Chapter 4.</li> <li>• Discussion of establishing validity and reliability of data through experimental design, the importance of attention to details and writing rich, descriptive, repeatable instructions.</li> <li>• Students write and revise/expand experimental procedures and generate list of materials</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Flinn Safety Certification Course</b> -- finish all units and their assessments. Submit copy of certificate(s) to Assignment Portal by 2/7/16.</li> <li>2) <b>Research Project</b> – Write up experimental design, due 2/7/16.</li> <li>3) <b>Research Project</b> – Literature Analysis &amp; Critique asst. due 2/9/16.</li> <li>4) <b>Materials list due in class on 2/8/16.</b> Bring hard copy to consultation session. <i>Instructors will order materials for research project</i></li> </ol>
<p><b>Week 4</b> <b>February 8</b></p> <p><b>Canned Lab Experimental Design Consultations</b></p>	<ul style="list-style-type: none"> <li>• What are teacher's responsibility when planning and leading lab activities? Generate a list of responsibilities and duties. Discuss</li> <li>• Instructor describes Canned Technology lab assignment/ activities. Q&amp;A follows.</li> <li>• Experimental design consultations – divided up by major; largest major (Biology) is divided up so everyone has consultation time during class period</li> <li>• Students sign up for date and lab to do for Canned Technology Lab assignment and begin working on write-up by exploring activity and available materials/probeware</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading asst:</b> Texas Safety Standards Ch 5 &amp; 6 – due 2/9/16.</li> <li>2) <b>Research Project</b> – Literature Analysis &amp; Critique asst. due 2/9/16. Bring a hard copy to class on 2/10</li> <li>3) <b>Canned Lab</b> - Write-Up due 2/14/16.</li> <li>4) <b>Research Project:</b> Resubmit experimental procedure before 2/13/16. Experiments may <u>not</u> begin until you have received approval from your instructor.</li> </ol>

<p style="text-align: center;"><b>February 10</b></p> <p style="text-align: center;"><b>Canned Lab Prep Literature Review Consultation</b></p>	<ul style="list-style-type: none"> <li>• Discussion on TX Safety standards Chapters 5 &amp; 6</li> <li>• Students run through canned lab and note revisions to make so that the activity meets the instructor's criteria. Students prepare materials for canned lab</li> <li>• Students prepare materials and equipment for canned lab. Write student instructions and teacher guidelines</li> <li>• Annotated Bibliography/Literature Review consultations. Divided up by major; largest major (Biology) divided among instructors so that all students have consultations during class. Students work on canned lab while waiting or after consultation. Students can also work on literature review after consultation and after preparing for canned lab.</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Canned Lab</b> Write-Up due 2/14/16</li> <li>2) <b>Reading:</b> Sherman Ch 5, p 1-7</li> <li>3) <b>Research Project:</b> Resubmit experimental procedure before 2/13/16. Experiments may <u>not</u> begin until you have received approval from your instructor.</li> </ol>
<p style="text-align: center;"><b>Week 5</b></p> <p style="text-align: center;"><b>February 15</b></p> <p style="text-align: center;"><b>Canned Labs Research Round 1</b></p>	<ul style="list-style-type: none"> <li>• Canned lab presentations (3)</li> <li>• Reading discussion: Sherman Ch 5, p 1-7</li> <li>• Students write down how their data will be organized and the graphs they will use</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Canned Lab – reflection</b> due 3/2/16 and <b>comments</b> on peer reflections due 3/6/16.</li> <li>2) <b>Research Project</b> – Do experiment and make adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper.</li> </ol>
<p style="text-align: center;"><b>February 17</b></p> <p style="text-align: center;"><b>Canned Labs Research Round 1</b></p>	<ul style="list-style-type: none"> <li>• Canned lab presentations (3)</li> <li>• Set up experiment – organize materials</li> </ul> <p><i>Note: All nonperishable materials borrowed from the classroom must be returned at the conclusion of your experimentation in good, clean condition</i></p>	<ol style="list-style-type: none"> <li>1) <b>Canned Lab – reflection</b> due 3/2/16 and <b>comments</b> on peer reflections due 3/6/16.</li> <li>2) <b>Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper.</li> </ol>
<p style="text-align: center;"><b>Week 6</b></p> <p style="text-align: center;"><b>February 22</b></p> <p style="text-align: center;"><b>Canned Labs Experiment Round 1</b></p>	<ul style="list-style-type: none"> <li>• Canned lab presentations (3)</li> <li>• Run experiments</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Revise sections of literature review and experimental design</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Canned Lab – reflection</b> due 3/2/16 and <b>comments</b> on peer reflections due 3/6/16.</li> <li>2) <b>Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper.</li> </ol>
<p style="text-align: center;"><b>February 24</b></p> <p style="text-align: center;"><b>Canned Labs Experiment Round 1</b></p>	<ul style="list-style-type: none"> <li>• Canned lab presentations (3)</li> <li>• Run experiments or</li> <li>• Revise sections of literature review and experimental design</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Canned Lab – reflection</b> due 3/2/16 and <b>comments</b> on peer reflections due 3/6/16.</li> <li>2) <b>Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper.</li> </ol>



<p style="text-align: center;"><b>Week 7</b> <b>February 29</b></p> <p style="text-align: center;"><b>Canned Labs</b> <b>Research Round 1</b></p>	<ul style="list-style-type: none"> <li>• Canned lab presentations (3)</li> <li>• Run experiments or</li> <li>• Revise sections of literature review and experimental design</li> <li>• Organize data</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading</b> Sherman Chapter 5 – due 3/1</li> <li>2) <b>Canned Lab – reflection</b> due 3/2/16 and <b>comments</b> on peer reflections due 3/6/16.</li> <li>3) <b>Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper.</li> </ol>
<p style="text-align: center;"><b>March 2</b></p> <p style="text-align: center;"><b>Statistics 1</b> <b>Research Round 1</b></p>	<ul style="list-style-type: none"> <li>• Reading Discussion of Sherman Chapter 5, p 7-28.</li> <li>• Discussion of distributions of data, measures of central tendency (mean, median, mode), variance, standard deviation, frequency distributions, how to use Excel® to do these statistics, installing Data Analysis pack on Excel</li> <li>• Students work examples in PowerPoint</li> <li>• Students run experiments</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Stats 1 HW, organize data</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Canned Lab – reflection</b> due 3/2/16 and <b>comments</b> on peer reflections due 3/6/16.</li> <li>2) <b>Statistics HW 1</b> – due 3/6/16</li> <li>3) <b>Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper.</li> </ol>
<p style="text-align: center;"><b>Week 8</b></p> <p style="text-align: center;"><b>March 7</b></p> <p style="text-align: center;"><b>Research Round 1</b></p>	<ul style="list-style-type: none"> <li>• Go over Stats 1 HW</li> <li>• Debrief Canned Lab</li> <li>• Run experiments</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Write revisions to experiment, organize data, work initial stats on data</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Research Project</b> –Presentation of initial results on 3/21/16. Be ready to present and answer questions!</li> </ol> <p><i>Be sure that you have an adequate number of trials and samples in each trial to validate your data.</i></p>
<p style="text-align: center;"><b>March 9</b></p> <p style="text-align: center;"><b>Statistics 2</b> <b>Research Round 1</b></p>	<ul style="list-style-type: none"> <li>• For each of the following graphs, what kinds of data sets can be described by each? Teams of 2 get a graph (circle, bar graph/histogram, scatterplot) and write an example of a data set (not actual data values) that could be described by their graph. Teams share results. Discuss</li> <li>• Discussion on graphs, purpose and functions of each type, scatterplots and linear regression, how to do graphs and linear regression in Excel®</li> <li>• Students work examples in PowerPoint</li> <li>• Run experiments</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Write revisions to experiment, organize data, work initial stats on data</li> <li>• Order more materials (if needed)</li> <li>• Discuss expectations for mid-point presentations on 3/21</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Research Project</b> –Presentation of initial results on 3/21/16. Be ready to present and answer questions!</li> <li>4) <b>Statistics HW 2</b> – due 3/22/16</li> </ol> <p><i>Be sure that you have an adequate number of trials and samples in each trial to validate your data.</i></p>

**SPRING BREAK: MARCH 14-18**

<p><b>Week 9</b> <b>March 21</b></p> <p><b>Research Project Presentations</b></p>	<ul style="list-style-type: none"> <li>• Research project presentations of initial results</li> </ul>	<p><b>1) Reading</b> Sherman Chapter 6 – due 3/22  <b>2) Research Project</b> – Write up experiment revisions and list of materials needed to replenish/replace what is needed. Bring revisions and list of materials to class on 3/23.</p> <p>Round 2 of experiment starts next week!</p>
<p><b>March 23</b></p> <p><b>Experiment Revisions Statistics 3</b></p>	<ul style="list-style-type: none"> <li>• Show a normal distribution. Students describe its properties and discuss with a neighbor.</li> <li>• Discussion on probability and the normal distribution. Characteristics of a normal distribution. Skewed distributions. Standard Error</li> <li>• Students work examples in PowerPoint</li> <li>• Reflection: How can I guarantee a statistically significant amount of data gathered from my research? What measurements that I make require the mean, standard deviation, and standard error to establish precision of my measurements? (Sherman Ch 5, p 29 #2 &amp; 3)</li> <li>• Research Experiment – consultation on revisions and order materials (if needed)</li> </ul>	<p><i>Be sure that you have an adequate number of trials and samples in each trial to validate your data.</i></p>
<p><b>Week 10</b> <b>March 28</b></p> <p><b>Research Round 2</b></p>	<ul style="list-style-type: none"> <li>• Round 2 of experimentation</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Consultation about revisions</li> </ul>	<p><i>Be sure that you have an adequate number of trials and samples in each trial to validate your data.</i></p>
<p><b>March 30</b></p> <p><b>Statistics 4 Research Round 2</b></p>	<ul style="list-style-type: none"> <li>• Reading Discussion of Sherman Chapter 6</li> <li>• Discussion on 95% confidence intervals, t-test calculations, using Excel to do t-test calculations, drawing conclusions based on statistical test of null hypothesis, alternate statistical tests depending on data set and purpose of research</li> <li>• Students work examples in PowerPoint</li> <li>• Round 2 of experimentation</li> </ul> <p>Or</p> <ul style="list-style-type: none"> <li>• Statistics 4 HW</li> </ul>	<p><b>1) Reading</b> – either:</p> <ul style="list-style-type: none"> <li>• Passmore, et al (2013) for Biology</li> <li>• Mayer, Damelin, Krajcik (2013) for Chemistry</li> <li>• Campbell, Nielson, Oh (2013) for Physics due 4/3/16.</li> </ul> <p><b>2) Statistics 3 HW</b> due 4/10/16.</p> <p><i>Be sure that you have an adequate number of trials and samples in each trial to validate your data.</i></p>
<p><b>Week 11</b> <b>April 4</b></p> <p><b>Models in Science Teaching Research Round 2</b></p>	<ul style="list-style-type: none"> <li>• Students brainstorm 3 ways to model the concept given – Student pairs given a different science concept from either life science or physical science. Students share what they came up with.</li> <li>• Students work through five different forms of models. Describe the concept demonstrated with this modeling tool. Where can it be used in the corresponding Biology, Chemistry, Physics, Physical Science course? Models include DNA modeling kit, molecular modeling kit, magnetic circles, toy cars and tracks, black box activity, Phet</li> <li>• Students share what they learned about the modeling tools</li> <li>• Reading Discussion – Modeling in Science Teaching – by pairs then whole group</li> <li>• Instructor discusses theory behind</li> </ul>	<p><b>1) Reading</b> : “<i>Fifteen Simple Discrepant Events That Teach Science Principles and Concepts</i>” E.L.Wright – due 4/5/16.</p>

	<p>modeling in science teaching</p> <ul style="list-style-type: none"><li>• What makes this so funny? Students analyze why a picture of water molecules is so funny.</li><li>• Students revise their list of models from the Engage to better suit the concept. Reflect on what was learned.</li><li>• Round 2 of experimentation</li></ul> <p>Or</p> <ul style="list-style-type: none"><li>• Analyze data from experiment</li></ul>	
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<p style="text-align: center;"><b>April 6</b> <b>Demonstrations</b></p>	<ul style="list-style-type: none"> <li>• Instructor demo show of 2-3 of their favorite demos they do when teaching content classes</li> <li>• Debrief of show – students describe the key characteristics of the demos and what the instructor did (big picture ideas)</li> <li>• Instructor explains requirements for demonstration write up and demo show</li> <li>• Students select a demonstration that illustrates an important concept/principle from Biology, Chemistry, or Physics. Students figure out the appropriate content standard, how to do this demonstration, and the materials needed</li> <li>• Re-run experiments (if needed)</li> <li>• Work on data analysis</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Research Project</b> – data analysis from experiment – due 4/12/16. Bring hard copy to consultation session on 4/13/16.</li> <li>2) <b>Demo Presentation Write-up</b> due 4/10/16.</li> </ol>
<p style="text-align: center;"><b>Week 12</b> <b>April 11</b> <b>Demonstration Show!</b></p>	<ul style="list-style-type: none"> <li>• Student demonstration presentations</li> <li>• Discuss Statistics 4 HW</li> <li>• Ask question: What kinds of data have you gathered? What kinds of graphs can you draw to illustrate the patterns and trends in the data? Discuss with table.</li> <li>• Students work on data analysis section of research paper. Instructors provide one-on-one guidance to students as they work</li> <li>• Instructor summarizes requirements for statistics, graphs, charts, and the analysis section of the paper – section for data analysis in research project rubric used as guide – emphasis on reliability of data, validity of data, error analysis</li> <li>• Re-run experiments (if needed)</li> <li>• Students work on data analysis</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Demo Presentation:</b> <ol style="list-style-type: none"> <li>a. <b>Reflection</b> due 4/15/16</li> <li>b. <b>Comments to peers on discussion board</b> due 4/17/16.</li> </ol> </li> <li>2) <b>Research Project</b> – Complete tables, graphs, and statistics for research project and complete data analysis section of research paper – due 4/12/16. Bring hard copy to consultation session on 4/13/16.</li> </ol>
<p style="text-align: center;"><b>April 13</b> <b>Data Analysis Consultation</b></p>	<ul style="list-style-type: none"> <li>• Data Analysis consultation time</li> <li>• Revise analysis of data – both statistically and written.</li> <li>• Write conclusions – Sherman Ch 6 #1 &amp; 2 and format p 21-22.</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading Assignment:</b> Sherman Chapter 7– due 4/17</li> <li>2) <b>Research Project</b> – make additions and revisions to data analysis section. Complete all statistical analyses of data.</li> </ol>
<p style="text-align: center;"><b>Week 13</b> <b>April 18</b> <b>Writing the Research Paper</b></p>	<ul style="list-style-type: none"> <li>• What are the major components of any research paper? What are the characteristics of a good research paper? Students make lists, discuss with their table then, discuss with whole class. Instructor compiles lists</li> <li>• Reading Discussion of Sherman Chapter 7</li> <li>• Instructor discusses what goes into each section of the research paper (Introduction, Literature Review, Experimental Methods, Results, Data Analysis, Conclusions, References, Abstract) and the order of writing the paper. Instructor reinforces that most of the paper is already written during the semester, but needs put together with good transitions.</li> <li>• Write Conclusion and rough draft of research paper</li> </ul>	<ol style="list-style-type: none"> <li>1) <b>Reading Assignment:</b> Sherman Chapter 8 – due 4/19</li> <li>2) <b>Research Project</b> - Conclusions section due 4/19. Bring hard copy to class on 4/20.</li> <li>3) <b>Research Project</b> – Rough draft of paper due 4/26.</li> <li>4) <b>Bring all borrowed materials back to class by April 20.</b></li> </ol>

<p style="text-align: center;"><b>April 20</b></p> <p style="text-align: center;"><b>Communication of Research Conclusion Consultations</b></p>	<ul style="list-style-type: none"> <li>• Students discuss with a partner “What makes a good lab report?” Lists generated regarding quality of content and quality of writing</li> <li>• Reading discussion of Sherman Chapter 8 – in pairs then with whole class</li> <li>• Students with a partner determine the following: What makes a good oral presentation? What makes a good speaker? What makes a good audience?</li> <li>• Students and instructor discuss oral presentation lists generated. Instructor discusses rubric for oral presentation.</li> <li>• Students with a different partner determine the following: What constitutes a good visual aid? What makes a visual aid poor quality? These are discussed in terms of content, organization, and attractiveness.</li> <li>• Students and instructor discuss visual aid lists generated. Instructor discusses rubrics for poster quality and presentation visual aid quality.</li> <li>• Conclusions consultation time</li> <li>• Clean up lab</li> </ul>	<p><b>Research Project</b> – Rough draft of research paper due 4/26/16. Incorporate all prior feedback from instructors into this draft. Bring hard copy to class on the 4/27/16 for peer review.</p>
<p style="text-align: center;"><b>Week 14</b> <b>April 25</b></p> <p style="text-align: center;"><b>How to Design Posters</b></p>	<ul style="list-style-type: none"> <li>• A well-done poster from a prior semester is shown to the class. Students carefully observe this poster and write down five things they notice about the poster. Instructor asks class for their observations and records their observations on the board. Instructor discusses the list with the class and points out key features of the poster.</li> <li>• Students complete Poster Cruising activity with a partner from their major. Students study posters made by either faculty or graduate students within their own major department.</li> <li>• Instructor and students debrief the Poster Cruising activity focusing on these three questions: Which parts of your research should you include in your poster? What are some things that you will need to do to make a good scientific poster? What questions do you have for the instructor?</li> <li>• Instructor then explains expectations for the poster design and for the poster presentations.</li> <li>• Students draft their poster on blank paper. Instructor monitors work and provides guidance and feedback.</li> </ul>	<p><b>1) Research Project</b> – Rough draft of research paper due 4/26/16. Incorporate all prior feedback from instructors into this draft. Bring hard copy to class on the 4/27/16 for peer review.</p>
<p style="text-align: center;"><b>April 27</b></p> <p style="text-align: center;"><b>Rough Draft Consultations Lab Inventory</b></p>	<ul style="list-style-type: none"> <li>• Instructors consult with students about their rough draft – divided by major, largest major (Biology) divided among instructors so all students have consultation time.</li> <li>• Students make revisions to rough draft based on instructor feedback after consultations and/or while waiting.</li> <li>• Lab Inventory – students inventory and organize contents of lab noting items we need more of</li> </ul>	<p><b>1) Research Project</b> – Poster due by class time on 5/4/16.</p> <p><b>2) Research Project</b> – Presentations on 5/9/16</p> <p><b>3) Research Project</b> – Final draft of paper due 5/10/16.</p> <p><b>4) All borrowed materials must be returned by class time on 4/29/16.</b></p>

	<ul style="list-style-type: none"> <li>• What do we need next semester?</li> </ul>	
<p><b>Week 15</b> <b>May 2</b></p> <p><b>Peer Review</b></p>	<ul style="list-style-type: none"> <li>• Peer review of research papers - Papers reviewed for quality of content then quality of mechanics of writing.</li> <li>• Reminders about expectations for poster and oral presentations</li> </ul>	<p><b>1) Research Project</b> – Poster due by class time on 5/4/16.</p> <p><b>2) Research Project</b> – Presentations on 5/9/16</p> <p><b>3) Research Project</b> – Final draft of paper due 5/10/16.</p>
<p><b>May 4</b></p> <p><b>Poster Session</b></p>	<ul style="list-style-type: none"> <li>• <i>Poster session today!</i> Be ready to explain your experiment to instructors from chemistry, biology and physics departments.</li> </ul>	<p><b>1) Research Project</b> – Presentations on 5/9/16</p> <p><b>2) Research Project</b> – Final draft of paper due by midnight on 5/10.</p>
<p><b>Week 16</b></p> <p><b>May 9</b> <b>5:00 p.m. – 7:00</b> <b>p.m.</b></p> <p><b>Research Project</b> <b>Presentations</b></p>	<ul style="list-style-type: none"> <li>• Research Project presentations</li> <li>• Course evaluations</li> </ul>	<p>Final draft of paper due by midnight on 5/10/16.</p>