

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

### SYLLABUS Spring 2014

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*UNT endeavors to offer you a high-quality education and to provide a supportive environment to help you learn and grow. And, as faculty members, we are committed to helping you be successful as a student. Here's how to succeed at UNT:*

*Show up.  
Find support.  
Take control.*

*Be prepared.  
Get involved.  
Be persistent.*

### 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 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 requires 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 both 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 teachers with an in-depth understanding of how research in their own

discipline 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
Safety Certification	February 3	10
Canned Tech Lab with Write-Up	February 23	20
Canned Tech Lab Reflection	March 23/24	2
Demonstration with Write-Up	April 13	10
Demonstration Reflection	April 17/18	2
Reading Assignments (8)	Throughout semester – see below for dates	8 @ 2 pts each = 16 pts
Statistics Assignments (4)	Throughout semester – see below for dates	4 @ 2 pts each = 8 pts
Three topics & questions for research	January 15	3
Research proposal	January 26	3
Experimental design & data analysis plan	January 28	3
Literature review	February 4	3
Presentation of initial experimental results	March 5	5
Data analysis	April 6	3
Conclusions	April 13	3
Rough draft of Research Paper	April 20	5
Final Research paper	April 27	20
Final presentation	April 23	5
Poster presentation	April 27	5
TOTAL POINTS		126

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

## Course Requirements and Expectations

- Some course topics will be covered only in class, and you must be present to receive credit.
- 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.

## 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 one of the instructors know ahead of time. If you let the instructor know, 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>.

## Course Safety Statement

Students in BIOL/CHEM/PHYS 4700 are urged 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 will be applied including verbal warnings, removal from lab, and/or referral to Dean of Students.**

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 this office by phone at (940) 565-4323.

**\*SETE (Student Evaluation of Teaching Effectiveness)**

Student feedback is important and an essential part of participation of this course. The Student Evaluation of Teaching (SETE) is a requirement for all organized classes at UNT. This short survey will be made available at 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.)**

<b>Class</b>	<b>Overview</b>	<b>Assignments</b>
<b>January 13</b>  <b>Introduction, Safety, and Research</b>	<ul style="list-style-type: none"> <li>• Intro to course, safety/Flinn course,</li> <li>• Introduction to scientific research and choosing topics for research</li> </ul>	<b>1) Reading</b> (1) Marder Chapter 1 & sections 5.1, 5.7, 5.8 – due 1/14. ( <i>Marder readings are available on Bb.</i> ) <b>2) Research Project</b> – Identify 3 potential topics for research and write questions for each – due 1/15 <b>3) 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 2/2.
<b>January 15</b>  <b>Research Design</b>	<ul style="list-style-type: none"> <li>• Seilman’s research</li> <li>• Experimental design and writing research proposals</li> <li>• Responsibilities of science teachers</li> </ul>	<b>1) Reading</b> (2) Texas Safety Standards: Ch 1, 4, 7 – due 1/19. <b>2) Reading</b> (3): Marder Chapter 2 & section 5.2 – due 1/19 <b>3) Flinn Safety Course</b> – due 2/2. (Be sure that you are logged into the course!)
<b>January 22</b>  <b>The Literature Search</b>	<ul style="list-style-type: none"> <li>• “Library Day” – meet at science library and get instruction about online databases, scientific journals, and other resources</li> </ul>	<b>1) Reading</b> (4): Texas Safety Standards Ch 2 & 3 – due 1/26 <b>2) Flinn Safety Certification Course</b> – due 2/2 (Be sure that you are logged in to the course!) <b>3) Research Project</b> – Research Proposal due 1/26. Bring hard copy to consultation session.
<b>January 27</b>  <b>Proposal Consultations</b>	<ul style="list-style-type: none"> <li>• Proposal consultation day – work with instructor on improving your research proposal</li> <li>• Put a list of materials together for research project including quantities!</li> <li>• Order materials for research project</li> <li>• Physics 4700 – tour of Physics storeroom and available materials</li> </ul>	<b>1) Research Project</b> – Write up of experimental design and list of materials due 1/28. Bring hard copy to consultation session.
<b>January 29</b>  <b>Proposal Presentations &amp; Intro to Data Analysis</b>	<ul style="list-style-type: none"> <li>• Proposal Presentations</li> <li>• Statistics/data analysis – fundamentals and techniques, writing hypotheses</li> <li>• Experimental Design consultation</li> </ul>	<b>1) Reading</b> (5): Texas Safety Standards Ch 5 & 6 – due 2/2 <b>2) Reading</b> (6): Lord (1999) article – due 2/2 <b>3) Flinn Safety Certification Course</b> -- finish all units and their assessments. Submit copy of certificate(s) to Assignment Portal by 2/2.

<b>February 3</b>  <b>College &amp; Career Readiness</b>	<ul style="list-style-type: none"> <li>College &amp; Career Readiness Standards workshop</li> <li>Gallery Walk of experimental design and data analysis plan</li> </ul>	<b>1) Research Project</b> – Literature Review due 2/4. Bring hard copy to consultation session.
<b>February 5</b>  <b>Statistics 1</b>	<ul style="list-style-type: none"> <li>Statistics: Sample size, measures of central tendency, how to use Excel for statistics</li> <li>Literature Review consultation</li> <li>Set up experiment (if time available)</li> </ul>	<b>1) Statistics HW 1</b> – due 2/9
<b>WEEK 5:</b>  <b>February 10 &amp; 12</b>  <b>Experiment – Round 1 &amp; Statistics 2</b>	<ul style="list-style-type: none"> <li>Set up and run experiments</li> <li>Statistics: Probability Distributions, Confidence Intervals, and Central Limit Theorem (2/12)</li> <li>Sign up for Canned-Lab Project (2/12)</li> </ul>	<b>1) Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take notes throughout the experiment! <b>2) Statistics HW 2</b> – due 2/16.
<b>February 17</b>  <b>Experiment Round 1 &amp; Canned Labs</b>	<ul style="list-style-type: none"> <li>Finish experiments (if needed)</li> <li>Canned-Lab planning and preparation</li> </ul>	<b>1) Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take notes throughout the experiment! <b>2) Canned-Lab write-ups</b> due 2/23.
<b>February 19</b>  <b>Canned Labs &amp; Statistics 3</b>	<ul style="list-style-type: none"> <li>Statistics: t-tests and hypothesis interpretations</li> <li>Canned-Lab preparation and practice</li> </ul>	<b>1) Research Project</b> – experimentation and adjustments to experiment/data analysis as needed. Take notes throughout the experiment! <b>2) Canned-Lab write-ups</b> due 2/23. <b>3) Statistics HW 3</b> – due 2/23.
<b>WEEK 7:</b>  <b>February 24 &amp; 26</b>  <b>Canned Labs</b>	<ul style="list-style-type: none"> <li>Canned lab presentations</li> </ul>	<b>1) Canned Lab</b> – reflection due 3/23 (within 24 hours preferred), and comments on peer reflections due 3/24. <b>2) Research Project</b> – presentation of initial results on 3/5. Be ready to present and answer questions!
<b>March 3</b>  <b>Statistics 4 &amp; Canned Labs</b>	<ul style="list-style-type: none"> <li>Canned lab presentations</li> <li>Statistics: t-tests and hypothesis interpretations</li> </ul>	<b>1) Canned Lab</b> – reflection due 3/23 and comments on peer reflections due 3/24. <b>2) Statistics HW 4</b> – due 3/9
<b>March 5</b>  <b>Research Presentations</b>	<ul style="list-style-type: none"> <li>Research project presentations of initial results</li> <li>Research Experiment – consultation on revisions and order materials (if needed)</li> </ul>	<b>1) Canned Lab</b> – reflection due 3/23 and comments on peer reflections due 3/24. <b>2) Statistics HW 4</b> – due 3/9
<b>WEEK 9:</b>  <b>March 17 &amp; 19</b>  <b>Canned Labs &amp; Statistics 5</b>	<ul style="list-style-type: none"> <li>Statistics – Linear Regression and Best Fit Determination</li> <li>Canned lab presentations</li> </ul>	<b>1) Canned Lab</b> – reflection due 3/23 and comments on peer reflections due 3/24. <b>2) Statistics HW 5</b> – due 3/23
<b>March 24</b>  <b>Research Project – Round 2</b>	<ul style="list-style-type: none"> <li>Canned lab debriefing</li> <li>Round 2 of experimentation</li> </ul>	<b>1) Reading (7): “Fifteen Simple Discrepant Events That Teach Science Principles and Concepts”</b> E.L.Wright – due 3/30

<b>March 26</b> <b>Research Project – Round 2 &amp; Statistics 6</b>	<ul style="list-style-type: none"> <li>Round 2 of experimentation</li> </ul>	<b>1) Reading (7): “Fifteen Simple Discrepant Events That Teach Science Principles and Concepts”</b> E.L.Wright – due 3/30 <b>2) Statistics HW 6</b> – due 3/30
<b>March 31</b> <b>Research Project - Round 2 Data Analysis</b>	<ul style="list-style-type: none"> <li>Round 2 of experimentation</li> <li>Data Analysis</li> </ul>	<b>1) Reading (8) Marder Chapter 5</b> – due 4/6 <b>2) Research Project</b> – data analysis from experiment – due 4/6. Bring hard copy to consultation session.
<b>April 2</b> <b>Demo Show!</b>	<ul style="list-style-type: none"> <li>Instructor demo show,</li> <li>Plan demonstration</li> <li>Re-run experiments (if needed)</li> </ul>	<b>1) Research Project</b> – data analysis from experiment – due 4/6. Bring hard copy to consultation session.
<b>April 7</b> <b>Demonstrations &amp; Data Analysis</b>	<ul style="list-style-type: none"> <li>Data Analysis consultation time</li> <li>Re-run experiments (as needed)</li> <li>Write conclusions</li> </ul>	
<b>April 9</b> <b>Demonstration Preparation</b>	<ul style="list-style-type: none"> <li>Writing the research paper</li> <li>Prepare and practice demonstrations</li> </ul>	<b>1) Demo Presentation Write-up</b> due 4/13. Be prepared to share handouts with class! <b>2) Research Project</b> – Conclusions – due 4/13. Bring hard copy to consultation session.
<b>April 14</b> <b>Demonstrations</b>	<ul style="list-style-type: none"> <li>Student demonstrations/mini-lecture</li> </ul>	<b>1) Demo Presentation</b> – reflection due 4/17 and comments on peer reflection due 4/18.
<b>April 16</b> <b>Conclusions and Clean Up</b>	<ul style="list-style-type: none"> <li>Conclusions consultation time</li> <li>Clean up lab</li> </ul>	<b>1) Demo Presentation</b> – reflection due 4/17 and comments on peer reflection due 4/18. <b>2) Research Project</b> – Rough draft of research paper due 4/20. Bring hard copy to Peer Review session.
<b>April 21</b> <b>Research Project Finalization</b>	<ul style="list-style-type: none"> <li>Designing posters for presentations</li> <li>Peer review of research papers</li> </ul>	<b>1) Research Project</b> – Final draft of paper due 4/27 <b>2) Research Project</b> – Presentations begin 4/23. Poster is due 4/27. <b>3) All borrowed materials must be returned by class time on 4/23</b>
<b>April 23</b> <b>Research Project Presentations &amp; Clean Up</b>	<ul style="list-style-type: none"> <li>Research project presentations (2-3)</li> <li>Clean up lab</li> </ul>	<b>1) Research Project</b> – Final draft of paper due 4/27 <b>2) Research Project</b> –Poster is due 4/27.
<b>April 28</b> <b>Poster Session</b>	<ul style="list-style-type: none"> <li>Poster session (outside evaluators invited from Chemistry, Biology, and Physics)</li> </ul>	
<b>April 30</b> <b>Research Project Presentations</b>	<ul style="list-style-type: none"> <li>Research Project presentations</li> <li>Course evaluations</li> </ul>	
<b>WEEK 16</b>	<b>Final Exam Week: May 5-9</b>	



