

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

SYLLABUS Fall 2013

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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 a faculty member, I am 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, are 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 21st 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:

OBJECTIVES: <i>Upon completion of this course, students will be able to...</i>	Texas PPR EC-12 Standards:	NSTA Standards for Science Teacher Preparation
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	September 22	10
Canned Tech Lab with Write-Up	October 13	15
Canned Tech Lab Reflection	October 27	2
Demonstration with Write-Up	November 24	10
Demonstration Reflection	December 1	2
Reading Assignments (8)	Throughout semester – see below for dates	8 @ 2 pts each = 16 pts
Statistics Assignments (5)	Throughout semester – see below for dates	5 @ 2 pts each = 10 pts
Three topics & questions for research	September 6	3
Research proposal	September 15	3
Literature review	September 17	3
Experimental design & data analysis plan	September 24	3
Presentation of initial experimental results	October 23	5
Data analysis	November 17	3
Conclusions	November 19	3
Rough draft of Research Paper	November 24	5
Final Research paper	December 2	20
Final presentation	December 2	5
Poster presentation	December 4	5
TOTAL POINTS		123

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.

PechaKucha Presentations

Presentations for the mid-semester research report and the final research report will be in a modified PechaKucha format (www.pechakucha.org) with NO slides containing bulleted lists, tables, databases, etc. You may use whatever program you prefer (PowerPoint, Prezi, etc.) to set the timing. The mid-semester report will be limited to 10 slides at 10 seconds each; the final inquiry report will be limited to 15 slides at 10 or 15 seconds each.

We find that many more excellent questions are asked following these presentations than with a standard PowerPoint presentation. It is through questions and answers that true scientific discourse takes place.

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>.

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.

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. 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.

***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.

Week – By – Week Plan (subject to change – Watch BlackBoard for announcements.)

Week/Date/Topic(s)	Lecture/ Lab work:	Assignments:
WEEK 1 August 28 & September 4 Introduction	<ul style="list-style-type: none"> • Intro to course, safety/Flinn course, introduction to scientific research • Seilman’s research (?) • Choosing topics for research, the literature search 	1) Reading (1) Marder Chapter 1 & sections 5.1, 5.7, 5.8 – due 9/1. 2) Reading (2) Texas Safety Standards: Ch 1, 4, 7 – due 9/1. 3) Research Project – Identify 3 potential topics for research and write questions for each – due 9/6 4) Flinn Safety Course- Go to http://labsafety.flinnsci.com/CertificateCourseSelection.aspx?CourseCode=HS . Create a login and get started on the safety course. Due 9/23.
WEEK 2: September 9 & 11 The Literature Search and Design	<ul style="list-style-type: none"> • “Library Day” – meet at science library and get instruction about online databases, scientific journals, and other resources • Experimental design and writing proposals 	1) Reading (3): Marder Chapter 2 & section 5.2 – due 9/8 2) Reading (4): Texas Safety Standards Ch 2 & 3 – due 9/15 3) Flinn Safety Certification Course – due 9/22 (Be sure that you are logged in to the course!) 4) Research Project – Research Proposal due 9/15. Bring hard copy to consultation session.
WEEK 3: September 16 & 18 Proposals & Statistics/Data Analysis	<ul style="list-style-type: none"> • Proposal consultation day, order materials • Statistics/data analysis, lit review consultation day, gallery walk of research proposals 	1) Reading (5): Texas Safety Standards Ch 5 & 6 – due 9/22 2) Flinn Safety Certification Course -- finish all units and their assessments. Bring copy of certificate to class on or before 9/23 3) Research Project – Literature Review due 9/17. Bring hard copy to consultation session.
WEEK 4: September 23 & 25 CCRS & Statistics	<ul style="list-style-type: none"> • College & Career Readiness Standards workshop • Statistics: Sample size, measures of central tendency • Gallery Walk of experimental design and data analysis plan 	1) Reading (6): Lord (1999) article – due 9/29 2) Research Project – Write up of experimental design and list of materials due 9/24. Bring hard copy to Gallery Walk. 3) Statistics HW 1 – due 9/29
WEEK 5: Sept 30 & Oct 2 Experiment – Round 1	<ul style="list-style-type: none"> • Set up and run experiments • Statistics: Probability Distributions 	1) Research Project – experimentation and adjustments to experiment/data analysis as needed. Take notes throughout the experiment! 2) Statistics HW 2 – due 10/6 3) Sign up (in pairs) for Canned-Lab Project
WEEK 6: October 7 & 9 Experiment Round 1 & Canned Labs	<ul style="list-style-type: none"> • Finish experiments (if needed) • Statistics: Central Limit Theorem & introduction to hypothesis testing: z-test and t-test • Canned-Lab planning and preparation • Canned-Lab preparation and practice 	1) Research Project – experimentation and adjustments to experiment/data analysis as needed. Take notes throughout the experiment! 2) Canned-Lab write-ups due Sunday, 10/13 3) Statistics HW 3 – due 10/15

WEEK 7: October 14 & 16 Canned Labs	<ul style="list-style-type: none"> • Canned lab presentations • Canned lab presentations • Statistics: Confidence intervals 	1) Research Project – presentation of initial results on 10/23. Be ready to present and answer questions!
WEEK 8: October 21 & 23 Research Project & Canned Labs	<ul style="list-style-type: none"> • Canned lab presentations • Statistics: χ^2 tests • Research project presentations of initial results 	1) Canned Lab – reflection due 10/27 and comments on peer reflections due 10/28. 2) Statistics HW 4 – due 10/27
WEEK 9: October 28 & 30 Canned Labs & Research Project	<ul style="list-style-type: none"> • Statistics: Linear regression and correlation (R & R^2) • Research Experiment – consultation on revisions and order materials (if needed) • Canned lab presentations 	1) Statistics HW 5 – due 11/3
WEEK 10: November 4 & 6 Research Project	<ul style="list-style-type: none"> • Canned lab debriefing • Round 2 of experimentation 	
WEEK 11: November 11 & 13 Research Project and Statistics	<ul style="list-style-type: none"> • Round 2 of experimentation • Statistics: Writing about and interpreting test results Statistics practice activity • Data Analysis 	1) Reading (7): “Fifteen Simple Discrepant Events That Teach Science Principles and Concepts” E.L.Wright – due 11/17 2) Reading (8) Marder Chapter 5 – due 11/17 3) Research Project – data analysis from experiment – due 11/17. Bring hard copy to consultation session. 4) Research Project – Conclusions – due 11/19. Bring hard copy to consultation session.
WEEK 12: November 18 & 20 Research Project - Consultation	<ul style="list-style-type: none"> • Instructor demo show, plan demonstration • Data Analysis consultation time • Conclusions consultation time • Re-run experiments (if needed) 	1) Research Project – Rough draft of research paper due 11/24. Bring hard copy to Peer Review session. 2) Demo Presentation Write-up due 11/24. Be prepared to share handouts with class!
WEEK 13: November 25 & 27 Demonstrations	<ul style="list-style-type: none"> • Prepare and practice demonstrations • Student demonstrations/mini-lecture • Peer Review of research papers 	1) Demo Presentation – reflection due 12/1 and comments on peer reflection due 12/2. 2) Research Project – Final draft of paper due Monday, 12/2 3) Research Project – Presentations begin 12/2. Poster is due Wednesday, 12/4.
WEEK 14: December 2 & 4 Research Project Presentations	<ul style="list-style-type: none"> • Research project presentations • Poster session (outside evaluators invited from Physics, Chemistry, Biology departments) 	Research Project – Presentations begin 12/2. Poster is due Wednesday, 12/4.
WEEK 15: Final Exam Week	Friday, December 13 8:00 – 10:00 a.m. <ul style="list-style-type: none"> • Course Evaluations • Research project presentations 	