

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

COURSE SYLLABUS Fall 2014

Dr. Kristin Sherman
Kristin.Sherman@unt.edu
Wooten Hall 343
Phone 940-565-2248
Office hours: W 12:00-2:00, R 1:30-3:30

Ms. Teresa Walls
Teresa.Walls@unt.edu
Wooten Hall 346
Phone 940-565-4858
Office Hours: M 11:30-1:30, T 12:30-2:30

UNT endeavors to offer you 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:

- *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 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 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
Three topics & questions for research	August 30	3
Research proposal	September 6	3
Experimental design & data analysis plan	September 13	3
Flinn Safety Certification	September 20	10
Reading Assignments (8)	Throughout semester – see below for dates	8 @ 2 pts each = 16 pts
Statistics Assignments (6)	Throughout semester – see below for dates	6 @ 2 pts each = 12 pts
Canned Tech Lab with Write-Up	October 4	20
Literature review	October 11	3
Canned Tech Lab Reflection and Discussion Board Feedback	October 13/October 15	2
Presentation of initial experimental results	October 15	5
Data analysis	November 5	3
Demonstration with Write-Up	November 15	10
Conclusions	November 17	3
Rough draft of Research Paper	November 19	5
Demonstration Reflection and Discussion Board Feedback	November 20/November 22	2
Portfolio Artifact 2a	November 26	5
Poster presentation	December 1	5
Final Research paper	December 3	20
Final presentation	December 3	5
TOTAL POINTS		135

Course Requirements and Expectations

- 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.

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. Sherman for chemistry majors and Mrs. Walls 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

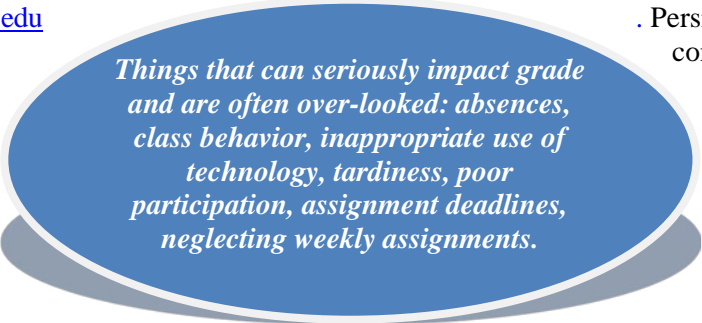
Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the 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.

<http://deanofstudents.unt.edu>

will result in serious the TNT program by a instructor, a director of advisor, and another

The Code of Student Conduct can be found at

- Persistent misbehavior of any kind consideration for removal from committee composed of the the program, the program TNT faculty member.



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 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.

***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.)

Class	Overview	Assignments
Week 1 August 25 Introduction, Safety, and Research	<ul style="list-style-type: none"> • Intro to course, safety, Flinn online safety course, • Introduction to scientific research and choosing topics for research 	1) Reading (1) Marder Chapter 1 & sections 5.1, 5.7, 5.8 – due 9/26/14. 2) Research Project – Identify 3 potential topics for research and write questions for each – due 8/30/14. 3) Flinn Safety Course- Go to http://labsafety.flinnsci.com/CertificateCourseSelection.aspx?CourseCode=HS . Create a login and get started on the safety course. Due 9/20/14.
August 27 Research Design	<ul style="list-style-type: none"> • Seilman’s research • Experimental design and writing research proposals 	1) Reading (2) Texas Safety Standards: Ch 1, 4, 7 – due 8/30/14. 2) Reading (3): Marder Chapter 2 & section 5.2 – due 8/30/14. 3) Flinn Safety Course – due 9/20/14. (Be sure that you are logged into the course as you work!)
Week 2 September 3 The Literature Search	<ul style="list-style-type: none"> • “Library Day” – meet at science library and get instruction about online databases, scientific journals, and other resources 	1) Reading (4): Texas Safety Standards Ch 2 & 3 – due 9/6/14 2) Flinn Safety Certification Course – due 9/20/14. (Be sure that you are logged in to the course!) 3) Research Project – Research Proposal due 9/6/14. Bring a hard copy to consultation session.
Week 3 September 8 Proposal Consultations	<ul style="list-style-type: none"> • Proposal consultation day – work with instructor on improving your research proposal • Put a list of materials together for research project including quantities! • Order materials for research project 	1) Research Project – Write up experimental design, due 9/13/14. 2) Materials list due in class on 9/10/14. Bring hard copy to consultation session.
September 10 Proposal Presentations & Intro to Data Analysis	<ul style="list-style-type: none"> • Proposal Presentations • Statistics/data analysis – fundamentals and techniques • Experimental Design consultation • Discuss Portfolio Reflection 4C 	1) Reading (5): Texas Safety Standards Ch 5 & 6 – due 9/13/14. 2) Reading (6): Lord (1999) article – due 9/13/14 3) Research Project – Write up experimental design, due 9/13/14. 4) Flinn Safety Certification Course - finish all units and their assessments. Submit copy of certificate(s) to Assignment Portal by 9/20/14.

Week 4 September 15 College & Career Readiness	<ul style="list-style-type: none"> College & Career Readiness Standards workshop Gallery Walk of experimental design and data analysis plan Experimental design consultation 	1) Flinn Safety Certification Course -- finish all units and their assessments. Submit copy of certificate(s) to Assignment Portal by 9/20/14. 2) Research Project – Literature Review due 10/11/14. Bring hard copy to consultation session on 10/13.
September 17 Statistics 1	<ul style="list-style-type: none"> Statistics: Sample size, measures of central tendency Set up experiment (if time available) 	1) Flinn Safety Certification Course -- finish all units and their assessments. Submit copy of certificate(s) to Assignment Portal by 9/20/14. 2) 4C portfolio reflection due 9/20/14 3) Research Project – Literature Review due 9/27/14. Bring hard copy to consultation session 4) Statistics HW 1 – due 9/20
Week 5 September 22 and 24 Experiment – Round 1 & Statistics 2	<ul style="list-style-type: none"> Set up and run experiments Stats 2: Probability Distributions and Central Limit Theorem Sign up for Canned-Lab Project (presentations on Oct. 6-8) 	1) Research Project – experimentation and adjustments to experiment/data analysis as needed. Take notes throughout the experiment! 2) Statistics HW 2 – due 9/27/14.
Week 6 September 29 Experiment Round 1 & Canned Labs	<ul style="list-style-type: none"> Finish experiments (if needed) Canned-Lab planning and preparation 	1) Research Project – experimentation and adjustments to experiment/data analysis as needed. Take notes throughout the experiment! 2) Canned-Lab write-ups due 10/4/14.
October 1 Canned Lab Prep & Statistics 3	<ul style="list-style-type: none"> Stats 3: Central Limit Theorem & introduction to hypothesis testing: z-test confidence intervals 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 10/4/14. 3) Statistics HW 3 – due 10/4/14. 4) Research Project literature review due 10/11.
Week 7 October 6 & 8 Canned Labs	<ul style="list-style-type: none"> Canned lab presentations 	1) Canned Lab – reflection due 10/13/14 and comments on peer reflections due 10/15/14. 2) Research Project – Literature review due 10/11. Presentation of initial results on 10/15/14. Be ready to present and answer questions!
Week 8 October 13 Statistics 4 & Canned Labs	<ul style="list-style-type: none"> Finish canned lab presentations if necessary Canned lab debriefing Stats 4: t-tests and hypothesis interpretations Lit. review consultation 	1) Canned Lab – reflection due 10/13/14 and comments on peer reflections due 10/15/14 2) Statistics HW 4 – due 10/18/14 3) Research Project- Be ready to share research results to date in class on Wednesday, 10/15.
October 15 Research Presentations	<ul style="list-style-type: none"> Research project presentations of initial results Research Experiment – consultation on revisions and order materials (if needed) 	1) Canned Lab –comments on peer reflections due 10/15/14.

Week 9 October 20 Canned Labs & Statistics 5	<ul style="list-style-type: none"> Stats 5: Chi-Squared testing 	1) Stats HW 5 – due 10/25/14
October 22 Research Project – Round 2	<ul style="list-style-type: none"> Stats 6- Linear Regression and Best Fit Determination Round 2 of experimentation 	1) Stats 6 HW due 10/25/14
Week 10 October 27 Research Project – Round 2 & Statistics 6	<ul style="list-style-type: none"> Using Models and Manipulatives Responsibilities of science teachers Round 2 of experimentation 	1) Reading (7): “ <i>Fifteen Simple Discrepant Events That Teach Science Principles and Concepts</i> ” E.L.Wright – due 11/1/14
October 29 Research Project - Round 2 Data Analysis	<ul style="list-style-type: none"> Round 2 of experimentation Data Analysis 	1) Reading (7): “ <i>Fifteen Simple Discrepant Events That Teach Science Principles and Concepts</i> ” E.L.Wright – due 11/1/14 2) Reading (8) Marder Chapter 5 – due 11/1/14 3) Research Project – data analysis from experiment – due 11/5/14 by class time. Bring hard copy to consultation session.
Week 11 November 3 Research Project Data Analysis consultation	<ul style="list-style-type: none"> Research project- Experimentation Round 2 	1) Research Project – data analysis from experiment – due 11/5/14 by class time.. Bring hard copy to consultation session.
November 5 Research Project	<ul style="list-style-type: none"> Data Analysis consultation time Re-run experiments (as needed) Write conclusions 	
Week 12 November 10 Demonstration Preparation	<ul style="list-style-type: none"> Instructor demo show, Plan demonstration, re-run experiments (if needed) 	1) Demo Presentation Write-up due 11/15/14. Submit on Bb.
November 12 Demonstration Prep	<ul style="list-style-type: none"> Putting the research paper together. Student demonstration preparation 	1) Demo Presentation: a. Write-up due 11/15/14 b. Reflection due 11/20/14 c. Comments to peers on discussion board due 11/22/14. 2) Research Project – Conclusions – due 11/15/14. Bring hard copy to consultation session.
Week 13 November 17 Student Demos Research Project conclusion	<ul style="list-style-type: none"> Student demonstration presentations Conclusions consultation time Clean up lab 	2) 1) Demo Presentation: a. Write-up due 11/15/14 b. Reflection due 11/20/14 c. Comments to peers on discussion board due 11/22/14. 2) Research Project – Rough draft of research paper due 11/18. Bring hard copy to class on the 19 th for peer review.

November 19 Research Project Finalization	<ul style="list-style-type: none"> • Designing posters for presentations • Peer review of research papers 	1) Research Project – Final draft of paper due 12/3/14 2) Research Project – Presentations on 12/3/14 3) All borrowed materials must be returned by class time on 12/1/14
Week 14 November 24 Research Project finalization	<ul style="list-style-type: none"> • Research project last-minute details • Clean up lab 	1) Research Project – Final draft of paper due 12/3/14 2) Research Project –Poster due 12/1/14
November 26 Portfolio Artifact 2a	<ul style="list-style-type: none"> • On-line program portfolio assignment. Turn in on Bb. 	1) 2a reflection due 11/26/14
Week 15 December 1 Poster Session	<ul style="list-style-type: none"> • <i>Poster session today!</i> Be ready to explain your experiment to instructors from chemistry, biology and physics departments. 	1) Research Project – Final draft of paper due 12/3/14
December 3 Research Project Presentations	<ul style="list-style-type: none"> • Research Project presentations • Course evaluations 	1) Research Project – Final draft of paper due 12/3/14
Week 16 December 8 & 10	Final Exam Week	