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

COURSE SYLLABUS Spring 2015

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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 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: *Upon completion of this course, students will be able to…*	**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
Reading Assignments (8)	Throughout the semester – see below for details	8 @ 2 pts each = 16 pts
Statistics Assignments (6)	Throughout the semester – see below for details	6 @ 2 pts each = 12 pts
Three topics, questions for research, and journal article	January 28	3
Research proposal	February 3	3
Flinn Safety Certification	February 8	10
Experimental design & data analysis plan	February 15	3
Literature review	February 22	3
Canned Tech Lab with Write-Up	March 1	20
Canned Tech Lab Reflection and Discussion Board Feedback	March 15 and 17	2
Presentation of initial experimental results	March 23	5
Data analysis	April 12	3
Demonstration with Write-Up	April 15	10
Demonstration Reflection and Discussion Board Feedback	April 17 and 19	2
Conclusions	April 19	3
Rough draft of Research Paper	April 26	5
Poster presentation	May 4	5
Final Research paper	May 3	20
Final presentation	May 6	5
Portfolio Artifact 2a	May 6	5
TOTAL POINTS		135

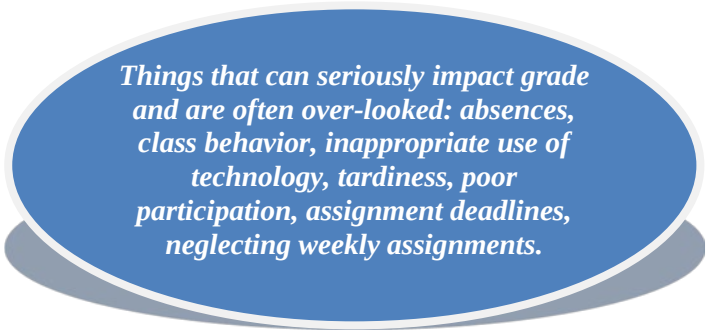
Course Requirements and Expectations

- 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 (Mrs. Littler for physics majors, 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. 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.

***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 **January 21** **Introduction, Safety, and Research**	• 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 1/25/15. **2) Reading** (2): Marder Chapter 2 & section 5.2 – due 1/25/15. **3) Research Project** – Identify 3 potential topics for research, write questions for each, and locate one journal article for each potential topic – due 1/28/15. **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 2/8/15.
Week 2 **January 26** **The Literature Search**	• "Library Day" –get instruction about online databases, scientific journals, and other resources • Begin searching the literature for research articles related to the research topic(s)	**1) Reading** (3) Texas Safety Standards: Ch 1, 4, 7 – due 1/27/15 **2) Research Project** – Identify 3 potential topics for research, write questions for each, and locate one journal article for each potential topic – due 1/28/15. **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 2/8/15.
January 28 **Research Design**	• Seilman's research • Experimental design and writing research proposals	**1) Reading** (4): Texas Safety Standards Ch 2 & 3 – due 2/1/15 **2) Reading** (5): Lord (1999) article – due 9/13/14 **3) Research Project** – Research Proposal due 2/3/15. Bring a hard copy to consultation session on 2/4/15. **4) Flinn Safety Course** – due 2/8/15. (Be sure that you are logged into the course as you work!)
Week 3 **February 2** **College & Career Readiness**	• College & Career Readiness Standards workshop	**1) Reading** (6): Texas Safety Standards Ch 5 & 6 – due 2/5/15. **2) Flinn Safety Certification Course** -- finish all units and their assessments. Submit copy of certificate(s) to Bb Assignment Portal by 2/8/15. **3) Research Project** – Research Proposal due 2/3/15. Bring a hard copy to consultation session on 2/4/15.
February 4 **Proposal Consultations**	• Proposal consultation day – work with instructor on improving your research proposal • Write up experimental procedure for your topic. Put a list of materials together for research project including quantities! • Order materials for research project	**1) Reading** (6): Texas Safety Standards Ch 5 & 6 – due 2/5/15. **2) Flinn Safety Certification Course** -- finish all units and their assessments. Submit copy of certificate(s) to Assignment Portal by 2/8/15. **3) Research Project** – Write up experimental design – due 2/15/15. **4) Materials list due in class on 2/11/15**. Bring hard copy to consultation session.

Week 4 **February 9** **Proposal Presentations**	• Proposal presentations • Experimental design to minimize error and maximize validity of data • Write up experimental procedure for your topic. Put a list of materials together for research project including quantities!	**1) Research Project** – Write up experimental design, due 2/15/15. **2) Research Project** – Literature Review due 2/22/15. ***Instructors will order materials for research project***
February 11 **Statistics 1** **Experimental Design Consultations**	• Statistics 1: Sample size, measures of central tendency, data analysis • Analyzing M&M's • Experimental design consultation • Work on gathering materials in lab for experiment – organize stuff • Finalize processes for experiment	**1) Research Project** – Write up experimental design, due 2/15/15. **2) Research Project** – Literature Review due 2/22/15. **3) Statistics HW 1** – due 2/15/15.
Week 5 **February 16** **Experiment Round 1**	• Discuss Statistics HW 1 • Set up and run experiment – trial runs, if necessary • Work on literature review if experiment being conducted at home.	**1) Research Project** – Literature Review due 2/22/15. 2) **Research Project** – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper. *Note: All nonperishable materials borrowed from the classroom must be returned at the conclusion of your experimentation in good, clean condition.*
February 18 **Statistics 2** **Experiment Round 1**	• Stats 2: Probability Distributions and Central Limit Theorem • Run experiment or • Work on literature review if experiment being conducted at home.	**1) Research Project** – Literature Review due 2/22/15. **2) Research Project** – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper. **3) Statistics HW 2** – due 2/22/15**.**
Week 6 **February 23** **Canned Labs** **Experiment Round 1**	• Discuss Statistics HW 2 • What is Canned Lab Project? • Sign up for Canned-Lab Project (presentations on March 2, 4, 9, 11) • Run experiments or • Literature review consultations.	**1) Research Project** – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper.
February 25 **Statistics 3** **Canned Lab Prep** **Experiment Round 1**	• Stats 3: Central Limit Theorem & introduction to hypothesis testing: z-test confidence intervals • Canned-Lab preparation and practice • Finish experimentation round 1 (if needed) • Literature review consultations	**1) Research Project** – experimentation and adjustments to experiment/data analysis as needed. Take thorough notes throughout the experiment, as well as photos to include in your paper. **2) Canned-Lab write-ups** due 3/1/15.

Week 7 **March 2** **Canned Labs**	• Discuss Statistics 3 HW • Canned lab presentations (3)	**1) Canned Lab** – **reflection** due 3/15/15 and **comments** on peer reflections due 3/17/17. **2) Research Project** –Presentation of initial results on 3/23/15. Be ready to present and answer questions!
March 4 **Statistics 4** **Canned Labs**	• Stats 4: t-tests and hypothesis interpretations • Canned lab presentations (2)	**1) Canned Lab** – **reflection** due 3/15/15 and **comments** on peer reflections due 3/17/17. **2) Research Project** –Presentation of initial results on 3/23/15. Be ready to present and answer questions! **3) Statistics HW 4** – due 3/22/15
Week 8 **March 9** **Canned Labs**	• Discuss Statistics 4 HW • Canned lab presentations (3)	**1) Canned Lab** – **reflection** due 3/15/15 and **comments** on peer reflections due 3/17/17. **2) Research Project** –Presentation of initial results on 3/23/15. Be ready to present and answer questions!
March 11 **Canned Labs**	• Stats 5- Linear Regression and Best Fit Determination • Canned lab presentations (3)	**1) Canned Lab** – **reflection** due 3/15/15 and **comments** on peer reflections due 3/17/17. **2) Research Project** –Presentation of initial results on 3/23/15. Be ready to present and answer questions!
SPRING BREAK: MARCH 16 - 20		

Week 9 **March 23** **Research Project Presentations, Consultations, Statistics 5**	• Research project presentations of initial results • Discuss Statistics HW 5 • Canned lab debriefing • Research Experiment – consultation on revisions and order materials (if needed)	**1) Research Project** – Write up experiment revisions and list of materials needed to replenish/replace what is needed. Round 2 of experiment starts next week!
March 25 **Science Teacher Responsibilities Statistics 6**	• Using Models and Manipulatives • Responsibilities of science teachers • Stats 6: Chi-Squared testing	**1) Stats 6 HW** due 3/29/15
Week 10 **March 30** **Research Project – Round 2**	• Discuss Statistics 6 HW • Round 2 of experimentation	Be sure that you have an adequate number of trials and samples in each trial to validate your data.
April 1 **Research Project - Round 2 Data Analysis**	• Round 2 of experimentation	Be sure that you have an adequate number of trials and samples in each trial to validate your data.
Week 11 **April 6** **Research Project**	• **Research project-** Experimentation Round 2 • Data Analysis – expectations and work on it.	**1) Reading** (7): "*Fifteen Simple Discrepant Events That Teach Science Principles and Concepts*" E.L.Wright – due 4/7/15.
April 8 **Demonstrations**	• Instructor demo show • Sign up for demonstrations • Plan demonstration, re-run experiments (if needed) • Work on data analysis	**1) Research Project** – data analysis from experiment – due 4/12/15. Bring hard copy to consultation session on 4/13/15. **2) Reading** (8) Marder Chapter 5 – due 4/12/15 **3) Demo Presentation Write-up** due 4/15/15.
Week 12 **April 13** **Data Analysis Consultation & Demonstration Prep**	• Data Analysis consultation time • Prep demonstrations • Write conclusions	**1) Demo Presentation Write-up** due 4/15/15.
April 15 **Demonstration Show!**	• Student demonstration presentations • Portfolio 2a expectations	**1) Demo Presentation:** a. **Write-up** due 4/15/15 b. **Reflection** due 4/17/15 c. **Comments to peers on discussion board** due 4/19/15. **2) Research Project** – Conclusions – due 4/19/15. Bring hard copy to consultation session.
Week 13 **April 20** **Research Project conclusion**	• Conclusions consultation time • Putting the research paper together.	**1) Research Project –** Rough draft of research paper due 4/26/15. Incorporate all prior feedback from instructors into this draft. Bring hard copy to class on the 4/27/15 for peer review.

April 22 **Research Project Posters**	• Designing posters for presentations o Exploring scientific posters o What is expected for students	**1) Research Project –** Final draft of paper due 5/3/15. **2) Research Project –** Poster due by class time on 5/4/15. **3) Research Project** – Presentations on 5/6/15 **4) All borrowed materials must be returned by class time on 4/29/15.**
Week 14 **April 27** **Peer Review**	• Peer review of research papers • Research project last-minute details • Work on Portfolio Section 2a reflection	**1) Research Project –** Final draft of paper due 5/3/15. **2) Research Project –** Poster due by class time on 5/4/15. **3) Research Project** – Presentations on 5/6/15 **4) All borrowed materials must be returned by class time on 4/29/15.**
April 29 **Clean Up & Inventory**	• Clean and organize equipment • Inventory materials	**1) Research Project –** Final draft of paper due 5/2/15. **2) Research Project –** Poster due by class time on 5/4/15. **3) Portfolio** Section 2a reflection due by 5/6/15. **4) Research Project** – Presentations on 5/6/15
Week 15 **May 4** **Poster Session**	• ***Poster session today!*** Be ready to explain your experiment to instructors from chemistry, biology and physics departments.	**1) Portfolio** Section 2a reflection due by 5/6/15. **2) Research Project** – Presentations on 5/6/15
December 3 **Research Project Presentations**	• Research Project presentations • Course evaluations	**1) Portfolio** Section 2a reflection due by 5/6/15.
Week 16 **May 11-15**	**Final Exam Week**	