I. Course Description

This is a blended course (50% online, 50% face-to-face) and is designed for graduate students and accommodates master’s and doctoral degree students in Curriculum & Instruction and other colleges on the campus who are interested in enhancing their science teaching skills. The major goal is to prepare teachers who can educate students to become scientifically literate. This aim requires educators who possess the competence to help students learn about the nature of science, to engage in science investigations, and to construct understanding of natural phenomena, forming an elaborate cognitive framework of scientific concepts. This class will meet face-to-face every other week.

II. Rationale

The challenge has never been greater to educate a society for the electronic/communication/information age of the 21st century. This is especially challenging in a highly multiethnic society with students coming from a variety of cultures and a range of economic backgrounds. Science teachers cannot be too well prepared. They must be very knowledgeable about science and technology, expert in pedagogy, and highly motivated to elevate the scientific and technological literacy of society and to help their students succeed academically.

The importance for science teachers to understand the nature of science cannot be overstated. After all, science is what they are teaching and it is critical to know about this discipline – a clear definition of science; about pseudoscience, junk and corrupted sciences; skepticism; the various methods of science; science facts, laws, and theories; and how science is related to engineering, technology and society. Many practicing science teachers, as well as beginning science teachers, lack an understanding of many of these ideas. Also, most science courses at the K-16 levels teach very little “about” the
nature of science, devoting most of the instruction to the content of science. Where is the subject matter balance in these courses?

Teaching science as a body of knowledge results in conveying the abstracted, distilled, polished, and pristine outcomes of the learning process that others have gone through to construct new knowledge. As a consequence, this approach often produces learning outcomes that have little meaning to students, resulting in the “rote” memorization of ideas that are learned poorly. Content with little or no process is not the recommended approach for science education. For these and many other reasons, science teachers should learn a great deal about teaching “science as inquiry” philosophy and related instructional approaches.

III. State Adopted Proficiencies for Teachers

1. **Learner-Centered Knowledge:** The teacher possesses and draws on a rich knowledge base of content and technology to provide relevant and meaningful learning experiences for all students.

2. **Learner-Centered Instruction:** The teacher collaboratively identifies needs and implements appropriate pedagogical and assessment strategies using technology and other resources.

3. **Equity In Excellence For All Learners:** The teacher respects, addresses, and validates the needs of diverse learners.

4. **Learner-Centered Communication:** The teacher demonstrates effective professional and interpersonal communication skills and serves as an advocate for all students.

5. **Learner-Centered Professional Development:** The teacher is a reflective practitioner and demonstrates a commitment to learn, to improve the profession, and to maintain professional ethics and personal integrity.

**Texas Education Agency STAAR Proficiencies, TExES Competencies, Texas Science Objectives, Science Common Standards:**

<table>
<thead>
<tr>
<th>State Science Standards/Course Goals</th>
<th>Course Assignments</th>
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| **Standard I.** The science teacher manages classroom, field, and laboratory activities to ensure the safety of all students and the ethical care and treatment of organisms and specimens. | • Article/Reading Reflection  
• [Discussion Board (DB) Posts]  
• Scientific Inquiry Investigations & Reflections  
• Video Assignments |
| **Standard II.** The science teacher understands the correct use of tools, materials, equipment, and technologies. | • Article/Reading Reflection - DB Posts  
• Science Process Skills  
• State Standards (Process/Content TEKS)  
• National Standards (NGSS)  
• Scientific Inquiry Investigations & Reflections  
• Video Assignments |
### Standard III. The science teacher understands the process of scientific inquiry and its role in science instruction.

- Article/Reading Reflection - DB Posts
- Scientific Inquiry Investigations & Reflections
- State Standards (TEKS)
- National Standards (NGSS)
- Inquiry Curriculum Unit
- Inquiry-based Lesson Plan
- Video Assignments

### Standard IV. The science teacher has theoretical and practical knowledge about teaching science and about how students learn science.

- Article/Reading Reflection - DB Posts
- Inquiry-based Lesson Plan
- Scientific Inquiry Investigations & Reflections
- DAST
- Synthesis Paper
- Inquiry-based Lesson Plan
- Video Assignments

### Standard V. The science teacher knows the varied and appropriate assessments and assessment practices to monitor science learning.

- Article/Reading Reflection - DB Posts
- Science Journal
- Science Fair Project
- Inquiry Curriculum Unit
- VNOS Assessments

### Standard VI. The science teacher understands the history and nature of science.

- Article/Reading Reflection - DB Posts
- Scientific Inquiry Investigations & Reflections
- VNOS Assessments
- State Standards (TEKS)
- National Standards (NGSS)
- Synthesis Paper
- Video Assignments

### Standard VII. The science teacher understands how science affects the daily lives of students and how science interacts with and influences personal and societal decisions.

- Article/Reading Reflection - DB Posts
- Scientific Inquiry Investigations & Reflections
- Science Journal
- Synthesis Paper
- VNOS Assessments
- Video Assignments

### IV. TEexES Competencies
This course is designed for teachers who are already certified. TExES competencies, although expanded upon within this course, are not identified since the participating teachers will have already completed their examinations.

V. Course Objectives and Learning Outcomes

Graduate students will be able to:

Nature of Science (NOS)

1. Explain their answer to these questions – What is Science? What is the Nature of Science (NOS)?

2. Describe the national science education standards (NGSS) and state science standards (TEKS).

3. Discuss the foundations for teaching science: nature of science, science process skills, how students construct science learning, teaching science as inquiry, and connecting science to other disciplines.

4. State, recognize, and explain the facets of the nature of science that are presented in the course textbook, which are as follows:
   - Science as a Way of Thinking,
   - Science as a Way of Investigating,
   - Science as a Body of Knowledge
   - Science and Social Interactions
   - Engineering and Technology
   - Science and Society

5. Plan, design, and assess science instruction to promote student learning among diverse student populations.

6. Participate in the discourse on current trends and issues in science education.

7. Write a synthesis paper on a scientific concept/theory/law and develop a 5-E lesson plan that incorporates this science concept.

8. State, recognize, and explain in a paragraph definition of science put forth in this course that contains four important ideas related to the nature of science.

9. Describe how scientists: (a) make careful observations, (b) design ingenious experiments, (c) rely heavily on empirical data to settle claims, (d) use logic and reasoning to form conclusions, (e) make public their findings in refereed journals, (f) use ethical principles to guide their work, (g) confirm or disprove claims, and (h) attempt to translate scientific knowledge into useful products for society.

10. Explain or recognize how to distinguish among authentic science, pseudoscience, junk and corrupt science.
Instructional Activities and Experiences

1. This topic is initiated with teachers completing the Views of Nature of Science (VNOS) questionnaire.

2. Complete a 12-item “Myths of Science Quiz.” This true/false instrument stimulates a great deal of discussion about science, revealing many misunderstandings of this broad human enterprise.

3. Summarize the Instructional Objectives for the unit to provide the scope and importance of the content. Participants will submit assignments within each unit to Blackboard (Bb).

4. Conduct a guided reading session highlighting important learning outcomes for the study of the nature of science.

5. Review the state science standards (TEKS) and Next Generation Science Standards (NGSS) to highlight the nature of science, and NGSS components, such as Science as Social Interaction, Engineering and Technology, and Science and Society.

6. Read *Just a Theory: Exploring the Nature of Science* by Moti Ben-Ari, that informs teachers about science. This book also addresses many areas of the nature of science that teachers should be informed about such as theory, pseudoscience, science and religion, logic and mathematics, and the future of science.

7. Read various peer-reviewed journal articles that cover current trends and issues in science education, nature of science, and scientific inquiry.

Scientific Inquiry (SI)

1. Define inquiry and contrast it with reception learning.

2. Distinguish among expository teaching, reception learning, discovery learning, open inquiry, and guided inquiry.

3. Explain and differentiate between teaching *science by inquiry* and teaching *science as inquiry*. Give their main purpose and their significance for science teaching. Also, tell which approach to science teaching is recommended in the national science education standards and Next Generation Science Standards.

4. List and recognize four guidelines Richard Suchman recommended for science teachers in the 1960s to promote inquiry in the classroom.

5. Describe and identify various ways to initiate and conduct inquiry sessions, and become adept at using these strategies to teach science, which are related to: asking questions, discrepant events, science process skills (basic and integrated), inductive
activities, deductive activities, gathering information, solving problems, and science fair projects.

6. List and recognize the five phases of the 5E Instructional Model.

7. Describe grouping techniques that facilitate teaching inquiry-based science.

8. Give and recognize problems associated with the inquiry approach in science instruction.

9. Given a description of a teaching situation, identify the types of inquiry activities that are being implemented and evaluate their effectiveness for enhancing learning.

10. Develop instructional activities that are inquiry oriented, which build on students' prior knowledge and actively engage them in learning about a given phenomenon.

**Instructional Activities and Experiences**

1. During class sessions the instructor will model many of the learning outcomes stated in the objectives.

2. Many science demonstrations, laboratory activities and model lessons will be conducted in class, involving learning “science as inquiry,” with high student engagement for learning science content and science processes.

3. The course participants will read vignettes in the assigned textbook in class, reflecting on certain aspects of inquiry and teaching science.

4. Participants will summarize the instructional objectives and submit them to Blackboard for feedback in order to increase and reinforce their understanding of the topic.

**Assessment of the Instructional Objectives/Learning Outcomes**

The intended learning outcomes specified for these units will be assessed from summaries of Instructional Objectives and submitted to the course Blackboard site and during question-and-answer sessions in class. All of the Instructional Objectives may be assessed on a semester test and the final exam.

**VI. Course Topics**

Course topics include, but are not limited to:

- What is Science?
- Nature of Science
- Science as a Way of Thinking,
- Science as a Way of Investigating,
- Science as a Body of Knowledge
- Science as Social Interactions
- Engineering and Technology
- Science and Society
- Scientific Inquiry
- Discovery Learning
- Open Inquiry
- Guided Inquiry
VII. Instructional Methods and Activities

- Traditional experiences (reading assignments, journal article reviews, written assignments)
- Online discussion via Blackboard (assignments, discussions, chat, wikis and other interactions).

VIII. Evaluation and Grade Assignment

_The methods of evaluation and the criteria for grade assignment are:_

**Attendance and Participation (15 pts)**
Students are expected to attend all class meetings.

**Readings/Article Reviews (50 pts)**
You will be a part of a Professional Learning Community (PLC) by responding to various questions and posts on the discussion board via Blackboard (Bb). The promptness and initiative of participating in threaded discussions done in a timely fashion will demonstrate self-motivation. The delivery of your posts will address your attention to detail in terms of being grammatically correct with rare misspellings. You will make posts that are relevant to the original discussion by staying on topic. By contributing to the professional learning community, you will demonstrate an effort to further the development of a collaborative learning experience. You will write a _one-paragraph reflection_ that addresses a given prompt. Then you will review two other students' postings and post one response/comment to each student's post (Total of two replies). Your replies to other students' posts only need to be about 1-2 sentences. You can feel free to provide/post responses to more than two classmates' postings to enhance a discussion; however, you will only receive credit for replying to two classmates' posts. Remember to be courteous and respectful to all peers and in your responses to postings. Professionalism is expected at ALL times.

**Book Reviews (50 pts)**
You will submit two book reviews based on the book, _Just a Theory: Exploring the Nature of Science_ by Moti Ben-Ari. This book addresses many areas of the nature of science that teachers should be informed about such as theory, pseudoscience, science and religion, logic and mathematics, and the future of science. Book reviews will be submitted on Bb via Blogs.

**Instructional Strategies Self-Study (25 pts)**
Students will select a specific science concept and lesson plan for study. Students will analyze their current classroom practices as they relate to NOS and scientific
inquiry. They will develop an inquiry-based science lesson plan that incorporate NOS and would be appropriate, responsible, and effective for their science concept. Students will teach their lesson in class to their peers for professional feedback. Students will submit a teaching reflection, modeling the dispositions of a reflective practitioner.

**Midterm Exam (25 pts)**

Students will be assessed over instructional objectives related to NOS and scientific inquiry.

**Synthesis Paper & Lesson Plan – Scientific Theory/Law (45 pts)**

Students will complete a synthesis paper encompassing a major theory or law in their content area including NOS and scientific inquiry. More details will be provided in class.

Students will select a specific science concept/theory/law. Students will research this concept/theory/law and make connections to the nature of science (NOS) and scientific inquiry. They will explore the history of this theory/law and write a 7-10 page synthesis paper (minimum 7 pages, not including reference page).

Students will then develop an engaging, inquiry-based science lesson plan (5-E) that incorporates aspects of NOS and the history of this concept/theory/law. Students will designate a specific grade level for their lesson plan based on the state science TEKS and NGSS. More details about this assignment will be provided on Blackboard (Bb).

**Synthesis Paper (25 pts):**

1. **Scientific theory/law must be approved by instructor.**
2. Paper should be a minimum of 7 pages, but no more than 10 pages. Use at least 6 references, with a minimum of 4 peer-reviewed articles from professional educational journals, written within the past five years, and books.
3. The paper must include the following subheadings in bold:
   1. **Title Page** – Include name of concept/theory/law, your name, course name, my name, semester/year (Page 1)
   2. **Introduction** – Discuss your motivation/personal interest for selecting this theory/law; What is the importance of educating students about this theory/law? (Pages 2-3)
   3. **Review of the Literature** – Discuss the historical development of concept/theory/law; What scientist(s) is/are credited for proposing the concept or contributing to the concept; Biography of the scientist(s) – what type of person was this scientist (discuss childhood through adulthood); What scientific processes did the scientist(s) utilize in proposing this concept?; How did this theory/law affect personal and societal decisions; What were some of the
challenges (if any) in society accepting this theory/law? (Pages 3-7)

4. Discussion - Discuss how students’ understanding of the nature of science will be improved by learning about the historical development of this theory/law (e.g. teaching science through the history of the discipline); Consider the connections you can make to the nature of science themes when teaching a lesson on this theory/law, as was discussed earlier in the semester: science is a way of knowing, scientific knowledge is based on empirical evidence, scientific knowledge is open to revision in light of new evidence, science is a human endeavor, science addresses questions about the natural and material world, etc. (Pages 7-8)

5. Conclusion - Explain why it is necessary to incorporate inquiry-based teaching and learning in the science classroom. Make reference to the state TEKS, national science education standards, 5-E instructional model. Also discuss the importance of assessment in inquiry-based lessons. (Pages 9-10)

6. References – Final page of paper (12 pt. font, single-spaced)

   5. Paper should be written in Times New Roman, 12 pt. font. double-spaced.
   6. Assignment is Due: Wed., Dec. 10, 2014

5-E Lesson Plan (20 pts):
Students will analyze their current or future classroom practices as they relate to the research-based instructional approaches discussed in the course. They will develop a 5-E inquiry-based lesson plan for a specific grade level, utilizing science process and concept TEKS, and will incorporate the science theory/law researched and make connections to the nature of science and other disciplines, as appropriate. A 5-E lesson template will be provided to the student.

Journal (5 pts)
Teacher as a reflective practitioner. Students will keep a reflective journal of their weekly experiences in the course and of concepts learned during the week. You should make an entry into your journal at least once per week and reflect on something that “grabbed” you the most from the videos/readings/scientific inquiry investigations/etc. and you fully intend to use in your class (present or future)!! For your Final reflection, you will post a reflection in your journal about Teaching Science.
Grading: **EDCI 5390/6390**

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<tr>
<th>Component</th>
<th>Points</th>
<th>Notes</th>
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<tr>
<td>Attendance &amp; Participation</td>
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<td>VNOS Questionnaire</td>
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<td>Readings/Articles/Science in the News</td>
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<td>Book Reviews</td>
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<td>Midterm</td>
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<td>Instructional Strategies Self-Study/</td>
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<td>Synthesis Paper</td>
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<td>Final Exam</td>
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**B. Grading Scale**

Grades:
- A = 193 – 215
- B = 171 – 192
- C = 150 -170
- D = 128 -149
- F = 127 or below

** Required, no credit given.
*** Doctoral students will be required to take a final exam for this course. Format of final exam will be decided by instructor and discussed with students.

**IX. Course Schedule and Policies**

A. A tentative course schedule and calendar will be provided on the first day of class!

B. Class Policies

**Late assignments**

Late assignments will not receive full credit. A deduction of 10% per day will be applied to any late assignment. Communicating an excuse for a late assignment does not constitute a waiver of the deadline or avoid the deduction.

**Attendance/tardiness**

Attendance will be recorded for this class. Points will be deducted for class absences. Notification of an absence does not constitute a class waiver.

**Make-up Exams**

NA

**Extra Credit**

Extra credit is not an option for this course.
X. Textbook(s)
Required


Recommended

XI. Bibliography

*The knowledge bases that support course content and procedures include:*


Journals:

XII. Course Policies

*Academic Integrity/Plagiarism*
University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of
examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one's own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in failure. See website http://judicialaffairs.tamucc.edu/.

**Dropping a Class**
I hope that you never find it necessary to drop this or any other class. However, events can sometimes occur that make dropping a course necessary or wise. Please consult with me before you decide to drop to be sure it is the best thing to do. Should dropping the course be the best course of action, you must initiate the process to drop the course by going to the Student Services Center and filling out a course drop form. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Check the university academic calendar website for dates related to dropping a class with an automatic grade of "W" this term. See website http://www.tamucc.edu/academics/academic_cal.html.

**Preferred methods of scholarly citations**
Publication Manual of the American Psychological Association, Sixth Edition is the preferred method for citations within papers.

**Classroom/professional behavior**
All students are expected to act in a responsible manner with consideration of fellow students and toward TAMU-CC faculty and staff members. Specific rules and information is available in the TAMU-CC Student Handbook and available through the website http://judicialaffairs.tamucc.edu/studentcofc.html.

**Cell Phone Usage During Class**
Vigorously discouraged! Cell phone usage is prohibited during class unless special prior permission has been granted by Dr. Jeffery. This includes text messaging, talking, vibrating phones, checking email, responding to email, and/or all other uses to which such devices may be employed. EDCI 5390/6390 is a professional development course in the Department of Curriculum and Instruction at TAMU-CC. You are expected to demonstrate a level of professionalism.

**Statement of Academic Continuity**
In the event of an unforeseen adverse event, and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

**Grade Appeals**
As stated in University Rule 13.02.99.C2, Student Grade Appeals, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Rule 13.02.99.C2, Student Grade Appeals, and University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules Web site at [http://www.tamucc.edu/provost/university_rules/index.html](http://www.tamucc.edu/provost/university_rules/index.html). For assistance and/or guidance in the grade appeal process, students may contact the Office of Student Affairs.

**Disabilities Accommodations**

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call or visit Disability Services at (361) 825-5816 in CCH 116. See website [http://disabilityservices.tamucc.edu/](http://disabilityservices.tamucc.edu/).

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816.