

The Nature of Science Across Time and Culture The Processes and Practices of Science



Biology 484x/684, Chemistry 490x, Enviro 475x, Geology 475, and Physics 490x 2 Cr.

This course is an examination of major concepts in the nature of science and how they evolved. This course compares and contrasts of the role and practice of science in various cultures and examination of the interaction between science, technology and culture. CREQ: ILAS 201, 301 or 401; Instructor Permission.

Instructor Information - Fall 2017

- **Instructor Name:** Paul Fix
- **Office Location:** Faraday Hall 326
- **Office Hours:** Tues. 9-12, Thurs. 1-3
 - **Send an email if you need to schedule an appointment outside of office hours.**
- **Telephone:** (815) 753-6819
- **Email:** pfix@niu.edu

Meeting Days/Times/Location

Class meetings will be held in **Montgomery Hall 324** on **Wednesdays** from **4:00-5:50 PM** until 9/20. Starting 9/27, class will be held in **Faraday 129**.

Materials

Book required for the course:

- Readings will come from current journals and periodicals chosen by instructor

Suggested Reading (not required):

- Ben-Ari, M., (2005) *Just a Theory: Exploring the Nature of Science*. Prometheus Books. (ISBN-10: 1591022851/ISBN-13: 978-1591022855)
- Dawkins, R., (2011) *The Magic of Reality: How We Know What's Really True*. Free Press. (ISBN-10: 9781451675047/ISBN-13: 978-1451675047)
- Project 2061 (American Association for the Advancement of Science). (1989). *Science for all Americans: A Project 2061 report on literacy goals in science, mathematics, and technology*. Washington, D.C: American Association for the Advancement of Science. Online version: <http://www.project2061.org/publications/sfaa/online/sfaatoc.htm>

Standards Addressed by This Course

- **NSTA Teaching Standards (2012): 2a, 2b, 2c, 3a, 3b, 5b, 5c, 6a, 6b**
- **Next Generation Science Standards (NGSS):** Appendix H, Nature of Science in the NGSS
 - Scientific Investigations Use a Variety of Methods
 - Scientific Knowledge is Based on Empirical Evidence
 - Scientific Knowledge is Open to Revision in Light of New Evidence
 - Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena
 - Science is A Way of Knowing
 - Science is a Human Endeavor
 - Science Addresses Questions About the Natural and Material World

Course Website

Blackboard. Note that you will need to use your Z-ID and because this course is cross-listed, each one of you will be put into GEOL 475 Master course. You will need to test whether you have access twenty-four hours after the first class. If you do not, it will be your responsibility to contact the instructor immediately.

Course Goals

It is well founded that people learn least when simply being told how something is done or what concepts to understand. Profound learning occurs when we are able to scaffold our understanding of material to a prior or shared experience. One can learn or memorize the basic tenets of the nature of science, but without an experience or concept in which to “hang” the information, a true appreciation of the complexity of the nature of science is difficult. This course will allow the secondary science licensure student an opportunity to begin to practice their teaching while learning the basic tenets of the nature of science.

By the end of this course, students will be able to:

1. Apply the basic tenets of the nature of science and the process of the scientific method to a science classroom.
2. Define, differentiate, and provide examples of the types of scientific inquiry.
3. Differentiate between the three dimensions of the Next Generation Science Standards (NGSS) and explain how they interrelate.
4. Explain the importance of teaching the NOS and impact on their students.
5. Apply research on how students learn to demonstrations, lessons, and case studies.
6. Show growth in one or more teaching demonstration core competencies.

Expectations

We will set a standard of professional comportment, in which professional behavior, including attendance, dress, participation, courtesy, and the submission of assignments by the due date are both expected and required. Professional demeanor, of the type that we expect in the educational workplace, is required at all times in this course. Please silence your cell phone and other electronic devices during class.

Attendance

Should you need to be late, leave early, or miss a class, please notify me in writing (email is fine) as much in advance as possible. Failure to notify me in writing of an absence *before class* will be regarded as an unexcused absence and there will be no make-up assignments, quizzes or tests. Due to the nature of the course and the work involved, attendance is very important. If you must miss class, it is your responsibility to get the notes from a classmate and to find out what went on in class during your absence.

In addition, 10 attendance points will be given for each class period that you fully attend and participate in. If you are late or have to leave early, only 5 points will be awarded for the period. If you are absent, 0 points will be awarded for that period. There will be no make-up for lost attendance points.

Assignments

You will be expected to complete a number of assignments throughout the semester. I will announce clear deadlines and these assignments must be handed *before the beginning of class*. **Late assignments turned in after class has begun will receive half credit.** Assignments that are one week or more late will not be accepted and a zero will be recorded in the grade book.

Tests and Quizzes

Test and Quizzes (not the final exam) will be given by way of Blackboard. It is your responsibility to make sure your computer works with Blackboard technology. It is important to notify me immediately if you cannot access the material on blackboard. Questions will consist of a blend of T/F, multiple choice, definitions, short answer, and essay questions.

Project and Presentations

There will be opportunities to conduct laboratory exercises during the semester. You may work with a partner for these projects and both parties will receive the same grade for project produced. In addition, you will be expected to give a two teaching demonstrations. You will be able to use the technology that is available in the room for your demos. If you need lab materials or equipment, please contact me at least *a week before your demo*.

Graduate Credit for Biology 684

Graduate students will be required to present research from two different peer-reviewed academic journals in a discipline of their choice and in the field of science education. The presentation details and grading rubric can be downloaded from blackboard in the "Scientific Journal Article Presentation" file.

Grading:

- Assignments (labs, activities, readings) 40%
- Anticipatory Set Demo 10%
- Discrepant Event Demo 20%
- Quizzes 10%
- Attendance 5%
- Final Exam 15%

Accommodations

If you need an accommodation for this class, please contact the Disability Resource Center as soon as possible. The DRC coordinates accommodations for students with disabilities. It is located on the 4th floor of the Health Services Building, and can be reached at 815-753-1303 (V) or drc@niu.edu.

Also, please contact me privately as soon as possible so we can discuss your accommodations. The sooner you let us know your needs, the sooner we can assist you in achieving your learning goals in this course.

Course Outline and Schedule on Next Page



Date	Topic	Class Topics/Activities	Assignments Due
8/30	Wk 1: Science...is a Process.	Introductions NOS survey Pseudoscience vs science activity	
9/6	Wk 2: Science...Uses a Variety of Methods.	What is the "Scientific Method"? Email Activity Types of Research	Umbrellaology Discussion board Horoscope Activity
9/13	Wk 3: Science...constructs explanations and designs solutions	Levels of Inquiry Inquiry lab activity Anticipatory set notes/demo assignment	Email Activity
9/20	Wk 4: Science Understanding...is Promoted Through Inquiry.	Peer review/feedback on anticipatory set ideas Next Generation Science Standards Begin course outline and NGSS assignment	Quiz 1 Anticipatory Set Ideas Bring in 2 syllabi
9/27	Wk 5: Scientific Inquiry...is Guided by the Next Generation Science Standards	Anticipatory set demos (30 min) Finish course outline and NGSS assignment	
10/4	Wk 6: Science...is Driven by Observations and Hypotheses	Anticipatory set demos (30 min) Hypothesis, observations, precision vs. accuracy, validity vs reliability Hypothesis activity	NGSS/NOS Discussion board
10/11	Wk 7: Science knowledge...is Based on Empirical Evidence	Anticipatory set demos (30 min) Using data as evidence, causation vs correlation, interpolation vs extrapolation Start Measurement Inquiry Lab	Hypothesis Activity Quiz 2
10/18	Wk8: Evidence continued...	Anticipatory set demos (24 min) Finish Measurement Inquiry Lab	

10/25	Wk 9: Science...is a Way of Knowing	Anticipatory set demos (24 min) Preconceptions/misconceptions notes, putting research on how students learn to practice, conceptual change Tying instruction to phenomenon/driving questions/discrepant events	Measurement Lab
11/1	Wk 10: Science...is Systematic and Logical	Discrepant Event peer review The Scientific Approach Induction vs deduction, observation vs inference Laetoli footprints activity	Quiz 3 3 Discrepant Event Ideas
11/8	Wk 11: Science knowledge...is Open to Revision	Discrepant event demos (50 min) Fact vs Theory vs law Scientific debate Taung child skull controversy	
11/15	Wk 12: Science knowledge...is Built by Obtaining, Evaluating, and Communicating Information	Discrepant event demos (50 min) Peer reviewing/scientific argumentation Fossil finding activity	
11/22	THANKSGIVING BREAK	NO CLASS	
11/29	Wk 13: Science ...is a Human Endeavor	Discrepant event demos (40 min) Culture influence on science and vice versa Bias in Science Diversity in Science	Quiz 4
12/6	Wk 14: Science Literacy...is important for all individuals.	Discrepant event demos (40 min) Scientific Literacy Importance of NOS Challenges in teaching NOS	
12/13	FINAL EXAM 4:00 - 5:50pm		