

Understanding Science

MED 6650

Weber State University

Dr. Adam Johnston

COURSE PHILOSOPHY:

What is “science” and what facets of science are important to teach in the classroom? Recently (and historically), reformers in science education have been advocating that students (and their teachers) need to understand the “nature of science” (NOS), the basic philosophical assumptions of science. But what are these fundamental assumptions of science?

How do they play out in the practice of science and in the society in which science operates? And, how does science get portrayed and, ultimately, learned in the classroom?

This course looks to develop ideas of what the NOS is and how it is incorporated into the classroom. We will investigate what the basic ideas of the NOS are, how well these ideas are understood by learners, how these ideas are typically displayed in our classrooms and society, and how science education can be best shaped in order to model and explicitly teach the NOS appropriately.

COURSE OBJECTIVES:

This course should enable the student to:

- Develop a rich understanding of the nature of science and why it is an important part of science literacy.
- Become familiar with research literature, methods, and results concerning the nature of science.
- Produce a philosophy of science teaching that considers nature of science concepts in the classroom.

THE DETAILS:

Instructor: Dr. Adam Johnston

- Phone: 801.626.7711 (office)
- E-mail: ajohnston@weber.edu
- Office Hours: By appointment; or Tues/Weds/Thurs 8:30-10:15a, but I realize that most of you are occupied during these times. I’m happy to meet you right before or after class if it’s convenient, or other times that we can schedule.

Meeting times: Mondays, 4:30 – 7:10 PM

Meeting place: McKay Education 325

Course Web Page: <http://physics.weber.edu/johnston/nos/>

READINGS:

Course readings are available through the website whenever possible. Most readings are accessible from campus via the library’s subscription to electronic journals. If necessary, print copies could be made available.

THE WORK:

There exist three major components to your involvement in this course:

- **Class participation.** It is expected that you will attend and participate in class. *How* you participate is up to you (listening, arguing, explaining, cooperating, etc.) and can take a variety of forms. At the very least, it should be evident that you have completed readings and you should complete all in-class activities and assignments. Your participation is vital for the success of this course, as well as for 20% of your grade.
- **Response papers.** Each week, you will complete a response paper on a specific; or, you will be asked to participate in an online discussion. These papers/discussions combine for 50% of your grade.
- **Final paper.** This paper, worth 30% of your grade, will be a reflection upon the entire course and its readings, discussions, and activities. The details of this assignment will be discussed in a separate handout.

IMPORTANT NOTES:

- You are a vital part of this course and its success, and for this reason you need to show up regularly. Many other reasons exist to justify you waking up for a weekly class: First, the material covered in class is such that it is very difficult to get the same understandings and experiences on your own time outside of class. Second, there will occasionally be stuff to play with and/or assignments to hand out. Third, your grade is

determined by your participation and contributions to class. Finally, your instructor is known for doing idiotic, life-threatening (to himself, not to you) labs and demonstrations, and it is always interesting to see what might happen next.

- Late work will be accepted for half credit if it is turned in within a week of its due date. Individual “dog-ate-it” and “had-to-get-married” stories will be considered on a case-by-case basis. To get more leniency, notify the instructor prior to any problems you might anticipate.
- Of course, if you’re ill, there are good reasons *not* to be in class. Please stay home when you’re sick, and make arrangements to turn in work electronically. We can supplement instruction with online discussion and email, and whenever possible assignments and readings will be made available via the course website. In addition, in the case that class can’t be held (because the instructor is sick, campus is closed, etc.), class announcements will be made via email and course webpage tools.
- Academic dishonesty on any work will not be tolerated. Extreme violations will result in automatic failure of the course. In this course, it is difficult to imagine what academic dishonesty would look like, since so much work is a creative, personal endeavor. Be aware, however, that professionalism is a part of your course grade, and you should reflect the same integrity that you would expect from your own students.
- Any student requiring accommodations or services due to a disability must contact Services for Students with Disabilities (SSD) in room 181 of the Student Service Center. SSD can also arrange to provide course materials (including this syllabus) in alternative formats if necessary. You are also welcome to discuss any special needs with the instructor, though you are not required to do so.
- This is intended to be a very interactive and student centered classroom. Please help us to make it so both by participating in class and by offering suggestions as to how to better structure the class. An inherent philosophy of this class is that knowledge is constructed in social arenas, so the expectation is that there will be great inspirations and new realizations made as we interact with one another. In fact, one of the benefits of teaching this class is that an instructor tends to learn as much (or more) from students as students should learn from instructors.
- Please do not hesitate to visit the instructor if you have any questions, concerns or comments about the course, or to discuss favorite cross-country ski routes, photography, music, poetry, physics, pottery, yeast, backpacking trails, etc. Often an instructor sits in an office, lonely and sad, during hours that should be filled with student interactions; so please feel free to drop in, even if it isn’t during a posted office hour. (The worst that could happen is you would be told to come back at another time.) Also, email tends to be an incredibly useful mechanism for getting in contact with instructors and getting your questions or comments responded to.

WEEKLY CALENDAR:

note: These things are almost always changed, but this is what you can plan on until otherwise notified.

Wednesday, August 26th: Accidental class meeting.

Course introductions. Punt and re-gather next week.

Reading assigned: Scudder, Collins

Monday, August 31: Introductions to each other and science education

Labs: Bubble observations, umbrellaology

Discuss: What is science and its purpose?

Assigned: Questionnaire (email). Read McComas (“Myths”). Response Paper.

Monday, September 7: Labor Day (Holiday)

Monday, September 14: Nature of Science Primer

Labs: Card Sort

Discuss: Myths of science; fact, law, & theory

Assigned: Read Smith & Scharmann, Settlege & Southerland; Response Paper

Monday, September 21: Online discussion/debate (no class meeting)

Discuss: Myths and the classroom (online)

Assigned: Online discussion

Monday, September 28:

Labs: Doing Science: Hot chocolate stirrings
Discuss: Debrief online discussion;
Assigned: Read Popper, Kuhn, Lightman; Response Paper

Monday, October 5:

Labs: History of Science in Astronomy
Discuss: Progression and change in the history of science
Assigned: Park; Response paper & pseudoscience investigation

Monday, October 12:

Labs: Present Pseudoscience investigations; Astrology Lab
Discuss: Debrief pseudoscience; creating scientific knowledge
Assigned: Read Johnston & Southerland

Monday, October 19:

Labs: Construction of knowledge and scientific inference: Measuring a molecule and constructing “undivided attention”
Discuss: Science as “discovered” versus “created”.
Assigned: Read Watson & Konicek; Ladson-Billings; Bransford, Browning, & Cocking; Response paper

Monday, October 26:

Labs: Conceptual change and constructivist laboratory
Discuss: What is the nature of learning in the science classroom?
Assigned: Manher & Bunge, Jackson et al.; Response paper

Monday, November 2:

Labs: Science and religion and the Simpsons
Discuss: Critical Instances
Assigned: Akerson et al., Southerland, Johnston & Sowell; Response paper

Monday, November 9:

Labs: Card sort revisited
Discuss: How do you learn? What does Professional Learning look like for the science teacher?
Assigned: Teaching Philosophy Inventory; pre-draft of final exam

Monday, November 23:

Labs: Vexations & Venture explanation
Discuss: Objectives of learning science versus Student learning outcomes
Assigned: Vexation & Venture

Monday, November 30:

Labs: Vexations & Venture sessions
Discuss: Final papers
Assigned: Final papers due Monday, December 7th