

SCI 465, Principles of Scientific Practices

Fall 2014

MWF 10:10-11:00 AM

Instructor: Wendy Adams
Office: Office 0232C Ross Hall / 2279 Ross Hall
Hours: MWF 12:15 – 1:00 p.m. / typically 1:00 - 4:00 p.m. in 2279
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Course Website: <http://www.unco.edu/nhs/physics/faculty/adams/Sci465home.html> Check it often!!

Course Objectives:

This is a “capstone” course which means it is designed to help you integrate your knowledge and will be a challenge. Rather than just memorizing facts in this class we will be thinking, creating and synthesizing. You will be asking questions, defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational skills, constructing explanations and designing solutions, engaging in argument from evidence, obtaining, evaluating and communicating information. Specifically the objectives are:

To examine science as a “way of knowing” through experiencing scientific inquiry via a course project, activities, readings, and discussion.

To provide content necessary to enable teacher licensure students to address the [Colorado Academic Standards](#).

At the end of this course students will be able to:

- Explain what it is to “do science” and how the idealized steps of the “scientific method” do not do an adequate job of explaining what it is to do science.
- Describe the difference between “Scientific Practice” and “Engineering Design”
- Describe what a generalization is and what it takes to prove and to disprove a generalization or scientific theory.
- Describe the necessity for observations and characterization of patterns to understand the invisible.
- Describe effortful practice and its necessity in becoming an expert.
- Describe differences in the process of scientific discovery as described in Derry text.
- Describe the value of a model regardless of whether it models the phenomena exactly.
- Explain the value of comparing and contrasting phenomena to understand the science.
- Explain the value of categorization and its place in science.
- Describe different types of tools scientists might use and whether these limit the value of the scientist’s contribution.
- Identify the quality of evidence based on level of public verifiability.

Material in this class will be presented at the “400” level. Therefore, you are expected to reflect senior-level thinking and work in completing your assignments. The course’s success depends on your regular contribution from your past experiences to class discussion.

Textbooks:

1. *Science Matters: Achieving Scientific Literacy*, by Robert M. Hazen, James S. Trefil
2. *What Science Is and How It Works*, Gregory N. Derry
3. Optional: *Step Ball Change*, Jeanne Ray

The first two books are required and will be used throughout the course.

Course Website:

<http://www.unco.edu/nhs/physics/faculty/adams/Sci465home.html>

All assignments will be listed on this page. You are responsible for checking this page daily since not all assignments will be announced in class.

Topics:

To learn what it means to do science as described in the objectives above, we will practice these skills in the context of specific science content. We will focus on major topics in the sciences that appear in Elementary Science Standards at both the State and National Levels. *Most* of the class activities will use ideas from a combination of disciplines such as physics and biology. We will learn about the following topics (not in this order):

- Biology
 - The human body: Reproduction, eyes, ears, voice
 - Animal communication
 - Flow and conservation of energy
- Chemistry
 - Organization of elements
 - Flow and conservation of energy
- Earth Science
 - Earthquakes
 - Flow and conservation of energy
- Physics
 - Sound and Waves
 - Flow and conservation of energy

Your goal is to approach each topic as an inquiry challenge – as a scientist would. You will be provided with ample opportunities to collaborate with your colleagues, achieve new levels of frustration (a good thing!), and accomplish much with your intellect. In the end, you will become a better scientist in order to better teach others to become scientists.

Grading:

Method of Assessment	Approximate weight
Pathway paper/presentation	15%
Course project	15%
In-Class activities & HW	30%
Quizzes	15%
Exams	10%
Final exam	15%

Grades will be assigned according to the following scale:

- 100 – 90% A
- 89 – 80% B
- 79 – 70% C
- 69 – 60% D
- less than 60% F

“A” quality work will require deep thinking, creativity and synthesis of ideas. Effort beyond “knowing the material”. A grading rubric will be provided and sample “A” quality work demonstrated.

Quizzes:

Some quizzes will be given in class and others online. These quizzes will be used as both pre-reading

quizzes and weekly quizzes. One of each type of quiz will be dropped – no exceptions.

Online quizzes will be posted at least a day in advance of the deadline. It is advised that you complete the quiz with time to spare, as technical difficulties may arise and prevent you from completing the quiz on time.

You are responsible for verifying that you are getting credit for online work. It will not be possible to correct several missing items that were discovered at the end of the semester. Only one of each type of quiz will be dropped.

In-class Activities and Homework:

If you miss class on the day an assignment is given or an activity is done you will probably NOT be able to make it up. Homework assignments will not be accepted late.

Assignments that are not collected the day they are done in class should be typed. Please use standard fonts such as 10-12 point Times Roman or Calibri. Creativity should go into the content rather than the way it looks. Depending on the assignment daily work can be single spaced; however, more formal papers (review paper and project) should have a cover page, be double spaced and follow the APA style recommendations - the style most commonly used for educational writing. <http://www.ccc.commnet.edu/library/apa/index.htm#contents2>

Assignments that are not collected the day they are done in class are expected to be written clearly and at the level a professional teacher would write. Grading will be based on the content as well as grammar and spelling. Please proof read all work before submitting. If you need help with your writing, the Writing Center, Ross Hall 1230, is an excellent resource.

Discussions with your peers are an important learning tool. The best way to learn something is to teach it. Also scientists rarely work alone, despite society's stigma that scientists are unsocial intellects working in some smelly lab. You are strongly encouraged to form friendships and exchange emails and phone numbers that will enable you to work on assignments outside of class especially with your table members.

Pathway Paper/Presentation:

You will be asked to read a biography of a scientist and give a poster presentation concerning this book. Presentations will be on two class days sometime during weeks 10-12 of the semester. More details concerning this assignment will be given in advance of the deadline.

Course Project:

You will apply your understanding of the various scientific practices and the nature of science in a course project. You are welcome to work together on this project as you form ideas; however, the final product must be your own work. Presentations will be scheduled on two class days during weeks 12 - 14. More details concerning this assignment will be given in advance of the deadline.

Exams:

Each exam will cover material from the previous 5 ½ weeks.

Final Exam:

The final exam is scheduled on Thursday, December 11, 2014 from 8:00 AM to 10:30 AM. Students will be expected to take the exam at this time and should **NOT** make plans that conflict.

Student Expectations:

- Students are expected to work an average of 2 hours outside of class for each hour spent in class.
- Students are expected to regularly attend class. Absences greater than professional teaching responsibilities will probably have a detrimental effect on your final grade.
- Students are expected to read assignments in text and related literature.
- Students are expected to participate in classroom discussions and activities.
- Students are expected to turn in assignments on announced due dates.
- Students are expected to actively participate in group functions and fulfill other group responsibilities.
- Students are expected to take tests and quizzes on the days they are given
- Students are expected to be responsible for their own work and be thoughtful of others.

- Students are expected to follow UNC's Honor Code and Student Code of Conduct
<http://www.unco.edu/dos/communityStandards/index.html>

Resources:

Students with disabilities who believe they may need accommodations in this class are encouraged to contact Disability Support Services (970) 351-2289 as soon as possible to better ensure that accommodations are implemented in a timely fashion. Students with accommodations must provide the disability access form at least 3 days before accommodations are needed.

Writing Center in Ross Hall 1230

Everything on this syllabus is subject to revision throughout the semester; however, adequate notice will be given.

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CONSENT FORM FOR HUMAN PARTICIPANTS IN RESEARCH
UNIVERSITY OF NORTHERN COLORADO

Project Title: Adams' Course Data

Researcher: Wendy Adams, Ph.D., School of Earth Sciences and Physics.

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The purpose of the proposed project is to better understand effective teaching methods for promoting student understanding of the content, student perceptions of the discipline and student understanding of the nature of science. Specifically I am using teaching methods that are considered best practices learned from education research. As part of my own evaluation of these teaching methods, I will be asking you about your views of science, physics and the nature of science. In addition I will ask you to complete a survey at the end of the semester about your opinion as to the value of various aspects of the course for learning.

To evaluate the effectiveness of the course, I will look at all the data from the course in aggregate, without students' names or other individual identifiers. The course data includes in class questions, quizzes, exam results and student responses to the surveys that are offered at the beginning and the end of the semester.

The risks, discomforts and benefits are the same as those encountered by students taking a typical college level physics course.

Participation is voluntary. You may decide not to participate in this study and if you begin participation you may still decide to stop and withdraw at any time. Your decision will be respected and will not result in loss of benefits to which you are otherwise entitled. Having read the above and having had an opportunity to ask any questions, please complete the survey. By completing the survey, you will give permission for your participation. You may keep this form for future reference. If you have any concerns about your treatment as a research participant, please contact the Office of Sponsored Programs, Kepner Hall, University of Northern Colorado Greeley, CO 80639; 970-351-2161.