SCIENCE IN OUR WORLD: CERTAINTY & CONTROVERSY
FALL 2015 SYLLABUS

There is nothing which can better deserve our patronage than the promotion of science and literature. Knowledge is in every country the surest basis of public happiness. —George Washington to Congress, January 8, 1790.

"Scientific knowledge is a body of statements of varying degrees of certainty - some most unsure, some nearly sure, none absolutely certain" —Richard Feynman (1918-88, Nobel prize in Physics 1965)

Welcome to SC200

Science will be part of the solution to every problem in the 21st century - and it will continue to illuminate humanity and humanity's place in the universe. This means it is not enough for universities to train scientists to do science. Non-scientists need to be scientifically literate too. Scientific literacy involves more than knowing something of what scientists have already learnt. It also involves an appreciation of the importance of science for daily life, business, politics, our collective future and our view of ourselves. And, just as importantly, it involves an ability to evaluate the science reported to non-scientists and to draw sensible conclusions from it. It is impossible to do any of that without understanding how scientists grope and stagger forward, and how their efforts appear in the media. **The aim of this course is to make the citizens and leaders of the future better consumers of science.**

Course Description

3 credits, non-science majors, assumes no background knowledge, and possibly even a loathing for science.

Location: 111 Forum. **Class Time:** Tuesday and Thursday, 2:30pm-3:45pm

Course Objectives

By analogy with literature, dance, wine, food and music appreciation courses, this is a science appreciation course. With extensive use of case studies, we will help students develop a critical appreciation of the process of scientific discovery and its implications.

1. ***The meaning, use and diversity of the scientific method***
   - Science is both imaginative and highly disciplined
   - Science is a very successful way to gain knowledge
   - Science is a human endeavor and so is often flawed, yet it can in the long run draw powerful context- and culture-independent conclusions
   - Why it works: organized skepticism
   - What conflicting evidence means and how we can sort it out (not all data are equal)
   - Why absolute proof is rare in science
   - What is meant by certainty in science - and how scientists convey it, and why it usually can't be conjured up over night
   - What science can and cannot deliver (knowledge and ethics)
   - Why it is hard to aim science at a target

2. ***The difference between good science, bad science, pseudoscience and everything else; evidence versus conviction; skeptics versus deniers***

3. ***The societal implications of thinking scientifically***
   - The impact of science on humanity's view of humanity
   - The enormous impact science will continue to have
   - The contemporary utility of science for everyday life, for business and for governance
   - Science is a civilizing enterprise that generates wonder and awe

Course Director

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Undergraduate Teaching Assistants

Abigail Kennedy ask5332@psu.edu , Julia Molchany jpm5722@psu.edu and Somil Patel spp5152@psu.edu . They can help with anything. They are not involved with grading.

Guest Instructors

For updated list and full contact details, see the class blog.

Course website

The course site is at Angel (https://cms.psu.edu). This site will contain administrative material, including timetable changes, class handouts (lecture notes will not be provided in full – handouts are to assist in note taking), tests in real time, and grades in semi-real time.

Course blog http://sites.psu.edu/siowfa15/

This can be read by anyone anywhere, but you can only post to it if you are registered on this course. Note that the posts will have to be done with your PSU ID and so will not be anonymous. Instructions on how to post are given at http://sites.psu.edu/siowfa15/tech-faq/.

Instructor blog http://sites.psu.edu/siowreflections/

This site (live linked from the course blog), summarizes the history, rationale, and background for this course. Andrew will blog about how he thinks the course is going, why things are being done the way they are, and student reaction. This is where generic feedback on tests and the blog will appear, together with grade distributions. You are very, very welcome to post comments, anonymously if you want. Nothing on the instructor blog is subject to assessment – say what you want.

Classroom Interaction

Talking is good, and has worked for millennia. So you can put your hand up at any time, and instructors will frequently ask the class questions and expect old fashioned verbal responses. We like to talk.

But we also like Poll Everywhere http://www.polleverywhere.com/ software which enables you and us to do both these things in a slightly more anonymous way by text or web interface. How to do this is on the Tech FAQ page on the course blog http://sites.psu.edu/siowfa15/tech-faq/. In most classes we will also have a Poll Everywhere channel for you to ask open-ended questions (the **'Comment Wall'**). We will attempt to monitor this back channel in real time during class. If you feel too nervous to stick your hand up, use this channel.

Materials you need for this class

There is no text book. Everything will be presented in class, or you will find it on the web. RELIABLE 24/7 internet access is essential. If this is a problem, let Andrew know by the end of the first week.

E-mail

Important notifications will be made in ***class and by email to your PSU accounts***. It is your responsibility to check your email frequently (daily). Under NO circumstances will failure on your part to read an email count as extenuating circumstances.

Assessment

40% Digital Expression: All of the written work and much of the exchange of ideas in this course will take place on the course blog. Students are required to write posts and comment on the posts of others. This participation will be assessed three separate times during the semester according to the rubric below. **Your best score from among the three periods will be taken as the blog grade.** Initial blog posts (see below) do NOT count towards the first blog period.

Blogging frequency is summarized in the rubric on the next page and the table on page 5. You can check how many posts you've made, and when, on the 'Contributions' page on the class blog. The assessment periods are defined by DATE – comments on entries from earlier periods are welcome and will be assessed in the period in which they are made.

4% Initial Blog posts: This task is to ensure you can work the blog. Post an entry which explains (i) why you are doing this course and (ii) why you are not planning to be a Science major, AND post a comment on someone else's post. ***The entry must include a picture and at least one live link, and the comment must include at least one live link.*** You get marks for simply posting an entry (50%) with a photo (20%) and a live link (5%), and for posting a comment (20%) with a live link (5%).

26% Class tests: There will be four of these during the semester, administered via Angel, so they can be taken on any internet-connected computer within the specified 24-hour period that the test is live. These will be multi-choice questions, open-book **[you can consult anything you want except each other]**, and will cover the material covered to that point in the course. You can take each test twice in the 24-hr period; we take your best score. The best two scores from the four class tests go to your class test grade.

0% Pop-quizzes: These will occur within class times throughout the semester, usually without warning. They are intended to provide you and the instructors with immediate feedback on how you are getting on. The score you get on them does NOT count towards the final grade.

10% Attendance: Your presence will be determined from the sheet attached to each pop quiz which you must hand back at the time. There will be twelve or more pop-quizzes at random and unannounced times during semester. To earn the 10% attendance credit, **you must be present at nine or more.** If you are present at eight or fewer, you get zero for attendance.

20% Final Exam: This will be identical in format as the class tests and will be administered via Angel in the same way. It will cover the entire content of the course. The final exam will be available for five days and you can take it twice in that period; again, we take your best score.

10% Extra credit: This can come from three sources, to maximum 10%.

(1) Individual blog posts that are particularly lucid, stimulating, artistic or lateral (max 5% per post).

(2) Suggested exam questions. These should be multiple choice, in the style of the questions in the quizzes and e-mailed to Dr. Read at least one week before the final exam. If they are different from any questions you've already had, and they get used (or something close to them), you get the extra credit, at 2.5% per question. Sending lots of (good) questions increases your chances of hitting on questions I'll use. You'll get up to 10% extra credit and know the answers!

(3) Finding a mistake in a class test or the final exam. If you think you have found a mistake that would cause scores to be changed, e-mail Andrew outlining your reasoning. If you are the first to raise the argument, and he buys it, and it causes him to re-grade the question, he will email the class explaining why and how the marks will be adjusted. Andrew rarely makes mistakes. Max. 5% per error.

Thus:

Best 1 of 3 Blog periods	40%	=max 40%
Best 2 of 4 class tests	13% each	=max 26%
Final 'at home' test	20%	=max 20%
Initial Blog post	4%	=max 4%
Attendance	If present at nine or more pop quizzes	= 10%

Extra credit is added, up to 10%.

Blog Scoring Rubric

Criteria	Unacceptable (0-69 pts) D or fail	Acceptable (70-79 pts) C	Good (80-89 pts) B	Excellent (90-100 pts) A
Frequency	No or infrequent participation	In a scoring period, one entry and three comments	In scoring period, I entry per two weeks 3 comments per two weeks	In scoring period, >I entry per week >3 comments per week
Entries	Entries are inadequate with no evidence of engagement	Entries are adequate, but reflect superficial engagement with the material	Entries are well developed and engaged with the material; lacks conceptual clarity	Entries are conceptually sophisticated, engaged in a substantive way with the material
Comments	No or few comments on blogs of others	Comments are shallow contributions to the discussion; does not enrich discussion	Comments elaborate on existing posts with further comment/observation. Many extend beyond personal reaction	Comments analyze the posts of others, extend the discussion in new directions, relate to previous online or classroom discussion
Content Contribution	Posts irrelevant information, tangential to discussion	Repeats some previous content, does not add substantively to the discussion	Content is factually accurate, but does not include much conceptual nuance or development	Posts draw directly upon the material to make a creative and substantive point that extends beyond the material
Clarity & Mechanics	Unclear, disorganized, unedited, URLs given without hotlinks	Open and respectful tone, some typos, some organization	Organized, well-edited and thoughtfully composed	Organized around a central point/argument, concise, even striking formulations, clear, easy to read style
Reference & Support	No or few references or support for position	Appeals to personal experience, but not to the work/experiences of others	Incorporates the work/experiences of other students, scholars and experts	Uses references to literature, readings, personal experience, experts, etc. in ways that strongly support the main position
Connections	Establishes no or few connections with other blogs, websites, articles, etc.	Infrequently establishes connections to other blogs, websites, articles, etc.	Regularly establishes connections to internet resources and other sources of contemporary culture, news and politics	Consistently draws course material into connection with issues of the day by integrating references to blogs, websites, articles, scholarship, etc.

This rubric is lightly modified from the one constructed by Dr Chris Long, Philosophy Dept, PSU http://tinyurl.com/3nmm4or

For examples of great entries and comments from previous years, see links and thoughts at http://sites.psu.edu/siowreflections/category/how_to_get_an_a_on_the_blog/

How many blogs and comments?

For an A grade on the ***frequency part of the rubric***, you need to post the following *within* a blog period. Note however that grade for a blog period is primarily determined by the quality of posts. Outstanding posts can make up for a deficit of posts; the right number of posts can still get a D (or lower) if the other criteria for an A are not achieved.

	Blog Period 1 *Aug 25-Sept 18*	**Blog Period 2** *Sept 19-Oct 23*	**Blog Period 3** *Oct 24-Dec 4*
Number of posts	5	6	6
Number of comments	13	16	16

Digital Expression

We are deliberately broad minded about what the blog posts might concern (within the broad constraint that they be relevant to the course). There are two types of posts: entries and comments. Posts might cover, for example, reaction to the course material, disagreements with what the instructors have said, questions, background material missed in class, different perspectives, verifying cases, contrary examples, cool things going on elsewhere in science – or in the non-science world – which might be of interest in the context of this course. Confused about something in the course? Post the question to the class. The right post could send the class off in new directions.

In short: Create, Reflect, Connect. And be grateful that for once, your hard work can be read by more than the person who marks it.

Initial Blog Posts

This requirement is simply to ensure that we have a chance to work out any tech problems – at our end or yours – early on. Create an entry on the blog which explains (i) why you are doing this course and (ii) why you are not planning to be a Science major, AND post a comment on someone else's post. You might, for example, agree with their post, express surprise, or give them a better reason. ***The entry must include a picture and at least one live link, and the comment must include at least one live link.*** If you have problems, see *Blog and Tech Help* below.

Important dates

Late Drop Deadline – Friday, November 13
Withdrawal Deadline – Friday, December 11

Deadline for Initial Blog posts– Noon, Wednesday September 2

End 1st Blog Assessment period – Noon, Friday September 18
End 2nd Blog Assessment period – Noon, Friday October 23
End 3rd Blog Assessment period – Noon, Friday December 4

Class Test 1 – Monday, September 14
Class Test 2 – Monday, October 12
Class Test 3 – Monday, November 2
Class Test 4 – Monday, December 7

Final date for e-mailing Andrew potential exam questions [extra credit] – Monday, December 7

Final Exam - available 24 hours/day Friday December 11 through Tuesday December 15.

Deadlines for on-line tests and exams are hard deadlines. When a test goes dead, it's gone.

How to get help

Course administration and assessment: contact Andrew (at end of class or by e-mail SC200@psu.edu).

Course content: There are various options here.

- Put your hand up in class! This approach is an oldie but a goodie
- Ask using the on-line real time Poll Anywhere back channel (Comment Wall) during class time
- Post a question directly to the Course Blog
- Post a comment to the Instructor Blog
- Ask the relevant instructor at the end of class
- Ask any of the TA's at the beginning or end of class
- E-mail the course team SC200@psu.edu. The question and reaction could be posted on the course blog
- E-mail either of the TA's. They may well post the question and reaction on the course blog or Angel

Blog and Tech help: See FAQ page on course blog http://sites.psu.edu/siowfa15/tech-faq/. If that doesn't help, email one of the class TA's, Abigail Kennedy ask5332@psu.edu, Julia Molchany jpm5722@psu.edu and Somil Patel spp5152@psu.edu.

Grading Scale

Final grades will be assigned based on the following percentages

A	95-100%
A-	90-94.9%
B+	87-89.9%
B	83-86.9%
B-	80-82.9%
C+	75-79.9%
C	70-74.9%
D	60-69.9%
Fail	<60

There will be no expected mean, no curving, no bell curve, no nothing. If you all get A's, Andrew will be delighted. If you all get D's, he'd be disappointed but, well, you'll still all get D's.

The class tests and the final exam consist of 28 questions, but we take the mark out of 25. Thus, you can get three questions wrong for free. Your score only starts to dip below 100% when you get the 4th question wrong. There is no extra credit for class tests (maximum 100%). This system allows us to stretch you and force you to think hard, and to better evaluate our teaching, without brutally penalizing you for the odd incorrect answer. Note this system very effectively rewards people who get only a few questions wrong. It has very little impact on scores when a quarter or more of the questions are answered incorrectly.

Attendance, missed classes and missed assessment

The best way to succeed in SC200 – and to make the most of what university offers – is to attend class. If you miss class for any reason it is your responsibility to catch up, and you will need to get notes from another student. To get the 10% for attendance, you must be at nine of the ≥12 pop quizzes which happen at random and unannounced times throughout the semester. **If you are present at only eight or fewer, you will get a zero for attendance – i.e. lose 10% of the final grade. *That's a lot*.** But being at nine is easy if you come to class regularly. If you start missing pop quizzes, you are not coming to class enough.

Instructors and your classmates will appreciate it if you stay away from class when you have an infectious illness like flu. The grading arrangements enable you to do this without impacting on your marks so long as you have been regularly attending when healthy. Likewise, religious holidays, family weddings, sports events, job interviews, sporting events… missing class for those things make no difference ***so long as you are otherwise attending regularly***. Andrew does not need paperwork or notification of absence for anything other than a situation (e.g. chronic illness) which causes you to miss many classes. If you have unexplained absences from pop quizzes early in semester, no allowance will be made for missing classes late in semester, whatever the reason.

There are no make-up class tests for this course. Since we take the highest marks from 2 of the 4 class tests spaced predictably throughout semester, you have to be REALLY unlucky for life's catastrophes to stop you getting two scores. Do not miss class tests lightly – the unexpected always strikes, especially near the end of semester. If a technical problem occurs during a class test, send an email sc200@psu.edu IMMEDIATELY. This is your proof that a problem occurred and will permit us to help you complete it.

If you are unable to take the final exam, please inform me at least ten days in advance, so other arrangements can be made for you. If you are unable to take the exam over the scheduled **five** days for some good reason (extremely foul and extraordinarily persistent weather, emergency, chronic illness), please email SC200@psu.edu so we can work to reschedule. You must do this before the end of the exam period. Note, however, that there is a **five** day window in which to complete the test, and it can be done from anywhere in the world. This means that very few of life's difficulties are likely to get in the way of completing this test. If a technical problem occurs during a final test, send me an email IMMEDIATELY. This is your proof that a problem occurred and will permit me to help you complete it. Do not leave the test to the last minute.

The same thing goes for blogging. If you do nothing in Blog Periods 1 and 2, and one of life's disasters strikes in Blog Period 3, you will have to do your best in Blog Period 3, whatever.

Classroom Etiquette

Laptops are not allowed to be used during class. This is because they are very distracting to the people sitting around or behind. If you think you have a very strong need for laptop access, please see Andrew.

In order to create a harmonious and orderly class environment that is respectful to all and conducive to learning, especially in a large lecture classroom, we all need to act with extra consideration. The following guidelines will help us to maintain a favorable learning environment for all. Please see Andrew privately if you have any personal circumstances (e.g. a previous class far across campus) or concerns that you think might make it difficult for you to agree to any of these.

- You will arrive on time.
- You will stay to the end of class (not leave early). Late arrivals and early departures are extremely distracting for other students.
- You will refrain from talking during class except as part of an activity -- large lecture halls are designed to amplify small sounds, so even whispering can be disruptive. If you must talk, you will leave the class room.
- You will wait to begin packing up your belongings until class is over to avoid the resulting disruptive noise and distracting movement.
- You will keep your phone set to vibrate, silent, or off for the duration of class.
- You will heed the laptop policy as described above.

IN RETURN

- We will start and end class on time. This is respectful of your time.
- We will break up periods of lecture with other activities and/or occasional breaks to make it easier to stay attentive and alert.
- We will incorporate lots of pictures, movies, demos, and other multimedia where appropriate to help you visualize the material, and to make class more interesting and fun.
- We will give you frequent opportunities to discuss concepts with each other. This helps you keep track of, and indeed increases, your own learning.
- We will ask you questions in class that are designed to help improve your understanding of the material.
- We will provide a welcoming environment for you to ask questions both in and outside of class.
- I will display the course announcements on the projector before class each day (though I often won't talk about them; you can read them on your own), which will include reminders about upcoming due dates.
- I or a member of the course team will respond to every email. If you don't get a response from one of us within 48 hours, please see me so we can track down why.

- *The Etiquette section is lightly edited from Julia Kregenow*: http://teachbetter.co/blog/2015/06/09/making-choices-and-explaining-them/

Poll Everywhere http://www.polleverywhere.com/

If you use the internet via a smart phone wirelessly through the university, there is no charge. If you access this by text from your cell phone, there is the standard rate text message, so it may be free, or up to twenty cents on some carriers if you do not have a text messaging plan. See Andrew if you think you have to pay. Poll Everywhere is very

serious about privacy. We cannot see your phone numbers, and you'll never receive follow-up text messages other than perhaps a text that your vote was received or that you did something wrong.

Paid work opportunities for 2016

I will look to recruit teaching assistants from this year's class to help with the blogging next year. I will in the first instance offer this to those with the highest scores this year. This will be an exciting opportunity to get paid while building a vitae line – and most importantly, to continue thinking about science.....

Academic Integrity

All Penn State policies regarding ethics, honorable behavior and academic integrity apply to this course (see links below). Be aware that academic dishonesty is not limited to simply cheating on an exam. To quote directly from the Faculty Senate Policies for students: "Academic integrity is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students." For any material or ideas obtained from other sources, such as the text or things you see on the web, in the library, etc., a source reference must be given. Direct quotes from any source must be identified as such, usually in "quotes". All exam and class test answers must be your own, and you must not provide any assistance to other students during tests. Any instances of academic dishonesty WILL be pursued under the University and Eberly College of Science regulations concerning academic integrity.
http://www.psu.edu/ufs/policies/ http://www.science.psu.edu/academic/Integrity

Nondiscrimination Statement

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, or veteran status. Discrimination against faculty, staff or students will not be tolerated at The Pennsylvania State University. Direct all enquiries regarding the nondiscrimination policy to the Affirmative Action Director, The Pennsylvania State University, 328 Boucke Building, University Park, Pa 16802-2801, Tel (814) 865-4700.

Eberly College of Science Code of Mutual Respect and Cooperation

The Eberly College of Science Code of Mutual Respect and Cooperation embodies the values that we hope our faculty, staff, and students possess and will endorse to make The Eberly College of Science a place where every individual feels respected and valued, as well as challenged and rewarded. It is available at http://www.science.psu.edu/climate/code-of-mutual-respect-and-cooperation-1.

PSU Disabilities Statement

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services website at http://equity.psu.edu/ods/.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation. If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.