Welcome to the sample syllabus for an asynchronous online Science Forward course intended to be taught at CUNY School of Professional Studies. This course was originally taught in 2019. It differs structurally from the honors Science Forward course in that each field of scientific inquiry covers two weeks, instead of one (so fewer are covered), and there are no large-scale student gatherings to open and close the semester. The learning goals are similar to the honors version, but they are expanded here to comply with formatting standards at SPS. In class, the specific skills focused on each week were often adjusted to suit the needs of a different student audience.

SCI 200 Science Forward: A Framework for Scientific Inquiry (CUNY SPS course)

General Education
Flexible Core: Scientific World
No pre- or co-requisites
Instructor: Kelly O'Donnell – kelly.odonnell@mhc.cuny.edu

Course Description
Surveys the life and physical sciences in scale order from astronomy, to climatology, to ecology, to neuroscience, to medicine. Outlines underlying concepts in the philosophy of science, and introduces the common skills that all scientists use. Develops strategies for hypothesis development, experimental design, analysis of data, and formal presentation of results and conclusions.

Flexible Core Scientific World Learning Outcomes
Students will:

1. Gather, interpret, and assess information from a variety of sources and points of view
2. Evaluate evidence and arguments critically or analytically
3. Produce well-reasoned written or oral arguments using evidence to support conclusions
4. Identify and apply the fundamental concepts and methods of a discipline or interdisciplinary field exploring the scientific world, including life and physical sciences, and statistics
5. Demonstrate how tools of science, mathematics, technology, or formal analysis can be used to analyze problems and develop solutions
6. Articulate and evaluate the empirical evidence supporting a scientific or formal theory
7. Articulate and evaluate the impact of technologies and scientific discoveries on the contemporary world, such as issues of personal privacy, security, or ethical responsibilities
8. Understand the scientific principles underlying matters of policy or public concern in which science plays a role

Course Specific Learning Outcomes
Students will:

A. Practice basic numeracy skills necessary for scientific thinking, such as converting units and making order of magnitude estimates, and incorporating statistical skills, such as calculating means;

B. Collect, statistically analyze, and present scientific data from a data collection experience that will become the basis of an original research project;
C. Describe and utilize aspects of good experimental design (replication, reproducibility, proper sample choice, controls, etc.) and scientific inquiry in multiple fields of science;
D. Understand that science makes progress and changes through time based upon newly available evidence;
E. Distinguish science from pseudoscience using critical thinking skills and employing reasonable skepticism;
F. Understand that scientific skills are not only applicable to coursework, but are also applicable to daily life.

Course Mechanics
This course is fully online and runs in a particular sequence. This means that you will need to participate in specific activities each week. You will be working both individually and in groups that are set up by me. You can think of the Discussion Board as our classroom – this is where much of your interaction with your classmates will take place. It is strongly recommended that you set aside a little time each day of the week to work on this course. Don't save all your work for the end of the week when assignments are due.

Our Course Materials are divided into weekly lesson plans that have required videos and readings and assignment details for successful completion of each week. If you have a questions about how the course works, feel free to use our "Q&A" discussion forum.

What You Can Expect From Me
Like you, I will be making time each day to pop into the course site and participate in discussions. If you have specific questions about your work, the best way to get a hold of me is via email. Please put the name of our course (SCI200) in the subject line along with your name. I will respond to emails within 24 hours except on Sundays (so plan your work accordingly). Assignments will be graded by the Wednesday following the due dates.

Required Text
O'Donnell KL, LA Brundage, and J Ugoretz (executive producers). 2018. Science Forward Video Series. 2018. URL: http://cuny.is/scienceforward. These freely available videos serve as the backbone content for the course (they are labeled as "**SF video**" in the reading list below).

We will be using chapters from the following free online textbooks (open educational resources):

- Earle S. *Physical Geology*. 2015. Available at: https://opentextbc.ca/geology/
- Doršner K. *Essentials of Environmental Science*. 16 July 2015. Available at: http://www.ck12.org/user:zg9yc25lckbnbwfpbc5jb20./book/Essentials-of-Environmental-Science/
- OpenStax. *Astronomy*. OpenStax. 13 October 2016. Available at: https://openstax.org/details/books/astronomy
- OpenStax. *Biology*. OpenStax. 21 October 2016. Available at: https://openstax.org/details/books/biology
- OpenStax. *Introductory Statistics*. OpenStax. 19 July 2013. Available at: https://openstax.org/details/books/introductory-statistics

- OpenStax. *Psychology*. OpenStax. 14 February 2014. Available at: https://openstax.org/details/books/psychology
- White and Dennin. 2008. Science Appreciation: Introduction to Science Literacy. Available at: http://www.compadre.org/portal/document/ServeFile.cfm?ID=2171

All other materials will be made available as links on the Blackboard course site (in the "Course Materials" area). These materials may be primary scientific literature available in the CUNY libraries and/or popular press articles and videos. No book needs to be purchased for this course. The citations for these readings are in the course schedule below.

Required Assignments

Weekly Self-Assessments: These are ungraded 5 question quizzes that you are required to complete, but are ungraded. These are for you to make sure you've understood some of the main points of the week. If you haven't, you should go back and make sure that you do. You will be able to take the quiz as many times as you like.

Weekly Assignments: Each week, students will be required to complete an assignment that focuses on one or more of the Science Sense skills. Please complete the self-assessment first before attempting the assignment. Some of the time, these assignments will be connected to your major assignments.

Discussion Board: There will be weekly discussion questions that will address the main topics and skills of the week. You may occasionally need to bring in outside sources (peer-reviewed literature, popular press, etc.) and they will need to be properly cited. Students may also be asked to reflect on the connections between the different fields of scientific inquiry.

Video Project: For this project, you will create a video in the style of one of your Science Forward custom videos. These won't be as long as ours, but your goal would be similar – explain a single scientific concept and the science skills needed to study that concept. You will need to choose a topic not already covered by one of our videos.

Semester-Long Collaborative Project: Early in the semester, students will be tasked with choosing a nearby green space and taking basic ecological measurements (tree diameter for example). All students will add these data to a class-wide database. In groups, students will then use these data to create an original research study including hypothesis development, observation, measurement, data analysis, and data presentation. They will analyze these data and present them in lab report format as their final project.

Final Poster Presentation: A poster presentation from the collaborative lab experience will be the final item you will complete for this course. Students will take the results of the lab report created in the semester-long collaborative project and present it in the format of a scientific research poster. Groups will need to create a concise summary of their findings and visualizations and put them in a poster format appropriate for a professional meeting. We will then have a virtual poster conference where students must create a video of themselves presenting their poster and their classmates will review it.

ASSIGNMENTS	Total Points
Self-Assessments (15 x 5 points each)	75
Weekly Assignments (12 x 20 points each)	240
Discussion Board (15 x 10 points each)	150
Video Project	150
Semester-Long Collaborative Project	200
Poster File Submission	35
Poster Presentation	150
Total	1000

Grading Policy
No late assignments will be accepted. After summing students' point totals, letter grades will be assigned as follows:

A	93-100	A-	90-92		
B+	87-89	B	83-86	B-	80-82
C+	77-79	C	73-76	C-	70-72
D	60-69	F	Below 60		

ACCESSIBILITY AND ACCOMMODATIONS
The CUNY School of Professional Studies is firmly committed to making higher education accessible to students with disabilities by removing architectural barriers and providing programs and support services necessary for them to benefit from the instruction and resources of the University. Early planning is essential for many of the resources and accommodations provided. For more information, please see: Disability Services on the CUNY Website.

ONLINE ETIQUETTE AND ANTI-HARASSMENT POLICY
The University strictly prohibits the use of University online resources or facilities, including Blackboard, for the purpose of harassment of any individual or for the posting of any material that is scandalous, libelous, offensive or otherwise against the University's policies. Please see: "Netiquette in an Online Academic Setting: A Guide for CUNY School of Professional Studies Students".

ACADEMIC INTEGRITY
Academic dishonesty is unacceptable and will not be tolerated. Cheating, forgery, plagiarism and collusion in dishonest acts undermine the educational mission of the City University of New York and the students' personal and intellectual growth. Please see: Academic Integrity on the CUNY SPS Website.

STUDENT SUPPORT SERVICES: If you need any additional help, please visit Student Support Services.

Schedule of Topics and Assignments and Sample Readings
Each week will have a detailed lesson plan with recommended timing of activities during the week. All assignments are due by 5:00 pm ET on the Fridays.

Week	Topic	Video/Reading	Assignment
1	**Philosophy of Science:** What is science and where do we find scientific information	1. **SF video:** What is Science? 2. **Video:** Carl Sagan's final interview 3. **Reading:** Chapter 1: Introduction to Science Literacy *from* White and Dennin. 2008. Science Appreciation: Introduction to Science Literacy. 4. **Reading:** Meyer-Rochow and Gal. 2003. Pressures generated when penguins pooh – calculations on avian defaecation. *Polar Biology.* 27:56-58.	• **Self-Assessment 1** • **Discussion Board 1 -** Introductions and First Science Impressions • **Weekly Assignment 1:** Exploring scientific literature
2	**Philosophy of Science:** The methods of science and how we determine appropriate samples for statistical analysis	1. **SF video:** The Science Senses 2. **Reading:** The University of California Museum of Paleontology, and the Regents of the University of California. 2017. "Nature of Science" chapter in *Understanding Evolution* OER. (There are 7 pages to click through) 3. **Reading:** Chapter 1: Sampling and Data *from* OpenStax. *Introductory Statistics*. OpenStax. 19 July 2013.	• **Self-Assessment 2** • **Discussion Board 2:** Evaluating an online claim – where do you go for science info? • **Weekly Assignment 2:** Video Topic and Outline
3	**Astronomy:** Calculating across large and small number scales	1. **SF video:** Tools of Seeing 2. **Reading:** Chapter 2: Numbers and Physical Reality *from* White and Dennin. 2008. Science Appreciation: Introduction to Science Literacy. READ PAGES 17-32 (the rest will be read in during the Climate Change units) 3. **Reading:** Chapter 1: Science and the Universe: A Brief Tour *from* OpenStax, *Astronomy*. OpenStax. 13 October 2016.	• **Self-Assessment 3** • **Discussion Board 3:** The Scale of Space • **Weekly Assignment 3:** Making estimates about the universe
4	**Astronomy:** Taking measurements and using proxies to find exoplanets	1. **SF video:** Astronomy 2. **Reading:** Billings. 2014. Astronomers Search for Moons Circling Distant Exoplanets. *Scientific American.* 310(1). *3.* **Reading:** Chapter 17: Analyzing Starlight *from* OpenStax, *Astronomy*. OpenStax. 13 October 2016.	• **Self-Assessment 4** • **Discussion Board 4:** Proxies - What does it mean to be earth-like? • **Weekly Assignment 4:** Video script

Week	Topic	Video/Reading	Assignment
5	**Climate Change:** How do we clearly communicate about the climate	1. **SF video:** Climate Change 2. **Reading:** Riebeek. 2011. The Carbon Cycle. *NASA Earth Observatory.* https://earthobservatory.nasa.gov/Features/CarbonCycle/ 3. **Reading:** Chapter 19: Climate Change *from* Earle. 2015. Physical Geology.`	• **Self-Assessment 5** • **Discussion Board 5:** Calculating your carbon footprint • **Weekly Assignment 5:** Communicating about climate change
6	**Climate Change:** How do we mathematically model our climate	1. **SF video**: Scientific Uncertainty 2. **Reading:** Hansen et al. 2012. Perception of climate change. *PNAS.* E2415-E2423. 3. **Reading:** GFDL 2018 Climate Modeling. Available here: https://www.gfdl.noaa.gov/climate-modeling/	• **Self-Assessment 6** • **Discussion Board 6:** Models and uncertainty • **Video Project Due**
7	**Water:** Measuring and estimating water use on a large and small scale	1. **SF video:** Water 2. **Video:** Science 360: Sustainability: Water – The Ogallala Aquifer 3. **Reading:** Chapter 13: Water Availability and Use *from* Doršner. 2015. Essentials of Environmental Science.	• **Self-Assessment 7** • **Discussion Board 7:** Calculating your water footprint • **Weekly Assignment 6:** Collaborative Project Task 1: Data Collection
8	**Water:** Using descriptive statistics to investigate urban water	1. **Video:** Science360: Sustainability: Water – Los Angeles and Water Imports 2. **Reading:** Chapter 2: Descriptive Statistics *from* OpenStax. *Introductory Statistics*. OpenStax. 19 July 2013. 3. **Reading:** NYC DEP. 2016. New York City 2016 Drinking Water Supply and Quality Report.	• **Self-Assessment 8** • **Discussion Board 8:** DEC water quality data analysis • **Weekly Assignment 7:** Collaborative Project Task 2: Annotated Bibliography
9	**Urban Ecology:** Designing and reproducing ecology experiments in the city	1. **SF video:** Urban Ecology 2. **Reading:** Chapter 44: Ecology and the Biosphere *from* OpenStax, *Biology*. OpenStax. 21 October 2016. Read only the Introduction and Sections 44.1, 44.2, and 44.5. 3. **Reading:** Helden and Leather. 2004. Biodiversity on urban roundabouts—Hemiptera, management and the species–area relationship. *Basic and Applied Ecology.* 5:367-377. [PDF] **4. Video:** SciShow: The Times and Troubles of the Scientific Method	• **Self-Assessment 9** • **Discussion Board 9:** Making ecological observations in the city • **Weekly Assignment 8:** Designing experiments in the city

Week	Topic	Video/Reading	Assignment
10	**Urban Ecology:** Calculating an estimate for ecosystem services	1. **Video:** TED talk: Sukhdev - What is the price of nature? 2. **Reading:** Costanza et al. 1997. The value of the world's ecosystem services and natural capital. *Nature.* 387:253-260. 3. **Reading:** Cardinale et al. 2012. Biodiversity loss and its impact on humanity. *Nature.* 486:59-67.	• **Self-Assessment 10** • **Discussion Board 10:** Estimating the value of an ecosystem service • **Weekly Assignment 9:** Collaborative Project Task 3: Methods/Results/Conclusions
11	**Neuroscience & Intelligence:** How do we determine what are good models for humans	1. **SF video:** Animal Communication 2. **Video:** Science360: Mind Mappers A transcript is available here: https://www.nsf.gov/news/special_reports/science_nation/mindmappers.jsp 3. **Reading:** Chapter 35: The Nervous System *from* OpenStax, *Biology*. OpenStax. 21 October 2016.	• **Self-Assessment 11** • **Discussion Board 11:** Debunking myths • **Weekly Assignment 10:** Proxies for humans
12	**Neuroscience & Intelligence:** Can we recreate human intelligence in machines	1. **SF video:** Artificial Intelligence 2. **Reading:** Chapter 7: Thinking and Intelligence *from* OpenStax, *Psychology*. OpenStax. 14 February 2014. 3. **Reading:** Levesque HJ. 2013. On our best behavior. From the IJCAI-13 Conference.	• **Self-Assessment 12** • **Discussion Board 12:** Chatting with the bots • **Final Lab Report Due**
13	**Medicine:** How are physical and computer models useful for finding new drugs	1. **SF video:** Drug Discovery and Development 2. **Reading:** Chapter 3: Biological Macromolecules *from* OpenStax. Biology. 21 October 2016. 3. **Video:** TED talk: Collins – We need better drugs now	• **Self-Assessment 13** • **Discussion Board 13:** Drug Discovery and Design • **Weekly Assignment 11:** Pattern recognition and the protein folding game, fold.it
14	**Medicine**: How do we properly design experiments so that they are controlled and reproducible	1. **SF video:** Cancer 2. **SF video:** Science and Ethics 3. **Reading:** Read the following sections *from* OpenStax. Biology. 21 October 2016. 15.1 The Genetic Code, 16.1 Regulation of Gene Expression, and 16.7 Cancer and Gene Regulation 4. **Reading:** FDA Drug Review Process website. Be sure to look at both the text on these two pages and the infographic. Go to Page 1 AND Page 2 5. **Video:** SciShow Placebos & Nocebos: How Your Brain Heals and Hurts You	• **Self-Assessment 14** • **Discussion Board 14:** Fake Medicine • **Weekly Assignment 12:** Controls in Clinical Trials

Week	Topic	Video/Reading	Assignment
15	**Science and Society:** How do we make scientifically-informed policy	1. **Reading:** "Science and Society" and "What has science done for you lately?" in the UC Berkeley's Understanding Science OER available here: https://undsci.berkeley.edu/article/0_0_0/scienceandsociety_01 (it's 5 pages to click through for the first part and then 7 pages to click through for the second).	• **Self-Assessment 15** • **Discussion Board 15:** The importance of scientific thinking • **Poster task 1:** Poster File
Finals week	**Presentations**	*None.*	• **Poster task 2:** Poster Presentation