

## The Scientific Process in a Changing World

Instructors: Professor Jeffrey Moore, Prof. Michelle Kovarik, Prof. Jordan Axelson

Course Lecture Times & Locations:

Section	Time	Day	Location
Lecture	9:00-10:20 AM	TR	n.a.

**Prerequisite:** Sophomore standing

This course is intended for students who have begun to develop their expertise in their chosen field. Ideally each student will bring their own academic interests and knowledge to bear on our case studies this semester.

**Required Materials:**

None. All readings will be provided through the course website.

**Course Overview**

Our rapidly changing world faces significant, multi-faceted problems at the nexus of technology and society. The response to these socioscientific issues will impact the future of the human condition. The scientific process has a role to play in finding timely, effective, and evidence-based solutions. This course showcases science as a dynamic and iterative **process** that includes collecting and connecting observations, making hypotheses based on the current understanding, and constructing models that are revised as new knowledge is acquired. It emphasizes the role of dialogue and communication in shaping responses to socioscientific issues.

There are two phases to the course. An initial case study will exemplify how the scientific process played out in a historical context. In the second phase, students will produce a final report about a contemporary socioscientific issue, present their results to the class, and generate a "publishable" product.

## **Course Objectives**

After completing the course, students will be able to:

F1. Demonstrate that science is a dynamic and iterative process that includes collecting observational data, making hypotheses based on the most current working model or framework, revising and updating understanding and conclusions based on validating or refuting hypotheses. Give examples in which setbacks or "failures" are shown to advance understanding and have value in the process of refinement to advance knowledge.

F2. Identify patterns, analyze data to find trends, and apply models.

F3. Compare and contrast primary literature to secondary sources, such as newspapers, news, commercials and advertisements, social media, radio, podcasts.

M1. Identify and reflect on the limitations and ambiguity of the current model, and how new information or new data may require a refinement or update of the model.

M2. Apply lessons learned from historical case studies to contemporary problems.

M3. Communicate with different audiences (ex. scientific or expert vs. layperson) while balancing accuracy with clarity.

M4. Identify gaps in knowledge or understanding and propose questions or make plans to address them.

M5. Work in teams consisting of individuals of different expertise.

H1. Identify competing factors that shape the outcome, progress, guidance, and intervention of science. Identify the influence and interplay between science, policy, economics, special interest groups, and society.

H2. Identify the stakeholders surrounding a problem and empathize with their experiences and weigh the impact of various outcomes on different stakeholders.

## Tentative Schedule

Week #	Tuesday	Thursday
1	Introduction to the History of Leaded Gasoline: When, Why, and How	The Conflict Begins: When new data challenges the status quo <i>Journal Entry 1</i>
2	Literature Search Basics Day 1: Group breakouts to identify primary sources from different search engines to identify literature relevant to case study <i>Journal Entry 2</i>	Literature Search Basics Day 2: Group breakouts to identify popular media sources from different search engines to identify literature relevant to case study <i>Journal Entry 3</i>
3	Plotting Data & Creating Figures for a Specific Audience: Best practices for communicating data, using software, and generating infographics.	Create a Timeline: Compile the progression of research and knowledge (expert vs. general public) showing evolution of problem over time <i>Journal Entry 4</i>
4	Biological & Environmental Effects of Lead	First person accounts of lead health effects, videos or readings of different stakeholders making arguments for/against lead in gasoline <i>Journal Entry 5</i>
5	Responsible Research and Innovation: Balancing Competing Factors & Influences	Sources of Error and Uncertainty in Experiments and Data <i>Journal Entry 6</i>
6	Risk Assessments: How decision making is hampered by uncertainty	The Clean Air Act & Science Policy (Guest speaker?) <i>Journal Entry 7</i>
7	Planning PSA Material: Group breakouts to plan a PSA product (ex. Poster, commercial)	Lessons Learned: Where are we today and how has technology, environment, health changed? <i>Journal Entry 8</i>
8	Effects of Lead Today: Flint Michigan <i>Journal Entry 9</i>	Group presentations of PSA products
9	Students propose ideas for final projects and rank preferences <i>Project Proposal</i>	Team Assignments Made. Groups will plan weekly meetings and develop a Team Code of Conduct
10	Teamwork Day	Teamwork Day
11	Instructor check-in. <i>Outline and List of 10 Sources.</i>	Instructor check-in
12	Teamwork Day	Teamwork Day
13	Peer Reviews. <i>First Draft of Final Report.</i>	Peer Reviews
14	Team Presentations	Team Presentations
15	Reports due	Final Products due
16	Finals	Finals

## **Attendance and Participation**

Attendance and participation are critical, and excessive absences will affect your final grade. After your second unexcused absence, your final grade will be reduced by half a letter grade for each class period that you miss (for example, a “B” will become a “B-” after your third unexcused absence and a C+ after your fourth). An excused absence will be granted only for legitimate approved reason and must be documented accordingly with an email request.

Sometimes unexpected (and often unwelcome) events intrude on our plans – mental and physical illness, family needs, etc. may affect your class performance this semester. To the extent that you are comfortable sharing this information with me, I would like to know as soon as possible so that we can make a plan to minimize disruption of your academic work. If you miss a major deadline due to illness, injury, or a family emergency, you should provide some confirmation of the event directly to me or to the Dean of Students office. If you will miss class for a scheduled, College-sanctioned event (e.g., religious observance, athletics), you should discuss your absence with me in advance (at least 3 days prior).

Active participation in class discussion will allow you to refine your ideas about course topics and practice articulating and supporting ideas for your assignments. As a result, participation is integral to your success and will be assessed accordingly. You will receive feedback on your participation at midterm from the mentor and from me. If you feel uncomfortable speaking up in class or have other concerns about participation, please arrange to meet with me as soon as possible to discuss ways to be an active member of the class.

## **Team Project**

During the second half of the class, students will identify a contemporary socioscientific issue in order to study how science and society actively influence each other. Students will form teams to study the area of interest and create their own case study.

Example topics include but are not limited to: Single-use plastics, high fructose corn syrup, climate, glyphosate and GMOs, climate change, ethics of personalized medicine, artificial intelligence, disparity in healthcare access, and traveling to Mars.

*Team Report:* Students will generate a report that analyzes the core issue by collecting current primary and secondary sources to provide different perspectives and data on the issue, by identifying who is being affected and who could benefit from a solution, by examining who or what is influencing the current progress toward understanding, and by clarifying the current gaps or limitations in knowledge and proposing questions or plans to address them.

*Team Presentation:* The teams will present their case studies to the rest of the class and invited guests during the last week of the semester.

*Team Final Product:* Final products will allow the teams to share their new knowledge with a wider audience. These final products can take many forms, though some possible forms could include a letter to an elected official, a letter to a special interest group or organization, an informational brochure or poster, a video, a children’s book, or outreach or volunteering event.

## **Grading**

This is a tentative grading rubric and is subject to change. The total score for each type of assignment represents totals after appropriate lowest scores have been dropped.

Grading rubrics will be made available to students for the PSA Group Product, Team Final Report, Team Presentation, and Team Final Product.

Class Attendance & Participation	18 × 5 pts =	90
Journal Entries	9 × 10 pts =	90
PSA Group Product		20
Team Project Proposal		10
Team Project Outline/Sources		10
Team Project First Draft		20
Team Final Report		70
Team Presentation		20
Team Final Product		20
Team Peer Evaluation		10
Total points		360

## **Course Readings**

TBD

## **Academic Integrity**

*References.* Any ideas in written assignments that (i) did not spring from your own mind and (ii) are not common knowledge to high school students should be cited at the end of each assignment. Rewrite all ideas in your own words and cite them. If you have a question about whether or not your rewording is acceptable, ask me! Use the ACS Style Guide to format your references. Plagiarism and academic dishonesty – copying from another student, copying from another source including the internet, failing to cite a reference, etc – will be subject to the strictest penalties.

*Collaboration.* I encourage you to discuss your work with classmates and to help one another to edit and revise assignments. That said, I expect each of you to do your own work. If you have any questions about whether or not your collaboration with a classmate complies with my expectations, please talk to me about it before turning in an assignment. For group assignments, it is critical that each team member contributes substantively. If your group is not functioning effectively, please bring this to my attention.