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## Term Information

Effective Term Spring 2025

## General Information

Course Bulletin Listing/Subject Area Chemistry  
Fiscal Unit/Academic Org Chemistry - D0628  
College/Academic Group Arts and Sciences  
Level/Career Graduate  
Course Number/Catalog 7630  
Course Title Problem-Posing Model of Chemistry Education  
Transcript Abbreviation Prob. Chem.  
Course Description The goal of this course is to understand the theoretical underpinnings and practical applications of the problem-posing model of education. Students will make interconnections with current socio-scientific issues pertaining to the nature of science and chemistry education research and will discuss, reflect, expand upon, and make sense of the processes by which chemistry is taught and learned.  
Semester Credit Hours/Units Fixed: 1.5

## Offering Information

Length Of Course 7 Week  
Flexibly Scheduled Course Never  
Does any section of this course have a distance education component? No  
Grading Basis Letter Grade  
Repeatable No  
Course Components Lecture  
Grade Roster Component Lecture  
Credit Available by Exam No  
Admission Condition Course No  
Off Campus Never  
Campus of Offering Columbus

## Prerequisites and Exclusions

Prerequisites/Corequisites  
Exclusions  
Electronically Enforced No

## Cross-Listings

Cross-Listings

## Subject/CIP Code

Subject/CIP Code 40.0501  
Subsidy Level Doctoral Course  
Intended Rank Masters, Doctoral

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## Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors

## Course Details

### **Course goals or learning objectives/outcomes**

- The goal of this course is to provide opportunities for students to understand the theoretical underpinnings and practical applications of Paulo Freire's problem-posing model of education.
- The following course goals or learning objectives (knowledge, skills, and attitudes/perspectives) are intended for students to obtain when completing the course.
- (1) comprehensive understanding of equity- and justice-based research in chemistry and science education research;
- (2) an organized annotated bibliography of seminal and recent chemistry education, learning science, and science education literature;
- (3) a portfolio of journal reflections, learning activities, and teaching strategies that draw upon and synthesize various theories;
- (4) creative synthesis of theory, philosophy, and current socio-scientific issues using chemistry content and lived experiences;
- (5) critical dissection of the affordances and limitations with various problem-posing approaches.

### **Content Topic List**

- (1) justice and equity-based research
- (2) culturally relevant, responsive, and sustaining pedagogy
- (3) socio-scientific issues
- (4) anti-racism
- (5) Indigenous ways of knowing
- (6) place-based education
- (7) democratic science
- (8) post-structuralist paradigms
- (9) post-humanist paradigms
- (10) systems thinking
- (11) chemistry and science chemistry topics

### **Sought Concurrence**

No

## Attachments

- Syllabus CHEM 7699 Problem-Posing Model of Chemistry Education\_v4.docx  
*(Syllabus. Owner: Hambach, Jennifer Lynn)*
- Draft of CHEM 7699 Problem-Posing Model of Chemistry Education\_v6\_trackedchanges.docx: Updated syllabus with tracked changes  
*(Other Supporting Documentation. Owner: Hambach, Jennifer Lynn)*
- Draft of CHEM 7699 Problem-Posing Model of Chemistry Education\_v6\_clean.docx: Updated syllabus "clean" version  
*(Syllabus. Owner: Hambach, Jennifer Lynn)*

**Comments**

- Please note that the requested course number has been changed from 7699 to 7630 to better align with the numbering system used in our program to identify core courses.

An updated syllabus has been attached (two versions - one with tracked changes and also a clean copy).

Prerequisites have been removed. *(by Hambach, Jennifer Lynn on 05/23/2024 10:50 AM)*

- Please see NMS Subcommittee feedback email sent 5/14/24. *(by Neff, Jennifer on 05/14/2024 04:30 PM)*

**Workflow Information**

Status	User(s)	Date/Time	Step
Submitted	Hambach, Jennifer Lynn	03/26/2024 09:43 AM	Submitted for Approval
Approved	Schultz, Zachary DALE	04/01/2024 10:15 AM	Unit Approval
Approved	Vankeerbergen, Bernadette Chantal	04/25/2024 03:54 PM	College Approval
Revision Requested	Neff, Jennifer	05/14/2024 04:30 PM	ASCCAO Approval
Submitted	Hambach, Jennifer Lynn	05/23/2024 10:50 AM	Submitted for Approval
Approved	Schultz, Zachary DALE	05/23/2024 10:55 AM	Unit Approval
Approved	Vankeerbergen, Bernadette Chantal	05/23/2024 11:14 AM	College Approval
Pending Approval	Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Hilty, Michael Neff, Jennifer Vankeerbergen, Bernadette Chantal Steele, Rachel Lea	05/23/2024 11:14 AM	ASCCAO Approval

## Chemistry 7699: Problem-Posing Model of Chemistry Education

12:45 PM – 3:25 PM: **2 hours and 40 minutes**

**Instructor:** Dr. Matt Wu  
Newman and Wolfrom Laboratory of Chemistry 1102A  
[wu.6250@osu.edu](mailto:wu.6250@osu.edu)

**Class:** T 12:45 PM – 3:25 PM; **University Hall 066**

**Office Hours:** By appointment

**Course Objectives:** The goal of this course is to understand, the theoretical underpinnings and practical applications of the problem-posing model of education. In this course, students will make interconnections with current socio-scientific issues pertaining to the nature of science and chemistry education research. Students will discuss, reflect, expand upon, and make sense of the processes by which chemistry is taught and learned. The learning objectives are:

- (1) Dissect the affordances and limitations with various problem-posing approaches.
- (2) Apply equity- and justice-based initiatives in chemistry and science education research.
- (3) Synthesize theory, philosophy, and research designs using chemistry content and lived experiences through analysis and research design.
- (4) Generate a portfolio of journal reflections, learning activities, and/or teaching strategies that draw upon and synthesize various theories.
- (5) Develop a curated annotated bibliography of seminal and recent chemistry education, learning science, and science education literature.

### Textbooks and Other Resources:

*Pedagogy of the Oppressed* by Paulo Freire, translated by Myra Bergman Ramos.

*Fatal Invention: How Science, Politics, and Big Business Re-Create Race in the Twenty-First Century* by Dorothy E. Roberts

Salient journals: *Journal of Chemical Education*, *Chemistry Education Research and Practice*, *Journal of Research in Science Teaching*, *Science Education*, *Qualitative Inquiry*, *Journal of the Learning Sciences*, etc.

Download either [Zotero](#) or [Mendeley](#) as your reference manager.

**Please bring your computer, a mouse, and charger for every class session!**

**Format:** Instructor/student-led discussions, readings, classroom activities, and multiple modalities by which students can participate (thinking aloud, recording/sharing reflections, enacting gestures, etc.)

**Attendance:** This is a highly interactive course that functions as a “laboratory” to unpack and apply theories into chemistry education research and practice. Therefore, punctual attendance is mandatory, especially considering the course’s frequency and duration. If there is a reason for

repeated attendance problems, please speak with me privately. If there are extenuating circumstances that affect your ability to participate fully, please arrange to also speak with me privately. Given the student-centered nature of this course, I will not be streaming and/or recording the class discussions. Most of what you learn will depend on interactions with your peers and the instructor. Only one absence will be allowed for the semester. All excused absences related to illnesses will require appropriate documentation. Two unexcused absences will result in a reduction of one letter grade in the final course grade (i.e., A to A-, B+ to B); additional absences will result in further reduction of one letter grade per additional absence.

**Participation:** Because of the student-centered nature of this course, participation is essential for your learning, your peers' learning, and my learning as well. **Specifically, each class session will leverage readings from the previous week.** However, I recognize that there are many ways in which one *can* participate. Contributing to discussions, posing questions, synthesizing literature, externalizing mental models, reflecting and drawing upon your lived experiences are all appropriate ways to participate.

**Philosophy:** Much of what we *do* in the class will reflect *what* and *how* we learn, as the design of the course will exemplify key tenets of the problem-posing model. In addition, chemistry ideas will incorporate socio-scientific issues, inspired by readings chosen at the instructor's discretion. You will be encouraged to think about how the course content relates to your own processes of conceptualizing equity- and justice-based chemistry education research. Because this is a graduate level course, students will engage in reading and analyzing a wealth of peer-reviewed articles. To maximize the meaningfulness of this course, **it is imperative** that all students come prepared, be open-minded, and communicate with their peers and the instructor.

**Grades:** Your final grade in this course will be determined by the total number of points earned. There will be no curve applied to this course.

Participation	120 points (7-1 sessions x 20 points)
Journals	480 points (7-1 entries x 80 points)
Student-led discussion	200 points
Final Exam	200 points
<b>Total</b>	<b>1000 points</b>

93% - 100%	A	77% - 80%	C+
90% - 93%	A-	73% - 77%	C
87% - 90%	B+	70% - 73%	C-
83% - 87%	B	67% - 70%	D+
80% - 83%	B-	60% - 76%	D
		0%	E

**Assessment:**

All journal assignments will be due before the corresponding class session begins (noted in course schedule). The key idea of the journal assignments is to synthesize how the readings may relate to your personal experiences, the insights you have gained from the readings, and/or how you can reconfigure the readings for chemistry education research-specific contexts. A rubric will be provided to identify what is required in the journal assignments.

Late assignments (e.g., journal submitted during or after that corresponding class session) will be considered late and graded up to 75% credit for between a day and a week late, and half-credit if the lateness exceeds a week.

The student-led discussion can be flexibly designed, leveraging a mix of activities, discussion, and slides. Key themes during the student-led lectures must address the **interconnections** (or lack thereof) across that week's assigned readings and **extrapolated insights** to inform chemistry education research and practice in a **novel and relevant manner**. Students will prepare for an hour-long session in which they lead the facilitation of that week's lesson. A rubric will be provided to inform how the student-led lecture will be designed and facilitated. Each student-led lecture will also be supplemented with instructor slides, questions, and activities, **at the instructor's discretion**.

The final exam will be during class time and at the same room location. Evaluation will cover all discussed topics and student ideas. The final exam will be a free-response essay (maximum 1000 words). The prompt will be disclosed on the day of the final. This summative assessment will not only invite you to synthesize ideas discussed throughout the course but also construct a compelling argument within the moment, which the course recognizes as an imperative skill for future professional contexts.

**Academic  
Misconduct:**

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

**Disability  
Services**

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or

experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are isolating while waiting for a COVID-19 test result, please let me know immediately. Those testing positive for COVID-19 should refer to the [Safe and Healthy Buckeyes site](#) for resources. Beyond five days of the required COVID-19 isolation period, I may rely on Student Life Disability Services to establish further reasonable accommodations. You can connect with them at [slds@osu.edu](mailto:slds@osu.edu); 614-292-3307; or [slds.osu.edu](http://slds.osu.edu).

**Religious  
Accommodations**

It is Ohio State's policy to reasonably accommodate the sincerely held religious beliefs and practices of all students. The policy permits a student to be absent for up to three days each academic semester for reasons of faith or religious or spiritual belief.

Students planning to use religious beliefs or practices accommodations for course requirements must inform the instructor in writing no later than 14 days after the course begins. The instructor is then responsible for scheduling an alternative time and date for the course requirement, which may be before or after the original time and date of the course requirement. These alternative accommodations will remain confidential. It is the student's responsibility to ensure that all course assignments are completed.

**Mental Health  
Statement:**

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers

services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](http://ccs.osu.edu) or calling [614-292-5766](tel:614-292-5766). CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at [614-292-5766](tel:614-292-5766) and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

**Sexual  
Misconduct and  
Relationship  
Violence**

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> or by contacting the Ohio State Title IX Coordinator at [titleix@osu.edu](mailto:titleix@osu.edu). Please do not hesitate and report as soon as you can.

**Diversity**

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.



### Course Schedule

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
<b>Week 1</b>		<b>Class #1</b>					
<b>Week 2</b>		<b>Class #2</b> <b>Journal #1 Due</b>					
<b>Week 3</b>		<b>Class #3</b> <b>Student-Led</b> <b>Lecture #1</b>  <b>Journal #2 Due</b>					
<b>Week 4</b>		<b>Class #4</b> <b>Student-Led</b> <b>Lecture #2</b>  <b>Journal #3 Due</b>					
<b>Week 5</b>		<b>Class #5</b> <b>Student-Led</b> <b>Lecture #3</b>  <b>Journal #4 Due</b>					
<b>Week 6</b>		<b>Class #6</b> <b>Student-Led</b> <b>Lecture #4</b>  <b>Journal #5 Due</b>					
<b>Week 7</b>		<b>Class #7</b> <b>Student-Led</b> <b>Lecture #5</b>  <b>Journal #6 Due</b>					
<b>Week 8</b>		<b>Final Exam!</b>					

**This schedule is tentative and may be subject to change**

## Class Sessions: A Detailed Description

Course activities are tentative and may be subject to change\*

Class #1	<p style="text-align: center;"><b>Introduction – Reorientation to Critical Theory</b></p> <ul style="list-style-type: none"><li>• Pre-class assignment: Chapter 1 – <i>Pedagogy of the Oppressed</i></li><li>• Lecture – What makes something Critical?</li><li>• Small group activities</li><li>• Connections with chemistry education research papers in real time</li><li>• Discussion and consensus model building</li></ul> <p><b>Homework</b></p> <ul style="list-style-type: none"><li>• Journal #1: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</li><li>• Readings<ul style="list-style-type: none"><li>○ Chapter 2 – <i>Pedagogy of the Oppressed</i></li><li>○ Chapters 1 and 2 – <i>Fatal Inventions</i></li></ul></li></ul>
Class #2	<p style="text-align: center;"><b>Banking vs. Problem-Posing Models of Education</b></p> <ul style="list-style-type: none"><li>• Co-construct consensus model of banking vs problem-posing models with grounded examples</li><li>• Small group activities</li><li>• Connections with chemistry education research papers in real time</li><li>• Argumentation and critique to refine understandings</li></ul> <p><b>Homework</b></p> <ul style="list-style-type: none"><li>• Journal #2: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</li><li>• Readings<ul style="list-style-type: none"><li>○ Nasir &amp; Hand (2008)</li><li>○ Chapter 3 and 4 – <i>Fatal Inventions</i></li></ul></li></ul>
Class #3	<p style="text-align: center;"><b>The Role of Chemistry Education for Pre-Med Students</b></p> <ul style="list-style-type: none"><li>• Barr, Matsui, Wanat, &amp; Gonzalez (2010)</li><li>• Dixson, Pomales, Hashemzadeh, &amp; Hashemzadeh (2022)</li></ul> <p><b>Homework</b></p> <p>Journal #3: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim</p>

	<p>for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 3 – <i>Pedagogy of the Oppressed</i></li> <li>○ Chapter 3 – Kendi (2019)</li> <li>○ Carlone (2017)</li> </ul> </li> </ul>
Class #4	<p style="text-align: center;"><b>Power</b></p> <ul style="list-style-type: none"> <li>• <i>Retraction Watch</i></li> </ul> <p><b>Homework</b> Journal #4: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Morales-Doyle (2023)</li> <li>○ Olave &amp; Aceves (2023)</li> <li>○ Sadler (2011)</li> </ul> </li> </ul>
Class #5	<p style="text-align: center;"><b>Reflection</b></p> <ul style="list-style-type: none"> <li>• Mid-course feedback</li> </ul> <p><b>Homework</b> Journal #5: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapters 7 and 8 – <i>Fatal Inventions</i></li> <li>○ Morton &amp; Parsons (2018)</li> </ul> </li> </ul>
Class #6	<p style="text-align: center;"><b>Identity</b></p> <ul style="list-style-type: none"> <li>• Carlone &amp; Johnson (2006)</li> </ul> <p><b>Homework</b> Journal #6: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 4 – <i>Pedagogy of the Oppressed</i></li> <li>○ (pp. 185 – 195) – Alexander (2010)</li> <li>○ Spencer, Maxwell, Erickson, Wall, Nicholas-Figueroa, Pratt, &amp; Shultz (2022)</li> <li>○ [Optional] Barry, Bang, Bruce, &amp; Barajas-López (2023)</li> </ul> </li> </ul>

<b>Becoming-Freire</b>	
Class #7	<p><b>Homework</b></p> <p>Journal #7: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 11 – <i>Fatal Inventions</i></li> <li>○ Vakil, Reith, &amp; Melo (2022)</li> <li>○ Chapter 18 – Kendi (2019)</li> </ul> </li> </ul>
Class #8 FINALS	<p>Same time and same location! The final exam will be a free-response essay. The prompt will be shown to you on the day of the final. The essay will be open-book, with a maximum of 1000 words.</p>

## Chemistry 763099: Problem-Posing Model of Chemistry Education

12:45 PM – 3:25 PM: 2 hours and 40 minutes

**Instructor:** Dr. Matt Wu  
Newman and Wolfrom Laboratory of Chemistry 1102A  
[wu.6250@osu.edu](mailto:wu.6250@osu.edu)

**Class:** T 12:45 PM – 3:25 PM; **University Hall 066**

**Office Hours:** By appointment

**Course Objectives:** The goal of this course is to understand, the theoretical underpinnings and practical applications of the problem-posing model of education. In this course, students will make interconnections with current socio-scientific issues pertaining to the nature of science and chemistry education research. Students will discuss, reflect, expand upon, and make sense of the processes by which chemistry is taught and learned. The learning objectives are:

- (1) Dissect the affordances and limitations with various problem-posing approaches.
- (2) Apply equity- and justice-based initiatives in chemistry and science education research.
- (3) Synthesize theory, philosophy, and research designs using chemistry content and lived experiences through analysis and research design.
- (4) Generate a portfolio of journal reflections, learning activities, and/or teaching strategies that draw upon and synthesize various theories.
- (5) Develop a curated annotated bibliography of seminal and recent chemistry education, learning science, and science education literature.

### Prerequisite Course

None

### **Textbooks and Other Resources:**

*Pedagogy of the Oppressed* by Paulo Freire, translated by Myra Bergman Ramos.

*Fatal Invention: How Science, Politics, and Big Business Re-Crete Race in the Twenty-First Century* by Dorothy E. Roberts

Salient journals: *Journal of Chemical Education*, *Chemistry Education Research and Practice*, *Journal of Research in Science Teaching*, *Science Education*, *Qualitative Inquiry*, *Journal of the Learning Sciences*, etc.

All reading assignments will be provided on the course Carmen Canvas Page.

Download either [Zotero](#) or [Mendeley](#) as your reference manager.

**Please bring your computer, a mouse, and charger for every class session!**

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**Format:** Instructor/student-led discussions, readings, classroom activities, and multiple modalities by which students can participate (thinking aloud, recording/sharing reflections, enacting gestures, etc.)

**Attendance:** This is a highly interactive course that functions as a “laboratory” to unpack and apply theories into chemistry education research and practice. Therefore, punctual attendance is mandatory, especially considering the course’s frequency and duration. If there is a reason for repeated attendance problems, please speak with me privately. If there are extenuating circumstances that affect your ability to participate fully, please arrange to also speak with me privately. Given the student-centered nature of this course, I will not be streaming and/or recording the class discussions. Most of what you learn will depend on interactions with your peers and the instructor. Only one absence will be allowed for the semester. All excused absences related to illnesses will require appropriate documentation. Two unexcused absences will result in a reduction of one letter grade in the final course grade (i.e., A to A-, B+ to B); additional absences will result in further reduction of one letter grade per additional absence.

**Participation:** Because of the student-centered nature of this course, participation is essential for your learning, your peers’ learning, and my learning as well. **Specifically, each class session will leverage readings from the previous week.** However, I recognize that there are many ways in which one *can* participate. Contributing to discussions, posing questions, synthesizing literature, externalizing mental models, reflecting and drawing upon your lived experiences are all appropriate ways to participate.

**Philosophy:** Much of what we *do* in the class will reflect *what* and *how* we learn, as the design of the course will exemplify key tenets of the problem-posing model. In addition, chemistry ideas will incorporate socio-scientific issues, inspired by readings chosen at the instructor’s discretion. You will be encouraged to think about how the course content relates to your own processes of conceptualizing equity- and justice-based chemistry education research. Because this is a graduate level course, students will engage in reading and analyzing a wealth of peer-reviewed articles. To maximize the meaningfulness of this course, **it is imperative** that all students come prepared, be open-minded, and communicate with their peers and the instructor.

**Grades:** Your final grade in this course will be determined by the total number of points earned. There will be no curve applied to this course.

Participation	120 points (7-1 sessions x 20 points)
Journals	480 points (7-1 entries x 80 points)
Student-led discussion	200 points

Final Exam	200 points
<b>Total</b>	<b>1000 points</b>

\*See grade ranges on the next page

94 <del>3</del> % - 100%	A	77% - <del>80</del> 79%	C+
90% - 93%	A-	73% - <del>76</del> 7%	C
87 <del>7</del> % - <del>89</del> 90%	B+	70% - <del>72</del> 3%	C-
83% - <del>86</del> 7%	B	67% - <del>69</del> 70%	D+
80% - <del>82</del> 3%	B-	63 <del>0</del> % - <del>67</del> 66%	D
		<del>0</del> 0% - 62%	———E

**Assessment:**

All journal assignments will be due before the corresponding class session begins (noted in course schedule). The key idea of the journal assignments is to synthesize how the readings may relate to your personal experiences, the insights you have gained from the readings, and/or how you can reconfigure the readings for chemistry education research-specific contexts. A rubric will be provided to identify what is required in the journal assignments.

Late assignments (e.g., journal submitted during or after that corresponding class session) will be considered late and graded up to 75% credit for between a day and a week late, and half-credit if the lateness exceeds a week.

The student-led discussion can be flexibly designed, leveraging a mix of activities, discussion, and slides. Key themes during the student-led lectures must address the **interconnections** (or lack thereof) across that week's assigned readings and **extrapolated insights** to inform chemistry education research and practice in a **novel and relevant manner**. Students will prepare for an hour-long session in which they lead the facilitation of that week's lesson. A rubric will be provided to inform how the student-led lecture will be designed and facilitated. Each student-led lecture will also be supplemented with instructor slides, questions, and activities, **at the instructor's discretion**.

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**Academic Misconduct:**

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed;

illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

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religious or spiritual belief system in reviewing such requests and shall keep requests for accommodations confidential.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities. If concerns arise about a requested accommodation, instructors are to consult their tenure initiating unit head for assistance.

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A student's request for time off shall be provided if the student's sincerely held religious belief or practice severely affects the student's ability to take an exam or meet an academic requirement and the student has notified their instructor, in writing during the first 14 days after the course begins, of the date of each absence. Although students are required to provide notice within the first 14 days after a course begins, instructors are strongly encouraged to work with the student to provide a reasonable accommodation if a request is made outside the notice period. A student may not be penalized for an absence approved under this policy.

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If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Office of Institutional Equity. It is Ohio State's policy to reasonably accommodate the sincerely held religious beliefs and practices of all students. The policy permits a student to be absent for up to three days each academic semester for reasons of faith or religious or spiritual belief.

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Students planning to use religious beliefs or practices accommodations for course requirements must inform the instructor in writing no later than 14 days after the course begins. The instructor is then responsible for scheduling an alternative time and date for the course requirement, which may be before or after the original time and date of the course requirement. These alternative accommodations will remain confidential. It is the student's responsibility to ensure that all course assignments are completed.

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As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](http://ccs.osu.edu) or calling [614-292-5766](tel:614-292-5766). CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at [614-292-5766](tel:614-292-5766) and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

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Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> or by contacting the Ohio State Title IX Coordinator at [titleix@osu.edu](mailto:titleix@osu.edu). Please do not hesitate and report as soon as you can.

**Diversity**

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

### Course Schedule

	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.
<b>Week 1</b>		Class #1					
<b>Week 2</b>		Class #2 Journal #1 Due					
<b>Week 3</b>		Class #3 Student-Led Lecture #1  Journal #2 Due					
<b>Week 4</b>		Class #4 Student-Led Lecture #2  Journal #3 Due					
<b>Week 5</b>		Class #5 Student-Led Lecture #3  Journal #4 Due					
<b>Week 6</b>		Class #6 Student-Led Lecture #4  Journal #5 Due					
<b>Week 7</b>		Class #7 Student-Led Lecture #5  Journal #6 Due					
<b>Week 8</b>		Final Exam!					

**This schedule is tentative and may be subject to change**

### Class Sessions: A Detailed Description

Course activities are tentative and may be subject to change\*

Class #1	<p style="text-align: center;"><b>Introduction – Reorientation to Critical Theory</b></p> <ul style="list-style-type: none"><li>• Pre-class assignment: Chapter 1 – <i>Pedagogy of the Oppressed</i></li><li>• Lecture – What makes something Critical?</li><li>• Small group activities</li><li>• Connections with chemistry education research papers in real time</li><li>• Discussion and consensus model building</li></ul> <p><b>Homework</b></p> <ul style="list-style-type: none"><li>• Journal #1: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</li><li>• Readings<ul style="list-style-type: none"><li>○ Chapter 2 – <i>Pedagogy of the Oppressed</i></li><li>○ Chapters 1 and 2 – <i>Fatal Inventions</i></li></ul></li></ul>
Class #2	<p style="text-align: center;"><b>Banking vs. Problem-Posing Models of Education</b></p> <ul style="list-style-type: none"><li>• Co-construct consensus model of banking vs problem-posing models with grounded examples</li><li>• Small group activities</li><li>• Connections with chemistry education research papers in real time</li><li>• Argumentation and critique to refine understandings</li></ul> <p><b>Homework</b></p> <ul style="list-style-type: none"><li>• Journal #2: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</li><li>• Readings<ul style="list-style-type: none"><li>○ Nasir &amp; Hand (2008)</li><li>○ Chapter 3 and 4 – <i>Fatal Inventions</i></li></ul></li></ul>
Class #3	<p style="text-align: center;"><b>The Role of Chemistry Education for Pre-Med Students</b></p> <ul style="list-style-type: none"><li>• Barr, Matsui, Wanat, &amp; Gonzalez (2010)</li><li>• Dixon, Pomales, Hashemzadeh, &amp; Hashemzadeh (2022)</li></ul> <p><b>Homework</b></p> <p>Journal #3: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim</p>

	<p>for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 3 – <i>Pedagogy of the Oppressed</i></li> <li>○ Chapter 3 – Kendi (2019)</li> <li>○ Carlone (2017)</li> </ul> </li> </ul>
Class #4	<p style="text-align: center;"><b>Power</b></p> <ul style="list-style-type: none"> <li>• <i>Retraction Watch</i></li> </ul> <p><b>Homework</b> Journal #4: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Morales-Doyle (2023)</li> <li>○ Olave &amp; Aceves (2023)</li> <li>○ Sadler (2011)</li> </ul> </li> </ul>
Class #5	<p style="text-align: center;"><b>Reflection</b></p> <ul style="list-style-type: none"> <li>• Mid-course feedback</li> </ul> <p><b>Homework</b> Journal #5: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapters 7 and 8 – <i>Fatal Inventions</i></li> <li>○ Morton &amp; Parsons (2018)</li> </ul> </li> </ul>
Class #6	<p style="text-align: center;"><b>Identity</b></p> <ul style="list-style-type: none"> <li>• Carlone &amp; Johnson (2006)</li> </ul> <p><b>Homework</b> Journal #6: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 4 – <i>Pedagogy of the Oppressed</i></li> <li>○ (pp. 185 – 195) – Alexander (2010)</li> <li>○ Spencer, Maxwell, Erickson, Wall, Nicholas-Figueroa, Pratt, &amp; Shultz (2022)</li> <li>○ [Optional] Barry, Bang, Bruce, &amp; Barajas-López (2023)</li> </ul> </li> </ul>

<b>Becoming-Freire</b>	
Class #7	<p><b>Homework</b></p> <p>Journal #7: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 11 – <i>Fatal Inventions</i></li> <li>○ Vakil, Reith, &amp; Melo (2022)</li> <li>○ Chapter 18 – Kendi (2019)</li> </ul> </li> </ul>
Class #8 FINALS	<p>Same time and same location! The final exam will be a free-response essay. The prompt will be shown to you on the day of the final. The essay will be open-book, with a maximum of 1000 words. <u>Please bring your laptops so that you can type your essay.</u></p>

## Chemistry 7630: Problem-Posing Model of Chemistry Education

12:45 PM – 3:25 PM: **2 hours and 40 minutes**

**Instructor:** Dr. Matt Wu  
Newman and Wolfrom Laboratory of Chemistry 1102A  
[wu.6250@osu.edu](mailto:wu.6250@osu.edu)

**Class:** T 12:45 PM – 3:25 PM; **University Hall 066**

**Office Hours:** By appointment

**Course Objectives:** The goal of this course is to understand, the theoretical underpinnings and practical applications of the problem-posing model of education. In this course, students will make interconnections with current socio-scientific issues pertaining to the nature of science and chemistry education research. Students will discuss, reflect, expand upon, and make sense of the processes by which chemistry is taught and learned. The learning objectives are:

- (1) Dissect the affordances and limitations with various problem-posing approaches.
- (2) Apply equity- and justice-based initiatives in chemistry and science education research.
- (3) Synthesize theory, philosophy, and research designs using chemistry content and lived experiences through analysis and research design.
- (4) Generate a portfolio of journal reflections, learning activities, and/or teaching strategies that draw upon and synthesize various theories.
- (5) Develop a curated annotated bibliography of seminal and recent chemistry education, learning science, and science education literature.

### Prerequisite Course

None

### Textbooks and Other Resources:

*Pedagogy of the Oppressed* by Paulo Freire, translated by Myra Bergman Ramos.

*Fatal Invention: How Science, Politics, and Big Business Re-Crete Race in the Twenty-First Century* by Dorothy E. Roberts

Salient journals: *Journal of Chemical Education*, *Chemistry Education Research and Practice*, *Journal of Research in Science Teaching*, *Science Education*, *Qualitative Inquiry*, *Journal of the Learning Sciences*, etc.

All reading assignments will be provided on the course Carmen Canvas Page.

Download either [Zotero](#) or [Mendeley](#) as your reference manager.

**Please bring your computer, a mouse, and charger for every class session!**

**Format:** Instructor/student-led discussions, readings, classroom activities, and multiple modalities by which students can participate (thinking aloud, recording/sharing reflections, enacting gestures, etc.)

**Attendance:** This is a highly interactive course that functions as a “laboratory” to unpack and apply theories into chemistry education research and practice. Therefore, punctual attendance is mandatory, especially considering the course’s frequency and duration. If there is a reason for repeated attendance problems, please speak with me privately. If there are extenuating circumstances that affect your ability to participate fully, please arrange to also speak with me privately. Given the student-centered nature of this course, I will not be streaming and/or recording the class discussions. Most of what you learn will depend on interactions with your peers and the instructor. Only one absence will be allowed for the semester. All excused absences related to illnesses will require appropriate documentation. Two unexcused absences will result in a reduction of one letter grade in the final course grade (i.e., A to A-, B+ to B); additional absences will result in further reduction of one letter grade per additional absence.

**Participation:** Because of the student-centered nature of this course, participation is essential for your learning, your peers’ learning, and my learning as well. **Specifically, each class session will leverage readings from the previous week.** However, I recognize that there are many ways in which one *can* participate. Contributing to discussions, posing questions, synthesizing literature, externalizing mental models, reflecting and drawing upon your lived experiences are all appropriate ways to participate.

**Philosophy:** Much of what we *do* in the class will reflect *what* and *how* we learn, as the design of the course will exemplify key tenets of the problem-posing model. In addition, chemistry ideas will incorporate socio-scientific issues, inspired by readings chosen at the instructor’s discretion. You will be encouraged to think about how the course content relates to your own processes of conceptualizing equity- and justice-based chemistry education research. Because this is a graduate level course, students will engage in reading and analyzing a wealth of peer-reviewed articles. To maximize the meaningfulness of this course, **it is imperative** that all students come prepared, be open-minded, and communicate with their peers and the instructor.

**Grades:** Your final grade in this course will be determined by the total number of points earned. There will be no curve applied to this course.

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Participation	120 points (7-1 sessions x 20 points)
Journals	480 points (7-1 entries x 80 points)
Student-led discussion	200 points
Final Exam	200 points
<b>Total</b>	<b>1000 points</b>

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\*See grade ranges on the next page



94% - 100%	A	77% - 79%	C+
90% - 93%	A-	73% - 76%	C
87% - 89%	B+	70% - 72%	C-
83% - 86%	B	67% - 69%	D+
80% - 82%	B-	63% - 66%	D
		0% - 62%	E

**Assessment:**

All journal assignments will be due before the corresponding class session begins (noted in course schedule). The key idea of the journal assignments is to synthesize how the readings may relate to your personal experiences, the insights you have gained from the readings, and/or how you can reconfigure the readings for chemistry education research-specific contexts. A rubric will be provided to identify what is required in the journal assignments.

Late assignments (e.g., journal submitted during or after that corresponding class session) will be considered late and graded up to 75% credit for between a day and a week late, and half-credit if the lateness exceeds a week.

The student-led discussion can be flexibly designed, leveraging a mix of activities, discussion, and slides. Key themes during the student-led lectures must address the **interconnections** (or lack thereof) across that week's assigned readings and **extrapolated insights** to inform chemistry education research and practice in a **novel and relevant manner**. Students will prepare for an hour-long session in which they lead the facilitation of that week's lesson. A rubric will be provided to inform how the student-led lecture will be designed and facilitated. Each student-led lecture will also be supplemented with instructor slides, questions, and activities, **at the instructor's discretion**.

The final exam will be during class time and at the same room location. Evaluation will cover all discussed topics and student ideas. The final exam will be a free-response essay (maximum 1000 words). The prompt will be disclosed on the day of the final. This summative assessment will not only invite you to synthesize ideas discussed throughout the course but also construct a compelling argument within the moment, which the course recognizes as an imperative skill for future professional contexts.

**Academic Misconduct:**

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty

Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

**Disability  
Services**

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

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### Course Schedule

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<b>Week 2</b>		<b>Class #2</b> <b>Journal #1 Due</b>					
<b>Week 3</b>		<b>Class #3</b> <b>Student-Led</b> <b>Lecture #1</b>  <b>Journal #2 Due</b>					
<b>Week 4</b>		<b>Class #4</b> <b>Student-Led</b> <b>Lecture #2</b>  <b>Journal #3 Due</b>					
<b>Week 5</b>		<b>Class #5</b> <b>Student-Led</b> <b>Lecture #3</b>  <b>Journal #4 Due</b>					
<b>Week 6</b>		<b>Class #6</b> <b>Student-Led</b> <b>Lecture #4</b>  <b>Journal #5 Due</b>					
<b>Week 7</b>		<b>Class #7</b> <b>Student-Led</b> <b>Lecture #5</b>  <b>Journal #6 Due</b>					
<b>Week 8</b>		<b>Final Exam!</b>					

**This schedule is tentative and may be subject to change**

## Class Sessions: A Detailed Description

Course activities are tentative and may be subject to change\*

Class #1	<p style="text-align: center;"><b>Introduction – Reorientation to Critical Theory</b></p> <ul style="list-style-type: none"><li>• Pre-class assignment: Chapter 1 – <i>Pedagogy of the Oppressed</i></li><li>• Lecture – What makes something Critical?</li><li>• Small group activities</li><li>• Connections with chemistry education research papers in real time</li><li>• Discussion and consensus model building</li></ul> <p><b>Homework</b></p> <ul style="list-style-type: none"><li>• Journal #1: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</li><li>• Readings<ul style="list-style-type: none"><li>○ Chapter 2 – <i>Pedagogy of the Oppressed</i></li><li>○ Chapters 1 and 2 – <i>Fatal Inventions</i></li></ul></li></ul>
Class #2	<p style="text-align: center;"><b>Banking vs. Problem-Posing Models of Education</b></p> <ul style="list-style-type: none"><li>• Co-construct consensus model of banking vs problem-posing models with grounded examples</li><li>• Small group activities</li><li>• Connections with chemistry education research papers in real time</li><li>• Argumentation and critique to refine understandings</li></ul> <p><b>Homework</b></p> <ul style="list-style-type: none"><li>• Journal #2: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</li><li>• Readings<ul style="list-style-type: none"><li>○ Nasir &amp; Hand (2008)</li><li>○ Chapter 3 and 4 – <i>Fatal Inventions</i></li></ul></li></ul>
Class #3	<p style="text-align: center;"><b>The Role of Chemistry Education for Pre-Med Students</b></p> <ul style="list-style-type: none"><li>• Barr, Matsui, Wanat, &amp; Gonzalez (2010)</li><li>• Dixson, Pomales, Hashemzadeh, &amp; Hashemzadeh (2022)</li></ul> <p><b>Homework</b></p> <p>Journal #3: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim</p>

	<p>for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 3 – <i>Pedagogy of the Oppressed</i></li> <li>○ Chapter 3 – Kendi (2019)</li> <li>○ Carlone (2017)</li> </ul> </li> </ul>
Class #4	<p style="text-align: center;"><b>Power</b></p> <ul style="list-style-type: none"> <li>• <i>Retraction Watch</i></li> </ul> <p><b>Homework</b> Journal #4: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Morales-Doyle (2023)</li> <li>○ Olave &amp; Aceves (2023)</li> <li>○ Sadler (2011)</li> </ul> </li> </ul>
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Class #6	<p style="text-align: center;"><b>Identity</b></p> <ul style="list-style-type: none"> <li>• Carlone &amp; Johnson (2006)</li> </ul> <p><b>Homework</b> Journal #6: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"> <li>• Readings <ul style="list-style-type: none"> <li>○ Chapter 4 – <i>Pedagogy of the Oppressed</i></li> <li>○ (pp. 185 – 195) – Alexander (2010)</li> <li>○ Spencer, Maxwell, Erickson, Wall, Nicholas-Figueroa, Pratt, &amp; Shultz (2022)</li> <li>○ [Optional] Barry, Bang, Bruce, &amp; Barajas-López (2023)</li> </ul> </li> </ul>

<b>Becoming-Freire</b>	
Class #7	<p><b>Homework</b></p> <p>Journal #7: Discuss your insights and/or uncertainties regarding this class session and how it relates to class work and outside readings. Aim for synthesis with specific examples. (~300, single-spaced, not including references)</p> <ul style="list-style-type: none"><li>• Readings<ul style="list-style-type: none"><li>○ Chapter 11 – <i>Fatal Inventions</i></li><li>○ Vakil, Reith, &amp; Melo (2022)</li><li>○ Chapter 18 – Kendi (2019)</li></ul></li></ul>
Class #8 FINALS	<p>Same time and same location! The final exam will be a free-response essay. The prompt will be shown to you on the day of the final. The essay will be open-book, with a maximum of 1000 words. Please bring your laptops so that you can type your essay.</p>