

Chemistry and Chemical Biology Capstone Project

Dave Song
April 28, 2023

Capstone Summary



As a PF in Chemistry and Chemical Biology my role has been facilitating the growth of our G1s as reflective educators as well as serving as a liaison between members of CCB and the Bok Center. This year, I focused on: (1) enhancing the quality of microteaching, (2) incorporating an inclusive and equitable teaching for chemistry workshop with Ashlie Sandoval, (3) garnering actionable mid- and end-of-year feedback from students, (4) implementing minor modifications to the Chem 301 curriculum to fulfill requirements of the Bok Teaching Certificate, and (5) improving CCB/Bok Center engagement interactions. This CCB PF Capstone Space presents the highlights of some of these efforts.



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CCB PF Capstone Space

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CCB PF Capstone Space
Harvard College/Graduate School of Arts and Sciences: ILE-FAS-BOKCCB
Term: Ongoing

Additional information will be shown if available from the Registrar.

Course Summary:

Date	Details	Due
	Chem 301 Mid-Year Feedback (January)	
	Microteaching #1 Boardwork	
	Microteaching #2 Post-Boardwork	
	Microteaching #3 Lesson Planning Doc	
	Peer Observation Visits	
	Reflection on Microteaching #1	
	Reflection on Microteaching #2	
	Reflection on Microteaching #3_fill	

Course Status

Unpublish **Published**

Import Existing Content

Choose Home Page

View Course Stream

Course Setup Checklist

New Announcement

View Course Notifications

< April 2023 >						
26	27	28	29	30	31	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	1	2	3	4	5	6

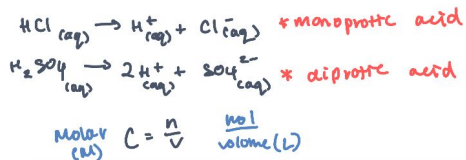
Course assignments are not weighted.



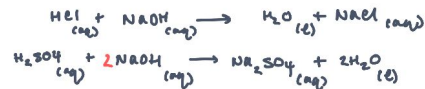
(1) Enhancing the Quality of Microteaching

Microteaching		✓	+	⋮
⋮	📄 Microteaching Guidelines	✓		⋮
⋮	Microteaching #1	✓		⋮
⋮	📄 Microteaching #1	✓		⋮
⋮	📄 Microteaching #1 Boardwork 1 pts	✓		⋮
⋮	📎 Microteaching #1 Boardwork--Student Submissions.zip	✓		⋮
⋮	📎 microteaching #1 G1 Example.png	✓		⋮
⋮	📄 Reflection on Microteaching #1 1 pts	✓		⋮
⋮	Microteaching #2	✓		⋮
⋮	📄 Microteaching #2	✓		⋮
⋮	📎 Microteaching 2 Introduction Slides.pdf	✓		⋮
⋮	📄 Microteaching #2 Post-Boardwork 1 pts	✓		⋮
⋮	📎 Microteaching #2 Post-Boardwork--Student Submissions.zip	✓		⋮

Microteaching #1: Presentation, Delivery, and Boardwork



Neutralization reactions:



Solution #1



$$[\text{H}_2\text{SO}_4] = \frac{x \text{ mol H}_2\text{SO}_4}{0.1000 \text{ L}}$$

$$V_1 = 0.1000 \text{ L}$$

$$n_{\text{H}_2\text{SO}_4} = x \text{ mol} \Rightarrow \text{solve for } x$$

NaOH



$$[\text{NaOH}] = 0.213 \text{ M}$$

$$V_{\text{NaOH}} = 0.0500 \text{ L}$$

$$n_{\text{NaOH Total}} = n_{\text{reacted}} + n_{\text{XS}}$$

Solution #2



$$[\text{NaOH}]_{\text{XS}}$$

$$V_2 = 0.150 \text{ L}$$

$$n_{\text{XS}} = ?$$

$$n_{\text{NaOH Total}} = (0.213 \text{ M})(0.0500 \text{ L})$$

$$= 0.01065 \text{ mol NaOH}$$

$$n_{\text{NaOH needed}} = x \text{ mol H}_2\text{SO}_4 \cdot \frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4}$$

$$= 2x$$

Substitute values:

$$0.01065 = 2x + n_{\text{NaOH XS}}$$

$$\textcircled{1} x = \frac{1}{2} (0.01065 - n_{\text{NaOH XS}})$$

BOARD 1

5.00L

125°C

$$10.2 \text{ g I}_2 \times \frac{\text{mol I}_2}{253.82 \text{ g}} = 0.0402 \text{ mol I}_2$$

$$10.0 \text{ g F}_2 \times \frac{\text{mol F}_2}{38.0 \text{ g}} = 0.263 \text{ mol F}_2$$

P = ?

	I ₂ + 5F ₂ → 2IF ₅	
I	0.0402 mol	0.263 mol
C	-0.0402	-5(0.0402)
E	0.0622 mol	0.0804 mol

RATIO

$$\frac{0.263 (\text{F}_2)}{0.0402 (\text{I}_2)} = 6.55 \quad (> \frac{5}{1})$$

* I₂ is LR.

NOTES FOR MYSELF

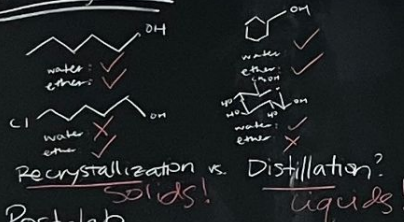
Microteaching #2: Content and Structure

LAB 2: PURIFY ORGANIC COMPOUNDS

Safety

- Use the HOOD
 - ↳ boiling
 - ↳ long safety
- PPE - lab coat, goggles, gloves, leg/foot coverage
- Beware of HEAT (Δ)
 - ↳ turn off hot plates (MelTemp) when not in use
 - ↳ steam, hot glass
- Use Δ water bath
 - ↳ ethanol is flammable!

Background



Recrystallization vs. Distillation?
 Solids! Liquids!

Post-lab

- I.D. unknowns
- MP & physical characteristics
- Recovery (g, %)
- Solubility behavior
- Explanation of errors

Marina M

Procedure

A RECRYSTALLIZATION

- I.D. solvent to use: 1:1 D → ethanol
- Douged solvent system
- Collect purified crystals
- I.D.!
 ↳ Look in notebook for full list

B DISTILLATION

- Set-Up:
-
- Set up heat
 - weigh
 - boiling stone
 - insulate
 - check w/TA!
 - Variac setting
 - weigh final → I.D.!

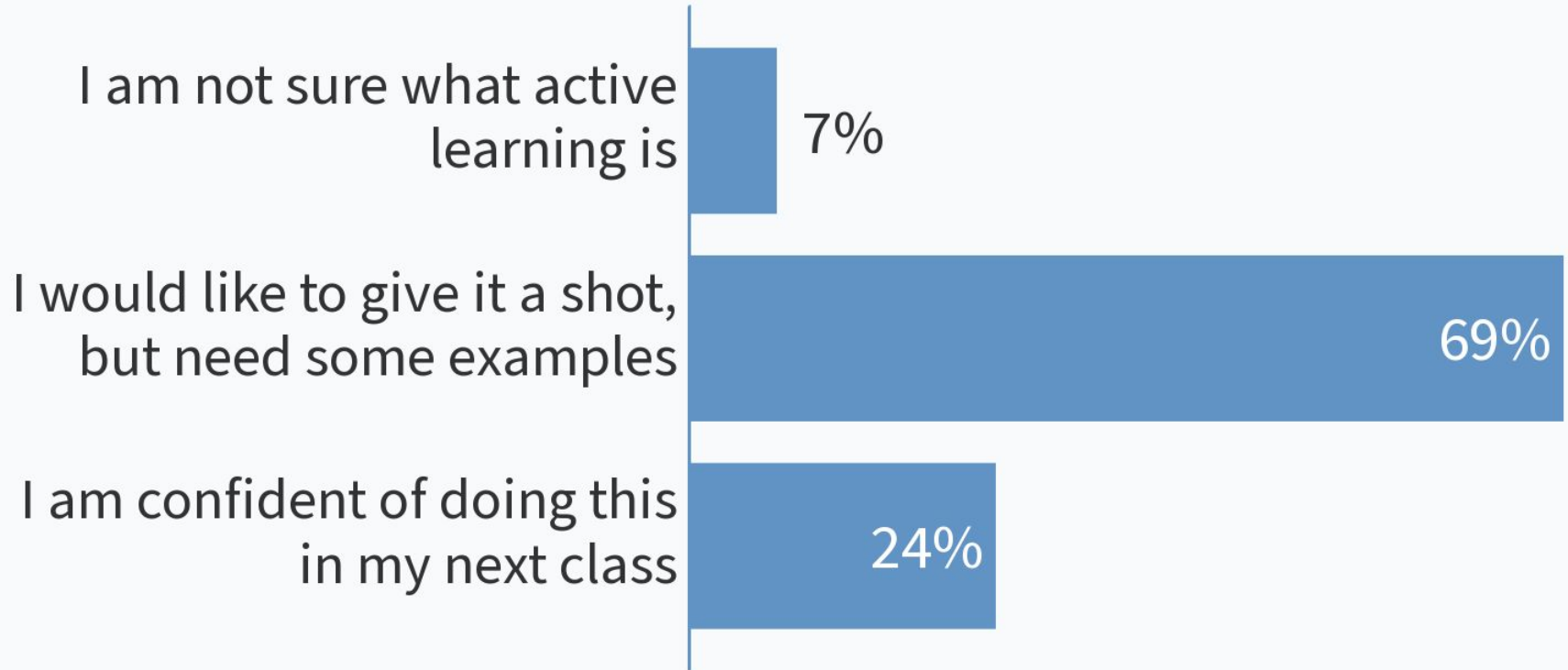
Promoting Active Learning in the Classroom



pollev.com/davidsong842

Text DAVIDSONG842 to
22333 once to join, then text
A, B, or C

How do you feel about incorporating active learning strategies into your teaching?



Microteaching #3: Interaction and Engagement



$\rightarrow \Delta G^\circ = -nF\Delta E^\circ$

$\Delta E^\circ = E^\circ \text{ acceptor} - E^\circ \text{ donor}$

[Activity: Take 30s to talk w/ a partner and decide what is the acceptor & donor
ask two groups to share their answer + reason]

$= E^\circ(\text{NAD}^+) - E^\circ(\text{R-OH})$

$= -0.32\text{V} - (-0.20\text{V}) = -0.12\text{V}$

$\Delta G^\circ = -nF\Delta E^\circ$

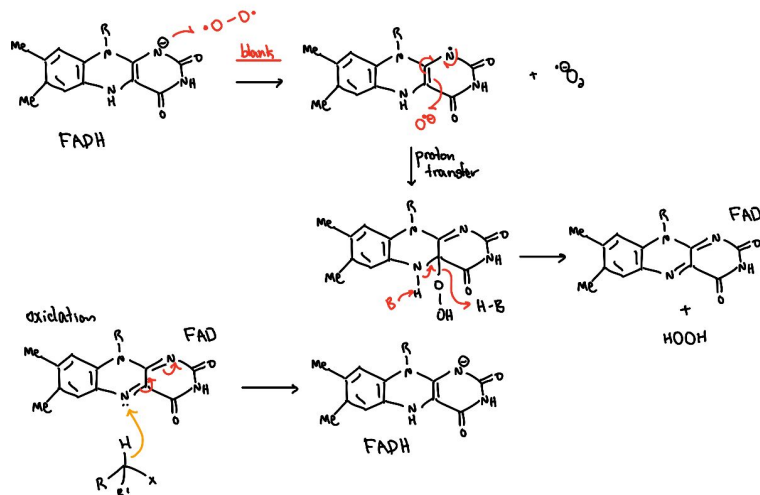
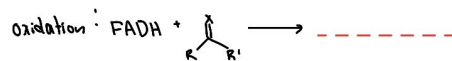
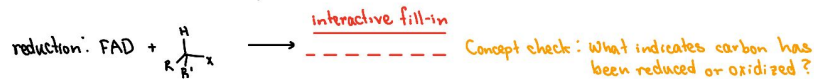
$= -2 \left(23 \frac{\text{kcal}}{\text{V mol}} \right) (-0.12\text{V})$

$= 5.5 \text{ kcal/mol}$

b) thermodynamically favoured? [ask class question]

no. ΔG is positive

oxidase enzymes: use FAD cofactor to directly oxidize the substrate. No NAD(P) needed.
*mechanistically consists of two half reactions



Interactive question: how do I know which way to draw the arrow between substrate and FAD?

Concept Checks:

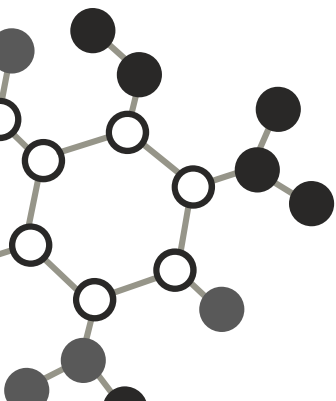
How many e⁻ do these reactions involve?

Can they involve fewer (more than 2e⁻)?

(2) Incorporating an Inclusive and Equitable Teaching Workshop w/ Ashlie Sandoval

☰ ▾ Jan Session	✓ + ⋮
☰ 📄 Jan Session Guidelines	✓ ⋮
☰ Wed Jan 18	✓ ⋮
☰ 📎 2023 CHEM TF Presentation_Title IX and Professional Conduct.pdf	✓ ⋮
☰ 📎 Student Records, Confidentiality, and Being an Officer of the University	✓ ⋮
☰ Thurs Jan 19	✓ ⋮
☰ 📎 Inclusive and Equitable Teaching Workshop_Presentation	✓ ⋮
☰ 📎 Inclusive and Equitable Teaching Workshop_Case Studies	✓ ⋮
☰ 📎 Inclusive and Equitable Teaching Workshop_Notes	✓ ⋮
☰ 📎 Active learning increases student performance in science, engineering, and mathematics.pdf	✓ ⋮

Inclusive and Equitable Teaching for Chemistry



HARVARD

THE DEREK BOK CENTER FOR
TEACHING AND LEARNING

Workshop Facilitator



Ashlie Sandoval
Assistant Director
of Equity and Inclusion
ashliesandoval@fas.harvard.edu

Workshop Objectives

01

INTRODUCTION TO INCLUSIVE TEACHING

What are the challenges and barriers that students face?
What are some strategies to address these challenges?

02

ACTIVE LEARNING

What is active learning and why is helpful for students and instructors?

03

CASE STUDIES

How would you increase equity and inclusion in these scenarios?

Case Study: Prompt 3

You're a TF for a materials chemistry course. Students are learning about X-ray crystallography and evaluating single crystal diffraction data in their labs. Last week, the course head and instructional team took the students on a field trip to a national lab so that the students could network with staff scientists, learn techniques beyond their labwork, such as collecting data at a synchrotron source, and see the opportunities and career pathways that chemistry could offer students.

For this week's section, you plan a lesson to enhance the benefits of the field trip, as well as to offer the benefit of the field trip to students who could not attend, and require students who attended to make a short presentation about their experience, discussing what they learned and their personal takeaways.

One student, Jason Li, in describing his experience says, "What I learned is that when using a 0.5 s exposure time, you can see a superior resolution for the same micron-sized crystal's diffraction pattern. And my personal takeaway from this experience is that x-ray diffraction has so many uses. The researcher said it could help us to infer techniques used by craftsmen of the past in the making of ancient sculptures. I think this knowledge might help with conservation. Near my grandparents' hometown, we have a cultural heritage site called Jingyin Temple, with a famous sculpture of the Buddha that Buddhists and visitors come to see. I think it would be great to one day be able to restore those."

Another student says loudly to students at his table, "I thought Chemistry was the antidote for religion, not a method for keeping it alive." The class snickers.

Jason stops presenting and looks down.

How would you respond?

Inclusive Teaching Takeaways





Developing an inclusive and equitable pedagogy is a lifetime practice.

Inclusive Moves Discussed Today





1. Defuse stereotype threat
2. Cultivate a growth mindset
3. Unpack the hidden curriculum
(reflect on your own assumptions)
4. Make course material relevant by helping students connect the material to prior knowledge
(get to know students, their goals and challenges)

(3) Garnering Actionable Feedback from Students



How would you describe: microteachings

Extremely worthwhile and valuable	15 respondents	50 %	
Valuable but could be improved	13 respondents	43 %	
Needs improvement to be useful to me	1 respondent	3 %	
Not valuable or worthwhile	1 respondent	3 %	

How would you describe: verbal feedback to microteachings (i.e., group discussion)

Extremely worthwhile and valuable	20 respondents	67 %	
Valuable but could be improved	7 respondents	23 %	
Needs improvement to be useful to me	3 respondents	10 %	
Not valuable or worthwhile at all		0 %	

How would you describe: Canvas submissions (e.g., written reflections, goals, boardwork submissions)

Extremely worthwhile and valuable	5 respondents	17 %	
Valuable but could be improved	10 respondents	33 %	
Needs improvement to be useful to me	7 respondents	23 %	
Not valuable or worthwhile at all	8 respondents	27 %	

*“The **most useful aspect** was the recorded microteaching because it allowed me to draw my own conclusions about my teaching and think about feedback from others from my perspective of a student instead of my perspective as a teacher.”*

*“The reflections and written feedback **were not very useful** because the verbal feedback was the same and I already iterated my reflective thoughts during the microteaching session.”*

*“**Make it** less of a time commitment--I believe that the course can be very useful but I think that it took a bit too much of our time. Though it was not extremely bad.”*

(4) Streamlining Video Observations into Curriculum

Option 1: Initial Meeting and Class Observation

Schedule an initial meeting with one of the PFs to debrief on the first few sections/labs, have questions answered and be directed to resources. Sometime after the individual meeting, one of the PFs will visit your section/lab to observe your teaching, paying special attention to specific areas you have discussed in the meeting and providing feedback to you.

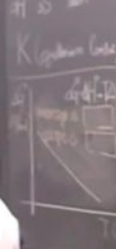
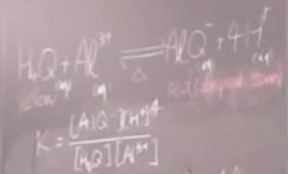
Option 2: Video Consultation towards Bok Teaching Certificate

Record one of your sections or pre-lab talks and the first half of lab (video recording equipment is available). Sometime after your recording, one of the PFs will consult with you on your video recording to help you gain formative feedback, put yourself in your students' shoes, implement a low-stakes way to learn more about your teaching, learn to read a classroom, expand your teaching repertoire, walk away with a few tangible things to work on, and see what is wonderful about your teaching.

Since many of you will not teach beyond your second teaching assignment required by CCB, pursuing **Option 2** this semester is a perfect opportunity to receive support in your teaching through Chem 301 while also working towards fulfilling the video consultation component of the [Bok Teaching Certificate](#) during a time you are guaranteed to be teaching. As an added bonus, all students completing Chem 301 will already be receiving credit for one of the three required [Bok Seminars](#). The final component of the teaching certificate is to reflect on your teaching by creating a teaching statement, an original syllabus, and a reflective piece---all of which can be satisfied in later semesters as you are narrowing-down your career prospects and working on job applications.



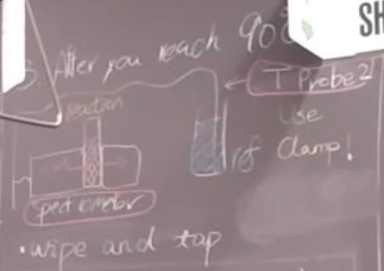
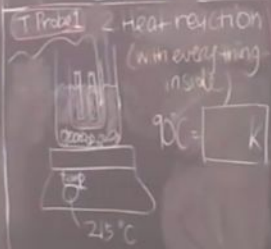
Lab 2
Objective: Add
reference cuvette
I Ads



$[\text{AlQ}] = \frac{A - A_0}{\epsilon \cdot c \cdot l}$ measure A and A_0
 $[\text{H}_2\text{Q}] = \square$
 $[\text{Al}^{3+}] = \square$
 $[\text{H}^+] = 0.01\text{M}$
 $\Delta G^\circ = -RT \ln K$

Procedure

1. Reference cuvette: calibrate spectrometer
Reaction: measure A at room temp

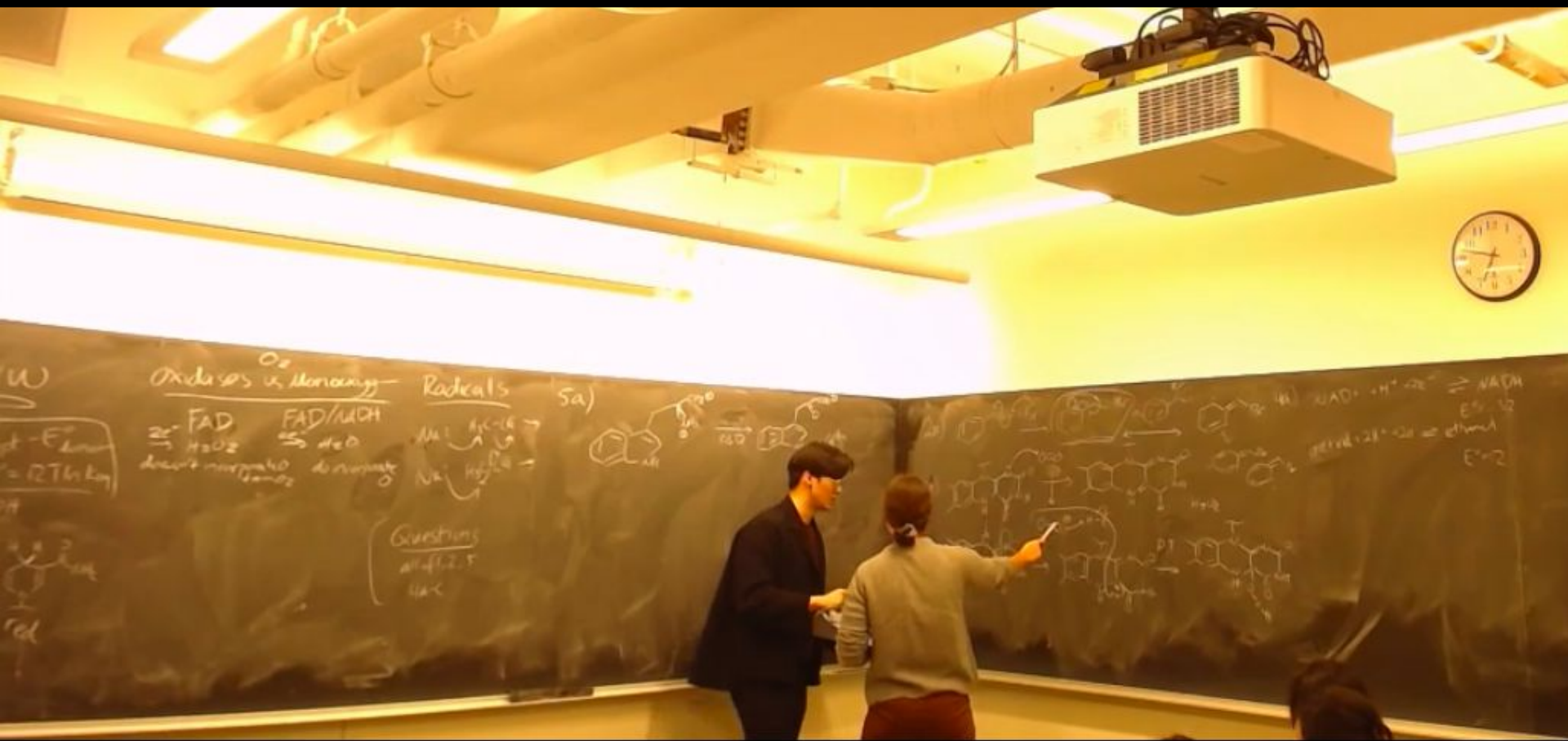


2. Heat reaction (with everything inside)
• Do it quickly (~30s)
• Start measurement on LoggerPro
- Temperature results for Q8
- $\Delta H^\circ = 75000 \text{ J/mol}$
 - $\Delta S^\circ = 160 \text{ J/mol K}$

Safety

- PPE do not heat above 90°C
- Spill \rightarrow Rinse 15 min
-
- * Plug in temp probe & spectrometer before starting the program
 - * Use personal email





(5) Improving CCB/Bok Center Engagement Interactions



Welcome Letter to CCB Department Draft

David Song

All Sections

Apr 12 at 11:14am

Dear colleagues,

Sam Veroneau and I have been serving as the CCB Pedagogy Fellows for the 2022-23 AY. We wanted to remind you of our role in liaising as a resource for Teaching Fellows in CCB and in connecting members of our community with teaching and mentoring resources at the [Bok Center for Teaching and Learning](#). Here are a few resources you can take advantage of as you start teaching this semester:

1. [Winter Teaching Week](#): These pre-semester conferences are a great way for Teaching Fellows to prepare for the semester, as well as for more experienced scholars to continue developing their teaching craft. The 2023 Winter Teaching Week kicks off on Tuesday, January 17, with an afternoon of fundamentals for new TFs, followed by two days of workshops exploring topics in pedagogy and classroom practice, and ending with communication-focused sessions on Friday, January 20. You may [register](#) for any of the workshops based on your teaching and professional development interests. Lunch will be provided for workshop attendees. The location is at the Bok office on the 3rd floor at 125 [Mt Auburn St](#).
2. [Bok Seminars](#): These short courses designed for GSAS PhD students at every stage of their career are offered on topics in teaching, learning, and communication.
3. [Teaching Certificates](#): GSAS PhD students who are interested in demonstrating their commitment to developing as teachers may pursue the Bok Teaching Certificate.
4. [Class/Video Observations](#): Learn more about your teaching and become reflective about your own classroom practice by requesting a class observation or video consultation.
5. [Bok Office Hours for PhD Students](#): Have additional questions on how to complete the Bok Center Teaching Certificate or are considering taking a Bok Seminar? Want to learn more about teaching or communication or how the Bok Center can support you? Drop in for these Zoom office hours to have all of your questions answered.

Please also feel free to reach us directly if you have any questions, and looking forward to being a part of your career as an educator!!

Here's to an awesome 2023,
Dave Song and Sam Veroneau

(5) Improving Teaching Team/Student Engagement Interactions



Microteaching #3 Preparation Materials and Assignment Details Draft

David Song

All Sections

Apr 28 at 8:52am

Dear Chem301 students,

Thank you all for an awesome discussion on interaction/engagement and active learning strategies. We are very excited to see how your teaching will come together in Microteaching #3! To help you prepare for your lesson planning for Microteaching #3, we have posted the reference materials under "**Requirements for Microteaching #3**" on the [Microteaching #3 canvas page](#). They are also added here to this announcement:

- [Microteaching #3 boardwork](#) ↓
- [Introduction to Microteaching #3 slides](#) ↗
- [Interaction/Engagement and Active Learning Examples doc](#) ↗
- [Bok Center Active Learning website](#)

As you are planning your Microteaching #3 lesson, please think about when and what questions you will ask during your microteaching and also **where you will incorporate at least 2 active learning strategies**. Please indicate this in a different color before uploading your planning doc to the [Microteaching #3 Lesson Planning Doc assignment link](#). This assignment is due on the day you are scheduled for Microteaching #3 before the start of class. Please review the teaching assignments and plan accordingly.

Best,

Dave on behalf of the [Chem 301 teaching team](#)