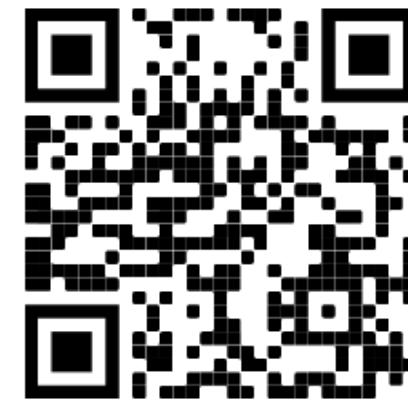


# Gathering Resources & Planning for a Foolproof\* Flipped Classroom



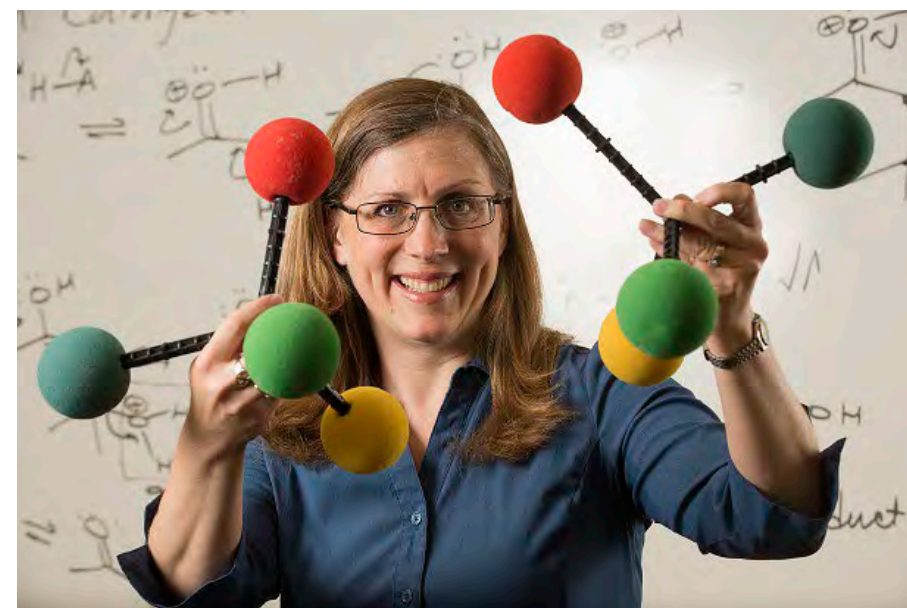
[chemistryconnected.com](http://chemistryconnected.com)

Laurie S. Starkey

Cal Poly Pomona

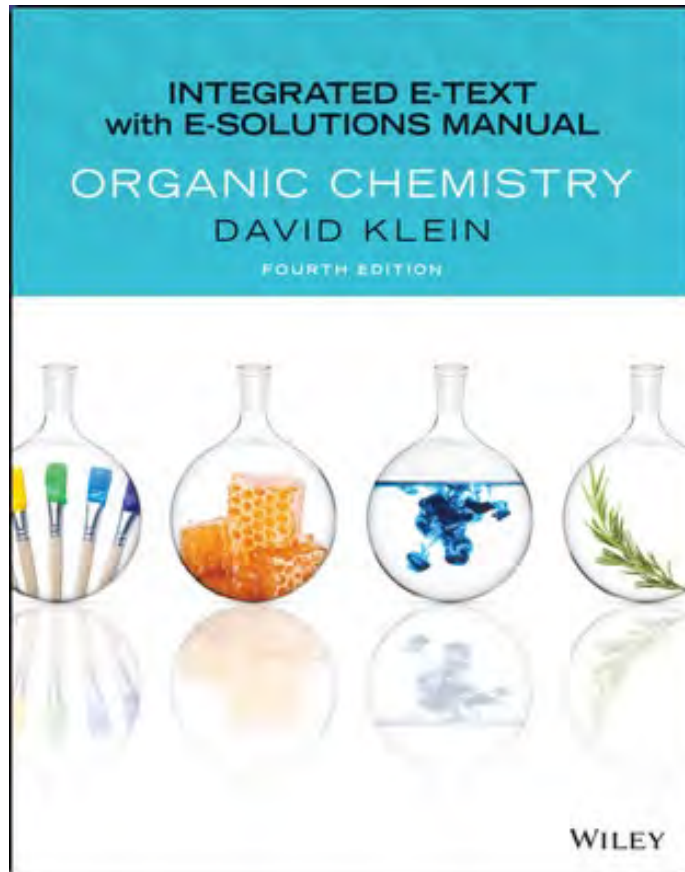
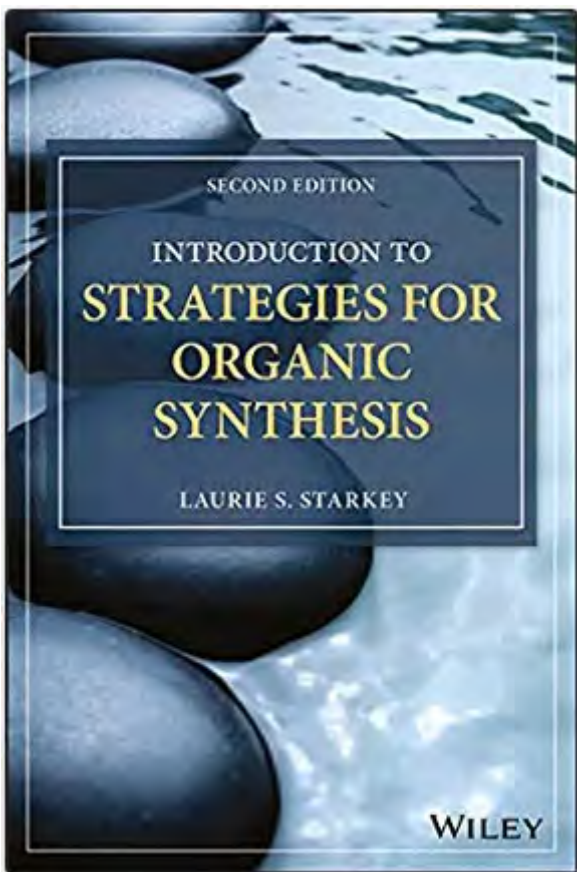
[lsstarkey@cpp.edu](mailto:lsstarkey@cpp.edu)

**BCCE 2022**

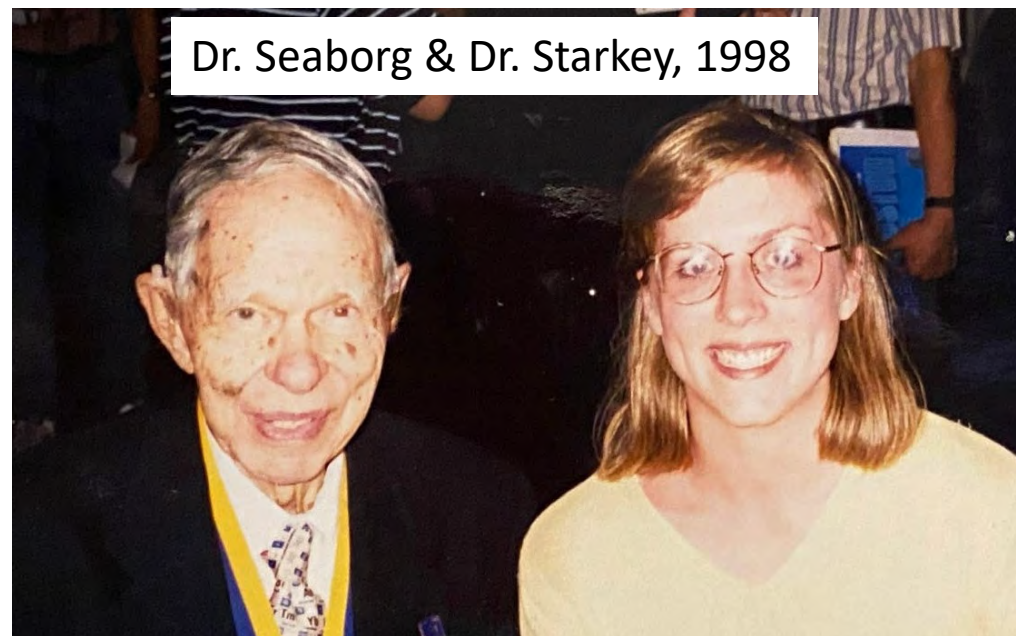


# About me...

Cal Poly Pomona since 1996.  
This is my 1<sup>st</sup> BCCE! Finally!



[chemistryconnected.com](http://chemistryconnected.com)



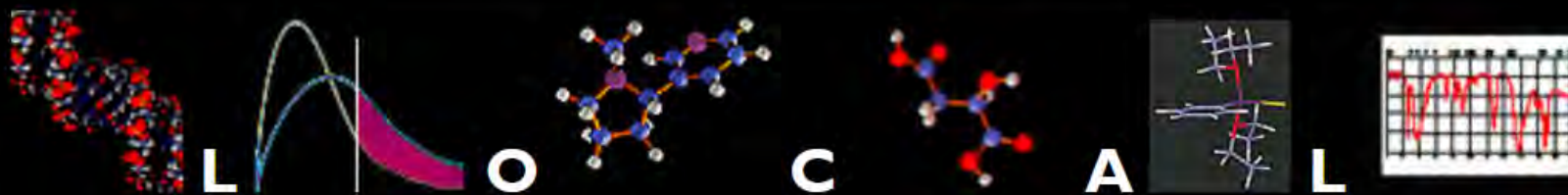
# Foolproofing\* the Flipped Classroom

- **Get student buy-in!!**
- Don't bite off more than you can chew
  - Start small (e.g., flip your nomenclature lesson)
- Don't reinvent the wheel
  - Utilize existing content: [LOCAL](#), [MERLOT](#), [PhET](#), YouTube, publisher videos
- Don't fly solo
  - Collaborate with colleagues (Facebook groups, f2f)
  - Leverage student help (Sr. project, [Adobe Express video](#))
- **Get student buy-in!!**

\*Sorry, but there is no such thing. Mistakes will be made. There may be tears.



# Resources for Organic Chemistry: LOCAL



## *Library for Organic Chemistry Active Learning*

Created by [Laurie Starkey](#), Professor of Organic Chemistry at [Cal Poly Pomona](#)  
To contribute materials, please contact Laurie (and thank you!) [lsstarkey@cpp.edu](mailto:lsstarkey@cpp.edu)

*Active-Learning Resources can also be found here: [organicERs.org](http://organicERs.org) | [MERLOT.org](http://MERLOT.org)*  
*see also: [video production](#) & [mindset resources](#)*



### Clicker Questions:

#### Bonding/Structure, Acid-Base, Nomenclature

[Lewis Structures & Line Drawings](#)  
[Resonance & Hybridization/3-D](#)  
[Acid-Base](#)  
[MO Theory](#)  
[Physical Properties](#)  
[Nomenclature](#)  
[Sites of Unsaturation \(DU\)](#)  
[Conformations of Alkanes & Cyclohexanes](#)

#### Stereochem, Radicals, Study of Reactions

[Chirality & Optical Activity](#)  
[R/S, E/Z Nomenclature](#)  
[Stereochemical Relationships](#)  
[Radical Reactions](#)  
  
[Thermodynamics, Kinetics & Reaction Coordinate Diagrams](#)

#### Substitution & Elimination Alkene/Alkyne Reactions

[Substitution Reactions \(S<sub>N</sub>1/S<sub>N</sub>2\)](#)  
[Elimination Reactions \(E1/E2\)](#)  
[Substitution vs. Elimination](#)  
[Dehydration of Alcohols](#)  
[Alkene Additions and Oxidation](#)  
[Alkyne Reactions](#)  
[Synthesis Strategies \(Klein Ch. 11\)](#)

#### Alcohols, Ethers & Epoxides

[Alcohol Reactions](#)  
[Grignard & Hydride Reagents](#)  
[Epoxide & Ether Reactions](#)  
[Alkoxides & Thiols](#)  
  
[Syntheses Involving Alcohols](#)



# Resources for Organic Chemistry: LOCAL

**Activities and Worksheets:** (see below table for BeyondLabz worksheets) 

## Bonding/Structure, Acid-Base, Nomenclature

### Worksheets

- [Day1 Review, Lewis Structures](#)
- [Bonding/Hybridization/3D Physical Props/lone prs/charges](#)
- [Resonance worksheet](#)
- [Resonance homework](#)
- [5-Minute Resonance Pattern Review \(Four Videos\)](#)
- [Acid-Base #1-A&I of ARIO](#)
- [Acid-Base #2-Resonance...](#)
- [Acid-Base homework](#)
- [Review Klein Ch.1-3](#)
- [Alkane IUPAC, Newman](#)
- [IUPAC & Cyclohexane](#)
- [Conformations homework](#)
- [Cyclohexane homework](#)

### Case Studies (NSF NCCSTS)

[Resonance & Hybridizaion website & case pdf](#)

## Stereochem, Radicals, Study of Reactions

### Worksheets

- [Stereoisomerism, IUPAC \(R/S\)](#)
- [Fischer Proj., Optical Activity, Compare](#)
- [R/S, E/Z, e.e.](#)
- [Klein Ch.4/5/15 Review](#)
- [Klein Chapter 6 - Kin/Thermo/ CurvedArrows/Carbocations](#)
- [Transition States, Curved Arrows](#)
- [Radical Reactions](#)

### Case Studies (NSF NCCSTS)

- [Adventures in Stereochemistry \(Alice\) website & case pdf](#)
- [Stereochem \(Bilirubin: E/Z but not Easy\) website & case pdf](#)
- [Chirality and the Origins of Life website & case pdf](#)

## Substitution & Elimination Alkene/Alkyne Reactions

### [Interesting Alkenes](#)

### Worksheets

- [Sn2 introduction](#)
- [Sn1 introduction](#)
- [Sn1/Sn2 Venn Diagram | \(Key\)](#)
- [E2 introduction, E2 vs Sn2](#)
- [E1, Sub/Elim Summary](#)
- [Substitution & Elimination](#)
  - [Summary/Categorizing Nu/Base](#)
  - [Predict the Product Sn1/Sn2/E2](#)
- [Sub/Elim Exam Review](#)
- [Alkenes - IUPAC, HX, Hydration](#)
- [Alkene Rxns - Br2, \[ox\], Synthesis](#)
- [Alkyne Reactions \(Hydration\)](#)
- [Alkyne Alkylation & Synthesis](#)

### 1st Semester Review

- [1st Semester Synthesis \(Klein Ch. 11\)](#)
- [1st Semester Final review](#)

## Alcohols, Ethers Epoxides, Amines

Interesting [Alcohols](#), [Phenols](#) and [Amines](#)

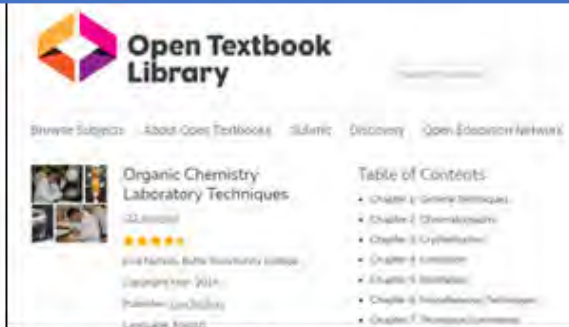
### Worksheets

- [Nucleophile/Electrophile Review](#)
- [Alcohols I \(IUPAC, acidity\)](#)
- [Alcohols II \(Prep/Grignard\)](#)
- [Alcohols III \(Reactions\)](#)
- [Ethers I \(Prep,Williamson\)](#)
- [Ethers II \(Epoxide open, HX\)](#)
- [ROH/ROR/Epoxide review](#)

### [Ch. 1-13, 15, 22 Review Worksheet](#)



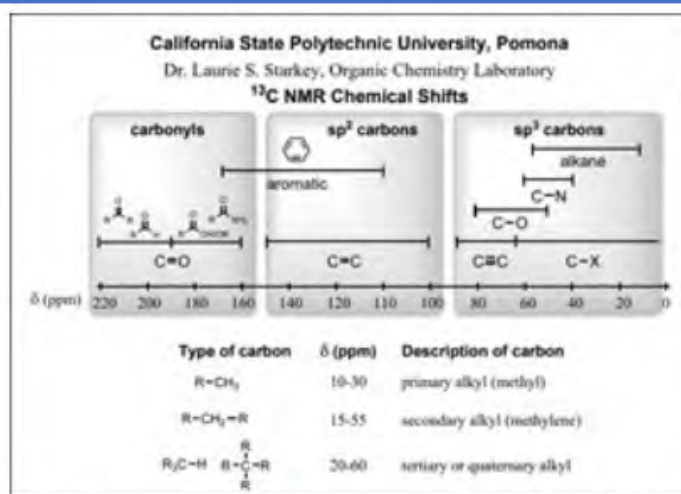
# Resources at [ChemistryConnected.com](http://ChemistryConnected.com)



## O-Chem Lab Techniques eBook

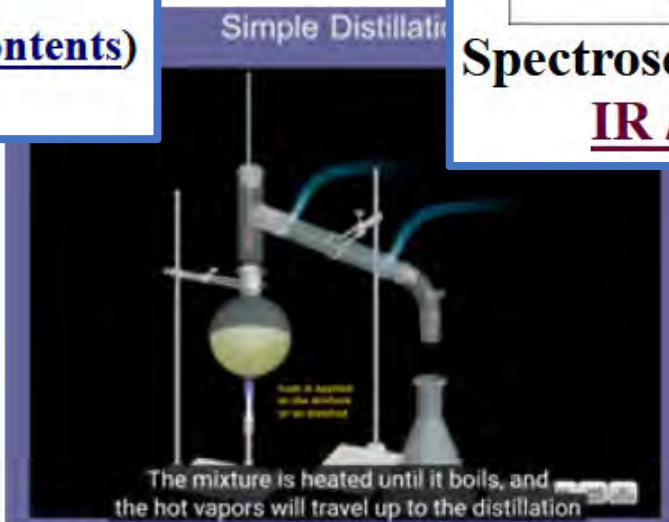
**FREE downloadable pdf**  
**with great pictures**

[Lab Manual \(PDF\)](#) ([Table of Contents](#))  
[Online Lab Manual](#)

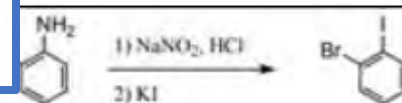


## Spectroscopy Handouts & Videos

### [IR / NMR / Mass Spec](#)



**Lab technique tutorials**  
**[Video Playlists on YouTube](#)**  
(Distillation, Extraction, TLC,  
Recrystallization, Melting Point)

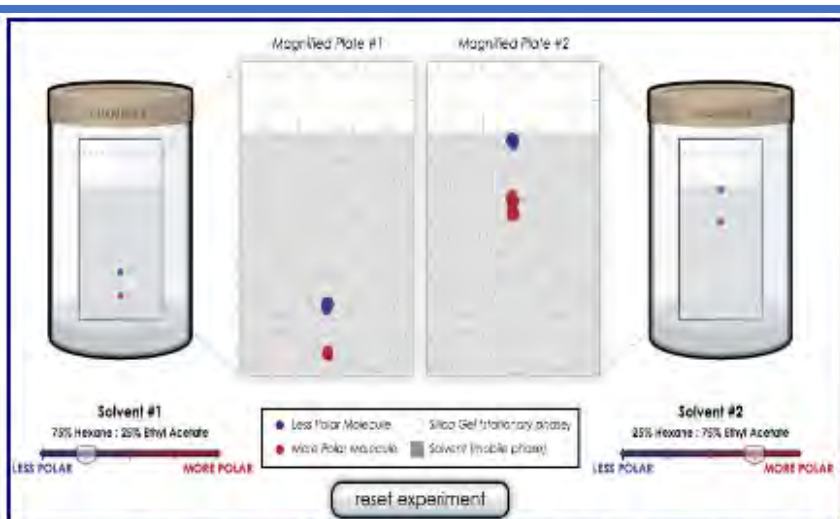


Reagent	MW	Density	Amount	Mole	Equiv.	Remarks
2-iodoaniline	172	1.56	2.0 mL			bp 229 °C
NaNO <sub>2</sub>	69	—	1.9 g			—
HCl (conc.)	—	—	5.0 mL			Corrosive!
KI	166	—	3.6 g			—
H <sub>2</sub> O	—	—	10 mL	—	—	—
2-iodobromo-benzene	283	2.2				bp 240 °C, mp 9 °C

Show your work here:

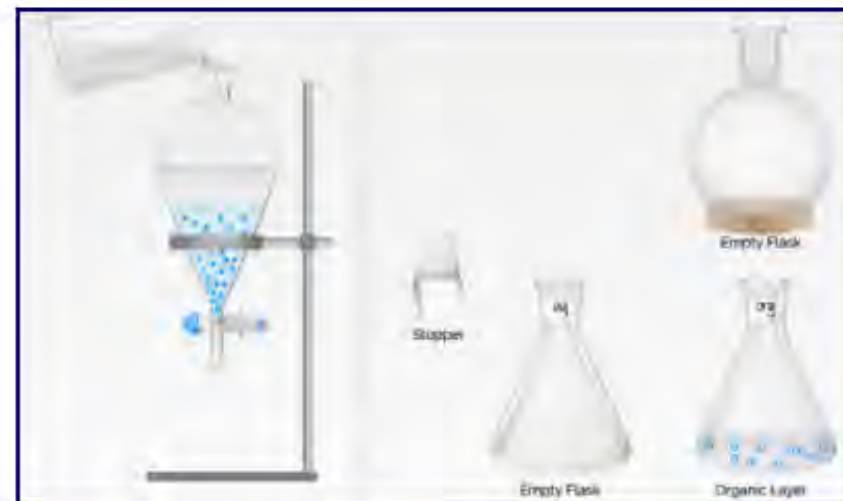
**Reagent Table practice**  
**[blank table](#) | [answer key](#) |**  
**[video solution](#)**

# Resources at [ChemistryConnected.com](http://ChemistryConnected.com)



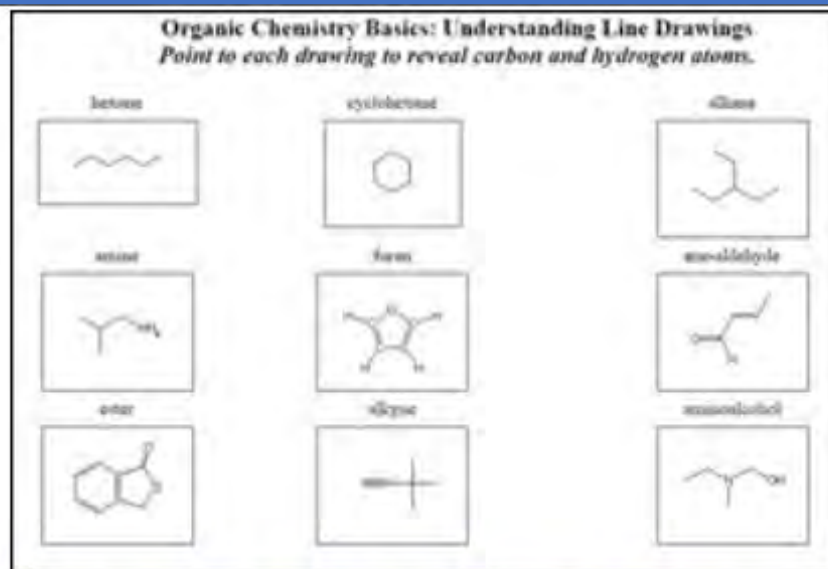
## TLC simulator (video)

- Thin Layer Chromatography: interactive [TLC simulation](#) (and [walk-through video](#))
- simulation [walk-through video](#)



## Extraction animation (video)

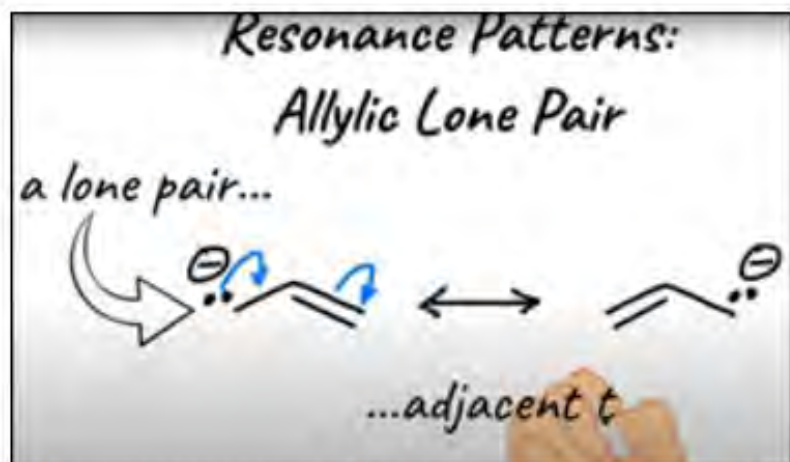
interactive "extract twice with ether" [animation](#) (and [worksheet](#))  
[animation walk-through video](#)



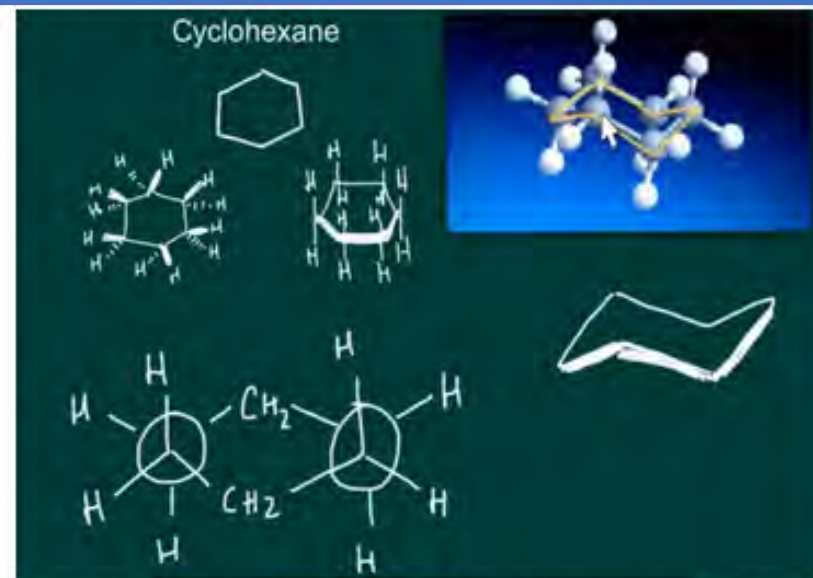
## Interactive Line Drawings page



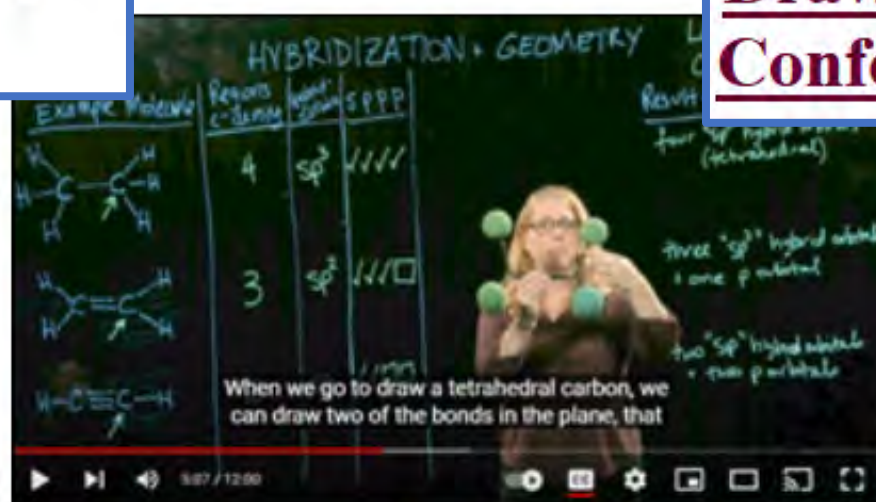
# Resources at [ChemistryConnected.com](http://ChemistryConnected.com)



**Resonance Pattern Tutorials**  
**4 videos (5 minute review)**  
**YouTube Playlist**



**Drawing Cyclohexane Chair**  
**Conformations video playlist**



**Introduction to hybridization video**



# ChemistryConnected YouTube Channel

<http://www.youtube.com/user/ChemistryConnected>



ChemistryConnected

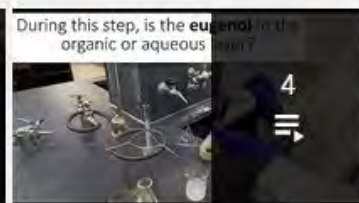
2.58K subscribers

Created playlists



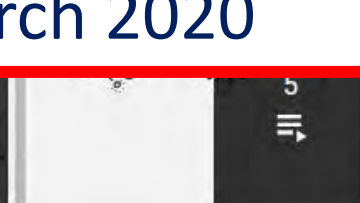
Friedel-Crafts Acylation of Ferrocene

[VIEW FULL PLAYLIST](#)



Solving Synthesis Problems using Aldol, Claisen, and Michael

[VIEW FULL PLAYLIST](#)



Resonance problems - set 1

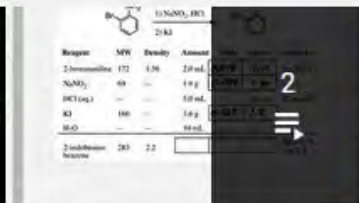
[VIEW FULL PLAYLIST](#)

During this step, is the **eugenol** in the organic or aqueous layer?



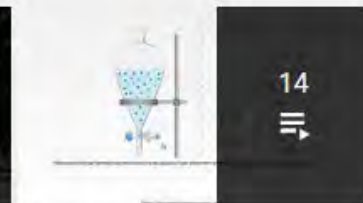
Drawing 3-D Sketches of Organic Molecules

[VIEW FULL PLAYLIST](#)



Hands-on Experiments for Kids

[VIEW FULL PLAYLIST](#)



Extraction Tutorial

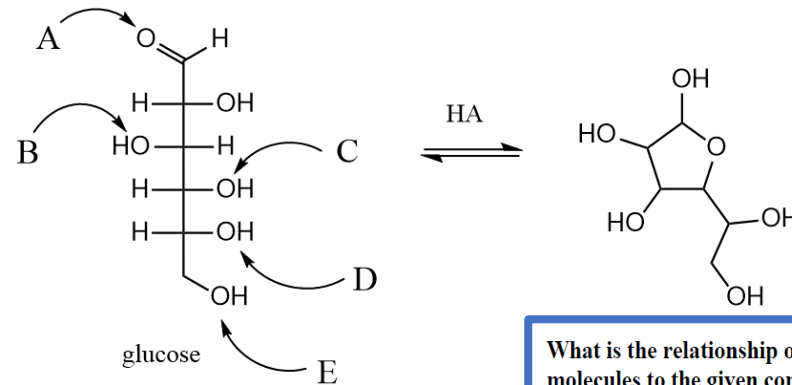
[VIEW FULL PLAYLIST](#)

“Inquisitive” lab demos  
eugenol video has over  
14,000 views since  
March 2020

# “Clickers” (CRS) to Encourage Active Learning

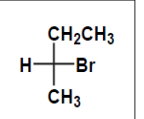
- **Formative assessment** (for students & faculty)
- transition, wrap-up, start of class, Exam review, **flipped classroom**
- More embedded questions
- Demonstrate tips/tricks
- Highlight common errors
- Encourage student participation (discuss with a neighbor)

Which of the oxygen atoms in glucose was involved in the cyclization to the furanose form shown?



What is the relationship of each of the following molecules to the given compound?

(e.g., identical, enantiomer, diastereomer, constitutional isomer, unrelated)



A)	identical	identical	identical	identical
B)	enantiomer	identical	enantiomer	enantiomer
C)	enantiomer	identical	enantiomer	identical
D)	identical	enantiomer	identical	enantiomer
E)	enantiomer	enantiomer	enantiomer	enantiomer

**Click = Commitment!**



# **Creative Clicker Question (Predicts Your Course Grade!)**

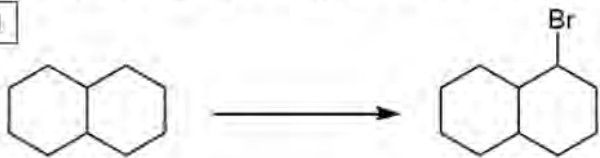
**How much work have you done in CHM 3140 so far to prepare for Exam 1? (Thursday, 10/22)**

- A) I read chapter 1 and worked ALL of the suggested problems.  
I have started reading/working on chapter 2.
- B) I read chapter 1 and worked MOST of the suggested problems.  
I read chapter 2 but haven't tried any problems yet.
- C) I read chapter 1 and worked some of the suggested problems.  
I haven't looked at chapter 2 yet.
- D) I looked up the answers to some of the problems in chapter 1  
and I knew I could do them.
- E) I've come to every lecture and have no trouble following along,  
but I haven't done much with the book or online problems yet.

# Clicker Questions & The Flipped Classroom

Transform the given starting material to the desired target molecule (TM).

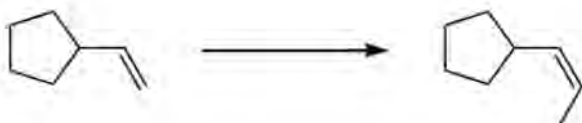
1



2



3



1 Which reagents would be best to achieve the following synthesis?



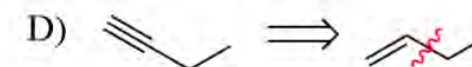
A) 1)  $\text{Br}_2$ , hv  
2) NaOEt  
3) HBr, ROOR

C) 1)  $\text{Br}_2$ , hv  
2) *t*-BuOK  
3) HBr, ROOR

B) 1)  $\text{Br}_2$ , hv  
2) NaOEt  
3) HBr

D) 1)  $\text{Br}_2$ , hv  
2) *t*-BuOK  
3) HBr

6 Which represents a logical disconnection in the retrosynthesis of the given target molecule?



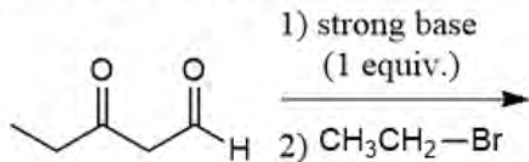
6 Synthesize 1-butyne, using acetylene as your only source of carbon atoms.



# Clicker Questions & The Flipped Classroom

Predict the major product.

2

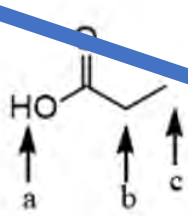
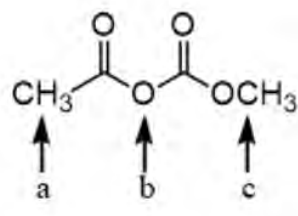
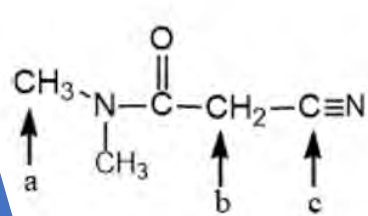


3

Draw LDA  
(lithium diisopropylamide)

4

Predict which site will react with one equivalent of LDA.



A) a

a

b

B) b

b

b

C) b

a

a

D) c

b

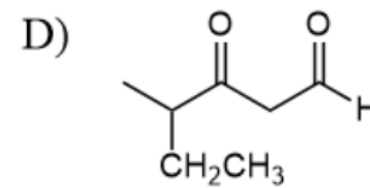
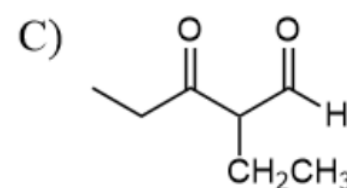
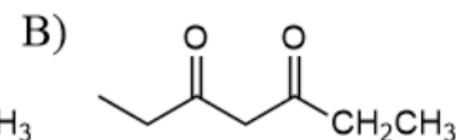
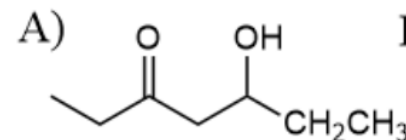
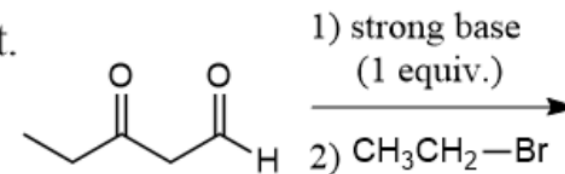
c

E) b

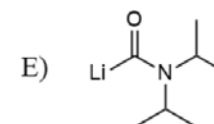
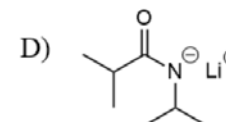
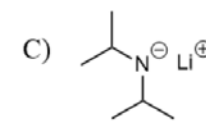
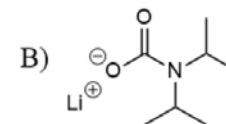
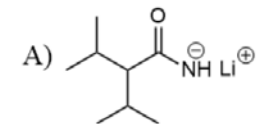
b

a

Predict the major product.

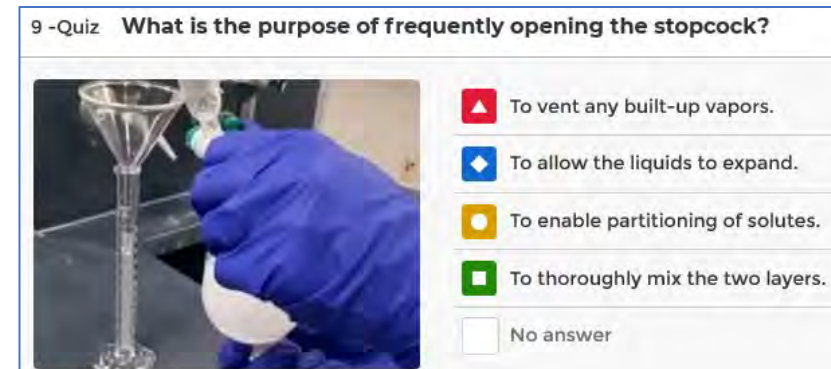
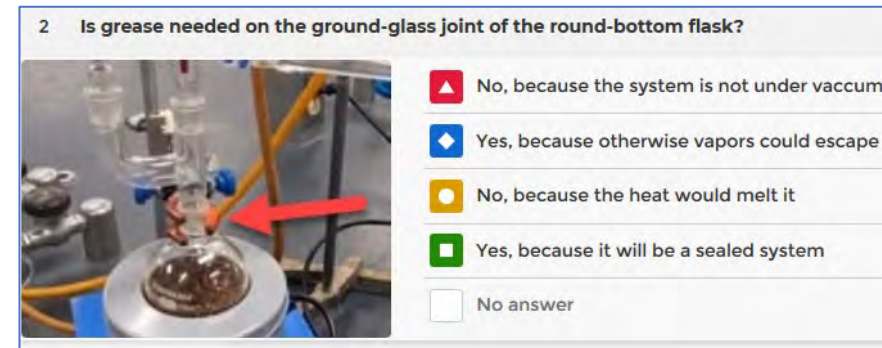
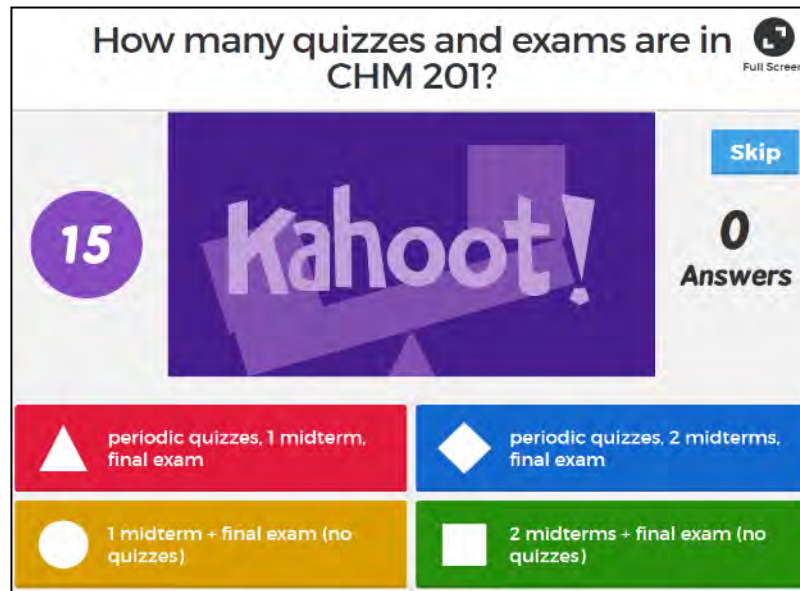
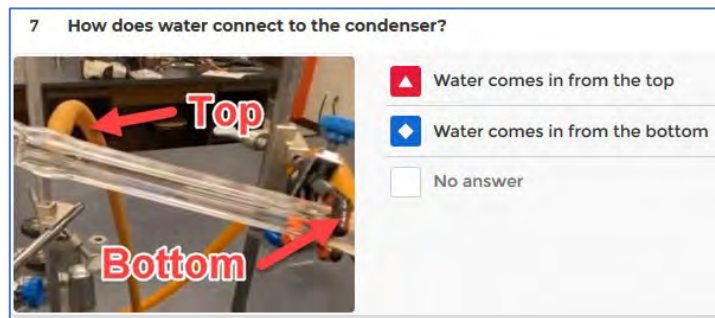
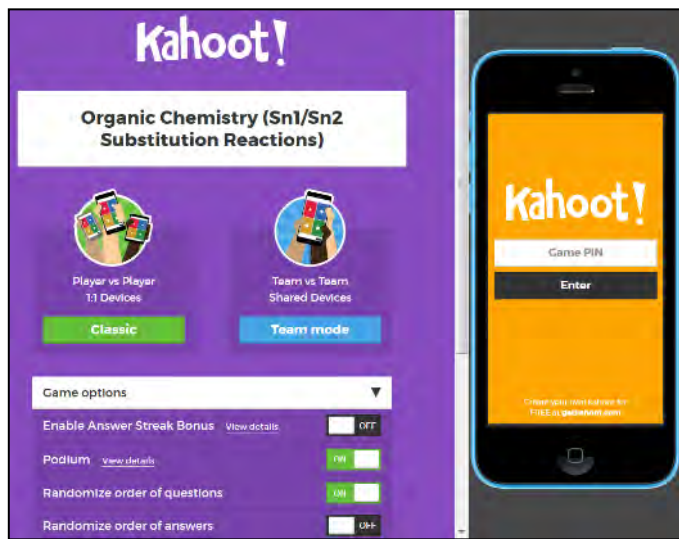


Which drawing represents LDA  
(lithium diisopropylamide)?



# Classroom ENGAGEMENT using Kahoot!

Clickers on steroids...FUN, gameshow-style multiple-choice questions using mobile devices (good for syllabus “quiz,” exam review, “inquisitive” lab interactivity and more Kahoot)





# Active Learning: Set Expectations, Rewards

## Example Grading Scheme

- 60% exams, lower-stakes final & lowest midterm is dropped
- 25% homework (WileyPLUS & “free red ink” assignments)
- 15% reflection (study groups, exam wrappers, writing prompts)

### How will your learning be measured?

Course grades are based on textbook-based homework (EOC), occasional quizzes, brief weekly assignments, three written midterm exams, and a final exam. I am planning on proctoring the written exams synchronously via Zoom, but please let me know if you need to adjust your time slot. *Each exam is cumulative but will emphasize the immediately preceding chapters.* Exams must be taken as scheduled and NO make-up exams will be given, but **the lowest midterm grade will be dropped**. If more than one midterm is missed, a grade of zero will be assigned for the missing midterm exam(s).

Homework problems	125 pts (25%)	End-of-Chapter (EOC) problems/WileyPLUS/Quiz
Weekly study/reflection	75 pts (15%)	Friday Fives, OLC Study Group, Exam Wrapper...
Ch. 1, 2, 3	Exam I	100 pts
Ch. 4, 5, 15	Exam II	100 pts
Ch. 6, 7	Exam III	100 pts
Ch. 1-11	Final Exam	100 pts
		(40%)
		(20%)

Thursday, 2/18 (60 min. during class time)  
Thursday, 3/18 (60 min. during class time)  
Thursday, 4/22 (60 min. during class time)  
Tuesday 5/18 (see schedule for times)



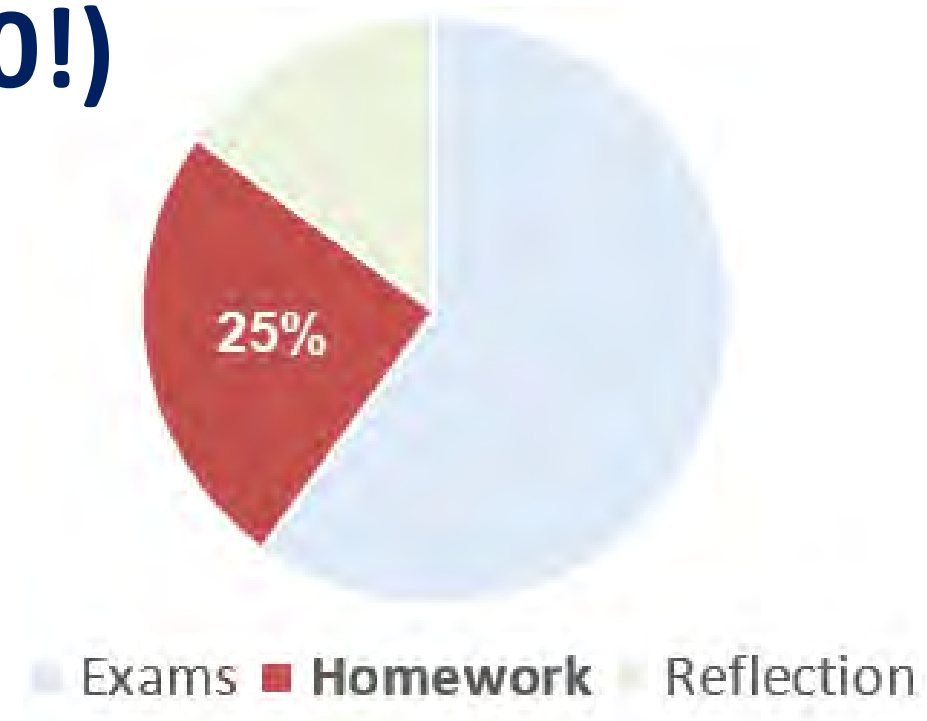
■ Exams ■ Homework ■ Reflection

**Goal: ENGAGE and MOTIVATE students!**

# Online Homework for Engagement with Text

## 25% Homework: Klein SkillBuilders and/or End-of-Chapter Problems (>5,500!)

- If you value it, assign points to it!  
(...and then *students value it!*)
- Encourages self-assessment and use of Solutions Manual
- **WileyPLUS**: interaction with e-textbook/resources, auto-grading = 24/7 feedback, 100% redesigned



# WileyPLUS customizable course shell

## Facilitates navigation and ENGAGEMENT with textbook

► Instructor Resources (Lecture Slides, Clicker Questions, Test Bank, Chapter Images)

▼ Getting Started

Klein, Organic Chemistry 4e, 2nd Semester

▼ Module 0: Academic Integrity

Academic Honesty Quiz  
100 pts

► Module 3: Acids and Bases

► Module 4: Alkanes and Cycloalkanes

► Module 5: Stereoisomerism

► Module 6: Chemical Reactivity and Mechanisms

► Module 7: Alkyl Halides: Nucleophilic Substitution and Elimination Reactions

▼ Module 8: Addition Reactions of Alkenes

DID YOU EVER WONDER...what Styrofoam is and how it is made?

8.1 - 8.4: Introduction & Nomenclature of Alkenes  
35 pts

8.5: Hydrohalogenation (SkillBuilders 8.1 & 8.2)  
75 pts

8.6 - 8.8: Addition of H<sub>2</sub>O (SkillBuilders 8.3 & 8.4)  
80 pts

8.9: Catalytic Hydrogenation (SkillBuilder 8.5)  
20 pts

8.10: Halogenation and Halohydrin Formation (SkillBuilder 8.6)  
30 pts

8.11 - 8.13: Dihydroxylation and Oxidative Cleavage (SkillBuilders 8.7 & 8.8)  
55 pts

8.14: Predicting the Products of an Addition Reaction (SkillBuilder 8.9)  
30 pts

8.15: Synthetic Strategies (SkillBuilders 8.10, 8.11 & 8.12)  
85 pts

End of Chapter Problems: Chapter 8  
160 pts

Mechanism Quiz: Chapter 8  
60 pts

8.6 - 8.8: Addition of H<sub>2</sub>O (SkillBuilders 8.3 & 8.4)

Readings and Interactives:

8.6: Acid-Catalyzed Hydration

A Mechanism for Acid-Catalyzed Hydration of Alkenes

Mechanism 8.2 Acid-Catalyzed Hydration

8.7: Oxymercuration-Demercuration

8.8: Hydroboration-Oxidation

A Mechanism for Hydroboration Oxidation of Alkenes

Mechanism 8.3 Hydroboration-Oxidation

Solved Problem Videos:

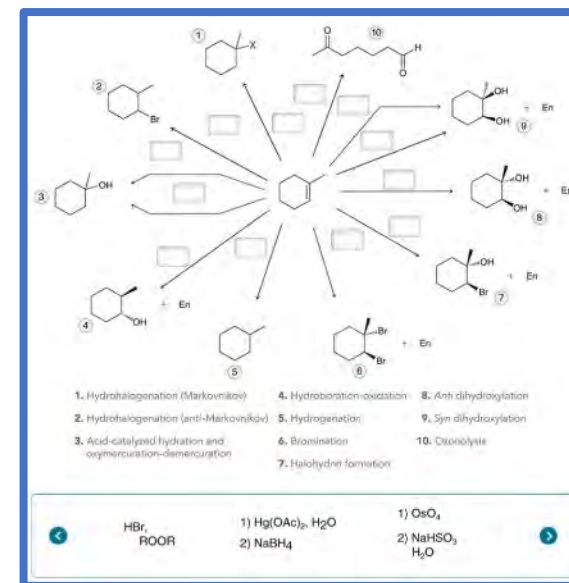
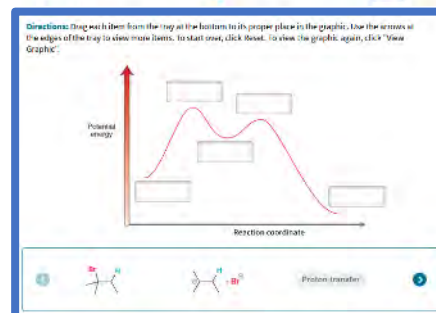
SkillBuilder 8.3, Problem 8.15a

SkillBuilder 8.3, Problem 8.15b

SkillBuilder 8.4, Problem 8.21

Legend:

Reading Video Interactive Lightboard



▼ ACS Final Review

ACS Problems: Chapters 1-6  
52 pts

ACS Problems: Chapters 7-11  
43 pts

ACS Problems: Chapters 12-18  
56 pts

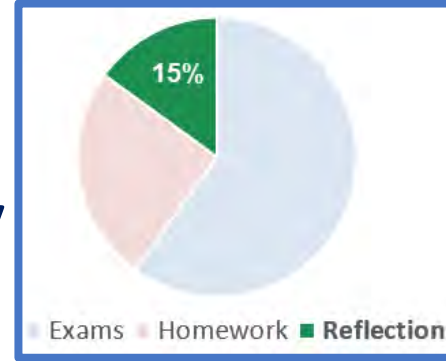
ACS Problems: Chapters 19-22  
31 pts

Mechanism Quizzes: Chapters 7-13  
25 pts



# Keeping Students Motivated

**15% of grade:**  
study groups and weekly  
“Friday5” reflection



Motivate Lab training (GPS)

- ✓ **Growth Mindset**
- ✓ **Purpose & Relevance**
- ✓ **Sense of Belonging**

Dustin Thoman  
[dthoman@sdsu.edu](mailto:dthoman@sdsu.edu)



# GPS: Encouraging a Growth Mindset

- Value formative assessment  
(points for textbook problems!)
- Discuss study strategies
- Drop lowest exam
- Metacognitive exercises
  - Exam Wrapper
  - Weekly “Friday5” study plan check-in



resources

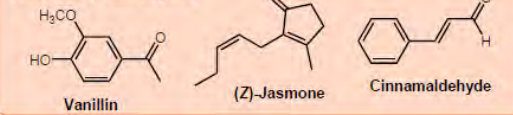


# GPS: Focusing on Purpose and Relevance

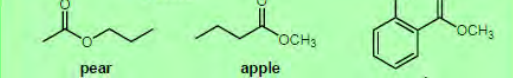
- Weekly reflection assignments
  - Find/share an interesting molecule
  - Tell me why this course matters to you
- Share stories of former students
- Provide “hooks” to grab attention

## Fragrant Carbonyl Compounds

### Ketones & Aldehydes



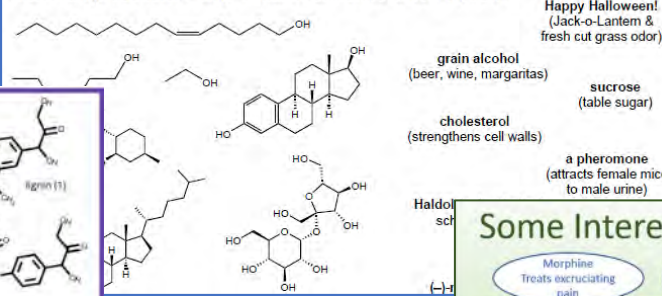
### Esters



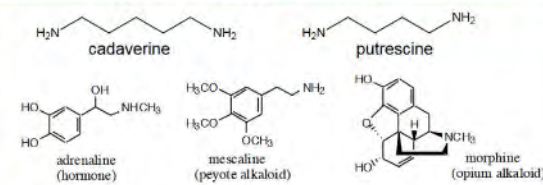
## Common Names of Carboxylic Acids

 formic acid found in ant stings	 acetic acid found in vinegar	 butyric acid found in butter	 valeric acid found in valerian root	 caproic acid found in goat milk	 heptanoic acid found in goat milk	 octanoic acid found in goat milk
 nonanoic acid found in goat milk	 11 undecanoic acid found in lemon	 13 tridecanoic acid found in lemon	 15 pentadecanoic acid found in lemon	 17 heptadecanoic acid found in lemon	 19 nonadecanoic acid found in lemon	 21 heneicosanoic acid found in lemon
 23 tricosanoic acid found in lemon	 25 pentacosanoic acid found in lemon	 27 heptacosanoic acid found in lemon	 29 nonacosanoic acid found in lemon	 31 triacontanoic acid found in lemon	 33 hentriacontanoic acid found in lemon	 35 triacontanoic acid found in lemon
 37 heptacosanoic acid found in lemon	 39 nonacosanoic acid found in lemon	 41 triacontanoic acid found in lemon	 43 hentriacontanoic acid found in lemon	 45 pentacosanoic acid found in lemon	 47 heptacosanoic acid found in lemon	 49 nonacosanoic acid found in lemon

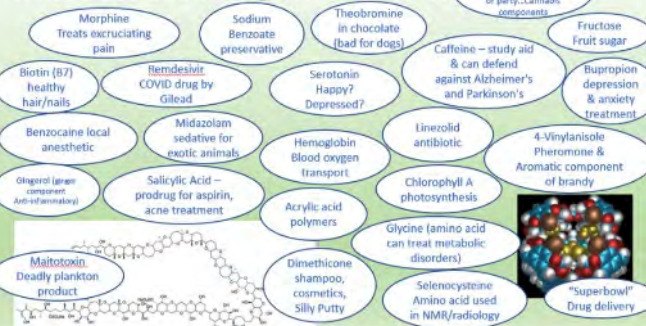
## Interesting Alcohols: Can you Match Structure & Description?



## Interesting Amines



## Some Interesting Molecules!



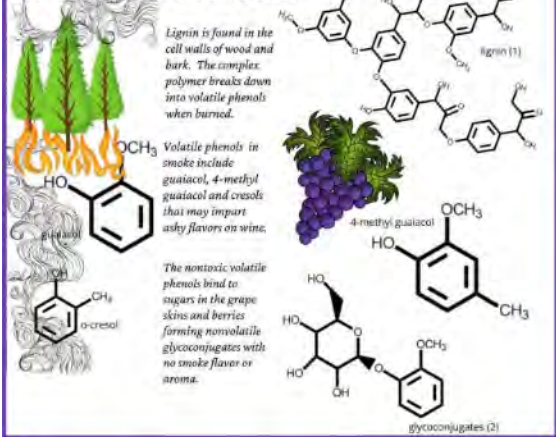
## CPP Grad & Veterinarian Kim De La Peza

- B.S. Animal Science CPP 2008
- D.V.M. Michigan State 2012
- Emergency Room Vet
- VCA Animal Hospital

What will your story be?



## Smoke Taint in Wine





# GPS: Build Community, Sense of Belonging

## Redesigned syllabus

- Student-centered, you/I/we

## Introduction video

- Introduce yourself, share your passion

## Course Padlet

- Students can introduce themselves

## Encourage study groups

- Organic Learning Community (OLC)
- Offer credit for weekly report w/selfie pic [Student testimonials](#)

**Communicate: Discord Server, Google Voice (texting)**



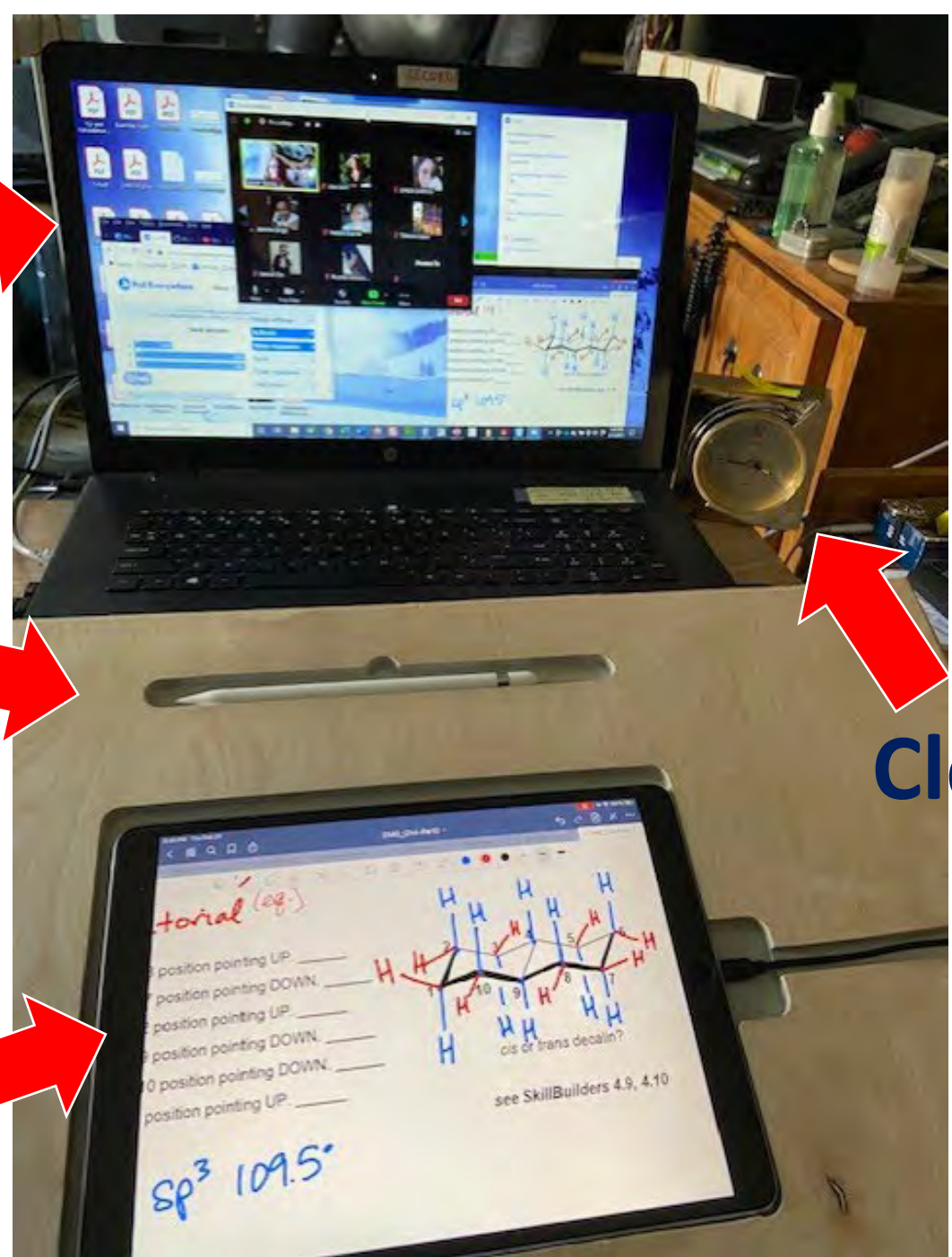
Welcome to Organic Chemistry!

# My Remote Classroom Laptop (Zoom & Webcam)

Support Board  
(Ergonomics!)



iPad (Zoom  
& GoodNotes)



Clock!



# How to: Teach, DRAW & Show Models Using Zoom

The screenshot shows a Zoom meeting window with several features highlighted by red boxes and arrows:

- Shared iPad screen:** Points to the top of the shared screen area.
- Zoom Attendees:** Points to the grid of participant video feeds.
- Chat Q/A:** Points to the chat window on the right side.
- Anonymous Polling:** Points to the bottom toolbar where the poll icon is located.
- My Webcam:** Points to the participant's own video feed in the grid.

The shared screen displays a chemistry reaction scheme and a poll results page.

**Chemistry Reaction Scheme:**

Reaction 1: Cyclopentanone  $\xrightarrow{\text{Step 1}}$  1-cyclopentanol  $\xrightarrow{\text{Step 2}}$  1-acetylcyclopentane

Reaction 2: Cyclopentanone  $\xrightarrow{\text{Step 1}}$  1-cyclopentanol  $\xrightarrow{\text{Step 2}}$  1-acetylcyclopentane

Reaction 3: Cyclopentanone  $\xrightarrow{\text{Step 1}}$  1-cyclopentanol  $\xrightarrow{\text{Step 2}}$  1-acetylcyclopentane

**Poll Results:**

Option	Percentage
A	11%
B	11%
C	56%
D	11%
E	22%



# Back in the Classroom: Best of Both Worlds?



**...or literal Sherpa?!**

**Thank you! Any Questions?** [lsstarkey@cpp.edu](mailto:lsstarkey@cpp.edu)



[chemistryconnected.com](http://chemistryconnected.com)

## Jedi Training in 2020-21

***"Luke, you  
must learn  
the ways of  
the force"***



***"I'm ready,  
Obi Wan."***



***"Ooooookay. Let's  
see here. After  
you've logged in,  
you're gonna  
want to go to the  
student portal  
and click Jedi...."***

