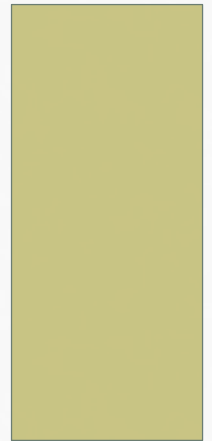


MIND THE GAP: EVALUATING
PREREQUISITE CONNECTIONS
BETWEEN COURSES

TEAGLE FOUNDATION GRANT



WHY AREN'T STUDENTS "READY" FOR THE NEXT COURSE?

- The prereq course "skipped" a needed topic *or*
- The prereq course wasn't rigorous enough *or*
- The prereq course was so long ago the material has become hazy in the mists of time *or*
- There's a gap in the topics/competencies expected in the next course and the prerequisite course *or*
- Maybe we need to change how we teach some topics (just in time review?) *or*
- Maybe we need to think about scaffolding some topics more intentionally across courses linked by prereqs

MIND THE GAP

- How do we know that prerequisite courses are teaching the material expected in the subsequent course?
- How do we know that the material taught in the prerequisite courses is being taught at the level expected?
- What skills and competencies do we want students to come into a class with?
- What skills and competencies do we want students to leave a class with?
- How do we make sure students are not falling into gaps in knowledge between classes?

APPROACH AND GOALS

- Keep the focus on student learning and content of courses, not on faculty teaching
- Get away from lists of topics/sections in text books and develop lists of what we expect students to do with those topics (Bloom's Taxonomy)
- Create lists of prerequisite competencies for courses. Share this list with (1) students and (2) instructors of the prereq courses. If possible, provide assignments or resources so that students can get caught up.
- Create lists of competencies for the course itself that can be used to help new instructors teach the course. Share with students and instructors of the next course in the sequence.

MIND THE GAP

- General Chemistry – full year (CHEM 115/215)
 - taught by lecturers and tenured/tenure-track faculty
- General Organic Chemistry (CHEM 130)
 - one semester organic chemistry course for some biology majors, dietetics majors
 - prereq for a one semester biochemistry course for the same population
 - taught by lecturers
- General Biochemistry (CHEM 349)
 - one semester general biochemistry course for some biology majors, dietetics majors
 - taught by lecturers

WHAT DOES CHEM 349 NEED FROM GENERAL CHEMISTRY?

Specific Learning outcomes from Chem 115/215 useful for Biochem 349

	where do they get this?	
1. calculate the relative number of moles of reactants and products in a reaction	115/215	
2. calculate the molarity of solutions	115/215	
3, identify hydrogen donors and hydrogen acceptors	115	
4. draw hydrogen bonds	215	dietetics majors will not have taken 215, as it is not required for their major.
5. predict if a chemical reaction will occur from ΔG values	215	
6. understand standard free energy	215	
6. calculate the thermodynamic quantity (ΔG°) from equilibrium constants	215	
7. understand relationship between large positive (or negative) ΔG° values & magnitude of the equilibrium constants and extent of a reaction	215	
8. calculate ΔG when the concentration of reactants and products are not at equilibrium-apply Le Chatelier's Rule	215	
9. Predict rates for zero, first and second order reactions	115/215	
10. draw a reaction profile in absence and presence of a catalyst	115/215	
11. Understand the significance of pK_a and its relation to acid strength	115/215	
12. understand the relationship between pK_a and pH and proton loss or gain and charge of element at differ pH values	I am not sure if this is done explicitly in 215	
13. Identify oxidation/reduction reactions and which molecules are being oxidized (reduced)	115/215	
14. Balance oxidation/reduction reactions by the "half-reaction" method	215	
15. Predict from ΔE° whether oxidation or reduction is favored	215	
16. Calculate the ΔG° for an oxidation/reduction reaction from ΔE° .	215	

WHAT DOES CHEM 349 NEED FROM ORGANIC CHEMISTRY?

Specific Learning outcomes from Ochem useful for Biochem 349

1. identify (from structures) key organic functional groups-alkanes, alkenes, alcohols, ketones, aldehydes, carboxylic acids, amines (primary, secondary, tertiary), thiols
2. Identify (from structures) the following types of linkages esters, amides, ethers
3. Relate structures of the key functional groups to physical properties- ie water solubility, acidic, basic nature, and determine the charge on these groups at neutral pH
4. Understand the terms- conjugation, isomers and enantiomers and relate to point 5
5. Identify cis and trans alkenes. identify chiral carbons and assign R/S configurations
6. understand carbon ring stability
7. understand the term aromatic
8. identify oxidation reduction reactions; Understand that alkanes are more reduced than alkenes: alcohol more reduced than ketone etc
9. understand how alcohols are formed from alkenes and H₂O
10. understand how esters are made from alcohols and carboxylic acids
11. understand how amides are made from amines and carboxylic acids
12. understand how carbon carbon bonds are made-aldol condensation/claisen condensation

CHANGES TO CHEM 130

Chem 130: General Organic Chemistry

Curriculum Goal:

Create a list of competencies for CHEM 130. Review and discuss competencies in the prerequisite course (CHEM 115) and in the next course in the sequence (CHEM 349). Modify and refine competencies as needed.

Textbook:

Essential Organic Chemistry by Bruice

Themes:

1. Molecular Structure and General Reactivity
 2. Conformations and Stereochemistry of Alkanes
 3. Substitution vs. Elimination Pathways with Haloalkanes
 4. Reactivity of Unsaturated Hydrocarbons
 5. Reduction/Oxidation Processes
 6. Carbonyl Derivatives (Part 1: Reactivity of Electrophilic Carbonyl Carbon)
 7. Carbonyl Derivatives (Part 2: Reactivity of Nucleophilic α -Carbon)
 -
 8. NMR Spectroscopy (Optional)
-

Course and Learning Objectives by Theme:

1. *Molecular Structure and General Reactivity* ****Sample Problem Set for (A)-(C) Attached****

CHANGES TO CHEM 130

DETAILED COMPETENCIES

4. *Substitution vs. Elimination Pathways with Haloalkanes*

(A) Describe the SN1 and SN2 reactions between an alkyl halide and a nucleophile

- Provide an arrow pushing mechanism for the SN1 and SN2 reactions
- Explain the stereochemical outcome of each transformation
- Construct reaction coordinate diagrams for both the SN1 and SN2 substitution reactions
- Describe the factors (of the alkyl halide and nucleophile) that enhance the rate of each reaction

(B) Distinguish elimination reactions from substitution processes

- Provide arrow-pushing mechanisms for the E1 and E2 reactions
- Describe the factors (of the alkyl halide and base) that enhance the rate of each reaction
- Predict whether a SN1/SN2/E1/E2 reaction will occur under given reaction conditions

(C) Provide examples of non-alkyl halide electrophiles that undergo substitution/elimination reactions

- Explain why certain non-alkyl halides are suitable electrophiles
- Recognize biochemical examples where non-alkyl halides will undergo SN1/SN2/E1/E2 reactions

CHANGES TO CHEM 130

FOCUS ON REACTIONS TO INCLUDE

5. *Reduction/Oxidation Processes (Chapter 9 and 12)*

PCC oxidation of alcohols (9)

CrO₃ oxidation of alcohols (9)

NaBH₄ reduction of aldehydes and ketones (12) - ****topic presented from later in text****

6. *Carbonyl Derivatives (Part 1: Reactivity of Electrophilic Carbonyl Carbon) (Chapter 11 and 12)*

Hydrolysis of esters and amides (11)

Transesterification (11)

Fischer esterification (11)

Amide synthesis (11)

Acetal formation (12)

Imine formation (12)

Conjugate addition (12)

HOW DID FUNDING THIS PROJECT HELP?

- We could pay faculty to do the work to create prerequisite competencies and course competencies
- We had an all day retreat for people to share the list and meet in small groups to discuss the connections between courses in more detail (65% attendance, representation across all courses)
- External validation that doing the work of curricular revision is valued

ONGOING CHALLENGES

- continue to have ongoing conversations about our courses and updating information continuously
- getting information to the people who need it: those who teach the prereq course, those who teach the subsequent course, and students taking the course
- nudging people towards thinking that maybe they could teach their own class differently to address any gaps.