EMU Biochemistry Program Assessment

Round 1: (1) Establish framework for assessment →knowledge progression through curriculum.
(2) Validate assessment instrument → One component of one student learning outcome (equilibrium).

Round 2: Implementation of assessment instrument for student learning outcome.

IMPLEMENT*

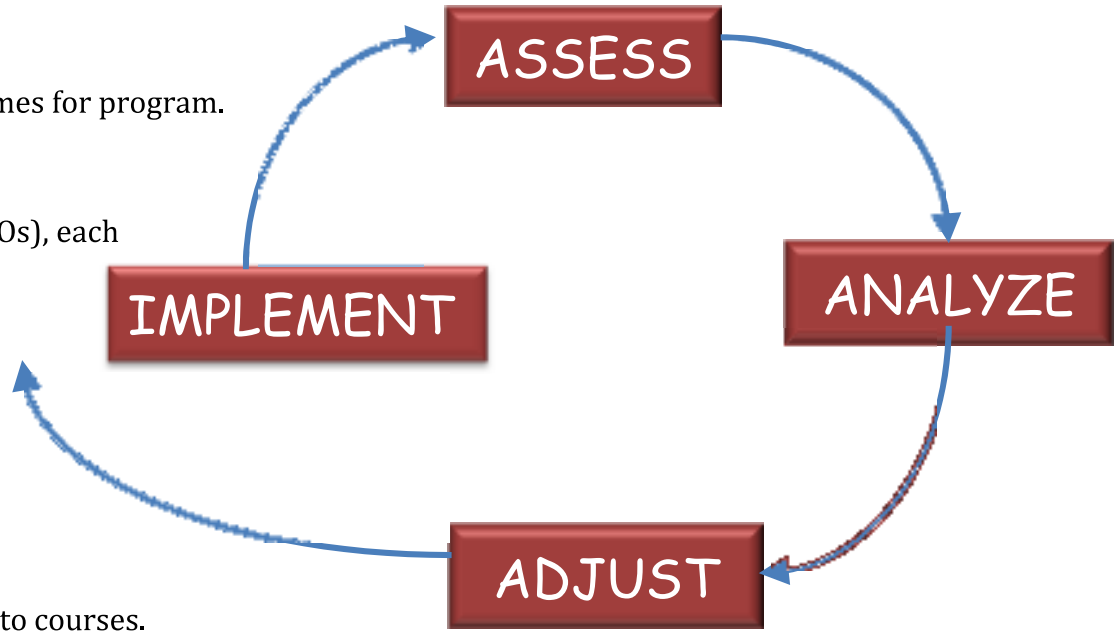
*The Framework for assessing "knowledge progression" in chemistry curriculum.

1. Program Review 2007-2008

   a. The model: Continuous Improvement
   b. The goal: Establish Student Learning Outcomes for program.

2. Assessment Committee (2008-2009)
   a. Propose four student learning outcomes (SLOs), each containing four to six components.
      - Conceptual/quantitative problem solving in chemistry
      - Lab techniques in chemistry
      - Professional skills/standards
      - Practice of chemistry as scientific endeavor

   b. Propose curriculum map (CM) → links SLOs to courses.
   c. Brought to Chem faculty to refine/approve SLOs and Curriculum Map.



IMPLEMENT *

Curriculum Map: Biochemistry Program	R 121	R 122	R **123/ 125**	R 124/ 126	270	271	R **281/ 282**	R 361	R 371	R **372**	R 373/ 376	381	461	463	465	R 451	R 452	R 453	481	475	Res Coop	415	411	412	413
Students will evaluate problems in chemistry using conceptual and quantitative approaches																									
Stoichiometry	*	*	*	*		*	*				*					*		*							
Phys.-Chem. properties	*	*	*	*	*	*		*	*	*	*			*		*	*						*	*	
Chemical bonding and reactivity	*	*	*	*	*	*		*	*	*	*			*	*	*	*			*		*	*		
Thermodynamics	*	*	*	*	*	*		*	*	*	*		*	*	*	*	*								
Kinetics			*	*	*			*	*	*			*	*	*	*						*	*		*
Equilibria			*	*	*	*	*	*	*	*	*		*	*	*	*						*	*		

R = Required course in General Biochemistry Curriculum AND Professional Biochemistry program

IMPLEMENT*

3. Develop assessment instrument for one component of SLO #1: Equilibrium (F '08).
4. Faculty survey of equilibrium exam questions used in chemistry courses (F '08).
5. Develop set of questions from survey that can be used to assess "knowledge progression" (W '09).

    - Variables tested:

        - Variable 1: Reversibility of chemical reactions.
        - Variable 2: Le Chatelier's Principle.
        - Variable 3: Quantitative aspects of equilibrium.

    - Bloom's level for each question.

        - K=Knowledge level, A=Applied level, S=Synthesis level

ASSESS*

*Assessing (validating) the assessment instrument

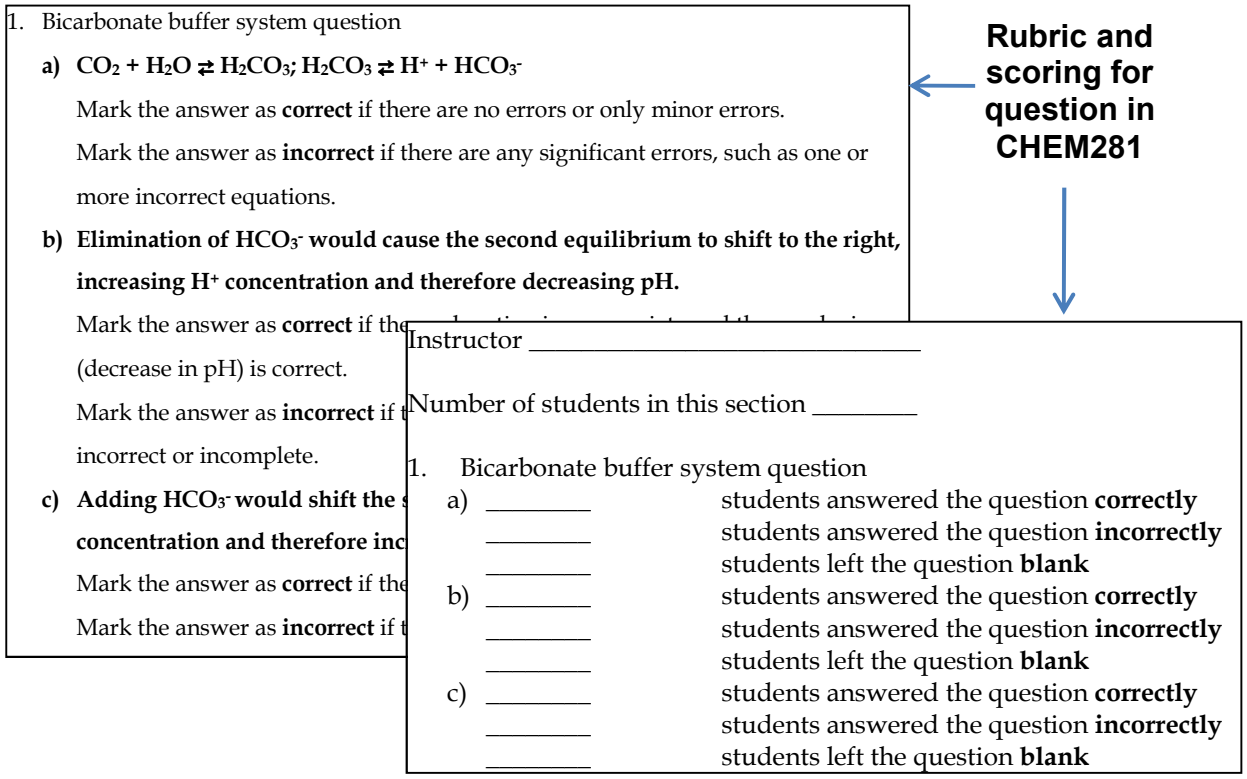
1. Assess conceptual and quantitative aspects of equilibrium at three levels of Bloom's taxonomy throughout curriculum.

    - 100-level: General Chemistry II (CHEM123)
    - 200-level: Quantitative Analysis (CHEM281)
    - 300-level: Organic Chemistry II (CHEM372)
    - 400-level: Biochemistry I (CHEM451)

2. Questions embedded in instructors' exams during the semester (after material presented).

ANALYZE/ADJUST

1. Interview students: Determine if equilibrium questions were clearly stated (Su/F '09).
    a. CHEM123 and CHEM451: Did not change in question
    b. CHEM372: Rewrite question.
    c. CHEM281: Make questions reflect language used in course.
2. Develop rubric for grading equilibrium questions (F '09).
3. Instructor review of questions and rubrics (F '09).



ADJUST*

Example of adjusting questions based on student interviews:

Original question in CHEM281

1. **Answer the following questions about the bicarbonate buffer system. The pKa for H_2CO_3 is 6.1.**

   A patient is found to have a $[HCO_3^-]$ of 29.5 mmol/L and a $[H_2CO_3]$ of 2.4 mmol/L. The pH of normal blood is 7.4. Is the patient suffering from acidosis (a blood pH more acidic than 7.4) or from alkalosis (a blood pH more basic than 7.4)? SHOW your answer assuming that the bicarbonate buffer system is the only buffer system controlling blood pH.

   Variable: 3, Level: K, A

Refined question in CHEM281

1. **HCO_3^- (bicarbonate) is an important species in biological systems. It comes from CO_2 dissolving in the blood (pH=7.42).**
   a) **Write the equilibrium reactions for CO_2 dissolving in blood (Hint: since blood is mostly water, you can consider it to be water in your reactions).**
   b) **Some medicines cause people to eliminate HCO_3^- in excess. How would loss of HCO_3^- affect blood pH?**
   c) **By adding more of which of the existing species in the system would the pH return to normal (pH 7.4)?**

*Modify assessment instrument after analysis.

Now that the Equilibrium exam questions are validated, the department can begin to collect data on student performance and determine where and what kind of adjustments need to be made in instruction. The Chemistry Department is going to continue with this assessment strategy for assessing student learning for the other chemistry concepts.