Understanding the Redesigned AP Chemistry Course: Curriculum and Science Practices for AP Chemistry

Jamie Benigna, John Hnatow

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Agenda

- Course Redesign Overview
- Validation Results
- Exam Revision
- Lab Manual Development
- Course Audit
- Q&A

Because of you…

- More students than ever are taking AP Chemistry
- AP students feel inspired and encouraged
- More students are pursuing STEM careers

Major Changes to AP Chemistry

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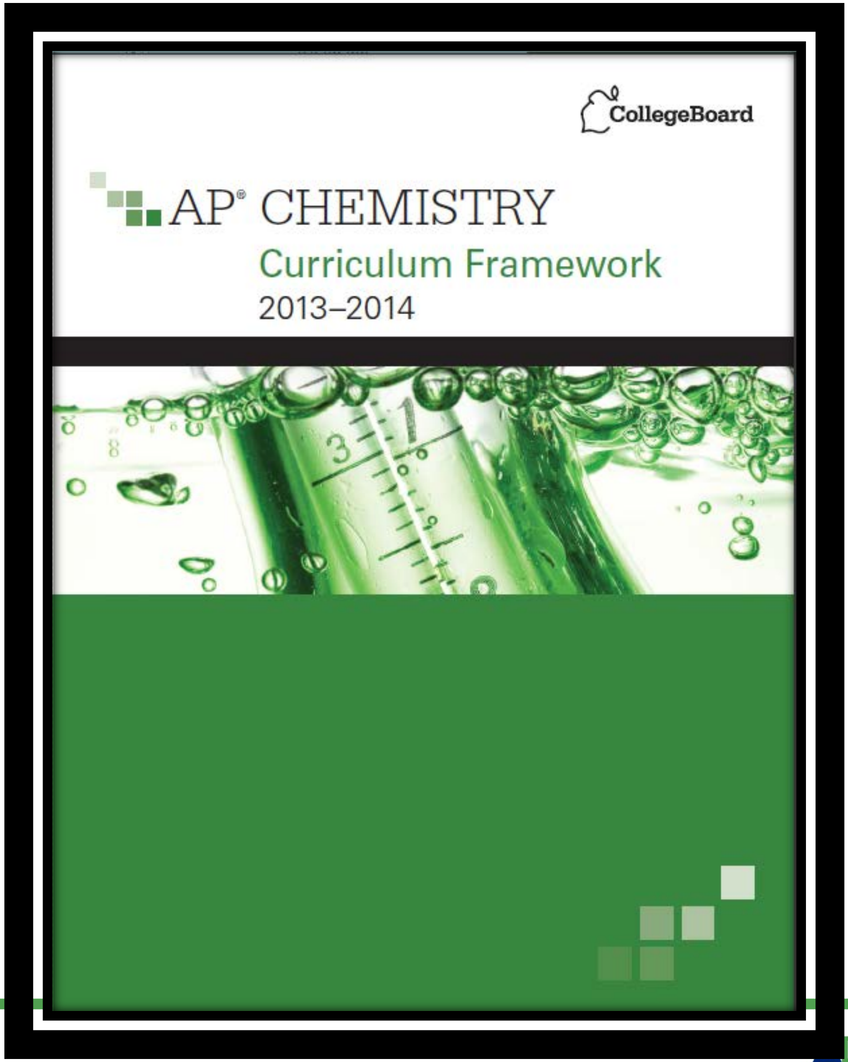
AP Chemistry, 2013-14

- Detailed curriculum framework
- New inquiry-based lab manual
- Revised exam
- Professional development opportunities



What's Changing?

New Approach: Essential Content + Skills + Inquiry

New Structure: 6 Big Ideas, 25 Enduring Understandings

New and Transparent Exam: Learning Objectives, Formula List, Calculator Policy

New Scope:

1. More emphasis on concepts and skills
2. Explicit exclusion statements
3. Specific content reductions

1. More emphasis on concepts and skills

Clear learning objectives provide a window for what content and science practices will be assessed.

Content

+

Skill

Learning Objective

Essential Knowledge 3.C.3
Electrochemistry shows the interconversion between chemical and electrical energy in galvanic and electrolytic cells.

Science Practice 5.1
The student can analyze data to identify patterns or relationships.

Learning Objective (3.C.3 & 5.1)
The student can analyze data regarding galvanic or electrolytic cells to identify properties of the underlying redox reactions.

2. Explicit Exclusion Statements in CF

Example from Big Idea 2: Bonding and IMFs

✘ *Calculations of molality, percent by mass, and percent by volume are beyond the scope of this course and the AP Exam.*

Rationale for Each Exclusion Statement

- In the Course and Exam Description each exclusion statement will have associated rationale statements pertaining to why the content is identified as prior knowledge or beyond the scope the course.
- For example:
  - Rationale: Calculations of molality are only necessary if colligative properties are included in the course. One of the goals of the redesign is a deeper conceptual understanding of chemistry and a reduction on algorithmic calculations. The calculations of percent by mass and percent volume are algorithmic.

3. Specific Content Reductions

- Memorization of the exceptions in electron configuration of atoms and solubility rules
- Constant volume calorimetry
- Writing nuclear reactions
- Lewis Acid-Base Theory
- Deriving the Henderson-Hasselbalch equation
- Computations of solubility as a function of pH
- Memorizing specific types of crystal structures
- Using standard enthalpies of formation to calculate the overall energy change in a reaction

Examples of Breadth and Depth of the Revised Course

Emphasized	No Longer Assessed
Refining models using experimental evidence , such as PES data to refine quantum mechanic models of the atom	**Memorizing** electron configuration exceptions and assigning quantum numbers
Representing the structure and function of large biomolecules based on IMFs	**Memorizing** specific types of crystal structures or memorizing solubility rule exceptions

Higher Ed Validation and AP Teacher Survey Results

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AP Chemistry Higher Ed Validation

Sixty faculty from leading higher ed institutions confirmed the following:

- ✓ The course will prepare students for continued success in sequent college chemistry courses.
- ✓ The revised AP Chemistry course provides an appropriate amount of breadth and depth.
- ✓ Higher ed institutions are willing to grant credit and placement to students who complete the course successfully.

AP Teacher Survey Results

Feedback about the **current** course:

- Does not meet pacing needs
- Too much material to cover in one year
- Not enough time to incorporate real-world applications
- Too much emphasis on picky details and not big picture ideas

AP Teacher Survey Results

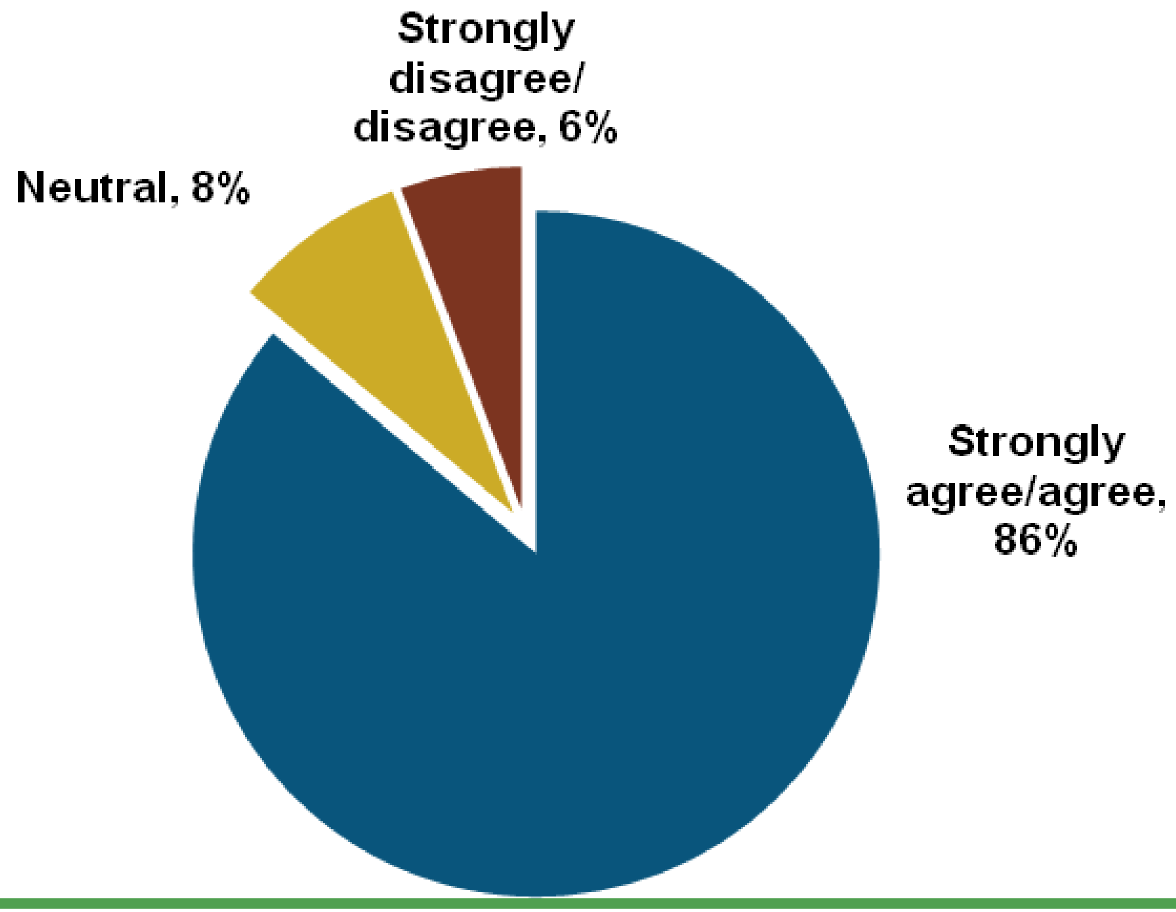
Feedback about the **revised** course:

- Clearly communicates course expectations to teachers
- Takes into account the limitations of the high school schedule
- Keeps current level of rigor and specificity

A Change for the Better

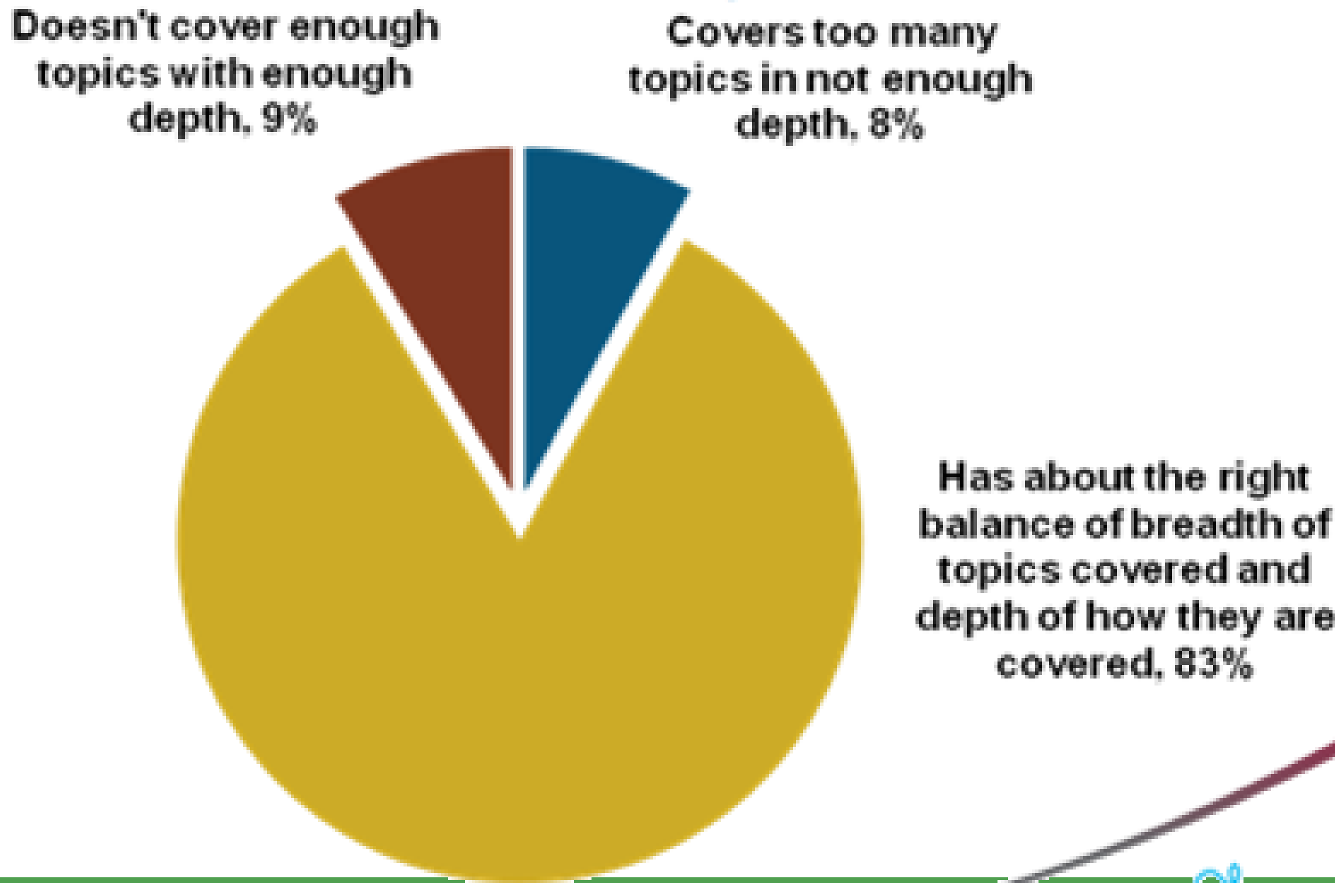
The revised AP Chemistry course is the right path for AP Chemistry to take

(% Agree/Disagree)



The Right Amount of Breadth and Depth

Which do you agree with most?
The revised AP Chemistry course…?



Q1545 AP Chemistry Teachers (n=343)

Teacher Concerns

- Teachers are supportive of the redesign, but are concerned about:
  - Credit and placement policies from higher education
  - Accessing appropriate professional development support
  - Getting students to think more conceptually

Besides a full-length practice exam, what instructional materials do you need?

- Lab manual
- More questions with rubrics
- Course and Exam Description
- Pacing guide
- Lesson plans/instructional materials
- PD for implementation
- Sample syllabi
- Suggested texts

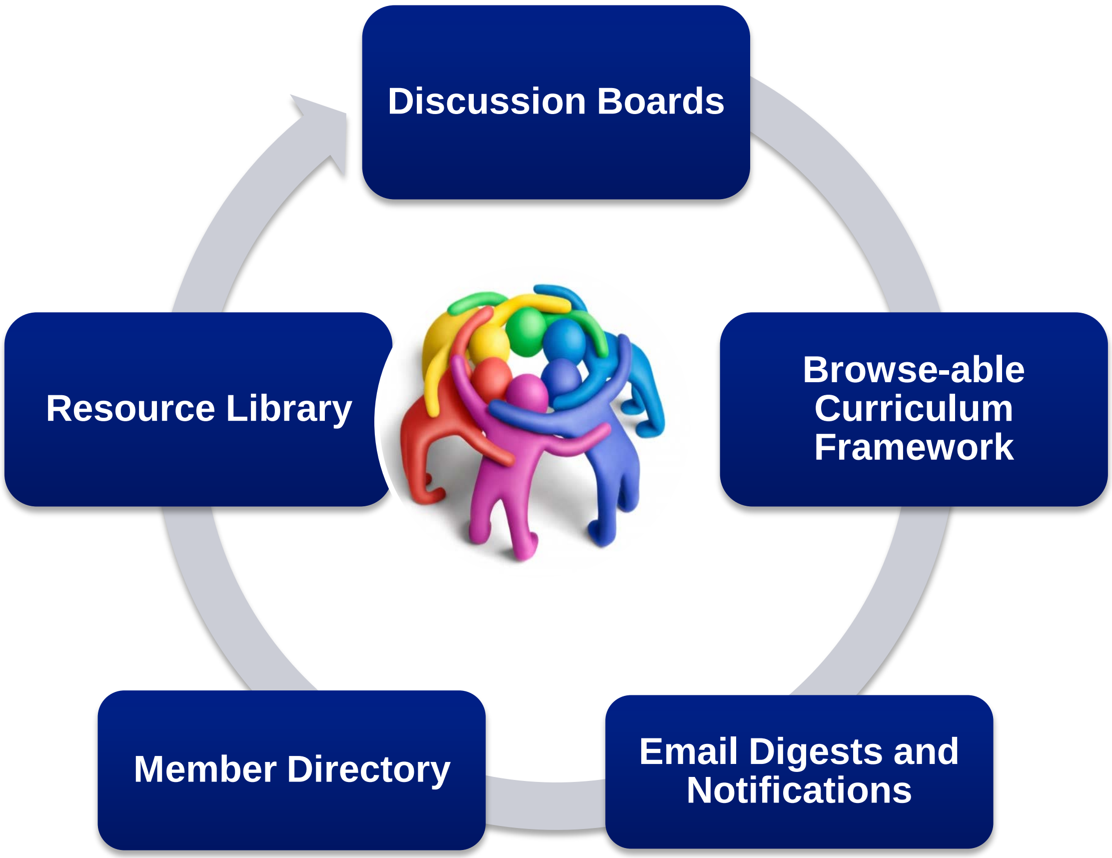
Teacher Support Available Now

- Advances in AP- Website dedicated to course and exam revisions and resources
- http://advancesinap.collegeboard.org/
- Curriculum Framework
- An Overview of Course Revisions
- Inquiry Instruction in the AP Science Classroom
- AP Chemistry Higher Ed Validation Study
- AP Teacher Community

Teacher Support: 2012-2013

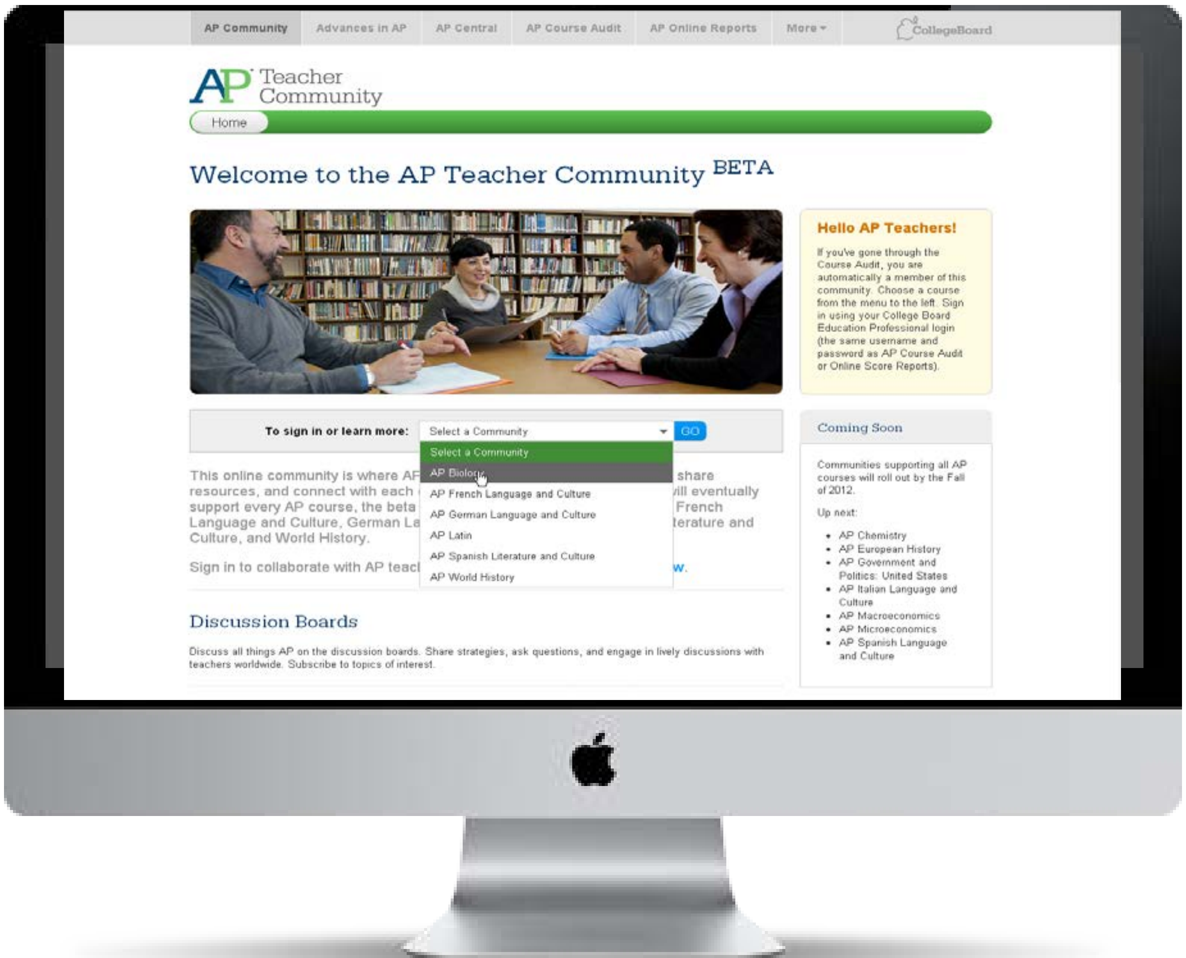
Teacher Support or Resource	Availability
AP Summer Institutes and One-day workshops: Introduction to new Curriculum Framework	Summer, 2012
New One Day Workshop- *AP Chemistry: Transitioning to Inquiry-Based Labs*	Fall, 2012
Course and Exam Description	February, 2013
Course Pacing and Planning Guides	February, 2013
Syllabus Development Guide& Sample Syllabi	February, 2013
Lab Manual	February, 2013
Practice Exam	June, 2013

Introducing the AP Teacher Community, a new online collaboration space and professional learning network for AP educators



Communities moderated by a respected educator

All AP Subjects will have a dedicated online AP Teacher Community by Fall 2012



All educators are welcome to join - Higher Education, future AP teachers, Pre-AP teachers, etc.

Select a community and sign in to request membership. You'll receive an email invite from the moderator.

https://apcommunity.collegeboard.org/

New Practice Exam for AP Chemistry

- Good news! In late summer AP will publish a new practice exam for chemistry.
- AP developed an “international form” for our large-volume courses – that will be released after it is administered in international locations.
- We will be publishing a new practice exam for AP Chemistry annually.
- New exams will be posted in a secure location and accessed by Course Audit-authorized teachers so that students cannot easily obtain them.

AP Course Audit Update

- 2013-14: All AP Chemistry teachers are required to submit a new course syllabus.
  - Feb. 2013: Course materials available
  - March 1, 2013: AP will begin accepting syllabi
  - September 1, 2013: AP's suggested date for submitting syllabi
  - Jan. 31, 2014: Deadline for submitting syllabi

Course Audit: Purpose and Participation

- The purpose of the audit is to ensure teachers are aware of the change.
- You can submit a sample syllabus if you'd prefer to wait to develop an individual syllabus until after having taught the course using a sample syllabus.

AP Chemistry Exam Updates

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Organization of the New Exam

Section 1: 90 minutes (50 percent exam weight)

- 60 multiple choice with up to 50% sets of multiple choice questions
- 90 minutes

Section 2 (50 percent exam weight)

- 7 free-response questions (3 long and 4 short)
- 90 minutes

Whole exam change

- No more standard reduction potential table (data needed will be given inside the stimulus of the problem)
- New streamlined formula chart (with constants)for use during entire exam
- Calculator can be used during the entire free response section.

Assessing Conceptual Understanding with Question Sets

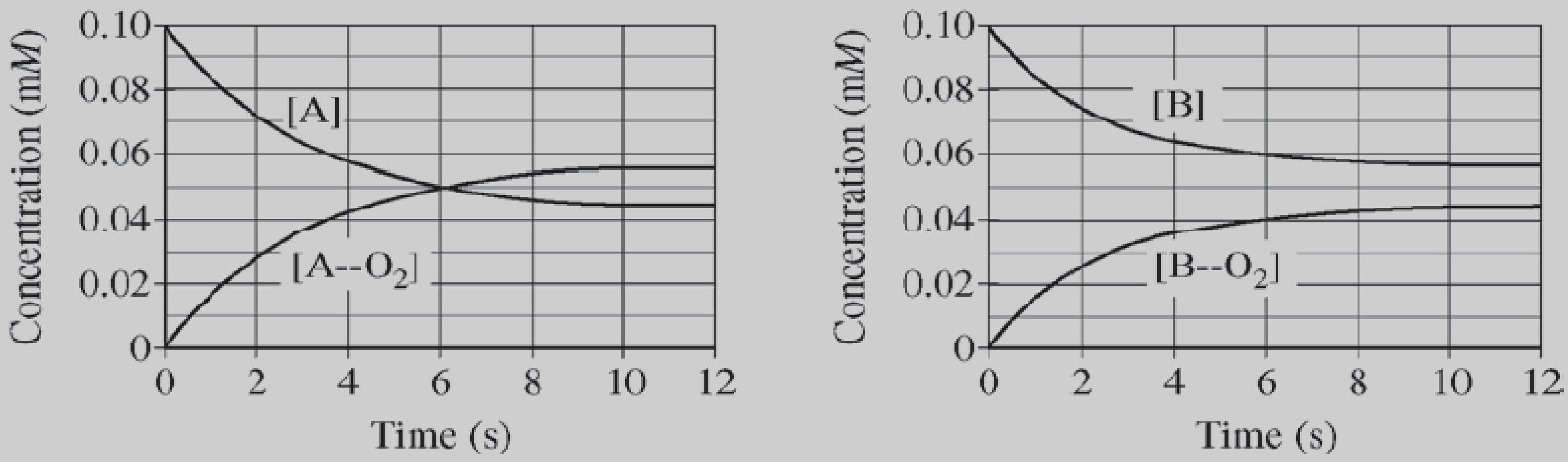
Questions 3–7 refer to the following:

A research group whose goal is to make an oxygen-carrying compound for use in artificial blood synthesized two candidate compounds, A and B. Each molecule of A or B can bind with one oxygen molecule (O_2). The equilibrium equations for the reactions between two compounds and oxygen are represented below.

(Note: X--O_2 represents a molecule of X bound to an oxygen molecule.)

$$A + O_2 \leftrightarrows A\text{--}O_2 \qquad\qquad B + O_2 \leftrightarrows B\text{--}O_2$$

The research group made a 0.10 m*M* aqueous solution of each compound and added enough oxygen to create an initial concentration of 0.20 m*M* O_2. The following graphs show the change in the concentrations of the species after the oxygen was added at time = 0.



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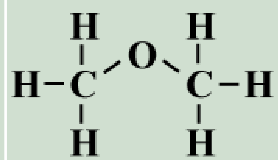
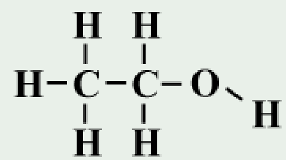
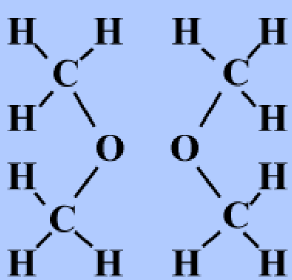
Question Set Using One Stimulus

3. On the basis of the data above, what is the approximate concentration of O_2 when compound A and O_2 have reacted for 4 seconds?
4. The binding of oxygen to A and the binding of oxygen to B are one-step elementary reactions. Which of the following is true regarding the rate constants of the forward reactions for the binding of O_2 to compound A and to compound B?
5. Which of the following is true regarding the equilibrium constants for binding of O_2 to compound A and to compound B?
6. Which of the following statements about the rates of the forward and reverse reaction for compound A is correct?
7. The binding of oxygen to compound A is exothermic. If the reaction occurs in an insulated container, which of the following is the most likely result for a measurement of temperature of the reaction mixture versus time?

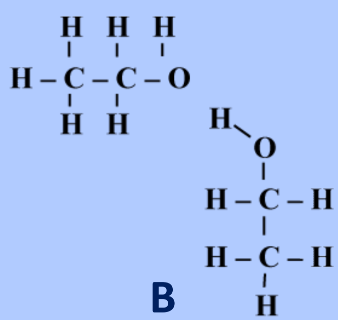
Particulate View

Compound	Molecular Structure	Normal Boiling Point
Dimethyl ether		250 K
Ethanol		351 K

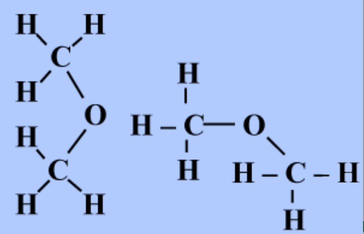
The structures and normal boiling points of dimethyl ether and ethanol are given in the table above. Which of the following diagrams best helps to explain the difference in boiling point of the two compounds?



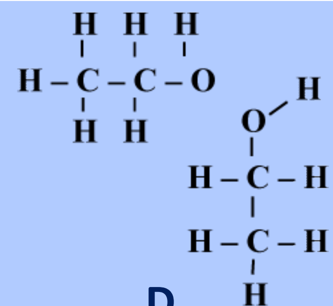
A



B



C



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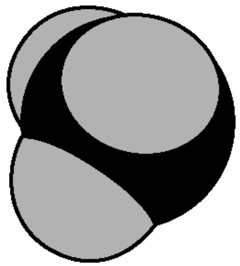
Learning Objectives for H-Bond Question

- **LO 2.1** Students can predict properties of substances based on their chemical formulas, and provide explanations of their properties based on particle views.

- **LO 2.13** The student is able to describe the relationships between the structural features of polar molecules and the forces of attraction between the particles.

Short Free Response
Atomic/Molecular View

Shown below are three models that can be used to represent a molecule of ammonia.



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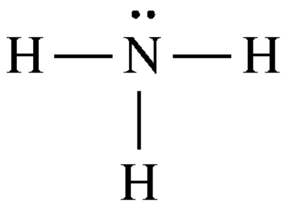

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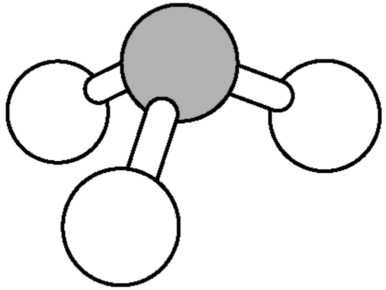

3

Select one of the models. Indicate clearly which model you selected, and describe:

a) one aspect of the ammonia molecule that the model represents accurately/well, and …

b) one aspect of the ammonia molecule that the model does not represent accurately/well.

Learning Objectives for NH_3 Question

- LO 2.1 Students can predict properties of substances based on their chemical formulas, and provide explanations of their properties based on particle views.

- LO 2.21 The student is able to use Lewis diagrams and VSEPR to predict the geometry of molecules, identify hybridization, and make predictions about polarity.

Long Free Response: Experimental Design

Design an experiment to collect data that supports the claim that a 1.0 *M* NaCl solution is a ***homogeneous*** mixture. Describe the steps, the data you would collect, and how the data support the claim. Laboratory equipment for your experiment should be taken from the list below. (You may not need all of the equipment.)

50-mL beakers	Drying oven
Volumetric pipettes (5 mL, 10 mL and 25 mL)	Hot plate
Stirring rod	Balance
100 mL of 1.0 M NaCl(aq)	Fume hood

Learning Objectives for Experimental Design Question

- LO 1.19 The student can design, and/or interpret data from, an experiment that uses gravimetric analysis to determine the concentration of an analyte in a solution.

- LO 2.9 The student is able to create or interpret representations that link the concept of molarity with particle views of solutions.

Inquiry-Based Lab Manual

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Guiding Principles & Requirements

- AP Chemistry labs are anchored in *America's Lab Report.*
  - Students should participate actively in scientific inquiry to develop an understanding of the way in which scientific knowledge is acquired.
- A minimum of sixteen hands-on lab investigations are required.
  - Six of the sixteen labs must be guided inquiry labs.
  - All sixteen labs support the lab learning objectives in the curriculum framework
- A minimum of 25 percent of instructional time is spent on labs.
- No new major equipment is required.

AP Chemistry Labs Aligned with the Learning Objectives of the Curriculum Framework

- There are 16 learning objectives that point directly to students performing investigations or engaging in design.

- **Example:**
  - **LO 1.16** The student can design and/or interpret the results of an experiment regarding the absorption of light to determine the concentration of an absorbing species in a solution. **[*See* SP 4.2, 5.1]**

16 Lab Learning Objectives in the CF

Learning Objective/Summary
LO 1.15 Spectroscopy for vibrational or electronic motions of molecules
LO 1.16 Concentration by spectrophotometry
LO 1.19 Concentration by gravimetric analysis
LO 1.20 Concentration by titration
LO 2.10 Understanding inter/intramolecular forces by separation
LO 2.22 Determining bonding types in solids
LO 3.5 Understanding conservation and stoichiometry through synthesis/decomposition reactions
LO 3.9 Evaluating redox titration data
LO 3.10 Classifying phys. and chem. changes through observation

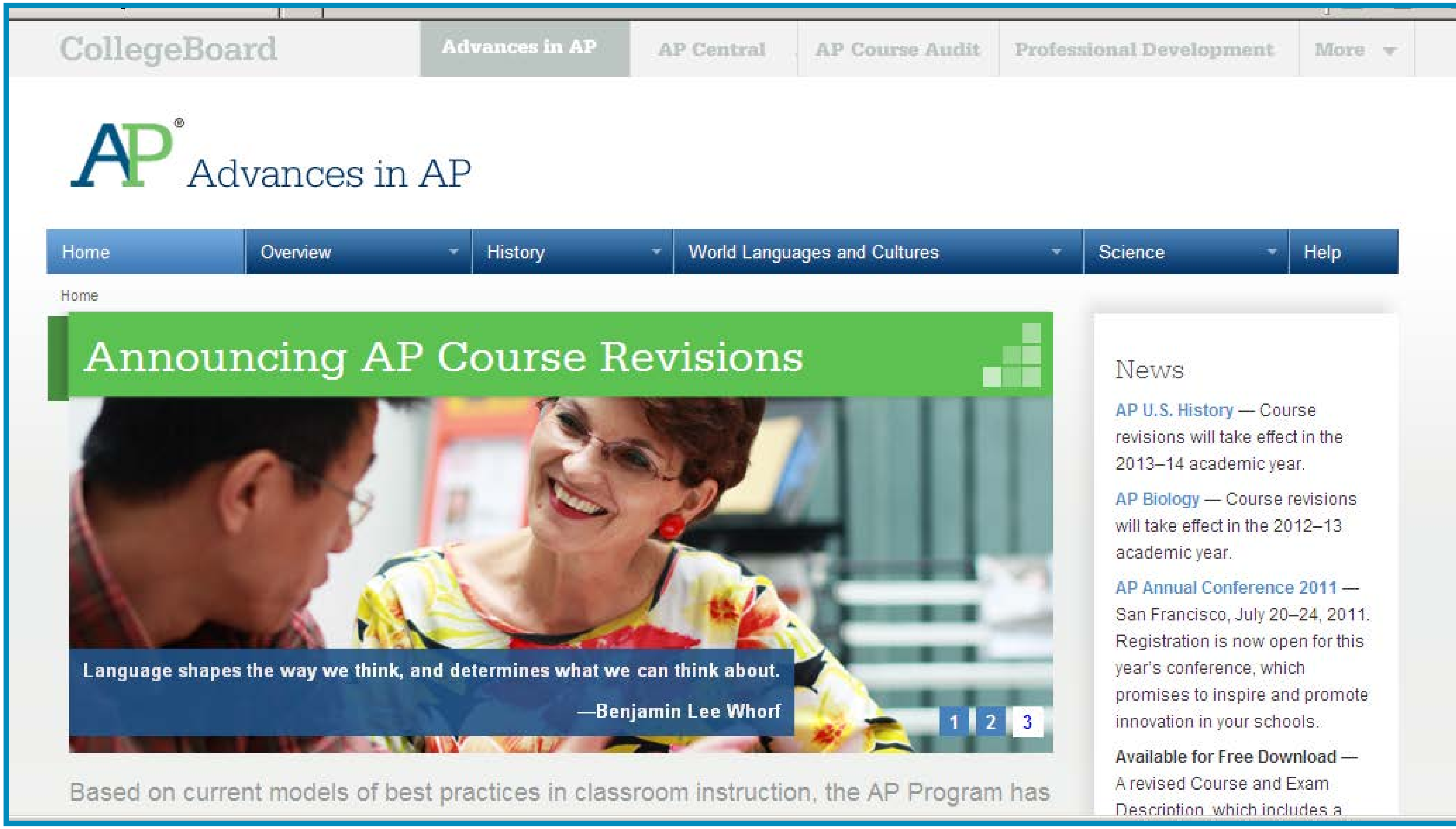
Lab Learning Objectives Continued

Learning Objective/Summary
LO 4.1 Factors affecting reaction rates
LO 4.2 Analyzing concentration vs. time data
LO 5.7 Understanding enthalpy changes in chemical reactions through calorimetry
LO 6.9 Using Le Chatelier to optimize rxn yield
LO 6.13 Identifying strength of acids/bases through titration
LO 6.18 Designing, preparing, and evaluating buffer solutions
LO 6.20 Identifying buffers/buffer mechanism through titration

Status of the Lab Manual

- Sixteen labs have been written and piloted
- July 2012: Focus testing of introductory chapters of lab manual at AP Annual Conference
- Sept 2012: Launch of PD workshops on transitioning to inquiry-based labs
- February 2013: Lab manual will be released
  - Free teacher manual as a pdf online
  - Hard copy student manual for purchase

AP Chemistry Redesign Information



Questions?

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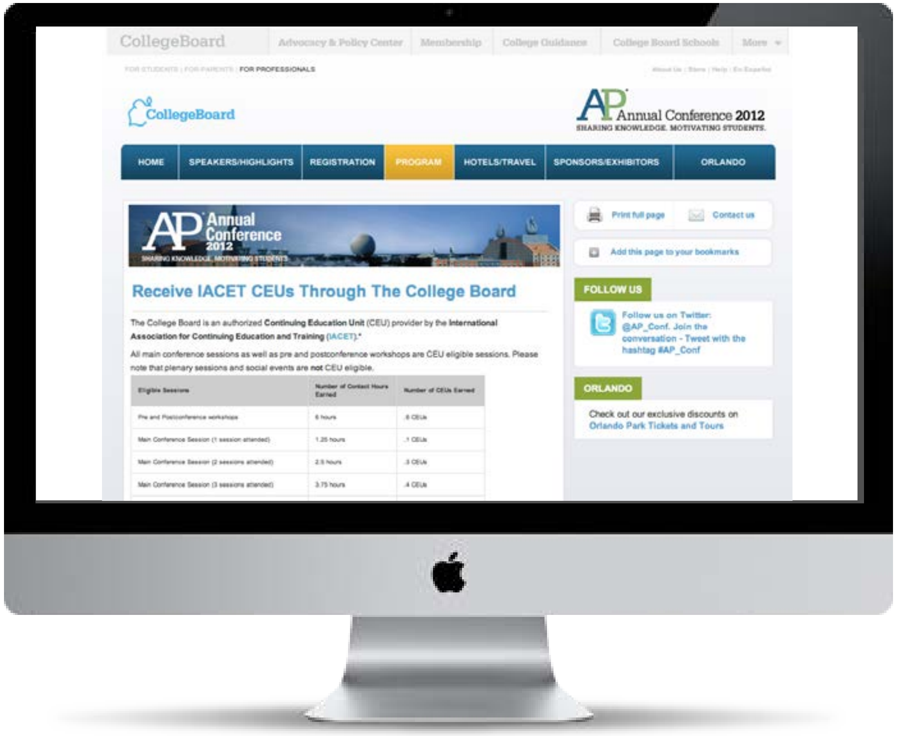
  - After the event write to: support@pesgce.com



Thank You

Contact: smagrogan@collegeboard.org

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