BUILDING A BRIDGE TO AP

How to Boost Your Honors/Chemistry 1 Course to Support Your Goals
MY SUCCESS WITH HONORS

- More students matriculate into AP
  - We consistently run the class with 18-22 students every year; before I taught Honors it was running every other year with similar numbers
- More students stay in AP at semester
- Scores have improved
- I have more time for review before the exam – my initial review of Chem I material now takes about a month instead of a quarter
OPPORTUNITIES IN HONORS/CHEMISTRY I

• Build Content
• Build Lab Skills
• Build Rapport
• Build AP Numbers
In terms of rigor and content, Honors should fall in between a standard chem I class and an AP Class.
HOW ON-LEVEL CHEM, HONORS CHEM AND AP CHEM ARE RELATED

• Chem I covers the WHAT, honors covers the WHY, and AP covers the HOW
  • In chem I, teach WHAT happens or WHAT to do:
    • Teach WHAT percent composition is, WHAT steps to follow to determine the empirical formula from these values
  • In Honors, teach WHY we know this, WHY we do this, WHY we need to know this in later units:
    • Given percent composition, WHY might we want to determine the empirical formula? WHY is that information useful in a forensic investigation?
  • In AP, teach HOW we know this to be true, HOW we get this data, HOW we can apply this concept to systems to make predictions:
    • HOW do we get these percent composition values? HOW can I apply the concept of percent composition to analyze my unknown hydrate?
Think of your chemistry 1 curriculum as a foundation upon which AP is built, and then ask yourself these questions:

• What good habits do I want to establish?
• What skills do I want to build?
• What topics can I hit really hard to free up time in AP?
• What excluded AP Topics do I still want to teach?
• What AP topics can I preview so they don’t seem foreign in AP?
WHAT GOOD HABITS DO I WANT TO ESTABLISH?

• Sig figs and units (from day 1!)
• show all work
• How to answer questions properly:
  • Consider this (vague) prompt: In the data table given below, was the quantity in trial 1 more or less than the quantity in trial 2?
    • Answer the question asked:
      • The first answer should be “more” or “less” – nothing else
    • Answer the question for the component specified
      • They must discuss in terms of trial 1
• Utilizing resources for finding information/help
WHAT SKILLS DO I WANT TO BUILD?

• Reading and interpreting questions
  • Incorporate released legacy exam questions into your class work and tests
  • Aim for 10-20% to be released (not secured!) AP questions

• Manipulating units
  • Be sure they know how to do a variety of calculations

• Mental math
  • Take away their calculators on some tests/assignments!
  • Have them make estimations before they calculate

• Reading/creating/interpreting charts, tables and graphs

• Drawing and interpreting particle-view diagrams
WHAT TOPICS CAN I HIT REALLY HARD TO FREE UP TIME IN AP?

- The math of chemistry:
  - scientific notation
  - metric system
  - unit conversions
  - Significant figures
- Atomic Theory
- Electron Configuration
- Periodic table and trends
- Lewis Structures and Molecular Geometry
- Naming
- Balancing
- **Stoichiometry**
- Gas laws
WHAT EXCLUDED AP TOPICS DO I STILL WANT TO TEACH?

• Honors is a great place to include the excluded

• Excluded content I cover in honors:
  • Quantum Numbers
  • Extended hybrid orbitals (dsp³, d²sp³)
  • Phase Diagrams
  • Colligative Properties
  • Very basic Organic Nomenclature
  • Organic functional groups
    • Note: I also vertically align to AP Biology here – I teach the functional groups they need to know
  • Nuclear Chemistry
WHAT AP TOPICS CAN I PREVIEW?

• Pick some of the more straight-forward pieces from harder units and introduce portions in Chem I
  • Examples from my curriculum:
    • In reactions:
      • Being sure they know the general equation for an acid-base reaction
      • Adding REDOX reactions and oxidation numbers if you don’t already do this in chem I
      • Teach stoichiometry using BCA tables
    • From thermochemistry:
      • Concept of enthalpy
      • Calorimetry with calculations
      • Hess’ Law
    • From Acids and Bases:
      • Strong acid/base titration with graphing the curve and calculations
      • Qualitative analysis of weak/strong acid-base titration curve – compare the shape to that of the strong/strong
    • From Kinetics:
      • Half-life calculations, as they apply to nuclear reactions
  • Also use honors to introduce them to some tools that they will use in AP so you don’t have to teach them how to use them later
    • PhET Sims
    • Modeling kits
    • POGIL activities
On the following slides is detailed information about my Atomic Structure and the Periodic Table Unit in all 3 levels of chemistry I teach:

- Chemistry I (on-level)
- Honors Chemistry
- AP Chemistry

Note that both Chemistry I and Honors Chemistry are required to cover the Indiana Academic Standards for Chemistry.
## AP Learning Objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>LO 1.5</td>
<td>The student is able to explain the distribution of electrons in an atom or ion based upon data. [See SP 1.5, 6.2]</td>
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<td>LO 1.6</td>
<td>The student is able to analyze data relating to electron energies for patterns and relationships. [See SP 5.1]</td>
</tr>
<tr>
<td>LO 1.7</td>
<td>The student is able to describe the electronic structure of the atom, using PES data, ionization energy data, and/or Coulomb’s Law to construct explanations of how the energies of electrons within shells in atoms vary. [See SP 5.1, 6.2]</td>
</tr>
<tr>
<td>LO 1.8</td>
<td>The student is able to explain the distribution of electrons using Coulomb’s Law to analyze measured energies. [See SP 6.2]</td>
</tr>
<tr>
<td>LO 1.9</td>
<td>The student is able to predict and/or justify trends in atomic properties based on location on the periodic table and/or the shell model. [See SP 6.4]</td>
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<tr>
<td>LO 1.10</td>
<td>Students can justify with evidence the arrangement of the periodic table and can apply periodic properties to chemical reactivity. [See SP 6.1]</td>
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<tr>
<td>LO 1.11</td>
<td>The student can analyze data, based on periodicity and the properties of binary compounds, to identify patterns and generate hypotheses related to the molecular design of compounds for which data are not supplied. [See SP 3.1, 5.1]</td>
</tr>
<tr>
<td>LO 1.12</td>
<td>The student is able to explain why a given set of data suggests, or does not suggest, the need to refine the atomic model from a classical shell model with the quantum mechanical model. [See SP 6.3]</td>
</tr>
<tr>
<td>LO 1.13</td>
<td>Given information about a particular model of the atom, the student is able to determine if the model is consistent with specified evidence. [See SP 5.3]</td>
</tr>
<tr>
<td>LO 1.16</td>
<td>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]</td>
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## Indiana Academic Standards

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<tr>
<td>C.2.1</td>
<td>Using available experimental data, explain how and why models of atomic structure have changed over time.</td>
</tr>
<tr>
<td>C.2.2</td>
<td>Determine the number of protons, neutrons, and electrons in isotopes and calculate the average atomic mass from isotopic abundance data.</td>
</tr>
<tr>
<td>C.2.3</td>
<td>Write the full and noble gas electron configuration of an element, determine its valence electrons, and relate this to its position on the periodic table.</td>
</tr>
<tr>
<td>C.2.4</td>
<td>Use the periodic table as a model to predict the relative properties of elements based on the pattern of valence electrons and periodic trends.</td>
</tr>
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Where can I extend to support AP?

AP Learning Objectives

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- LO 1.6: The student is able to analyze data relating to electron energies for patterns and relationships. [See SP 5.1]
- LO 1.7: The student is able to describe the electronic structure of the atom, using PES data, ionization energy data, and/or Coulomb’s Law to construct explanations of how the energies of electrons within shells in atoms vary. [See SP 5.1, 6.2]
- LO 1.8: The student is able to explain the distribution of electrons using Coulomb’s Law to analyze measured energies. [See SP 6.2]
- LO 1.9: The student is able to predict and/or justify trends in atomic properties based on location on the periodic table and/or the shell model. [See SP 6.4]
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Honors Curriculum

- Have them examine 2nd and 3rd ionization energies, and determine families for unknown elements just given this information
- Extend the concept of electronegativity to bond polarity and ranking polar bonds
- Add quantum numbers
- Do calculations with light equations
HOW DOES MY HONORS CLASS DIFFER FROM MY ON-LEVEL CLASS IN THIS UNIT?

• Unit outlines for this unit in all 3 classes are available in the supporting materials
• Pacing: honors takes 8 days vs. 11 in on-level
• Depth:
  • Extensions to the on-level material:
    • Data that led to the modifications of atomic models
    • Calculations with light
    • Flame tests in the light lab
    • Analysis of unknowns in the light lab
    • Explanations for periodic trends
  • Additional topics covered beyond the on-level curriculum:
    • Quantum numbers
    • Subatomic particle interactions
# A Comparison of Notes – Atomic Models

## AP Chemistry Notes

In the 19th century, scientists were playing with... They had made several observations:

- Rays left the cathode when electricity was passed through it, and carried charge to the anode.
- The rays were in a straight line.
- The rays made things fluoresce.
- The rays attracted to a magnet in a way that was consistent with negative particles.
- They behaved the same regardless of the cathode material.

In 1897, called these particles... He also knew that the atom was... He predicted the existence of...

In 1898, used an ingenious experiment to determine the... These experiments used the effect of...

In 1911, performed ingenious experiments of his own in an attempt to test the... His experiments were the... His basic premise was to... He expected the atoms with... He discovered...

This led to the development of a new model of the atom...

## Honors Chemistry Notes

<table>
<thead>
<tr>
<th>Date</th>
<th>Scientist</th>
<th>Discovery/Theory/Experiment</th>
<th>New Model/Structure</th>
<th>Why Did This Model Change?</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 BC</td>
<td></td>
<td>Atomic Theory: 1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Atomic Theory: 2.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Atomic Theory: 3.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Atomic Theory: 4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Atomic Theory: 5.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1897</td>
<td>JJ Thomson</td>
<td>Discovers positively charged nucleus</td>
<td>Ernest Rutherford 1911</td>
<td></td>
</tr>
<tr>
<td>1913</td>
<td>JJ Thomson</td>
<td>Publishes atomic theory: atom is a sphere</td>
<td>John Dalton 1808</td>
<td></td>
</tr>
<tr>
<td>1913</td>
<td></td>
<td>Discovers electron, develops Plum Pudding Model of the atom</td>
<td>Niels Bohr 1913</td>
<td></td>
</tr>
<tr>
<td>1929</td>
<td></td>
<td>Does work that leads to electron cloud model</td>
<td>Erwin Schrodinger 1926</td>
<td></td>
</tr>
<tr>
<td>1913</td>
<td>Niels Bohr</td>
<td>Proposes electrons move in orbits around nucleus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1926</td>
<td>James Chadwick</td>
<td>Confirms existence of neutron</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## On-level Chemistry Notes
BUILDING YOUR ASSESSMENTS

• It can be easy to build your honors assessments once you have your on-level assessments. Start with the on-level test and increase the rigor:
  • Lengthen the test
  • Reduce the number of lower depth-of-knowledge questions
  • Change out some MC questions for legacy released AP MC questions
  • Add a released AP legacy question to a FR
  • Use the same questions, but make the system being analyzed more complex

• Advantages to having a common section on on-level and honors tests:
  • allows direct data-based comparisons between the two levels
  • Ensures that you aren’t forgetting to cover the basics!
  • Alleviates some of the burden of writing a whole new test

• Examples comparing on-level and honors tests are in downloadable documents
MY ADVICE FOR BUILDING YOUR HONORS CURRICULUM

- Think of your on-level through AP course as a continuum
- Start with the material you MUST cover (On-level chem is your baseline)
  - I start with my on-level unit overview, and then adjust from there
  - Think about your approach in honors:
    - Have them do some research and draw their own conclusions
    - Remember their math skills are probably more advanced
    - Expect them to make more connections
- Think about the “terminal” AP knowledge needed for that unit, and then ask yourself the questions discussed earlier:
  - What good habits do I want to establish in this unit?
  - What skills do I want to build in this unit?
  - What topics can I hit really hard to free up time in AP in this unit?
  - What excluded AP Topics do I still want to teach in this unit?
  - What AP topics can I preview so they don’t seem foreign in in this unit?
- Fill in the available time in honors with the answers to the questions above
- Thoughts on pacing:
  - Some of my Honors units are longer than on-level, some are shorter
  - In general, my honors/on-level units are within a week of each other
BUILDING LAB SKILLS
LAY THE FOUNDATION

• Lab safety
• Glassware names and appropriate uses for different kinds
• Procedures for your lab (if possible):
  • Entering the lab
  • Gathering materials
  • Dispensing chemicals
  • Reporting accidents
  • Waste disposal
  • Cleaning up
  • Checking out/exiting the lab
• Precision in the lab
  • Balances
  • glassware
BUILDING SKILLS

• Inquiry
• Making data tables
• Making graphs
• Error analysis
• Lab notebooking (if you do this)
BUILD LAB TECHNIQUES

• Making solutions
  • From solids
  • From stock solutions
  • Diluting acids
• Filtering
• Use of specific instrumentation (Vernier, PASCO, pH probes, etc.)
• Titration
• Spectrophotometry
OTHER LAB OPPORTUNITIES

• If there are 2 AP labs for the same topic that you like, put 1 in Honors
  • In my class:
    • Molar Volume of a Gas in Honors
    • Molar Mass of a Volatile Liquid in AP

• If you have an AP lab for a topic that lends itself well to honors, do the “cookbook” lab in honors, and then do this lab as inquiry in AP
  • Ex: calorimetry
  • Ex: physical and chemical properties

• Align units, have honors to do some of the lab work for AP
  • Example: Preparation and Standardization of NaOH for Acid/Base Labs
    • have Honors make the solution and do the Standardization of NaOH Lab
    • AP Chem students then use the standardized solution to do other acid/base labs (buffers, indicators, acid in cola/juice, etc.)
EASY WAYS TO MODIFY A LAB FOR HONORS

• Take away data tables and have them produce their own
• Don’t tell them what compounds they are using
• Have them compare data with other groups and analyze error
• Discuss the reasons behind the error
• Have them come up with a question at the end of the lab requiring more data, and (if time) perform an additional experiment to answer their question

• A sample lab for comparing on-level chem, honors chem and AP Chem are in the downloadable documents
BUILDING RAPPORT

Build the relationships now so they trust you when it’s hard
TAKE THE TIME
YOU HAVE TIME IN HONORS THAT YOU DON’T HAVE IN AP

Take the time to....

- Explore the deeper questions
- Do the fun, “touchy feely” things
  - Build gum drop molecules
  - S'mores lab in stoichiometry
  - Make ice cream with freezing point depression
  - Radioactive decay of candy
- Talk to them about why you love and teach chemistry
- Show them that you care about their success and that you like your job
- Get to know them as people and let them get to know you
FOSTER THE LOVE OF CHEMISTRY

• Go into the cool, popular topics
  • Explore quarks, leptons, string theory, dark matter:
    • The Particle Adventure: http://www.particleadventure.org/modern_atom.html
  • Talk about quantum mechanics
    • Quantum Mechanics Series from the Cassiopeia Project: https://www.youtube.com/watch?v=n4LnvLAjmcU

• Talk about/research applications of topics
  • Thermochemistry:
    • Salting roads
    • Making ice cream
  • Reactions:
    • Metal plating
    • Rusting
    • Use of combustion in cars, power plants, etc.

• Relate things to their personal lives
  • Calculate their annual radiation dose:
    • https://www.epa.gov/radiation/calculate-your-radiation-dose
  • Have them bring in household acids/bases and test the pH
  • Do chromatography with markers or Koolaid
PUSH THEM WHILE ENCOURAGING THEM

• Encourage them to derive some processes or formulas that you might normally just tell an on-level class
  • Examples:
    • Give them graphs relating variables and have them derive relationships
    • Do the lab before you introduce the content, and see if they can summarize phenomena
    • Give them an overarching topic and have them research the components
  • Have them do a science fair or research project
  • Give them choice
BUILDING AP NUMBERS

Honors and chemistry I are your best recruitment tools
BE CLEAR ABOUT THE CORRELATION BETWEEN HONORS AND AP

• Tell them how the grade in Honors/chemistry I can predict their AP grade
  • For me:
    • An AP grade is usually +/- half a letter grade compared to Honors (assuming the same level of dedication to comprehension)
    • An AP grade is usually +/- one letter grade compared to chemistry I (assuming the same level of dedication to comprehension)

• Point out questions on tests (after you give them back) that are AP questions

• Show them your AP syllabus – highlight/point out what you cover in Honors that is review in AP

• When introducing a topic that leads into AP material, tell them

• When asking them to do things a specific way, tell them “I want you to do it like this so when you go into AP…”

• Consider teaching a lesson or two in the same way you teach AP – use your AP notes, etc.
BUILD EXPECTATION FOR AP

• When they have questions that are beyond the chem I/honors curriculum, explain to them the ways in which you can address that question in AP

• Build in “teasers”…
  • You’re going to synthesize aspirin!
  • We'll dissolve a penny and figure out how much copper it was actually made of!
  • You'll be seen as the elite students in this school (and nation-wide) that have taken AP Chemistry!

• Invite them to take AP! Give them (and their parents) a letter with information and testimonials from past AP and honors students
TALK UP AP CHEM BENEFITS

• College credit (obviously), but more importantly...
• Success in future science classes
• R-E-S-P-E-C-T from admissions committees
• Building a close relationship with you which leads to great letters of rec
• Improving study skills
• Improving problem solving skills
• Pushing their boundaries
SURVEY, CERTIFICATE, AND DOWNLOADS

To complete a brief survey about webinar, and to generate your certificate of attendance, visit:

To Download Resources:

Want to present a webinar this year? Send an email!
AACTconnect@acs.org