6-2016

AP Chemistry: Bonding and Intermolecular Forces (11th-12th grade)

Carrie Duesing
Trinity University, cduesi@neisd.net

AP Chemistry: Bonding and Intermolecular Forces

Grade Level: 11th – 12th

Subject/Topic Area(s): AP Chemistry

Designed By: Carrie Duesing

Time Frame: 2 weeks

School District: Northeast ISD

School: Robert E. Lee High School

School Address and Phone: 1400 Jackson Keller, San Antonio, TX, 78213; (210) 356-0800

Brief Summary of Unit (Including curricular context and unit goals):

This unit is designed for Advanced Placement Chemistry as a review and extension of topics introduced in first year chemistry. Students will review the different types of bonds and intermolecular forces to help them make predictions about the properties of materials and analyze data and draw conclusions. In class, students will utilize this information to better understand how they can predict the properties of materials and how scientific data help us understand properties and interactions of materials.

The unit culminates with an inquiry lab where students are tasked with deducing the type of bonding in a sample of a solid based on the chemical and physical properties associated with different types of bonds and intermolecular forces.

Stage 1 – Desired Results

Established Goals (e.g., standards)

2.A: Matter can be described by its physical properties. The physical properties of a substance generally depend on the spacing between the particles (atoms, molecules, ions) that make up the substance and the forces of attraction among them.

2.B: Forces of attraction between particles (including the noble gases and also different parts of some large molecules) are important in determining many macroscopic properties of a substance, including how the observable physical state changes with temperature.

2.C: The strong electrostatic forces of attraction holding atoms together in a unit are called chemical bonds.

2.D: The type of bonding in the solid state can be deduced from the properties of the solid state.

Transfer

Students will independently use their learning to...

Make predictions about the properties of materials.

Analyze data and draw conclusions.

Meaning

Understandings

Students will understand that….

Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them.

Essential Questions

How can you predict the properties of materials?

How does scientific data help us understand properties and interactions of materials?

Acquisition

Knowledge

Students will know…

- that the difference in properties can be explained by differences in the strength of attraction between the particles and/or their overall organization
- the key attributes of the different intermolecular forces, including London Dispersion Forces, induced dipole, dipole-dipole interactions, and Hydrogen bonds
- how to apply Coulomb's Law
- the difference between metallic, ionic and covalent bonds and the role of electronegativity in determining bond type
- the definitions of covalent network solid and molecular solid

Skills

Students will be able to...

- draw particle diagrams for different phases of matter
- utilize distillation to separate chemical species
- draw Lewis Dot structures of covalent compounds
- determine the polarity of a compound from a molecular formula, drawing, model, or Lewis Dot structure
- use polarity to predict the strength and type of intermolecular interactions between compounds
- use the VSEPR model to predict molecular geometry
- design or evaluate a plan to collect and/or interpret data needed to deduce the type of bonding in a sample of a solid.

<table>
<tr><th colspan="3">Stage 2 – Evidence</th></tr>
<tr><td>CODE
(M or T)</td><td>Evaluative Criteria
(for rubric)</td><td></td></tr>
<tr><td>M, T

T
M, A
A
A
A
M, A</td><td></td><td>Performance Task(s)
Students will demonstrate meaning-making and transfer by…
analyzing the properties of various solids to determine the likely intermolecular forces or type of bond for the chemical species in question (Deduce the Type of Bonding in a Sample of a Solid Lab)

Other Evidence (e.g., formative)
Chromatography Lab
Molecular Models
String Molecule activity
Formal Charge Practice
Intermolecular Forces Jigsaw
Bonding Multiple Choice Quiz</td></tr>
<tr><th colspan="3">Stage 3 – Learning Plan</th></tr>
<tr><td>CODE
(A, M, T)
A</td><td colspan="2">Pre-Assessment
How will you check students’ prior knowledge, skill levels, and potential misconceptions?
Chalk Talk: Ionic, Covalent, Metallic, Intermolecular forces</td></tr>
<tr><td>A</td><td>Learning Activities

Day 1: Chalk Talk: Vocabulary will be posted around the room

Ionic
Covalent
Metallic
Intermolecular forces
Students will each get a marker and will silently make their way around the room , adding anything they can recall to the paper with the appropriate topic. Time will stop when each student had contributed to each topic.

The discussion will be guided by the comments made by the students in the chalk talk, but will include the following:
- Simplified, a bond involves some sort of electron interactions. The bond itself is attraction between particles that allow those distinct particles to behave as a unit. McCormick, René. "AP* Chemistry Chemical Bonding & Molecular Structure." National Math Science Initiative, 2008. Web. 15 June 2016.
- Energy is released when bonds are formed, energy is consumed to break bonds: always. Therefore, it requires more energy to exist alone than bonded to other atoms</td><td>Progress Monitoring (e.g., formative data)

When students have completed their chalk talk, the teacher will use the comments as a jumping off point to discuss the students’ understanding of bonding/intermolecular forces and address misconceptions</td></tr>
</table>

	- Chemical and physical properties of materials can be explained by the structure and the arrangement of atoms, ions, or molecules and the forces between them. - In order to better understand and predict properties, we must know the different types of bonds and intermolecular forces. After the chalk talk discussion, the teacher will review ionic bonds including valence electrons, electronegativity difference, and properties of ionic compounds from the NMSI Notes: Chemical Bonding and Molecular Structure.	NMSI Notes: Chemical Bonding and Molecular Structure and Bonding powerpoint
T, M	Give out Chromatography pre-lab for homework Day 2: Transition to covalent compounds by doing the chromatography lab and discuss polarity. This lab will introduce a lab technique to separate different chemical species based on the type of bonds present.	Chromatography Lab
A	While students are waiting for their materials to separate on the filter paper, they will be asked to draw particle diagrams for the lab.	
A	Day 3: Students will collect their chomatography papers from yesterday and calculate the Rf value for their sample. The teacher will use the results from the lab to guide a discussion that reviews covalent compounds including the octet rule and Lewis dot diagrams from the NMSI Notes: Chemical Bonding and Molecular Structure.	NMSI Notes: Chemical Bonding and Molecular Structure and Bonding powerpoint
A	Students will practice Lewis dot diagrams as a review from 1st year chemistry.	Molecular Models
A, M	Day 4: Students will practice VSEPR model with “String Molecules” as an inquiry activity, then apply their new understanding by building models and completing the Molecular Molecules practice from the day before. (Trout, L. "Lesson 3: Valence Shell Electron Pair Repulsion (VSEPR) Model." *AP® Chemistry Guided Inquiry Activities for the Classroom*. College Board, 2013. Web. 15 June 2016. Instructions for the “String Molecules” activity can be found on p 27 of this PDF: https://secure-media.collegeboard.org/digitalServices/pdf/ap/ap-chemistry-guided-inquiry-activities-curriculum-module.pdf Copies of “Handout 4” will be given to the students to guide their understanding about molecule shape names and bonding angles)	
A	Day 5 Introduce bond order, formal charge, resonance and polarity	NMSI Notes: Chemical Bonding and Molecular Structure and Bonding powerpoint

	Explanation of Formal Charge from Moog, Richard Samuel., and John J. Farrell. *Chemistry: A Guided Inquiry*. New York, NY: John Wiley & Sons, 2002. Print.	
A	Online practice of formal charge on the following website: http://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/questions/General/formchg.htm (Reusch, W. "Formal Charge Exercise." *Formal Charge Exercise*. Michigan State University, n.d. Web. 16 June 2016.)	Online practice of formal charge on the following website: http://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/questions/General/formchg.htm
M	Exit Ticket: What determines the polarity of a molecule? What determines the polarity of a bond? How does polarity relate to the process of chromatography?	
A	Day 6: Intermolecular forces - Students will participate in a jigsaw on the intemolecular forces: LDS, dipole-dipole, induced dipole, and hydrogen bonds and fill out a notes page to share with their home group (Bennett, L. "Jigsaw Activity." *Intermolecular Forces (IMFs)*. Naperville Central High School/College of Dupage, IL, 2012. Web. 15 June 2016.) - discuss covalent network solid and molecular solid	Intermolecular forces jigsaw
A	Day 7: Review properties of ionic and covalent compounds - discuss metallic compounds - big overview from NMSI Notes: Chemical Bonding and Molecular Structure.	NMSI Notes: Chemical Bonding and Molecular Structure and Bonding powerpoint
T, M	Day 8: Start brainstorming tests to differentiate types of bonding/intermolecular forces - melting point, conductivity, solubility, state of matter Write a proposal to test 3 different solids, including what will be learned depending on results.	Proposal for “Deducing the Type of Bonding in a Sample of a Solid Lab”
M, A	MC bonding quiz (10 questions, 15 minutes, no calculator) Groves, P. "AP Chemistry Page." *AP Chemistry Page*. South Pasadena High School, n.d. Web. 16 June 2016.	Bonding quiz
T, M, A	Day 9: Test 3 solids and predict type of bonding and whether intermolecular forces (and if so, which type/s is most likely)	Deduce the Type of Bonding in a Sample of a Solid Lab
T	Day 10: Finish testing solids and explain results in lab conclusion.	