Allegheny–Clarion Valley School District

Chemistry - Organic: Unit 4 - Geometry & Orbitals

Unit #:	ACVSD-00068650	Date(s)	11-17-2018 to 12-19-2018

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Grade(s): 11, 12
Subject(s): Science

Unit Focus

This unit focuses on how atomic orbitals relate to organic chemistry and the types of bonding that are used. Students will use VSEPR Theory to determine the type of hybridization occurring, the orbitals and quantity of orbitals used to create the new hybrid orbitals, and how to assign the molecular geometry and bond angles of the molecule.

Prior Learnings/Connection

Students must know how to read Bond-Line structures, have experience with VSEPR Theory, and how to draw/read Lewis Structures.

Stage 1: Desired Results - Key Understandings

Standard(s)

Pennsylvania Assessment Anchors and Eligible Content
Chemistry: 11

- Relate the physical properties of matter to its atomic or molecular structure *CHEM.A.1.1.4*
- 1 Explain how atoms combine to form compounds through ionic and covalent bonding. *CHEM.B.1.3.1*
- Classify a bond as being polar covalent, non-polar covalent, or ionic. *CHEM.B.1.3.2*
- Use illustrations to predict the polarity of a molecule. *CHEM.B.1.3.3*
- Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a

Transfer

What kinds of long-term, independent accomplishments are desired? Students will be able to independently use their learning to...

Meaning

Understanding(s)

What specifically do you want students to understand? What inferences should they make? Students will understand that...

U1 Students will understand...

- s orbitals are spherical in shape
- p orbitals have a dumbbell shape
- a bond is formed when an electron of one atom overlaps with an electron of another atom in atomic orbitals
- when two electrons are shared, it

Essential Question(s)

What thought-provoking questions will foster inquiry, meaning making, and transfer? Students will keep considering...

Q1 How do orbitals for electrons influence the type of bonding?
Why do different types of hybridization have different shapes?
How can the hybridization (or lack of) create different types of bonds (single, double, triple)?

compound (e.g., computer models, ball-and-stick models, graphical models, solid-sphere models, structural formulas, skeletal formulas, Lewis dot structures). *CHEM.B.1.4.1* • Utilize Lewis dot structures to predict the structure and bonding in simple compounds. *CHEM.B.1.4.2*	is a covalent bond • atoms in the second row (C, N, O, F) have one s orbital and three p orbitals in their valence shell • orbitals mix together to create hybridized or hybrid orbitals (sp^3, sp^2 , and sp) which have a lower energy than the original p orbital(s) used, but more energy than the s orbital used • because the hybrid orbitals have a lower average energy, they are more stable • if 1 s orbital is mixed with 3 p orbitals, 4 new "sp^3 hybridized orbitals" will be created • if 1 s orbital is mixed with 2 p orbitals, 3 new "sp^2 hybridized orbitals" will be created, with 1 remaining unhybridized p orbital • if 1 s orbital is mixed with 1 p orbital, 2 new "sp hybridized orbitals" will be created, with 2 remaining unhybridized p orbitals • hybridized orbitals can be used to either hold a lone pair of electrons, or overlap to form a sigma (single) bond with another atom • unhybridized p orbitals can overlap between atoms to form an additional pi bond (double bond). • the type of hybridization occurring can be determined from the sum of lone pairs and the number of bonding regions ◦ if the sum is 4, then you have 4 sp^3 orbitals = tetrahedral geometry, 109.5 BA ◦ if the sum is 3, then you have 3 sp^2 orbitals + 1 p	

	orbital = trigonal planar, 120 BA ◦ if the sum is 2, then you have 2 sp orbitals + 2 p orbitals = linear, 180 BA • "Bent" molecules are from lone pairs	
	Acquisition of Knowledge and Skill	
	Knowledge	**Skill(s)**
	What facts and basic concepts should students know and be able to recall? Students will know... K1 Students will be able to define and appropriately use the following vocabulary... • molecular geometry • valence shell electrons • hybridization • hybridization state • orbitals • sp^3 hybridization • sp^2 hybridization • sp hybridization • s orbital • p orbital • Valence Shell Electron Pair Repulsion Theory (VSEPR) • lone pair • linear geometry • trigonal planar geometry • tetrahedral geometry • bent geometry • bond angles	*What discrete skills and processes should students be able to use? Students will be skilled at...* S1 Students will be able to... • describe the shape and quantities of s and p orbitals in different types of hybridizations • draw energy-orbital diagrams of each type of hybridization and the resulting hybridized and if applicable, unhybridized orbitals • determine the type of hybridization occurring in a molecule by counting the number of lone pairs and bonding regions around a center atom of a molecule base on a bond-line or Lewis structure of the molecule • use VSEPR Theory to assign the molecular geometry of a molecule base on a bond-line or Lewis structure of the molecule • use VSEPR Theory to assign the bond angle(s) of a molecule base on a bond-line or Lewis structure of the molecule • use a model kit to build molecules, then determine the type of hybridization, geometry, and bond

		angles occurring around each central atom • draw and explain how/what orbitals are overlapping in a molecule to generate the bond(s) present

Stage 2: Assessment Evidence

Performance Task(s)

Alignment	Code	Assessment Evidence
	PT1	**Untitled** **Performance Task** Formative: • Student note packet highlighting and practice problems • Practice with building organic molecules from kits and bond-line drawings and in-class problems • Drawing the hybridization of atomic orbitals to create new hybrid orbitals • Lab - Building organic molecules using the orbital attachments Summative: • Quick quiz on type of hybrization, molecular geometry, and bond angles • Chapter 4 test • Molecule Lab concept questions

Stage 3: Learning Plan

Alignment	Code	Learning Activities
	LA1	**Untitled** **Learning Activity** The students will follow the learning plan for 2 weeks:

Day 1:

- The students will read the introduction to "Chapter 4 - Geometry" They will look at and discuss why the shapes of molecules are important. Using molecules, they will be able to see the effect that sterics (shapes) of molecules could have on reactions.
- We will discuss examples of hybrid things they have seen in their own life and question how it might apply to this chapter by scanning through the rest of the packet.

Days 2 & 3:

- The students will move on to Section 1 - Orbitals and Hybridization States. They will read,l highlight, and annotate the section. The shapes of the molecules were learned in chem I, but must be reviewed
- We will use the formula of "Lone pairs + # bonding regions" around a center atom to determine the type of hybridization occurring. We will make a list of the different types of orbitals used in each type of hybridization.
- Homework: complete the in-packet exercises of 4.2 - 4.8.

Day 4:

- We will go over the homework from day 3.
- We will then take notes on how to draw the different orbital diagrams for each type of hybridization. We will make special note to push the concept that "What you put in is what you get out" when it comes to the quantities of orbitals.

Day 5:

- We will work through practice problems on the board to identify what type of hybridization is occurring in each of the Lewis or bond-line structures. The students will complete the examples in their notebooks and work with their lab partner. Time permitting, they may put their answers on the board to share with the class.

Days 6 & 7:

- The students will read, annotate, and highlight section 4.2 - Geometry.
- We will add the types of molecular geometries and bond angles into their notes that they took for the different types of hybridization.
- They will complete the in-packet practice problems 4.10 - 4.17.
- Time permitting, they will look at the additional organic text book pictures showing how the hybridized and unhybridized orbitals overlap.

Day 8:

- We will review the types of hybridization, molecular geometries, and bond angles by completing several practice problems together on the white board.
- They will then watch the Crash Course Chemistry video "Orbitals" and Professor Dave's "Organic

		Hybridization Orbitals" from YouTube. Day 9: • We will review all of the concepts of the packet, going back through and discussing the important parts of the text that were highlighted and annotated. Day 10: • The students will take their Chapter 4 Test for hybridization, molecular geometries, and bond angles.