Allegheny–Clarion Valley School District

Chemistry - Organic: Unit 7 - Configurations (Stereochemistry R/S)

Unit #:	ACVSD-00069616	Date(s)	04-22-2019 to 05-20-2019

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

Unit Focus

This unit teaches students to determine if an organic molecule has any stereocenters and then determine which isomer (R or S) they are. They will also learn to assign this from Fischer Projections as well as Bond-Line drawings, utilizing wedges and dashes.

Prior Learnings/Connection

Reading bond-line drawings, wedge/dash drawings, determining molar mass from the periodic table

Stage 1: Desired Results - Key Understandings

Standard(s)

Pennsylvania Assessment Anchors and Eligible Content
Chemistry: 11

- Classify observations as qualitative and/or quantitative. *CHEM.A.1.1.2*
- Relate the physical properties of matter to its atomic or molecular structure *CHEM.A.1.1.4*
- Apply a systematic set of rules (IUPAC) for naming compounds and writing chemical formulas (e.g., binary covalent, binary ionic, ionic compounds containing polyatomic ions). *CHEM.A.1.1.5*
- Describe how chemical bonding can affect whether a substance dissolves in a given liquid. *CHEM.A.1.2.5*

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 that...

- Stereocenters occur at carbons that are bonded to four different elements (or configurations of bonded elements).
- Molecules with stereocenters generally create various isomers

Essential Question(s)

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

Q1

- How do we see/utilize isomerism in the real world?
- Why is it important to understand how different isomers are arranged and how they can be separated?

• Explain the relationship between the electron configuration and the atomic structure of a given atom or ion (e.g., energy levels and/or orbitals with electrons, distribution of electrons in orbitals, shapes of orbitals). *CHEM.A.2.2.3* • Recognize and describe different types of models that can be used to illustrate the bonds that hold atoms together in a 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*	in the forms of (diastereomers and enantiomers) • Chiral compounds have mirror images. (These are enantiomers of each other) • Achiral compounds do not have mirror images. • Diastereomers are not mirror images, they must have at least two stereocenters. • Meso compound do not have mirror images because they have a plane of symmetry. • "R" configurations are when the stereocenter priorities rotate to the right. (Clockwise) • "S" configurations are when stereocenter priorities rotate to the left. (Counter clockwise) • "E" and "Z" can be used in place of cis/trans isomerism because they are determined from priorities in the same way R/S is. (This is superior because cis/trans requires that two of the groups on each side are identical.) • Stereoisomerism appears in the front of the molecule's IUPAC name. • There are two ways to draw a molecule's enantiomer (mirror image or switching wedge/dash). • The number of total stereoisomers can be predicted from the number of stereocenters in a molecule from the formula 2^x. • Fischer projections are used to easily depict the carbon-back bone of an organic molecule. • When assigning R/S configurations to Fischer projections, the wedge can only be on a hotizontal line	

and the dash on a vertical line.
- Enantiomers and diastereomers have different optical activity and can be seperated base on their different physical properties (like distillation).
- Racemic mixtures are a 50/50 mixture of the R and S enantiomers, they will not exhibit optical activity.

Acquisition of Knowledge and Skill

Knowledge

What facts and basic concepts should students know and be able to recall? Students will know...

K1 Students will be able to define and use the following vocabulary:

- chiral
- achiral
- stereocenter
- asymmetrical carbon
- isomer
- consitutional isomer
- enantiomer
- diastereomer
- meso compound
- R versus S (clockwise and counterclockwise rotations)
- E versus Z
- Fischer Projection
- optical activity
- racemic mixture

Skill(s)

What discrete skills and processes should students be able to use? Students will be skilled at...

S1 Students will be able to...

- locate all stereocenters of a compound.
- explain what conditions make it impossible for a stereocenter to exist.
- determine if a compound is chiral or achiral.
- assign a system of numbering to determine if a stereocenter is R or S (left or right handed).
- assign a system of numbering to see if a double bond is E or Z (in comparison to cis or trans).
- use two different methods to draw an enantiomer of a compound.
- draw all of the diastereomers of a molecule with two stereocenters.
- predict the total number of disatereomers/enantiomers of a molecule.
- determine if a compound is meso.
- draw the Fischer projection of a

		molecule. • assign R/S status to a Fischer projection. • draw the enantiomer of a Fischer projection. • explain how isomers can be separated by the use of optical activity. • explain how isomers can be separated by distillation. • explain what a racemic mixture is and what effects/implications there can be from one.

Stage 2: Assessment Evidence

Performance Task(s)

Alignment	Code	Assessment Evidence
	PT1	**Untitled** **Performance Task** Diagnostic: • Classroom questioning and discussion • Classroom practice problems and reading packets Formative: (These are described specifically in the Learning Plan) • Homework (optional and required) • In-class assignments • Think-pair-share responses and reading activities • Pre-Lab questions (Ester Lab) • Laboratory Procedures/Safety • Laboratory concept questions Summative: • Quizzes (Locating/assigning R/S and Fischer Projections)

		• Concept questions from lab • Chapter test

Stage 3: Learning Plan

Alignment	Code	Learning Activities

	LA1	**Untitled**
		
		Learning Activity
		
		Stereochemistry Learning Plan
		Day 1:
		
		• Students will read/discuss section 7.1 while highlighting, annotating, and taking notes from the text.
		• They will also answer the practice problems to locate stereocenters (7.1 - 7.15).
		• Time permitting: several in-class practice problems at the board with locating stereocenters in different types of molecules.
		• Handout: Klein Packet and Types of Isomers guide
		
		Days 2-3:
		
		• The students will move on to Section 7.2 - Determining the configuration of a stereocenter. They will read, highlight, and annotate the section. The priorities of the attached groups must be practiced.
		• In-Class/HW:
		  ◦ complete the in-packet exercises of 7.16-7.42
		  ◦ Problem packet #1, pages 1-5
		
		Days 4-5:
		
		• The students will complete Section 7.3 - Nomenclature. They will read, highlight, and annotate the section. The IUPAC nomenclature system must be reviewed.
		• In-Class/HW:
		  ◦ complete the in-packet exercises of 7.43-7.49
		  ◦ Problem packet #1, pages 9, 10, 11
		
		Days 5-6:
		
		• The students will complete Section 7.4 - Drawing Enantiomers. They will read, highlight, and annotate the section. The system for assigning R/S priorities may need reviewed. Time permitting, watch the Professor Dave Explains video of "Enantiomers".
		• In-Class/HW:

- Complete the in-packet exercises of 7.50-7.63
- Problem packet #1, pages 6, 7, 8

Days 7-9:

- The students will complete Section 7.5 - Drawing Diastereomers. They will read, highlight, and annotate the section. Time permitting, watch the Professor Dave Explains video of "Diastereomers".
- In-Class/HW:
  - Complete the in-packet exercises of 7.64-7.70
  - Problem packet #1, page 12 (and additional practice examples on the board for "barn doors")
  - Problem Packet #2

Days 10-11:

- The students will complete Section 7.6 - Meso Compounds. They will read, highlight, and annotate the section. Time permitting, watch the Professor Dave Explains video of "Meso Compounds".
- In-Class/HW:
  - Complete the in-packet exercises of 7.71-7.74
  - Problem Packet #3 "Stereoisomers" and predicting types of isomerism
  - Review for quiz on day 12

Day 12:

- Quiz on sections 7.1 - 7.6. (Identify stereocenters, predict the numner of stereoisomers, assign R/S and E/Z, define enantiomers, diastereomers, and meso compounds, draw/label the total number of enantiomers and diastereomers for an organic molecule - "barn door" problem)

Days 13-15:

- The students will complete Section 7.7 - Drawing Fischer Projections. They will read, highlight, and annotate the section. Watch the Professor Dave Explains video of "Fischer Projections".
- In-Class/HW:
  - Complete the in-packet exercises of 7.75-7.81
  - Problem packet #1, pages 13, 14, 15, 17, 18
  - Problem Packet #4 "Enantiomers, Diastereomers, and Meso Compounds"

Days 16-17

- In-class review for quiz 2.
- Students will complete/review the "Fischer Projection and Stereochemistry Practice for Quiz 2" worksheet.

Day 18:

- Quiz 2 on assigning R/S to Fischer Projections, drawing a molecule from its IUPAC name, Determining the relationship between two Fischer projections, drawing the Fischer projection from a wedge/dash projection,

		putting the Fischer projection back into a wedge/dash drawing, and drawing the enantiomers of Fischer projections. OPTIONAL EXTENSION: • 1-2 days of learning about optical activity as it relates to stereochemistry. Section 7.8 and Problem Packet #1 pages 19-21. Days 19-20: • Review all the types of problems for the chapter test: ◦ Locating stereocenters in a molecule ◦ Assigning R and S configurations and assigning E and Z configurations to both wedge/dash drawings and Fischer projections ◦ Nomenclature (writing simple names and drawing the picture from the name) ◦ Drawing enantiomers (2 ways, mirror image and switching wedge/dash) ◦ Predicting the number of possible stereo-molecules based off of the formula 2n where n is the number of stereocenters ◦ Identifying/defining/classifying enantiomers, diastereomers, meso compounds or same compounds ◦ Drawing Fischer projections into bond-line (wedge/dash) drawings Day 21: • Chapter test on Stereochemistry. Day 22-24: • The students will complete the creation of an Ester Lab via the Vial Organics Method. They will also complete the accompanying concept/research questions.