Unit 4: Reactions of Alkenes

Content Area: **Science**
Course(s):
Time Period: **Marking Period 2**
Length: **3 Weeks**
Status: **Published**

Brief Summary of Unit

The simplest chemical reactions involving alkenes can summarized with two words: electrophilic addition. What that entails, and what it means for the alkene, is that despite there being roughly 10 distinct reactions that fall under this category there are a significant amount of similarities between them. This unit focuses on the reaction mechanisms behind alkene reactions.

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Standards

LA.W.11-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
LA.W.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (MLA or APA Style Manuals).
LA.W.11-12.9	Draw evidence from literary or informational texts to support analysis, reflection, and research.
LA.RI.11-12.7	Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
MA.N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
MA.A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems.
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.A-SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
SCI.HS-PS1-5	Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

SCI.HS-PS1-4	Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
SCI.HS-PS3-5	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.
SCI.HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
SCI.HS-PS2-6	Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
SCI.HS-PS1-7	Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
SCI.HS-PS1-6	Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
SCI.HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
WRK.K-12.P.3	Consider the environmental, social and economic impacts of decisions.
WRK.K-12.P.4	Demonstrate creativity and innovation.
WRK.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
WRK.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.
TECH.K-12.1.1.c	use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
TECH.K-12.1.3.b	evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
TECH.K-12.1.6.a	choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.

Essential Questions

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What is the basic mechanism behind electrophilic addition reactions?

What does product formation in alkene reactions depend on?

Enduring Understandings

The techniques for writing reaction mechanisms for electrophilic addition of alkenes can be applied to other organic reaction processes.

Identifying the most stable carbocation intermediate formed is necessary to properly develop and complete a mechanism.

The major product from an electrophilic addition reaction is linked to the stability of intermediate(s) formed during the process.

Objectives

Students will know that electrophilic addition on an alkene takes place at the location of the double bond.

Students will be skilled at identifying a carbocation as primary, secondary, or tertiary.

Students will know that reactions of alkenes prefer the formation of the most-stable carbocation intermediate possible during the mechanism.

Students will know Markovnikov's Rule can be applied to determine potential regioselectivity of a reaction.

Students will be skilled at rearranging carbocations during some, but not all, reactions.

Students will know that not all reactions produce carbocations and the reason(s) why.

Students will know reactions can be regioselective and predominantly produce one of two (or more) possible isomers.

Students will know that some reactions require a catalyst but the same product may be created through a different process.

Students will be skilled at writing the mechanisms for the following reactions: hydrogen halide addition, acid catalyzed addition of water or alcohol, oxymercuration and alkoxymercuration reduction, hydroboration-oxidation, addition of halogens, radical addition, and hydrogenation.

Students will know the stability of cis and trans isomers is linked to the physical distance between substituents on the sp2 carbons.

Students will be skilled at interpreting heats of hydrogenation in order to rank the stability of alkenes.

Students will be skilled at applying known mechanisms to develop pathways to synthesize new compounds.

Learning Plan

Preview essential questions and connect them to the concepts we will cover in the unit.

Demonstrate the mechanism for the addition of hydrogen halides.

Model the structure of carbocations and what influences their stabilities.

Define Markovnikov's Rule and regioselectivity and apply it to the acid-catalyzed additions of water and alcohol to an alkene.

Discuss the factors that affect carbocation stability and why some rearrange.

Complete the Carbocation and Rearrangements Modelling Activity.

Model reactions that do not include carbocation intermediates (halogen addition,

oxymercuration/alkoxymercuration-reduction, hydroboration-oxidation).

Investigate the hydration of alkenes. (http://www.nuffieldfoundation.org/practical-chemistry/hydration-alkenes; can be a ‘paper’ lab and include experimental differences between acid-catalyzed and oxymercuration requirements.)

Contrast the addition of radicals to alkenes with the previously seen chlorination/bromination.

Present hydrogenation (addition of hydrogen) and compare the stability of an alkene isomers based on the energy released (heat of hydrogenation).

Assessment

Formative Assessment

Completion of practice problems assigned by teacher (textbook or otherwise).

Predict products of reactions without writing an entire mechanism (utilizing Markovnikov’s Rule).

Determine whether carbocation intermediates will form and/or arrange.

Predict the results of the Hydration of Alkenes experiment.

Identify similarities and differences between radical reactions of alkenes and alkanes.

Rank the stability of alkenes based on heat of hydrogenation.

Benchmark Assessment

Write detailed mechanisms of all reaction types.

Correctly build carbocation intermediates and arrange them if needed (Carbocation and Rearrangements Modelling Activity).

MidTerm Exam

Alternative Assessment

Experimental report on Hydration of Alkenes (teacher discretion with respect to presentation).

Summative Assessment

Unit Quizzes

Unit Tests

Materials

Guided notes or teacher handouts

Organic Chemistry (Bruice, 2007) – electronic textbook

Activity/Lab Handouts (Includes materials specific to each activity: Hydration of Alkenes [http://www.nuffieldfoundation.org/practical-chemistry/hydration-alkenes])

Molecular Modeling Kits (teacher provided)

Molecular Modeling Websites (an example: https:\\molview.org)

Safety Supplies (specifics to when they are required included in lab handouts)

Integrated Accommodations and Modifications Spec Ed., ELL, At-Risk, G&T, Career Education, 504s

https://docs.google.com/spreadsheets/d/1WPR9w7-UpEeDhl7-1U_EjbNwTuqMkUj8KIJdNwAS0Es/edit?usp=sharing