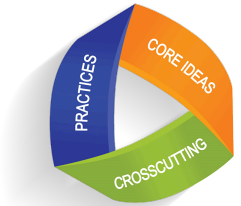
Patterns Chemistry
Unit 5 Chemical Reactions

Updated January 2024



Unit 5: Chemical Reactions - approximately 640-minutes or 7-8 class periods (90 minutes)

Unit Resources

Unit walk through Unit 5 INB Vocabulary Paper Packet Rubrics Unit 5 Webinar	Whiteboard Meetings Teacher Notes CER Resource Posters + useful slides for classroom setup Links to Instructional Materials for All Unit 5 Tasks [English, Spanish, WCAG]

Chemical Reactions - Predict the products of simple chemical reactions, balance equations, construct explanations for observed reaction outcomes, and provide evidence for the conservation of mass.

Anchoring Phenomenon: There is a large variety of natural and manmade sources of pollution, these pollutants have far reaching impacts on our health, the quality of our air and water, as well as the stability of our climate. EPA National Air Quality Data (could be used in unit opener)

Unit Essential Question: How are pollutants produced and what are their chemical consequences for our air, water, and climate?

NGSS Performance Expectations with links to evidence statements

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.	**HS-ETS1-1** Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

Practices: Mathematical and Computational Thinking, Constructing Explanations, Defining Problems, Designing Solutions

Crosscutting Concepts: Patterns, Energy and Matter, Influence of Science, Engineering, and Technology on Society and the Natural World
Disciplinary Core Ideas: Structure and Properties of Matter, Chemical Reactions, Defining and Delimiting Engineering Problems

Social, Emotional, Learning tip: Hey teachers! Consider building some positive classroom culture and community using these low stakes talk scripts.

Task Set # (Minutes)	Essential Questions & Activities	Practice & Extension	SEPs CCCs DCIs	Evidence of Student Learning/ Assessment
Engage				
0 (50-90 mins)	**EQ:** How have the tribes managed natural resources before Federal intervention and after? **Phenomenon:** The tribes have managed the resources on the lands since time immemorial. Teacher Notes 1. Tribal resource management slides			Students will understand how resource management has changed through termination and restoration of the tribes. Students investigate what tribes are currently doing for resource management.
1 (50-90 mins)	**EQ:** How are pollutants produced and how do they affect the environment? **Phenomenon:** There is a large variety of natural and manmade sources of pollution. These pollutants have far reaching impacts on our health, the quality of our air, and water as well as the stability of our climate. Teacher notes 1. Unit opener slideshow 2. Introductory pollution activity (chose one) ○ Students use text set to write CER ○ Students create slide deck		**SEP:** Asking questions **CCC:** Energy and Matter **DCI:** Structure and Properties of Matter, Chemical Reactions	Students generate questions about pollutants, including their sources and their consequences. Students write a summary on the article they read and reflect on their reading comprehension strategy.

2 (90-120 mins)	**EQ:** How are different pollutants made? **Phenomenon**: There are many different kinds of pollutants that come from different places and different chemicals. Teacher Notes 1. Reaction sort activity (slides, student handout and printout)		**SEP:** Using models **CCC:** Patterns **DCI:** Chemical Reactions	Students sort reactions by type in the first activity, then they apply that knowledge to identify reactions that create pollutants and support them with evidence in the second activity.
Explore and Explain				
3 (90 min)	**EQ:** How are atoms cycled in earth's systems, where does the matter go? **Phenomenon**: The matter composing pollution does not disappear, atoms/elements/molecules/compounds cycle through earth systems and change in form. Teacher Notes 1. Balancing equations simulation: ○ PhET Balancing Equations Student Template - with this PhET simulation. 2. Chemical reaction application: the nitrogen cycle ○ **Watch** Happening Now: Dead Zones in the Gulf 2021 (3 min) then **complete** Balanced or Imbalanced? The Nitrogen Cycle (30min)	CK-12 Balancing Chemical Rxns Balancing Equations - Living Systems **Extra balancing practice** Leveled Balancing Practice Additional Balancing Practice **Support for learning balancing equations** Counting atoms/balancing equations practice with drawings	**SEP:** Mathematical and Computational Thinking, Construct explanations **CCC:** Energy and Matter, Patterns **DCI:** Chemical Reactions	Self-assessment on balancing OPTIONAL: Formative Quiz 1 or Formative Quiz 2 on identifying reaction types and balancing.
4	**EQ:** Can we predict the outcomes of reactions using patterns of valence electron configurations and electronegativity?	Additional practice predicting products	**SEP:** Constructing an explanation	Predicting products practice

(2 - 90 min days or 4 - 50 min days)	**Phenomenon**: Chemical reactions can harm or clean up our environment. Teacher Notes 1. Predicting Reactions Lab folder (slides, student template) 2. Predicting Products Student practice, KEY	Single and Double Rxn Practice Problems	**CCC:** Patterns **DCI:** Chemical Reactions	Completed Predicting Reactions Inquiry Lab Student Template with CER.
Elaborate and Evaluate				
5 (360 min)	**EQ:** How can we utilize chemical reactions to remove contaminants from water and return nutrients to the ecosystem? Teacher Notes 1. Water Quality Engineering Project (Updated 2025) a. Teacher Support Materials	Engagement 5.1 Water Pollution	**SEP:** Designing solutions **CCC:** Cause and Effect **DCI:** Chemical Reactions	Completed Engineering Portfolio
6 (90 min)	• End of Unit Exam (2025) and KEY • Additional Unit 5 Exam Questions • Alternative Assessment: COE and Rubric • Alternative Assessment: WBP • Unit 5 Canvas Quiz in Canvas Commons - Search "Patterns Chemistry Unit 5"			

Science and Engineering Practice Look Fors:

Practice	Grades 9-12 Science and Engineering Practice "Look Fors"

Practice 1a: Asking Questions	• Ask questions:
	  ○ that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information.
	  ○ that arise from examining models or a theory, to clarify and/or seek additional information and relationships.
	  ○ to determine relationships, including quantitative relationships, between independent and dependent variables.
	  ○ to clarify and refine a model, an explanation, or an engineering problem.
	• Evaluate a question to determine if it is testable and relevant.
	• Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment) with available resources and, when appropriate, frame a hypothesis based on a model or theory.
	• Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design

Practice 1b: Defining Problems	• Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations.
Practice 2: Developing and Using Models	• Evaluate merits and limitations of two different models of the same proposed tool, process, mechanism, or system in order to select or revise a model that best fits the evidence or design criteria. • Design a test of a model to ascertain its reliability. • Develop, revise, and/or use a model based on evidence to illustrate and/or predict the relationships between systems or between components of a system. • Develop and/or use multiple types of models to provide mechanistic accounts and/or predict phenomena, and move flexibly between model types based on merits and limitations. • Develop a complex model that allows for manipulation and testing of a proposed process or system. • Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
Practice 3: Planning and Carrying Out Investigations	• Work as an individual or a team to produce data as evidence to revise models, support explanations or test solutions to problems. Students should consider confounding variables and evaluate design to ensure controls. • Critically analyze design of an experiment to decide the accuracy of data needed to produce reliable measurements and limitations of the data (number of trials, cost, risk, time etc.) • Select appropriate tools to collect, record, analyze and evaluate data. • Make directional hypotheses about dependent and independent variable relationships.
Practice 4: Analyzing and Interpreting Data	• Analyze data using tools, technologies, and/or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. • Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficient for linear fits) to scientific and engineering questions and problems, using digital tools when feasible. • Consider limitations of data analysis (e.g., measurement error, sample selection) when analyzing and interpreting data. • Compare and contrast various types of data sets (e.g., self generated, archival) to examine consistency of measurements and observations. • Evaluate the impact of new data on a working explanation and/or model of a proposed process or system. Analyze data to identify design features or characteristics of the components of a proposed process or system to optimize it relative to criteria for success.
Practice 5: Using Mathematics and	• Create and/or revise a computational model or simulation of a phenomenon, designed device, process or system to see if a model “makes sense” by comparing the outcomes with what is known about the real world • Use mathematical, computational, and/or algorithmic representation of phenomena or design solutions to describe and/or support claims and/or explanations.

Computational Thinking	• Apply techniques of algebra and functions to represent and solve scientific and engineering problems. For example, apply ratios, rates, percentages and unit conversions to problems involving quantities with derived or compound units.
Practice 6a: Constructing Explanations and Designing Solutions	• Make a claim regarding the relationship between independent and dependent variables. • Construct and revise an explanation based on reliable and varied evidence to describe the natural world and its laws. • Apply scientific ideas, principles and/or evidence to explain phenomena and solve design problems, taking into account possible unanticipated effects. • Apply scientific reasoning to link evidence to claims and assess the extent to which the reasoning and data support the conclusion.
Practice 6b: Designing Solutions	• Design, evaluate and/or refine a solution to a complex real-world problem, based on scientific knowledge, evidence, criteria and tradeoff considerations.
Practice 7: Engaging in Argument from Evidence	• Compare and evaluate competing arguments or design solutions in light of currently accepted explanations, new evidence, limitations, constraints, and ethical issues to determine the merits of arguments. • Respectfully provide and/or receive critiques on scientific arguments by probing reasoning and evidence, challenging ideas and conclusions, responding thoughtfully to diverse perspectives, and determining additional information required to resolve contradictions. • Construct, use, and/or present oral and written claims and arguments or counter-arguments based on data and evidence about the natural world or effectiveness of a design solution that reflects scientific knowledge and student-generated evidence. • Evaluate competing design solutions to a real-world problem based on scientific ideas and principles, empirical evidence, and/or logical arguments regarding relevant factors (economic, societal, environmental, ethical considerations).
Practice 8: Obtaining, Evaluating, and Communicating Information	• Critically read scientific literature adapted for classroom use to determine the central ideas or conclusions and/or to obtain scientific and/or technical information to summarize complex evidence, concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. • Compare, integrate and evaluate sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a scientific question or solve a problem. • Gather, read, and evaluate scientific and/or technical information from multiple authoritative sources, assessing the evidence and usefulness of each source. Evaluate the validity and reliability of and/or synthesize multiple claims, methods, and/or designs that appear in scientific and technical texts or media reports, verifying the data when possible. • Communicate scientific and/or technical information or ideas (e.g. about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).