Unit 3 Nuclear - Distance Learning Patterns Chemistry

Unit 3: Nuclear Chemistry- approximately 12-14 class periods

Unit Resources: Unit 3 Tracker Student Interactive Notebook	Vocabulary	Rubrics	Essential Unit Experiences are highlighted in green. This unit is in the Canvas Commons Patterns Chemistry course - search “Patterns Chemistry”

ALT# 3: Nuclear Processes - Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

Anchoring Phenomenon/Dilemma: Nuclear waste disposal is a problem locally and globally, but nuclear power is a bridge to reducing carbon dioxide emissions and nuclear weapons have had significant historical impacts.

Unit Essential Question: As a global society, should we continue to develop nuclear technologies? Do they have the potential to save more lives than harm them?

NGSS Performance Expectations Academic Supporting Targets (ASTs) with links to evidence statements:

HS-PS1-8. (AST 3.1): Conducts an investigation to develop a model that illustrates the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

HS-ESS1-1 and HS-ESS1-3 (AST 3.4): Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun’s core to release energy in the form of radiation and communicate scientific ideas about the way stars, over their life cycle, produce elements.

HS-ESS1-6 (AST 3.5): Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth’s formation and early history (radiometric dating).

Practices: Analyzing and Interpreting Data / Developing a model / Constructing an explanation / Arguing from Evidence / Obtaining, evaluating, and communicating information

Crosscutting Concepts: Scale, proportion and quantity / Energy and Matter / Stability and change

Disciplinary Core Ideas: The history of planet Earth / Nuclear processes / The universe and its stars / Energy in chemical processes and everyday life

Task Set # (Days)	Essential Question & Activities	Practice & Extension	SEPs CCCs DCIs	Evidence of Student Learning/ Assessment
Engage				
1 (50-60 mins)	**EQ: As a global society, should we continue to use nuclear power?** **Phenomenon**: Nuclear technology has both advantages and disadvantages in a society. ● Use this Unit 3 Opener slideshow (20 minutes with two short embedded videos) to frame the unit essential question and create a driving question board: ○ Example Template ○ During slideshow presentation students should go into the Jamboard and add post-its to the H, K, and W Jamboard pages ○ Examples of student generated questions. Ask students, what do we need to know to answer our unit essential question (should we, as a global society, continue to use nuclear technologies?) (30 min.)	Possible extension/TAG ideas: Engagement 3.1 Engagement 3.2 Engagement 3.3 Engagement 3.4 Engagement 3.5	**SEP:** Asking Questions / Obtaining evaluating, and communicating information **CCC:** Energy and matter / Stability and change **DCI:** Nuclear processes / The universe and its stars / Energy in chemical processes and everyday life	Students develop questions and share out on sticky notes and verbally (small groups) Students discuss merits of questions and share out to large group their most pressing question
2 (45 mins)	**EQ: Where do elements come from (stable and radioactive)?** **Phenomenon:** The elements are formed in highly energetic interactions within a star. ● TS 2 Teacher Notes TS 2 Teacher Notes ○ Play short video: The Elements Forged in Stars ○ Article Choices: ■ Where do Chemical Elements Come From?	Finish Reading summary (with CER Resource Sheet) Submission Form for reading summary	**SEP:** Asking Questions / Obtaining evaluating, and communicating information **CCC:** Energy and matter / Stability and change	Students obtain information from readings and summarize

	■ How elements are formed ■ The Sun, an Engine of Nuclear Energy ■ Big Think: Where do all of the elements come from? ○ Summary Template		**DCI:** Nuclear processes / The universe and its stars / Energy in chemical processes and everyday life	
3 (50 mins)	**EQ:** How can we predict if an element is stable or unstable? **Phenomenon**: Some isotopes spontaneously decay. • TS3 Teacher notes • Students practice predicting nuclear reaction outcomes with Band of Stability Practice problems (also available on GoFormative, code: 6SHD3N) and Fission vs. Fusion. • **Career Learning:** Using nuclear reactions for good: Career profile of a Nuclear Medicine Technologist ○ Watch Career Profile - Nuclear Medicine (4 min) on nuclear medicine technologists ○ Review the Nuclear Medicine Technologist career profile. ○ Also check out Medical Dosimetrist Profile, which requires a few more years of school and pays more (point out this is a career ladder). • Check out the Most Radioactive Places on Earth (11 min)	Additional Band of Stability Practice problems Fission vs. Fusion	**SEP:** Developing a model **CCC:** Energy and Matter / Stability and Change **DCI:** Nuclear processes	Students use models of reactions with chemical symbols to predict outcomes of nuclear reactions. Use formative probe to assess student learning.
4 (90 mins)	**EQ:** Which type of nuclear reaction occurs in nuclear power plants? **Phenomenon**: There are different types of nuclear reactions that impact our lives in different ways. • TS 4 Teacher Notes **Nuclear Reactions-**	HW: talk to family members about nuclear power or radioactive waste, bring stories back to class to share.	**SEP:** Developing a model **CCC:** Energy and Matter / Stability and Change **DCI:** Nuclear processes	Students sort cards by reaction type, symbolize reaction types, and write reaction descriptions

	• Play video: Nuclear Energy Explained - how does it work? (5 min)
	
	• Nuclear power and types of radiation slides
	  ◦ students work through interactive notebook and sort types of radiation from this spreadsheet
	  ◦ students work through Marie Curie's lab (Click on Tutorial at the top to watch an instructional video)
	
	• Additional optional Review alpha and beta decay as well as fission with Phet Demonstrations on the teacher computer (does not work with chromebook) (10 min)
		Nuclear Decay Guided Inquiry
		
		Stable vs Unstable Practice		

Explore and Explain				

5
(60-90 mins)
	EQ: Is nuclear waste safe?
	Phenomenon: Nuclear processes leave behind nuclear waste.
	
	• TS 5 Teacher Notes
	
	• Warm-up: Nuclear reactions formative probe (practice concepts from task set 3)
	
	• Half Life Patterns Lab Teacher Slides and Student Slides
	  ◦ Half Life Student Lab Template
	  ◦ Data discussion template for half life
	  ◦ link to dice simulator (see teacher notes for video demonstration of how this works)
	  ◦ For the lab, students analyze data, determine the pattern, conduct a data discussions/board meeting, and write a conclusion.
		Finish Half Life Student Lab Template
		
		and
		
		Ways to Solve for Half Life Practice Problems with examples for students to follow
		
		and/or
		
		Half Life Practice (Both are pdfs)
			SEP: Developing a model / Analyzing Data / Constructing an Explanation
			CCC: Scale, proportion and quantity
			DCI: The history of planet Earth / Nuclear processes
				Students analyze fossil isotope data to develop the exponential decay equation.
				
				Students construct an explanation of why this equation helps us date fossils as well as earth's ancient materials.
				
				Students turn in inquiry lab report.

Elaborate and Evaluate				
6 (2-3 days)	**EQ:** Should we, as a global society, continue to develop nuclear technology?	Study for test and/or finish project/ writing	**SEP:** Arguing from evidence	Students develop an argument in favor of nuclear power or

	Phenomenon: Nuclear technologies create radioactive waste, but they also have positive benefits to society, should we continue to use and develop these technologies?
	
	• TS 6 Teacher Notes Distance Learning Flash Debate Process
	
	• Socratic Seminar & Writing assignment: Nuclear Technology: Good or Bad?.
	  ○ Students develop an evidenced-based written argument that either argues in favor or against the development and/or use of nuclear technology.
	  ○ They can choose between a number of specific technologies/questions to investigate.
	  ○ There are a variety of articles and videos on this document that the students can use to support their arguments.
	  ○ This assignment will prepare them to participate in a Socratic seminar or Flash Debate (see teacher notes linked above)
	  ○ Flash Debate Student Template
	  ○ Student support and peer review document
	
	• Consider doing a joint project with social studies on nuclear weapons and power.
	
	• Culminating Experience Hanford Socratic Seminar resources
		assignment that summarizes Socratic Seminar discussion, etc.	**CCC:** Scale, proportion and quantity / Energy and matter
			DCI: Energy in chemical processes and everyday life
				against nuclear power using evidence from a variety of sources. Student addresses the other side of the argument and effectively critiques it with evidence.

7 (optional TS, only watch video if short on time, 60 mins)	**EQ** - How old is the Earth?
	Phenomena - We can use the decay of elements to help us determine the age of the Earth.
	
	• Watch "How do we know Earth is 4.6 Billion Years Old?".
	  ○ Connect this article to what we found out about dating fossils.
	  ○ Conclusion: We use the decay of different elements and isotopes to date rocks/fossils of varying ages.
			SEP: Constructing an explanation
			
			CCC: Energy and matter / Stability and change
			
			DCI: Nuclear processes / The universe and its	

	The elements with the longer half-lifes are used to date the oldest rocks (from Earth's beginning). ● And/or do this CER on the Age of the Earth "Unraveling Earth's History," ○ In this activity, students read about planetary formation and how we determine the age of various solar system objects using radiometric dating. ○ Students then graph data from Mars, a meteorite, the Moon, and Earth to write a CER on when those bodies formed.		stars / Energy in chemical processes and everyday life	
(1 day)	**Unit Test** ● See the Unit 3 Test Bank in the restricted teachers folder. ● Example for assessment options beyond standard test: ○ Collection of Evidence (COE) rubric and COE slides ■ Students make a copy of the slides and demonstrate their understanding of unit concepts and science practices using the various slide templates provided in the slides masters. ● Return to the opener Jamboard [Template (make a copy of the Jamboard for each class period)] to review content			

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 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 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 6a: Constructing Explanations	● 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 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).

Other Unit Resources