Phoenixville Area School District Understanding by Design (UbD) Science Template

Grade Level &/or HS Subject: 11/ Chemistry **Unit Name: Nuclear Chemistry**

Stage 1 Desired Results

Overarching NGSS & PA Standards:

PA-SPM3: 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.

PA-HS2: Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.

Transfer

Students will be able to independently use their learning to…

Ask questions and/or define problems

Develop and/or use models

Plan and/or carry out investigations

Analyze and interpret data using computational thinking

Obtain, evaluate, and communicate information (supported by evidence)

Construct explanations and design solutions

Meaning-Making

Students will understand that…

- Unstable atoms decay to stable isotopes and emit various types of radiation.
- Different types of radiation require different types of shielding and/or remediation.
- Radioactive decay can be quantified using half-lives of isotopes.
- Nuclear reactions release vast amounts of energy and are important sources of power for millions.
- The dangers of nuclear energy are well documented and have pros and cons when compared to other sources of generating energy.

ESSENTIAL QUESTIONS

Students will keep considering...

- *What holds subatomic particles together?*
- *Why are some atoms unstable?*
- *What is radiation?*
- *How is energy released from nuclear reactions?*
- *What hazards do nuclear reactions pose?*
- *Is mass and/or energy conserved in a nuclear reaction?*
- *What is decay?*
- *How can radiation be remediated?*

Which branch(es) of science apply: **PS E&SS**	***Knowledge and Skills Acquisition***	
	UNDERSTANDINGS *Students will know…* • Unstable nuclei decay into stable isotopes. • Gamma rays, alpha particles, and beta particles are the three main types of radiation. • Gamma rays are the most dangerous type or radiation requiring the most shielding. • Half-life can be used to calculate amounts of isotopes. • Fusion is the combination of smaller nuclei into larger and releases vast amounts of energy. • Fission is the splitting of a larger nucleus into smaller and releases vast amounts of energy. • Nuclear reactions have been responsible for disasters and remain dangerous to this day. • Nuclear energy has positive and negative attributes when compared to other modern methods of energy production.	*Students will be skilled at…* • *Use a model to predict the relationships between systems or between components of a system* • Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources. • Apply scientific principles and evidence to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects. • Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. • Reason abstractly and quantitatively. • Use mathematical representations of phenomena to support claims. •
	KEY VOCABULARY • Isotope • Decay • Radiation • Half-life • Fusion • Fission • Gamma ray • Alpha particle • Beta particle • Reactor • Proton • Neutron • Chain reaction	

<table>
<tr><th colspan="3">Stage 2 – Evidence</th></tr>
<tr><th>Evaluative Criteria</th><th colspan="2">Assessment Evidence</th></tr>
<tr><td>Lab Report Rubrics

Student Model Rubrics

Mathematical Solutions

Discussion Rubrics

Formative Checks for Understanding</td><td>PERFORMANCE TASK(S):
Students will develop models in which they identify and describe the relevant components of the nucleus during decay.
Students develop models in which they identify and describe the relevant types of radiation involved with nuclear processes.
Students will collaborate to determine proper shielding for specific types of radiation using materials available to the average person.
Students will use provided half-life data to calculate the age of hypothetical archaeological artifacts.
Students develop models in which they identify and describe the relevant components and processes of fusion and fission.
Students will research current and future methods of nuclear energy production.
Students will collaborate to construct presentations discussing the pros and cons of a specific form of nuclear energy.</td><td>Differentiation Considerations:
Assignments can be scaffolded to a variety of difficulties.
Example models can be made for students who struggle to start.
Some data can be given at the start of activities.
Teacher prompts to get students talking.
Extra time and chunking for the larger assignments.</td></tr>
<tr><td>Mathematical Solutions

Test Keys / Rubrics

Presentation Rubrics</td><td>OTHER EVIDENCE:
PHET simulations
Unit tests (multiple choice and written response)
Quizzes (multiple choice and written response)
Mathematical problems: half-life
Power point presentations</td><td>Differentiation Considerations:
Multiple-choice assessments can be shortened.
Assignments can be made vocabulary based for EL’s
Larger assignments can be chunked with multiple student check ins.</td></tr>
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