

**Kenai Peninsula Borough School District**  
**Science: Physical Science**  
**Unit Title 7: NUCLEAR CHANGES**

**NGSS Standards:**

**HS-PS1-1.** Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

**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-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.

**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.

**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.

**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.

**HS-PS1-7.** Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

**HS-PS1-8.** 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.

**HS-PS2-6.** Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

**HS-PS2-3.** Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.

**HS-PS3-1** Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

**HS-PS3-2.** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative positions of particles (objects).

**HS-PS3-3.** Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

**HS-PS3-4.** Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

**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.

**HS-PS4-1.** Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

**HS-PS4-2.** Evaluate questions about the advantages of using a digital transmission and storage of information.

**HS-PS4-3.** Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

**HS-PS4-4.** Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.

**HS-PS4-5.** Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

*(HS-PS2-1), (HS-PS2-4), (HS-PS2-5), (HS-PS2-6)*

**ELA/LITERACY:**

**RST.9-10.7** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. (HS-PS1-1) (HS-PS2-1) (HS-PS3-3) (HS-PS3-4) (HS-PS3-5)

**RST.11-12.1** Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS1-3), (HS-PS1-5) (HS-PS2-1) (HS-PS2-6) (HS-PS3-3)

**WHST.9-12.2** Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-PS1-2) (HS-PS1-5) (HS-PS2-6)

**WHST.9-12.5** Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience. (HS-PS1-2)

WHST.9-12.7 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. (HS-PS1-3) (HS-PS1-6) (HS-PS2-5) (HS-PS2-3)

**WHST.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 specific 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. (HS-PS1-3) (HS-PS2-5) (HS-PS3-4) (HS-PS3-5)

**WHST.9-12.9** Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3) (HS-PS3-4) (HS-PS3-5)

**SL.11-12.5** 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. (HS-PS1-4) (HS-PS3-1) (HS-PS3-2) (HS-PS3-5)

#### **MATHEMATICS:**

**MP.2** Reason abstractly and quantitatively. (HS-PS1-5) (HS-PS1-7) (HS-PS2-1) (HS-PS2-4) (HS-PS3-1) (HS-PS3-2) (HS-PS3-3) (HS-PS3-4) (HS-PS3-5)

- a. decontextualize to abstract a given situation and represent it symbolically and manipulate the representing symbols.
- b. reflect during the manipulation process in order to probe into the meanings for the symbols involved
- c. create a coherent representation of the problem
- d. make sense of quantities and their relationships in problem situations
- e. attend to the meanings of quantities
- f. use flexibility with different properties of operations and objects
- g. translate an algebraic problem to a real-world context
- h. explain the relationship between the symbolic abstraction and the context of the problem
- i. compute using different properties
- j. consider the quantitative values, including units, for the numbers in a problem

**MP.4** Model with mathematics. (HS-PS1-4) (HS-PS1-8) (HS-PS2-1) (HS-PS2-4) (HS-PS2-6) (HS-PS3-1) (HS-PS3-2) (HS-PS3-3) (HS-PS3-4) (HS-PS3-5)

**HSN-Q.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. (HS-PS1-2) (HS-PS1-3) (HS-PS1-4) (HS-PS1-5) (HS-PS1-7) (HS-PS1-8) (HS-PS2-1) (HS-PS2-4) (HS-PS2-5) (HS-PS2-6) (HS-PS3-1) (HS-PS3-3)

**HSN-Q.2** Define appropriate quantities for the purpose of descriptive modeling. (HS-PS1-4) (HS-PS1-7) (HS-PS1-8) (HS-PS2-1) (HS-PS2-4) (HS-PS2-5) (HS-PS2-6) (HS-PS3-1) (HS-PS3-3)

**HSN-Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2) (HS-PS1-3) (HS-PS1-4) (HS-PS1-5) (HS-PS1-7) (HS-PS1-8) (HS-PS2-1) (HS-PS2-4) (HS-PS2-5) (HS-PS2-6) (HS-PS3-1) (HS-PS3-3)

**HSA.SSE.1** Interpret expressions that represent a quantity in terms of its context. (HS-PS2-1) (HS-PS2-4)

**HSA.SSE.3** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (HS-PS2-1) (HS-PS2-4)

**HSA.CED.1** Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. (HS-PS2-1)

**HSA.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (HS-PS2-1)

**HSA.CED.4** Rearrange formulas (literal equations) to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS2-1)

**HSF-IF.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (HS-PS2-1)

**HSS-IS.1** Represent data with plots on the real number line (dot plots, histograms, and box plots). (HS-PS2-1)

#### **ESSENTIAL QUESTIONS:**

1. Compare and contrast the energy associated nuclear fission, nuclear fusion and radiation (alpha, beta, gamma) and relate them to safety concerns.
2. Compare and contrast concepts of fusion, fission and radioactive decay.
3. Relate the equation  $E=mc^2$  to energy produced during a nuclear reaction.
4. Compare and contrast chemical versus nuclear reactions.

#### **BIG IDEAS:**

1. Types of radioactive decay and nuclear reactions.
2. Differentiate between alpha, beta and gamma radiation.
3. Einstein's equation.

**Vocabulary:** Radioactive decay, Fission, Fusion, Alpha, Beta, Gamma, Critical mass