Orange Public Schools

Office of STEM-Focused Learning & Gifted Education
Science Curriculum Guide

Physics Honors

Unit 5: From the Nucleus to the Universe

33.5 Instructional Days

Board Approved: 9/13/23

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YEARLONG SCOPE AND SEQUENCE

UNIT 1	UNIT 2	UNIT 3	UNIT 4	UNIT 5
Forces and Motion	**Forces at a Distance**	**Energy Conversion**	**Waves and Electromagnetic Radiation**	**From the Nucleus to the Universe**
23.5 days	45 days	48 days	27.5 days	33.5 days
In Storyline 1, students learn how to model motion using models that are grounded in mathematical relationships. They investigate and model uniform motion, nonuniform motion, circular motion, and projectile motion. Students also explore how various forces affect the motion of objects. Students explore the relationship between forces and motion. *This unit addresses HS-PS2-1, HS-PS2-2, HS-PS2-4, and HS-ESS2-1.*	In Storyline 2, students investigate gravitational forces, electrical forces, magnetic forces, and forces in materials. They connect orbital motion to gravitational forces and construct explanations about electric fields and currents. Students investigate gravitational, electric, and magnetic forces, and the forces within atoms. *This unit addresses HS-PS1-3, HS-PS2-4, HS-PS2-5, HS-PS2-6, HS-PS3-5, and HS-ESS1-4.*	In Storyline 3, students explore energy conversions by quantifying how much energy transfers between objects and energy fields. They use bar charts and equations to define systems and to model energy conversions. They consider heat transfer in engines, heat pumps, and Earth's interior, connecting the convection of Earth's mantle to plate tectonics. Students evaluate the costs and benefits associated with different methods of energy production and identify variables essential to a sustainable energy future for Earth's growing human population. Students explore energy conversions in collisions, in engines and heat pumps, and in electromagnetic systems. *This unit addresses HS-PS2-2, HS-PS2-3, HS-PS2-5, HS-PS3-1, HS-PS3-2, HS-PS3-3, HS-PS3-4, HS-PS3-5, HS-ESS2-1, HS-ESS2-3, HS-ESS3-2, and HS-ESS3-3.*	In Storyline 4, students explore waves and electromagnetic radiation, as well as technological applications of transmitting and capturing information and energy. In Investigation 1 1, students experiment with waves. In Investigation 12, students explore electromagnetic radiation. In Investigation 13, students design instrumentation to transmit information. Students investigate the properties and behaviors of waves, using mathematical relationships. *This unit addresses HS-PS3-3, HS-PS4-1, HS-PS4-2, HS-PS4-3, HS-PS4-4, and HS-PS4-5.*	In Storyline 5, students investigate and model atomic nuclei and the processes they undergo. They learn how the predictable decay processes of specific atomic nuclei are used by scientists to date materials. They also explore evidence relating to the origin of the universe and compare the sun to other stars in the universe. Students explore the beginning of the universe, the death of stars, and the radioactive decay of atoms. *This unit addresses HS-PS1-8, HS-ESS1-1, HS-ESS1-2, HS-ESS1-3, HS-ESS1-5, HS-ESS1-6, and HS-ESS2-1.*

UNIT OVERVIEW AND CONCEPTUAL FLOW

Content Area	Science	**Course**	Physics Honors
Unit Plan Title	Unit 5: From the Nucleus to the Universe	**Duration**	33.5 days

UNIT OVERVIEW

In Storyline 5, students investigate and model atomic nuclei and the processes they undergo. They learn how the predictable decay processes of specific atomic nuclei are used by scientists to date materials. They also explore evidence relating to the origin of the universe and compare the sun to other stars in the universe. Students explore the beginning of the universe, the death of stars, and the radioactive decay of atoms.

This unit addresses HS-PS1-8, HS-ESS1-1, HS-ESS1-2, HS-ESS1-3, HS-ESS1-5, HS-ESS1-6, and HS-ESS2-1.

CONCEPTUAL FLOW

Anchoring Phenomenon	description
Investigations	**Investigation #14:** Nuclear Physics • **Experience 1** - Nuclear Particles • **Experience 2** - Nuclear Forces • **Experience 3** - Fission and Fusion **Investigation #15:** Ages of Rocks • **Experience 1** - Radioactive Decay • **Experience 2** - Radiometric Dating • **Experience 3** - Geologic Time **Investigation #16:** The Universe • **Experience 1** - The Sun • **Experience 2** - Stars • **Experience 3** - The Big Bang

ESSENTIAL QUESTION(S) AND ENDURING UNDERSTANDINGS

Essential Questions /Focus Questions	Enduring Understandings
• How did the atoms that make up your body form? • How can your electricity come from the fusion of atoms? • How did Earth form? • How will the sun change over time?	• Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. • In nuclear processes, atoms are not conserved, but the total number of protons plus neutrons is conserved. • The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. • The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and the maps of spectra of the primordial radiation that still fills the universe. • Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities. • Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve supernova stage and explode. • Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. • Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. • Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. • Although active geologic processes, such as plate tectonics and erosion, have destroyed or altered most of the very early rock record on Earth, other objects in the solar system, such as lunar rocks, asteroids, and meteorites, have changed little over billions of years. Studying these objects can provide information about Earth's formation and early history. • Earth's systems, being dynamic and interacting, cause feedback effects than can increase or decrease the original changes.

NGSS PERFORMANCE EXPECTATION(S)

Students who demonstrate understanding can:

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-ESS1-1 **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.**

HS-ESS1-2 **Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.**

HS-ESS1-3 **Communicate scientific ideas about the way stars, over their life cycle, produce elements.**

HS-ESS1-5 **Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.**

HS-ESS1-6 **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.**

HS-ESS2-1 **Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.**

3-DIMENSIONAL LEARNING

SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
☐ **Asking Questions and Defining Problems** ☒ **Developing and Using Models** ☐ **Planning and Carrying Out Investigations** ☐ **Analyzing and Interpreting Data** ☐ **Using Mathematics and Computational Thinking** ☒ **Constructing Explanations and Designing Solutions** ☒ **Engaging in Argument from Evidence** ☒ **Obtaining, Evaluating, and Communicating Information**	**PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. **ESS1.A: The Universe and Its Stars** The star called the sun is changing and will burn out over a lifespan of approximately 10 billion years. **PS3.D: Energy in Chemical Processes and Everyday Life** Nuclear Fusion processes in the center of the sun release the energy that ultimately reaches Earth as radiation. (secondary) **ESS1.A: The Universe and Its Stars** The study of stars' light spectra and brightness is used to identify compositional elements of stars, their movements, and their distances from Earth. The Big Bang theory is supported by observations of distant galaxies receding from our own, of the measured composition of stars and non-stellar gases, and of the maps of spectra of the primordial radiation (cosmic microwave background) that still fills the universe. Other than the hydrogen and helium formed at the time of the Big Bang, nuclear fusion within stars produces all atomic nuclei	☒ **Patterns** ☐ **Cause and Effect** ☒ **Scale, Proportion, and Quantity** ☐ **Systems and System Models** ☒ **Energy and Matter** ☐ **Structure and function.** ☒ **Stability and change**.

	lighter than and including iron, and the process releases electromagnetic energy. Heavier elements are produced when certain massive stars achieve a supernova stage and explode. **ESS1.C: The History of Planet Earth** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **ESS2.A: Earth Materials and Systems** Earth's systems, being dynamic and interacting, cause feedback effects that can increase or decrease the original changes. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. (ESS2.B Grade 8 GBE) (secondary) **PS1.C: Nuclear Processes** Spontaneous radioactive decays follow a characteristic exponential decay law. Nuclear lifetimes allow radiometric dating to be used to determine the ages of rocks and other materials. (secondary) **PS4.B: Electromagnetic Radiation** Atoms of each element emit and absorb characteristic frequencies of light. These characteristics allow identification of the presence of an element, even in microscopic quantities.	

INTERDISCIPLINARY CONNECTIONS

English Language Arts

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-PS3-4)

RST.11-12.7
Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ETS1-3)

RST.11-12.8
Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ETS1-3)

RST.11-12.9
Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. (HS-ETS1-3)

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-PS3-4)

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-PS3-4)

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

Mathematics

MP.2
Reason abstractly and quantitatively. (HS-PS3-4) (HS-ETS1-3)

MP.4
Model with mathematics. (HS-PS3-4) (HS-ETS1-2) (HS-ETS1-3)

HSN.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. (HS-PS2-1) (HS-PS2-4) (HS-PS2-6) (HS-PS1-8)

HSN.Q.A.2
Define appropriate quantities for the purpose of descriptive modeling. (HS-PS2-1) (HS-PS2-4) (HS-PS2-6) (HS-PS1-8)

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

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

HSA.SSE.B.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.A.1
Create equations and inequalities in one variable and use them to solve problems. (HS-PS2-1)
HSA.CED.A.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.A.4
Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (HS-PS2-1)
HSF-IF.C.7
Graph functions expressed symbolically and show key features of the graph, by in hand in simple cases and using technology for more complicated cases. (HS-PS2-1)
HSS-IS.A.1
Represent data with plots on the real number line (dot plots, histograms, and box plots). (HS-PS2-1)

INTEGRATED ACCOMMODATIONS & MODIFICATIONS

Special Education / 504

- Adhere to all modifications and health concerns stated in each IEP.
- Give students a MENU of options, allowing them to choose assignments from different levels based on difficulty.
- Accommodate Instructional Strategies: use of post-its, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time
- Allow extra time to complete assignments or tests
- Allow students to demonstrate understanding of a problem by drawing a functional model of the answer and then explaining the reasoning orally and/or writing.
- Provide breaks between tasks, use positive reinforcement, use proximity
- Work in a small group
- Use large print books, Braille, or digital texts

Strategies for students with 504 plans

English Language Learners

- Simplify written and verbal instructions
- Use manipulatives to promote conceptual understanding and enhance vocabulary usage
- Allow for alternate forms of responses- drawing or speaking instead of writing to demonstrate knowledge when you are not specifically assessing writing
- Allow the use of an online dictionary to look up the definition and hear the pronunciation of unknown words
- Provide graphic representations, gestures, drawings, equations, and pictures during all segments of instruction
- Utilize program translations tools such as Snap and Read (if available)
- Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information
- Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve real life problems.
- Reword questions in simpler language
- Provide class notes ahead of time to allow students to preview material and increase comprehension
- Provide extended time

Gifted and Talented

- Organize and offer flexible small group learning opportunities / activities.
- Utilize elevated contextual complexity
- Inquiry based or open-ended assignments, performance tasks and projects
- Allow more time to study concepts with greater depth
- Provide options, alternatives and choices to differentiate and broaden the curriculum.
- Promote the synthesis of concepts and making real world connections
- Provide students with enrichment practice that are imbedded in the curriculum
    - allowing students to design problems to be addressed by the class
    - allowing students to modify the lesson by introducing a related phenomenon
    - allow for interest-based extension activities
- Utilize an enhanced set of introductory activities (e.g. phenomena, organizers, concept maps etc.)
- Provide whole group enrichment explorations.
- Teach cognitive and methodological skills
- Allow for the use of stations
- Organize integrated problem-solving simulations.

Students at Risk for Failure

- Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum
- Modify Instructional Strategies; extended time, reading aloud text, graphic organizers, flexible grouping, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Utilize Scaffolded Questioning, Field Trips, Google Expeditions, Peer Support, Modified Assignments, Chunking of Information, Peer Buddies
- Assure constant parental/ guardian contact throughout the year with successes/ challenges
- Provide academic contracts to students and guardians
- Create an interactive notebook with samples, key vocabulary words, student goals/ objectives.
- Always plan to address students at risk in the designing of learning tasks, instructions, and directions.
- Try to anticipate where the needs will be and then address them prior to lessons.
- Teacher should allow for preferential seating
- Include Visual Cues/Modeling
- Allow for technology Integration, especially Assistive Technology

21ST CENTURY SKILLS
NJSLS CAREER READINESS, LIFE LITERACIES AND KEY SKILLS

An education in career readiness, life literacies, and key skills fosters a population that: continually self-reflects and seeks to improve the essential life and career practices that lead to success; uses effective communication and collaboration skills and resources to interact with a global society; possesses financial literacy and responsibility at home and in the broader community; plans, executes, and alters career goals in response to changing societal and economic conditions; and seeks to attain skill and content mastery to achieve success in a chosen career path.

New Jersey Student Learning Standards for Career Readiness, Life Literacies and Key Skills

9.1 Personal Financial Literacy

Civic Responsibility:

You can give back in areas that matter to you.

- **9.1.12.CFR.1:** Compare and contrast the role of philanthropy, volunteer service, and charities in community development and quality of life in a variety of cultures.

9.2 Career Awareness, Exploration and Preparation

Career Awareness and Planning:

An individual's passions, aptitude and skills can affect his/her employment and earning potential.

- **9.2.12.CAP.2:** Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.

9.3 Career and Technical Education

Engineering and Technology Career Pathway

- **9.3.ST-ET.5:** Apply the knowledge learned in STEM to solve problems.

Science and Mathematics Career Pathway

- **9.3.ST-SM.2:** Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.
- **9.3.ST-SM.3:** Analyze the impact that science and mathematics has on society.

9.4 Life Literacies and Key Skills

Creativity and Innovation:

Collaboration with individuals with diverse perspectives can result in new ways of thinking and/or innovative solutions. Curiosity and a willingness to try new ideas (intellectual risk-taking) contributes to the development of creativity and innovation skills.

- **9.4.12.CI.1:** Demonstrate the ability to reflect, analyze and use creative skills and ideas.
- **9.4.12.CI.3:** Investigate new challenges and opportunities for personal growth, advancement and transition.

Critical Thinking and Problem-solving:

The ability to solve problems effectively begins with gathering data, seeking resources, and applying critical thinking skills.

- **9.4.12.CT.1:** Identify problem-solving strategies used in the development of an innovative product or practice.
- **9.4.12.CT.3:** Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others (e.g., political. economic, cultural).

Digital Citizenship:

Sending and receiving copies of media on the internet creates the opportunity for unauthorized use of data, such as personally owned video, photos, and music. Digital identities must be managed in order to create a positive digital footprint.

- **9.4.12.DC.4:** Explain the privacy concerns related to the collection of data (e.g. cookies) and generation of data through automated processes that may not be evident to users

Information and Media Literacy:

Digital tools can be used to modify and display data in various ways that can be organized to communicate ideas.

- **9.4.12.IML.2:** Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.

Technology Literacy:

Different digital tools have different purposes. Collaborating digitally as a team can often develop a better artifact than an individual working alone.

	• **9.4.12.TL.1**: Assess digital tools based on features such as accessibility options, capacities and utility for accomplishing a specified task • **9.4.12.TL.3**: Analyze the effectiveness of the process and quality of collaborative environments. • **9.4.12.TL.4**: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.

Practices

- Act as a responsible and contributing community member and employee.
- Consider the environmental, social and economic impacts of decisions.
- Demonstrate creativity and innovation.
- Utilize critical thinking to make sense of problems and persevere in solving them.
- Model integrity, ethical leadership and effective management.
- Plan education and career paths aligned to personal goals.
- Use technology to enhance productivity increase collaboration and communicate effectively.

NJSLS COMPUTER SCIENCE & DESIGN THINKING

All students will be prepared to succeed in today's knowledge-based economy by providing equitable and expanded access to high-quality, standards-based computer science and technological design education.
https://www.nj.gov/education/standards/compsci/Docs/2020%20NJSLS-CSDT.pdf

8.1 Computer Science

Data & Analysis: Computing systems exist to process data. The amount of digital data generated in the world is rapidly expanding, so the need to process data effectively is increasingly important. Data is collected and stored so that it can be analyzed to better understand the world and make more accurate predictions.

- **8.1.12.DA.5**: Create data visualizations from large data sets to summarize, communicate, and support different interpretations of real-world phenomena.
- **8.1.12.DA.6**: Create and refine computational models to better represent the relationships among different elements of data collected from a phenomenon or process.

Algorithms & Programming: An algorithm is a sequence of steps designed to accomplish a specific task. Algorithms are translated into programs, or code, to provide instructions for computing devices. Algorithms and programming control all computing systems, empowering people to communicate with the world in new ways and solve compelling problems.

- **8.1.12.AP.1**: Design algorithms to solve computational problems using a combination of original and existing algorithms.
- **8.1.12.AP.2**: Create generalized computational solutions using collections instead of repeatedly using simple variables.
- **8.1.12.AP.3**: Select and combine control structures for a specific application based upon performance and readability, and identify trade-offs to justify the choice.
- **8.1.12.AP.5**: Decompose problems into smaller components through systematic analysis, using constructs such as procedures, modules, and/or objects.
- **8.1.12.AP.6**: Create artifacts by using procedures within a program, combinations of data and procedures, or independent but interrelated programs.

8.2 Design Thinking

Engineering Design:
People design for enjoyment and to solve problems, extend human capabilities, satisfy needs and wants, and improve the human condition. Engineering Design, a systematic approach to creating solutions to technological problems and finding ways to meet people's needs and desires, allows for the effective and efficient development of products and systems.

- **8.2.12.ED.1**: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
- **8.2.12.ED.4**: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

Interaction of Technology and Humans:
Societies influence technological development. Societies are characterized by common elements such as shared values, differentiated roles, and cultural norms, as well as by entities such as community institutions, organizations, and businesses. Interaction of Technology and Humans concerns the ways society drives the improvement and creation of new technologies, and how technologies both serve and change society.

- **8.2.12.ITH.1**: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.
- **8.2.12.ITH.2**: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

UNIT PACING GUIDE			
Lesson/ Investigation	**Learning Goal(s)**	**NGSS Performance Expectation(s)**	**Pacing**
Investigation #14: Nuclear Physics	Students explore the atomic nucleus, the forces that hold it together, and the energy it stores.	**HS-PS1-8**	**11 days** (Plus, optional extension task(s) if time allows within the allotted 11-day window.)
Investigation #15: Ages of Rocks	Students explore the process of radiometric dating to determine the ages of materials and apply these techniques to an investigation of the history of Earth through geologic processes.	**HS-PS1-8** **HS-ESS1-5** **HS-ESS1-6** **HS-ESS2-1**	**11 days** (Plus, optional extension task(s) if time allows within the allotted 11-day window.)
Investigation #16: The Universe	Students evaluate the evidence supporting the current understanding of the origin of the universe, the Big Bang model.	**HS-ESS1-1** **HS-ESS1-2** **HS-ESS1-3**	**11 days** (Plus, optional extension task(s) if time allows within the allotted 11-day window.)

LESSON #1 PACING GUIDE WITH EMBEDDED ASSESSMENTS

Suggested Instructional Days: (11)

Investigation #14: Nuclear Physics

In this investigation, students explore the components of the atomic nucleus, the forces within the nucleus, and the processes of fission and fusion. Students explore the atomic nucleus, the forces that hold it together, and the energy it stores.

NJSLS Specific to this Investigation/Lesson		
Performance Expectation	**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.	
Science & Engineering Practices	**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Developing and Using Models	Energy and Matter	PS1.C: Nuclear Processes

Anchoring Phenomenon

How did the atoms that make up your body form?	**Explaining Phenomena** To fully understand how atoms formed, students must understand macro- and micro-processes in the universe. **Anchoring Phenomenon video** → How did the atoms that make up your body form? **Student Handbook** → p. 652

Investigative Phenomenon

How can your electricity come from the fusion of atoms?	**Explaining Phenomena** To understand how electricity is produced by the fusion of atoms, students must understand the properties of subatomic particles and the conversion of mass to energy. **Investigative Phenomenon video** → How can your electricity come from the fusion of atoms?

Learning Goal	Teacher Preparation	Instructional Sequence	Assessments
EXPERIENCE 1 (3 days) **Nuclear Particles** Students explore atomic nuclei, elementary particles, and the relationship between matter and energy.	**Teacher's Guide** → p. 360 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕Analyzing Data/ ⊕Phet Simulation/ ⊕Explain Video/ ⊕Math Tutorial/⊕Writing About Science These OPTIONAL activities	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → Subatomic Particles ⊕ **PhET Simulation:** → Nuclear Particles **EXPLAIN** **Student Handbook:** → pgs. 570—580	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → NA

	can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → The human body is made of elements, some of which are a result of nuclear fusion in the sun. **Connection to Investigative Phenomenon** → Students apply knowledge of subatomic particles to the concepts of electrical power generation and transmission.	**Modeling:** → The Nucleus ⊕ **Explain Video:** → Atomic Nucleus ⊕ **Math Tutorial Video** **ELABORATE** **Peer Review Rubric:** → Evaluate the Nucleus ⊕ **Writing About Science:** → Skills in Nuclear Particles **EVALUATE** **Quiz:** → Nuclear Particles	
EXPERIENCE 2 (3 days) **Nuclear Forces** Students model the strong and weak nuclear forces and the forces that drive nuclear structure.	**Teacher's Guide** → p. 366 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕Analyzing Data/ ⊕Phet Simulation/ ⊕Explain Video/ ⊕Math Tutorial/⊕Writing About Science These OPTIONAL activities can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → The human body is made of elements, some of which are a result of nuclear fusion in the sun. **Connection to Investigative Phenomenon** → Students perform calculations involving binding energy to better understand the large	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → Forces and Atomic Nuclei ⊕ **Analyzing Data:** → Valley of Stability ⊕ **PhET Simulation:** → Nuclear Forces **EXPLAIN** **Student Handbook:** → pgs. 581—593 **Claim-Evidence-Reasoning/Modeling:** → Nuclear Forces ⊕ **Explain Video:** → Strong Nuclear Force ⊕ **Math Tutorial Video** **ELABORATE** **Discussion Rubric/Peer Review Rubric:** → Evaluate Nuclear Forces	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → NA

	amounts of energy released in a nuclear fusion reaction.	⊕ **Writing About Science:** → Skills in Nuclear Forces **EVALUATE** **Quiz:** → Nuclear Forces	
EXPERIENCE 3 (3 days) **Fission and Fusion** Students explore the sources of the large energy changes that occur during nuclear fission and fusion and how the energy is used by humans.	**Teacher's Guide** → p. 372 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕Analyzing Data/ ⊕Phet Simulation/ ⊕Explain Video/ ⊕Math Tutorial/⊕Writing About Science These OPTIONAL activities can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → The human body is made of elements, some of which are a result of nuclear fusion in the sun. **Connection to Investigative Phenomenon** → Students apply acquired knowledge to describe how the electricity that powers a homo can come from nuclear fission.	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → Nuclear Reactions and Critical Mass ⊕ **PhET Simulation:** → Fission and Fusion **EXPLAIN** **Student Handbook:** → pgs. 594—606 **Claim-Evidence-Reasoning:** → Generating Fission ⊕ **Explain Video:** → Nuclear Reactions ⊕ **Math Tutorial Video** **ELABORATE** **Discussion Rubric:** → Generating Fission ⊕ **Writing About Science:** → Skills in Fission and Fusion **EVALUATE** **Quiz:** → Fission and fusion	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → NA
OPTIONAL Alternate Phenomena by Performance Expectation			
HS-PS1-8 Note: Optional extension task(s) if time allows within the allotted 11-day window.			

LESSON #2 PACING GUIDE WITH EMBEDDED ASSESSMENTS

Suggested Instructional Days: (11)

Investigation #15: Ages of Rocks

In this investigation, students explore the process of radiometric dating to determine the ages of materials and apply these techniques to an investigation of the history of Earth through geologic processes.

NJSLS Specific to this Investigation/Lesson		
Performance Expectation	**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.	
Science & Engineering Practices	**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Developing and Using Models	Energy and Matter	PS1.C: Nuclear Processes
Performance Expectation	**HS-ESS1-5** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.	
Science & Engineering Practices	**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Engaging in Argument from Evidence	Patterns	ESS1.C: The History of Planet Earth ESS2.B: Plate Tectonics and Large-Scale System Interactions PS1.C: Nuclear Processes
Performance Expectation	**HS-ESS1-6** 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.	
Science & Engineering Practices	**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Constructing Explanations and Designing Solutions	Stability and Change	ESS1.C: The History of Planet Earth PS1.C: Nuclear Processes
Performance Expectation	**HS-ESS2-1** Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.	
Science & Engineering Practices	**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Developing and Using Models	Stability and Change	ESS2.A: Earth Materials and Systems ESS2.B: Plate Tectonics and Large-Scale System Interactions

Anchoring Phenomenon

How did the atoms that make up your body form?	**Explaining Phenomena** To fully understand how atoms formed, students must understand macro- and micro-processes in the universe. **Anchoring Phenomenon video** → How did the atoms that make up your body form? **Student Handbook** → p. 652

Investigative Phenomenon

How did Earth form?	**Explaining Phenomena** To fully understand the phenomenon of Earth's formation, students must be able to understand the process of radiometric dating and to construct explanations of how exponential decay can be used to determine the age of materials and the history of Earth itself. **Investigative Phenomenon video** → How did Earth form?

Learning Goal	Teacher Preparation	Instructional Sequence	Assessments
EXPERIENCE 1 (3 days) **Radioactive Decay**	**Teacher's Guide** → p. 384	**ENGAGE** **Teachers' Guide:**	**Experience Assessment** **Student Handbook**

Students investigate the processes of alpha, beta, and gamma decay of radioactive isotopes.	**Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕**Analyzing Data/** ⊕**Phet Simulation/** ⊕**Explain Video/** ⊕**Math Tutorial/**⊕**Writing About Science** These OPTIONAL activities can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → Some atoms in the human body did not exist at the time of the formation of the solar system. **Connection to Investigative Phenomenon** → Students apply the concepts of radioactive decay to explain how radioactivity can be used to determine Earth's age.	**Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → Half-Life Simulation ⊕ **PhET Simulation:** → Radioactive Decay **EXPLAIN** **Student Handbook:** → pgs. 610—621 **Claim-Evidence-Reasoning:** → Penetrating Particles ⊕ **Explain Video:** → Half-Life and Radioactive Decay ⊕ **Math Tutorial Video** **ELABORATE** **Discussion Rubric/Peer Review Rubric:** → Penetrating Particles ⊕ **Writing About Science:** → Skills in Radioactive Decay **EVALUATE** **Quiz:** → Radioactive Decay	→ Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → The comparison of certain types of atoms, called isotopes, found on the Moon and elsewhere in the solar system may provide information about how the Moon formed. Ratios of specific oxygen isotopes present in rock vary with location in the solar system. The figure shows the oxygen isotope distribution trends in rock samples from the surfaces of Earth, Mars, the Moon, and Vesta.
EXPERIENCE 2 (3 days) **Radiometric Dating** Students investigate applications of the half-lives of radioactive elements to determine the age of materials that contain them.	**Teacher's Guide** → p. 390 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:**	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment**

	→ See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕**Analyzing Data/** ⊕**Phet Simulation/** ⊕**Explain Video/** ⊕**Math Tutorial/**⊕**Writing About Science** These OPTIONAL activities can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → Some atoms in the human body did not exist at the time of the formation of the solar system. **Connection to Investigative Phenomenon** → Students apply scientific reasoning and evidence from ancient Earth materials to construct an account of Earth's formation and early history.	→ Radiometric Dating of Rocks ⊕ **Analyzing Data:** → Radiometric Dating **EXPLAIN** **Student Handbook:** → pgs. 622—635 **Claim-Evidence-Reasoning:** → Radiometric Dating ⊕ **Explain Video:** → Radiometric Dating ⊕ **Math Tutorial Video** **ELABORATE** **Discussion Rubric:** → Radiometric Dating ⊕ **Writing About Science:** → Skills in Radiometric Dating **EVALUATE** **Quiz:** → Skills in Radiometric Dating	**NJSLA Released Item/Question(s) link:** → Figure 2 shows tectonic plate boundaries on Earth, with areas labeled W, X, Y, and Z. . .
EXPERIENCE 3 (3 days) **Geologic Time** Students investigate the history of Earth as revealed by the record contained in rocks.	**Teacher's Guide** → p. 396 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕**Analyzing Data/** ⊕**Phet Simulation/** ⊕**Explain Video/** ⊕**Math Tutorial/**⊕**Writing About Science** These OPTIONAL activities can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon**	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → Tectonics and Seafloor Spreading ⊕ **Analyzing Data:** → Seafloor Spreading **EXPLAIN** **Student Handbook:** → pgs. 636—650 **Claim-Evidence-Reasoning:** → Craters ⊕ **Explain Video:** → A Brief History of Geologic Time	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → Which question is best addressed by analyzing the data?

	→ Some atoms in the human body did not exist at the time of the formation of the solar system. **Connection to Investigative Phenomenon** → Students develop and apply the geologic time scale as a temporal model of changes to Earth's physical and biological features throughout its history.	⊕ **Math Tutorial** **ELABORATE** **Discussion Rubric/Peer Review Rubric:** → Craters ⊕ **Writing About Science:** → Skills in Geologic Time **EVALUATE** **Quiz:** → Geologic Time	

OPTIONAL Alternate Phenomena by Performance Expectation

HS-PS1-8
HS-ESS1-5
HS-ESS1-6
HS-ESS2-1

Note: Optional extension task(s) if time allows within the allotted 11-day window.

LESSON #3 PACING GUIDE WITH EMBEDDED ASSESSMENTS

Suggested Instructional Days: (11)

Investigation #16: The Universe

In this investigation, students explore the nuclear fusion processes that are responsible for nucleosynthesis, light in the dark universe, and Earth temperatures that support life. They evaluate the evidence supporting the Big Bang model.

NJSLS Specific to this Investigation/Lesson			
Performance Expectation	**HS-ESS1-1** 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.		
Science & Engineering Practices		**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Developing and Using Models		Scale, Proportion, and Quantity	ESS1.A: The Universe and Its Stars PS3.D: Energy in Chemical Processes and Everyday Life
Performance Expectation	**HS-ESS1-2** Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.		
Science & Engineering Practices		**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Constructing Explanations and Designing Solutions		Energy and Matter	ESS1.A: The Universe and Its Stars PS4.B: Electromagnetic Radiation
Performance Expectation	**HS-ESS1-3** Communicate scientific ideas about the way stars, over their life cycle, produce elements.		
Science & Engineering Practices		**Cross-Cutting Concepts**	**Disciplinary Core Ideas**
Obtaining, Evaluating, and Communicating Information		Energy and Matter	ESS1.A: The Universe and Its Stars

Anchoring Phenomenon

How did the atoms that make up your body form?	**Explaining Phenomena** To fully understand how atoms formed, students must understand macro- and micro-processes in the universe. **Anchoring Phenomenon video** → How did the atoms that make up your body form? **Student Handbook** → p. 652

Investigative Phenomenon

How will the sun change over time?	**Explaining Phenomena** To fully understand the phenomenon of changes to the sun over time, students should understand the sun's fusion processes and the life cycle of stars. Students can construct an explanation about the future of the sun using these concepts and the concept of cosmological redshift. **Investigative Phenomenon video** → How will the sun change over time?

Learning Goal	Teacher Preparation	Instructional Sequence	Assessments
EXPERIENCE 1 (3 days) **The Sun** Students focus on how energy is produced in the sun and how it is transferred from the sun's core to Earth.	**Teacher's Guide** → p. 408 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA**

	preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕**Analyzing Data/** ⊕**Phet Simulation/** ⊕**Explain Video/** ⊕**Math Tutorial/**⊕**Writing About Science** These OPTIONAL activities can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → Some atoms that form the human body formed during the Big Bang. **Connection to Investigative Phenomenon** → Students learn that during nuclear fusion occurring in the sun, mass is destroyed to make 4He nuclei.	necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → Sunlight Intensity and Solar Flares ⊕ **Analyzing Data:** → Solar Cycles and Sunspots ⊕ **PhET Simulation:** → The Sun **EXPLAIN** **Student Handbook:** → pgs. 654—664 **Claim-Evidence-Reasoning:** → The Role of the Sun ⊕ **Explain Video:** → The Polar Lights ⊕ **Math Tutorial Video** **ELABORATE** **Discussion Rubric:** → The Role of the Sun ⊕ **Writing About Science:** → Skills in The Sun **EVALUATE** **Quiz:** → The Sun	**Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → NA
EXPERIENCE 2 (3 days) **Stars** Students explore distances to the stars and how the brightness and color of stars compare.	**Teacher's Guide** → p. 414 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕**Analyzing Data/** ⊕**Phet Simulation/** ⊕**Explain Video/** ⊕**Math Tutorial/**⊕**Writing About Science** These OPTIONAL activities	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → Elemental Composition of Stars ⊕ **Analyzing Data:** → Elemental Composition of the Solar System ⊕ **PhET Simulation:** → Stars	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → NA

	can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → Some atoms that form the human body formed during the Big Bang. **Connection to Investigative Phenomenon** → Students investigate the EM emissions of elements and explain how stellar spectroscopy can provide information about a star's composition and age.	**EXPLAIN** **Student Handbook:** → pgs. 665—678 **Modeling:** → Discovering Exoplanets ⊕ **Explain Video:** → How to Detect a Supernova ⊕ **Math Tutorial Video** **ELABORATE** **Discussion Rubric/Peer Review Rubric:** → Evaluate Discovering Exoplanets ⊕ **Writing About Science:** → Skills in Stars **EVALUATE** **Quiz:** → Stars	
EXPERIENCE 3 (3 days) **The Big Bang** Students explore the Big Bang theory, including the redshift of stars, the cosmic microwave background, and the composition of the universe.	**Teacher's Guide** → p. 420 **Differentiation** → Review the versions of each lab; select the appropriate version(s) for each student/student group → See "Address Misconceptions" section of Teacher Guide; provides ideas to address common student preconceptions with tips and explanations. → See "Differentiated Instruction" section of Teacher Guide for advice and tips for special needs students → See "Remediation Suggestions" section of Teacher Guide; provides multiple suggestions for students struggling with specific concepts. → ⊕Analyzing Data/ ⊕Phet Simulation/ ⊕Explain Video/ ⊕Math Tutorial/⊕Writing About Science These OPTIONAL activities can be personalized and assigned to enhance instruction, as time allows. **Connection to Anchoring Phenomenon** → Some atoms that form the human body formed during the Big Bang.	**ENGAGE** **Teachers' Guide:** **Everyday Phenomenon** → See Teacher Preparation for page number **NOTE:** Introduce students to this investigation with the Investigative Phenomenon video. Its purpose is to provide students with another opportunity to interact with an engaging event and gather knowledge necessary to make sense of the Anchoring Phenomenon. **EXPLORE** **Inquiry Lab:** → The Expansion of the Universe **EXPLAIN** **Student Handbook:** → pgs. 679—690 **Claim-Evidence-Reasoning/Modeling:** → Origins of the Universe ⊕ **Explain Video:** → The Genesis of the Universe ⊕ **Math Tutorial Video** **ELABORATE** **Discussion Rubric/Peer Review Rubric:** → Origins of the Universe	**Experience Assessment** **Student Handbook** → Revisit Investigative Phenomenon **Quiz** **Investigation Assessment** **Performance-Based Assessment** **Virtual Lab PBA** **Engineering Workbench Investigation Assessment** **NJSLA Released Item/Question(s) link:** → NA

	Connection to Investigative Phenomenon → Students compare properties of our universe at different times after the Big Bang to properties of the sun.	⊕ **Writing About Science:** → Skills in The Big Bang **EVALUATE** **Quiz:** → The Big Bang	
OPTIONAL Alternate Phenomena by Performance Expectation			
HS-ESS1-1 **HS-ESS1-2** **HS-ESS1-3** Note: Optional extension task(s) if time allows within the allotted 11-day window.			