BPS Science Department Earth Science - Unit 3 - Natural Resources

Unit 3- During this unit, students will construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. They will evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. Students will create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity. Students will also evaluate or refine a technological solution that reduces the impacts of human activities on natural systems. They will design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. Students will also evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that accounts for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts

Driving Questions:

- How has human society been influenced by the availability of rock, mineral, and energy resources?
- What is the impact of developing and using rock, mineral, and energy resources on Earth's living and non-living systems?
- How can the engineering design process be used to solve environmental, social, and economic problems related to the availability, development, and use of rock, mineral, and energy resources?

NYSSLS Standards:

Lesson 3.1: In this lesson, students learn how general principles of resource management are applied to identify and characterize in detail resource management problems to be solved (DCI ESS3.A Natural Resources, DCI ESS3.C Human Impacts of Earth Systems, CCC Science Addresses Questions About the Natural and Material World, SEP Asking Questions and Defining Problems). They develop and test various solutions to those problems (DCI ETS1.A Defining and Delimiting Engineering Problems), and identify and refine the most optimal solutions (SEP Engaging in Argument from Evidence).

- **HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios**
  - **ESS3.A Natural Resources**
    - All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)
- **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.**
  - **ETS1.A Defining and Delimiting Engineering Problems**
    - Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them. (HS-ETS1-1)
- **HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that accounts for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**
  - **ETS1.B Developing Possible Solutions**
    - When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (HS-ETS1-3)
- **HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.**
  - **ETS1.C Optimizing the Design Solution**
    - Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2)

Lesson 3.2: In this lesson, students learn how natural resource availability has guided the development of human society (DCI ESS3.A Natural Resources), construct explanations for how geologic processes determine natural resource abundance and distribution (SEP Constructing Explanations and Designing Solutions), and describe a model for resource production and use over time (CCC Systems and System Models). Students examine ways in which scientists and engineers can make major contributions by developing technologies (DCI ESS3.C Human Impacts of Earth Systems) and evaluate different solutions for mining various types of rock and mineral resources. They learn that in evaluating solutions, it is important to take into account a range of constraints (DCI ETS1.B Developing Possible Solutions).

- **HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.**
  - **ESS3.A Natural Resources**
    - Resource availability has guided the development of human society.(HS-ESS3-1)

BPS Science Department Earth Science - Unit 3 - Natural Resources

- **HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.**
  - **ESS3.A Natural Resources**
    - All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)
- **HS-ESS3-3 Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.**
  - **ESS3.C Human Impacts on Earth Systems**
    - The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)
- **HS-ESS3-4 Evaluate or refine a technological solution that reduces the impacts of human activities on natural systems.**
  - **ESS3.C Human Impacts on Earth Systems**
    - Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)
- **HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that accounts for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**
  - **ETS1.B Developing Possible Solutions**
    - When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (HS-ETS1-3)

Lesson 3.3: In this lesson, students develop an understanding of what makes some energy resources renewable and others nonrenewable (DCI ESS3.A Natural Resources). Students explore similarities and differences in the processes (CCC Structure and Function) used to extract and use fossil fuels (e.g., petroleum, natural gas, and coal), including the exploitation of tar sands and oil shale, and ways to minimize the environmental impact of those processes (SEP Constructing Explanations and Designing Solutions, DCI ESS3.C Human Impacts of Earth Systems, DCI ETS1.B Developing Possible Solutions, CCC Stability and Change). Students investigate various renewable energy sources (e.g., solar and wind power) (CCC System and System Models) and compare the pros and cons of each (SEP Engaging in Argument from Evidence).

- **HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.**
  - **ESS3.A Natural Resources**
    - All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. (HS-ESS3-2)
- **HS-ESS3-4 Evaluate or refine a technological solution that reduces the impacts of human activities on natural systems.**
  - **ESS3.C Human Impacts on Earth Systems**
    - Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4)
- **HS-ESS3-6 Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.**
  - **ESS3.D Global Climate Change**
    - Through computer simulations and other studies, important discoveries are still being made about how the ocean, the atmosphere, and the biosphere interact and are modified in response to human activities. (HS-ESS3-6)
- **HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and tradeoffs that accounts for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.**
  - **ETS1.B Developing Possible Solutions**
    - When evaluating solutions it is important to take into account a range of constraints including cost, safety, reliability and aesthetics and to consider social, cultural and environmental impacts. (HS-ETS1-3)

Science & Engineering Practices (link to SEP break-down):	Crosscutting Concepts (link to guiding questions for CCC):
• Asking Questions and Defining Problems • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • Using Mathematics and Computational Thinking	• Stability and Change • Structure and Function • System and System Models • Science Addresses Questions About the Natural and Material World

BPS Science Department Earth Science - Unit 3 - Natural Resources

Opportunities for Student Collaboration p. 111H (Complete Collaboration Strategy Guide):
● **Self-Assessment** p.112 ● **Think-Pair-Share** pp. 113, 115, 118, 120, 123, 131, 139, 149, 154, 156, 157 ● **Claims, Evidence, Reasoning** pp. 114, 134, 148, 151 ● ● **Group Discussion** pp. 117, 125, 130, 133, 142, 159,163 ● **One Moves** pp. 121, 155 ● **Whip Around** p. 135 ● **Jigsaw** p. 136 ● **See, Run, Do** p. 153 ● **Which is False?** p. 160 ●

Time Frame	Lesson Framework	Instructional Sequence	Resources- HMH Dimensions- Earth & Space Science Textbook	Resources- HMH Dimensions Digital Component	Additional Resources
10/24/22-11/10/22	**Unit 3: Natural Resources**		• **Unit Opener (Pre-Assessment):** **Predict-** What are some ways in which the use of rock, mineral, and energy resources affect other natural resources on Earth? (pp. 110-111)	• **Unit Project: Recycling Resources-** Students research existing local recycling operations (glass, paper, plastic, electronics, clothing, etc.) and evaluate the operations in terms of how well they serve the community, how efficient they are, and how environmentally sound they are. They then suggest modifications to one or more aspects of the system (e.g., adding a component, changing locations, modifying collection and transport systems) and devise an action plan to implement the changes.	
	Lesson 3.1-Designing Solutions to Resource Problems In this lesson, you will define natural resource problems and construct explanations for engineering problems, including making arguments based on science regarding the ideal possible solution and how to optimize it. **Vocabulary**: nonrenewable renewable sustainable fossil fuel engineering design process constraint criterion tradeoff iterate	**Engage**	• **Phenomenon: Can You Explain It?** What materials should be used for bags in stores—paper or plastic? (p. 112)		
		Explore/ Explain	• **Exploration 1-** Managing Natural Resources (pp. 113-115) ○ Costs if Making Jeans • **Exploration 2-** Define a Problem (pp. 116-118) • **Exploration 3-** Develop Solutions (pp. 119-120) • **Exploration 4-** Optimize a Solution (pp. 121-122) • **Exploration 5-** The Power of Iteration (p. 123)	• **Lesson 1- Designing Solutions to Resource Problems PPT (editable)** • **Exploration 2:** **Hands-On Lab- New Light: Criteria and Constraints-** In this lab, students rank criteria by importance for entrance lighting, including the cost, effect on wildlife, etc. • **Exploration 5:** **Hands-On Lab- Practice Run-** In this lab, students use coins to explore iteration.	
		Elaborate	• **Continue Your Exploration-** **Hands On Lab- Brightness and Color** (p. 124)- In this lab, students compare light bulbs in terms of energy use and environmental impact.	• **Continue Your Exploration:** ○ Resource Solutions ○ Engineering Specialist ○ Crop Lines	
		Evaluate	• **Lesson Self Check** (pp. 125-127)- Can You Explain It- Revisit • **Make Your Own Study Guide** (p. 127) • **Checkpoint Questions** (pp. 126-127)	• **Can You Explain It?** Revisit • **Checkpoint Questions** • **Make Your Own Study Guide** • **Unit 3- Lesson 1 Quiz**	

BPS Science Department Earth Science - Unit 3 - Natural Resources

	Lesson 3.2 Rock and Mineral Resources In this lesson, you will use models and computational thinking to engage in arguments regarding rock and mineral resources and the impacts of their extraction and use. **Vocabulary**: alloy rare earth elements mining ore recycle reclamation	**Engage**	• **Phenomenon: Can You Explain It?-** What elements are used to manufacture smartphones and where do these resources come from? (p. 128)		*Native American Quarrying and Mining (p. 130) *Figure 4: World Mineral Production from 2005-2009 (p. 130) *Surface Mining Methods in South Africa and India (p.136)
		Explore/ Explain	• **Exploration 1-** The History of Rock and Mineral Extraction (pp. 129-131) • **Exploration 2-** Minerals for New Technologies (pp. 132-135) • **Exploration 3-** Rock and Mineral Extraction (pp. 136-138) • **Exploration 4-** Impacts of Mineral Use (pp. 139-141)	• **Lesson 2- Rock and Mineral Resources (editable)** • **Exploration 3:** **Hands-On Lab- Copper Recovery-** In this lab, students recover copper from an aqueous solution, and explain how the chemical reaction that occurs between the copper sulfate solution and the iron produces solid copper metal. • **Exploration 4:** **Hands-On Lab- Reclamation-** In this lab, students explore restoration and reclamation of land using gelatin. • **Exploration 4:** **Hands-On Lab- Investigating Ore Deposits-** In this lab, students model ore exploration, improve their methods, and evaluate their model.	
		Elaborate	• **Continue Your Exploration- Careers in Science:** Recycling Technician (p. 142)	• **Continue Your Exploration:** ○ GPS for Underground Mining ○ Conflict Minerals	
		Evaluate	• **Lesson Self Check** (pp. 143-145)- Can You Explain It- Revisit • **Make Your Own Study Guide** (p. 145) • **Checkpoint Questions** (pp. 144-145)	• **Can You Explain It?** Revisit • **Checkpoint Questions** • **Make Your Own Study Guide** • **Unit 3- Lesson 2 Quiz**	
	Lesson 3.3 Energy Resources In this lesson you will use models, define problems, and construct explanations for renewable and nonrenewable energy resources and their impact on the environment.. **Vocabulary**: hydraulic fracturing tar sand oil shale hydroelectric energy tidal energy geothermal energy	**Engage**	• **Phenomenon: Can You Explain It?-** How is hydraulic fracturing used to obtain energy from Earth's interior? (p. 146)		
		Explore/ Explain	• **Exploration 1-** Petroleum and Natural Gas (pp. 147-149) • **Exploration 2-** Coal, Tar Sands, and Oil Shale (pp. 150-154) ○ An Alternative to Hydraulic Fracturing • **Exploration 3-** Solar and Wind Energy (pp. 155-157) • **Exploration 4-** Hydroelectric, Tidal, and Geothermal Energy (pp. 158-161)	• **Lesson 3- Energy Resources PPT (editable)** • **Exploration 3:** **Hands-On Lab- Solar Cooker-** In this lab, students design and build a solar cooker, test the solar cooker, and analyze results to identify ways that the design could be improved. • **Exploration 4:** **Hands-On Lab- Generation of Natural Gas from Biomass-** In this lab, students build a waste material digester to produce and gather methane gas, and research the practicality of methane as a fuel in the agriculture industry and other industries.	
		Elaborate	• **Continue Your Exploration- Guided Research:** Harnessing the Power of the Sun (p. 162)	• **Continue Your Exploration:** ○ France Cuts Nuclear Power	

BPS Science Department Earth Science - Unit 3 - Natural Resources

				○ **Hands-On Lab- Oil Well-** In this lab, students model the drilling process used to extract oil from underground.	
		Evaluate	• **Lesson Self Check** (pp. 163-165)- Can You Explain It- Revisit • **Make Your Own Study Guide** (p. 165) • **Checkpoint Questions** (pp. 164-165)	• **Can You Explain It?** Revisit • **Checkpoint Questions** • **Make Your Own Study Guide** • **Unit 3- Lesson 3 Quiz**	
	Thing Explainer		• **Stuff in the Earth We Can Burn** (pp. 166-169)		
	Enrichment: Unit Connection Activities (Optional)		• **Engineering-** Mining Asteroids • **Social Studies-** Exploration, Colonialism, and Natural Resources • **Environmental Science-** Environmental Law		
	Unit Close		• **Synthesize the Unit** (p. 171) • **Driving Questions**-Revist • **Practice and Review Questions** (pp. 171-172) • **Unit Project** (p. 172) • **Unit Performance Task-** (p. 173)	• **Assessment Guide**: ○ Unit Test A- provides an in-depth assessment of the Performance Expectations aligned to the unit. ○ Unit Test B can be used to assess students who need extra support	Castle Learning HMH Earth & Space Science Unit 3- Natural Resources (Editable item bank available under Public Assignments in Castle Learning)

Resources

http://ngss.nsta.org/Classroom-Resources.aspx - Searchable NYSSLS/NGSS aligned resources curated by NSTA

BPS Earth Science Website– BPS Earth Science curriculum resource hub

BPS Science Department Recommended Virtual Labs – Virtual lab resources with embedded links to virtual labs and student sheets. Must be logged into BPS google account through BPS Gmail account to access.

BPS Science Department CER Student Writing Template (BPS Science Department CER Practice with a Graph)

NYSED's Office of State Assessment webpage - Access to Released Regents Earth Science Examinations

Science Learning Standards (HS) – NYSSLS High School Standards for Earth Science

NYSED Bilingual Glossaries – NYS Statewide Language Regional Bilingual Education Resource for NYSED approved bilingual glossaries.

English Language Learners (ELL) Enhancements To access hyperlinked material, you must be logged	**Listening** • **Cross- Linguistic Practices:** Gives students opportunities to make connections between what they hear and their home language (For example, allow students to listen to a passage and identify cognates.) • **Build background knowledge** • **Activating Prior Knowledge**	**Speaking** • **Sentence Frames** - to begin a sentence - such as *Evolution is…* or *I think that evolution is…* • **Academic Conversation Starters:** Have a visual of a list of academic sentence starters that students can refer to in a discussion such as *I expect __ to happen.* or *My data shows that…*	**Reading** • **Supplementary Text** to reinforce concepts. If necessary, use lower Lexile levels to ensure comprehension. • **Visual Aids** - Pictures or models to support vocabulary words/ concepts • Video to review introduce a topic - use **closed captioning** so students can read along and listen to content	**Writing** • **Sentence Frames** - to begin a sentence- such as *Biodiversity is…* or *An example of competition is….* • **Cloze passages** with word banks • **Word banks**	**Instructional Accommodations (depending on the student's needs)** • **Extended time** for tests in class, projects and assignments • **Directions read.** Broken down as necessary • **Model** how to complete the activity in the lesson • **Oral simplification** of directions or questions

BPS Science Department Earth Science - Unit 3 - Natural Resources

into your BPS Google Drive	• **Activating prior knowledge** means both eliciting from students what they already know and building initial knowledge that they need in order to access upcoming content • **Visuals** - GIFs, pictures- will assist students in understanding what they are listening to. **Visual thinking strategies** set the lens for learning. • Video to review/ introduce a topic – use **closed captioning** so students see the words and pronunciations while they listen to the content. • **Word stretching / Vowel stretching** allows student to listen closely to the pronunciation words • **Performance Level Descriptors** - this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of listening Scroll for grades 9-12.	This aids students in having more science focused dialogue. • **Choral Reading** - Build fluency, self-confidence and motivation with reading/speaking • Create **movement** to go with the word. Movement can be a motivating factor and kinesthetic tool for conceptualizing the rhythm and flow of fluent reading while triggering brain function for optimal learning • **Performance Level Descriptors** - this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of speaking. Scroll for grades 9-12	• **4 Square / Frayer models** to help students gain a deeper understanding of vocabulary. • **Highlighting** important text to assist students in answering questions after the reading. • **Chunking**-Break reading of text into chunks or paragraphs • **Vocabulary Morphology**- segmenting words into affixes (prefixes/suffixes) and roots/base words. Understanding that words connected by meaning/origin can be connected by spelling can be critical to expanding a student's vocabulary. • **Performance Level Descriptors**- this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of reading. Scroll for grades 9-12.	• **Graphic Organizers** to help break down the writing process and organize thoughts • **Standards-based sentence stems** • **Performance Level Descriptors**- this document provides teachers with a description of what output they can expect from students based on earned NYSESLAT levels in the modality of writing. Scroll for grades 9-12.	• **Translated version** of test when available. Student may have both version English and native language version • Use of **approved bilingual glossaries** from NYS in each subject

Special Education Modifications **Special Education students must have accommodations as per Individual Educational Plan (IEP)**	**Instructional** • **Pre-teach** vocabulary • Use **picture vocabulary** • Scaffold **Depth of Knowledge** questions • Provide copy of notes/**notes in "cloze"** form • Use of **Think, Pair, and Share** strategy to help process information • **Scaffold** written assignments with the use of **graphic organizers** • Allow for **multiple ways to respond** (verbal, written, response board) • Provide **model of performance task** • **Modify informational text** to fit the needs of the students • Provide a digital or paper i**nteractive notebook** • Present complex **tasks in multiple ways** Provide **mnemonic strategies** for Living Environment concepts	**Technology:** • **Audio** reading of text • **Text to type** functions • **Videos** to clarify/visualize Living Environment concepts • **Record class lecture/discussions** and make accessible to student • **Nearpod**- interactive presentations of notes • **Playposit** - show a video clip about the topic and add your own questions for them to answer as they watch • Allow students to type answers in chat on **Teams** **Other:** • Arrange seating for maximum engagement and minimum distraction • Accessible lab space (counter level)	**In Class Assessments** • Provide **review packet or review sheet** of concepts covered on the test • Practice similar questions prior to the test • Provide **multiple options** for projects • Give a **timeline** of when things are due and remind them of the process often. • **Use of timer** in class • Break all complex tasks into chunks

BPS Science Department Earth Science - Unit 3 - Natural Resources

BPS Science K-12 Schoology Folder: 9-12 Resources Earth Science Resources Curriculum Materials	**SUTW Strategies** ● Informal Outline ● Color-Coding – Informative/Explanatory Text ● Two-column notes ● I-V-F Topic Sentence progressing to Four Step Summary Paragraph ● CUPS – Capitalization, Usage, Punctuation, Spelling ● Transitions
Culturally and Linguistically Responsive Teaching (CLRT) in the Science Classroom	Materials, resources, and/or discussions address diverse cultural backgrounds and real-world applications ● Artifacts (posters, charts, etc.) in the science classroom are representative of the cultures of the student population ● All students are given an opportunity to engage in science discourse ● Teacher demonstrates high expectations for all students CLRT resources which align to Science content are denoted with a *