Unit 3: Earth's Resources

Content Area: **Science**
Course(s):
Time Period: **MP3**
Length: **45 days**
Status: **Published**

NJSLS - Science

HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ESS3-2	Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

Science and Engineering Practices

Constructing Explanations and Designing Solutions — Construct explanations and evaluate or refine technological solutions based on scientific knowledge and evidence. *(HS-ESS3-1, HS-ESS3-4)*

Engaging in Argument from Evidence — Evaluate competing design solutions using cost-benefit ratios and prioritized trade-offs. *(HS-ESS3-2, HS-ETS1-3)*

Planning and Carrying Out Investigations — Plan and conduct an investigation to produce data that serve as the basis for evidence. *(HS-ESS2-5)*

Using Mathematics and Computational Thinking — Use ratios, rates, and quantitative reasoning to compare resource-management options. *(HS-ESS3-2)*

Influence of Engineering, Technology, and Science on Society — New technologies and regulations can change the balance of costs, risks, and benefits of resource use. *(HS-ESS3-4)*

Disciplinary Core Ideas

ESS3.A: Natural Resources — Resources such as forests, soil, minerals, fresh water, and clean air are distributed unevenly as a result of past geologic processes, and many are not renewable over human lifetimes. *(HS-ESS3-1, HS-ESS3-2)*

ESS3.C: Human Impacts on Earth Systems — Resource extraction, agriculture, and land use can degrade natural systems; scientists and engineers can develop technologies and management practices that reduce these impacts. *(HS-ESS3-4)*

ESS2.C: The Roles of Water in Earth's Surface Processes — The physical and chemical properties of water shape Earth materials and drive surface processes such as weathering, erosion, and the movement of pollutants. *(HS-ESS2-5)*

ETS1.B: Developing Possible Solutions — Competing solutions are evaluated using cost-benefit analysis and prioritized criteria and constraints (e.g., mining regulation, forest management). *(HS-ETS1-3)*

Crosscutting Concepts

Cause and Effect — Resource extraction and land use cause measurable changes in natural systems that can be reduced through management. *(HS-ESS3-4)*

Stability and Change — Sustainable-yield management seeks to keep renewable resources stable while nonrenewable resources are depleted. *(HS-ESS3-1)*

Scale, Proportion, and Quantity — Cost-benefit ratios and resource quantities are compared across scales to inform decisions. *(HS-ESS3-2)*

Systems and System Models — Soil, watersheds, and the atmosphere are modeled as interacting systems affected by human use. *(HS-ESS2-5)*

Influence of Science, Engineering, and Technology on Society and the Natural World — Technology and policy shape how resources are extracted, regulated, and conserved. *(HS-ESS3-2, HS-ETS1-3)*

Rationale and Transfer Goals

In this unit, students formulate answers to the question, “How do we obtain the resources we depend on — forests, soil, minerals, fresh water, and clean air — and how can we manage them sustainably?” Students examine resource management and forestry, the formation and degradation of soil, mineral resources and mining, water resources and pollution, and the atmosphere and air quality. Throughout, cost-benefit analysis and the evaluation of technological and policy solutions are the central analytical tools.

The crosscutting concepts of cause and effect, stability and change, and the influence of science and technology on society organize the disciplinary core ideas. The transfer goal is for students to independently evaluate and refine competing resource-management solutions using evidence and cost-benefit reasoning — recognizing that every resource decision involves trade-offs.

Enduring Understandings

- Humans depend on Earth's forests, soil, minerals, water, and atmosphere; many of these resources are limited and unevenly distributed as a result of past geologic processes.
- Resource extraction and land use carry environmental costs that can be reduced through management, technology, and regulation.

- Every resource decision involves trade-offs; cost-benefit analysis is a tool for weighing them.
- Soil is a living, slowly formed resource; its degradation threatens food security, and conservation practices can protect it.
- Mining supplies materials essential to modern life — including the electronics we use every day — but its impacts require regulation and reclamation.
- Fresh water and clean air are shared resources whose quality depends on collective management and policy.

Essential Questions

- Why are Earth's resources distributed the way they are, and why are so many of them limited?
- Can the benefits of mining outweigh its costs — and where do the minerals in our phones actually come from?
- How do soil and water sustain us, and what happens when we degrade them?
- How can technology and policy reduce the impact of resource use on natural systems?
- How do we decide between competing uses of a shared resource?

Content - What will students know?

- Resource management balances human use with sustainable yield; renewable resources can be depleted if used faster than they regenerate.
- Forests provide ecosystem services and products; deforestation and forest-management strategies have distinct trade-offs.
- Soil forms slowly through weathering and biological activity, has recognizable horizons, and is degraded by erosion, nutrient depletion, and salinization; conservation practices (contour farming, terracing, no-till, cover crops) protect it.
- Agriculture and food production depend on soil, water, and inputs, and involve trade-offs among yield, sustainability, and environmental impact.
- Minerals form through geologic processes; mining methods (surface and subsurface) extract them at environmental cost, requiring impact regulation and reclamation.
- Water is unevenly distributed; freshwater sources can be depleted (aquifer drawdown, over-allocation) and polluted, and can be treated.
- The atmosphere has a layered structure; air pollution (including acid deposition) can be reduced through technology and legislation such as the Clean Air Act.

Skills - What will students be able to do?

- Evaluate competing resource-management and mining solutions using cost-benefit ratios (HS-ESS3-2).
- Plan and conduct an investigation of the properties of water and its effects on soil and other Earth materials (HS-ESS2-5).
- Classify soil and test soil properties through hands-on (fall-friendly, outdoor) investigation.

- Identify minerals using physical properties and connect mineral resources to everyday technology.
- Analyze mining impacts and the trade-offs of regulation and reclamation.
- Evaluate or refine a technological solution that reduces impacts on water or air quality (HS-ESS3-4).

Activities - How will we teach the content and skills?

- Forestry: launch with the Chapter 11 Central Case ("Battling Over Clayoquot's Big Trees") and the "Reforesting Africa" success story; run "Making Recycled Paper" and a sustainable-yield decision task.
- Soil (high-engagement entry): open with "Dark Earth in the Amazon" (terra preta) as the hook for why soil is fascinating; run outdoor "Classifying Soil" and "Testing Soil Properties" labs and the "Combating Erosion" modeling activity; use the Chapter 12 Central Case ("Possible Transgenic Maize in Oaxaca, Mexico").
- Mining (high-engagement entry): launch with "Mining for… Cell Phones?" and the investigative phenomenon "Can we make the benefits of mining outweigh the costs?"; run "Mineral Identification"; stage the Point Counterpoint debate "Is It Safe to Mine Salt in Retsof, NY?" (a regionally relevant case) and a cost-benefit evaluation of a mining proposal (HS-ESS3-2).
- Water: use the Chapter 14 Central Case ("Looking for Water… in the Desert") and the Colorado River phenomenon; run a water-properties investigation, watershed mapping, and the "Wastewater Treatment" closer look.
- Atmosphere: use the Chapter 15 Central Case ("Charging Toward Cleaner Air in London") and the congestion-charging phenomenon; run "Is the Rainwater Acidic?" with "The Clean Air Act and Acid Rain," and have students evaluate an air-pollution-control solution (HS-ESS3-4).
- Structure lessons around authentic, community-connected questions; provide multiple means of representation and varied grouping (UDL).

Evidence/Assessments - How will we know what students have learned?

- **Assessments can be reviewed for each course in[this folder](#).**

- Formative: soil and mineral labs, a water-properties investigation, and a cost-benefit worksheet.
- Summative: Savvas Chapter 11–15 assessments, a mining cost-benefit evaluation, and a pollution-control or resource-management solution design.
- Evaluate competing design solutions for managing energy and mineral resources based on cost-benefit ratios.
- Evaluate or refine a technological solution that reduces the impacts of human activities on natural systems.
- Plan and conduct an investigation of the properties of water and its effects on Earth materials.
- Construct an evidence-based explanation of how resource availability has influenced human activity.
- Environmental Benchmark #3 (administered during the last week of MP3; assesses Unit 3 content only).

Spiraling for Mastery

The spiral column draws on Unit 2 (Ecosystems & Human Impact).

Content or Skill for This Unit	Spiral Focus from Previous Unit	Instructional Activity
Cost-benefit evaluation of resource-management and mining solutions (HS-ESS3-2).	Unit 2: evaluating sustainable-city solutions with prioritized trade-offs (Ch. 10, HS-ETS1-3).	Extend trade-off reasoning from urban design to forestry and mining cost-benefit analysis.
Reducing human impacts through technology and policy (HS-ESS3-4).	Unit 2: designing solutions to protect biodiversity (Ch. 7, HS-LS2-7).	Move from biodiversity-protection solutions to pollution-control and reclamation technologies.
Water's properties and effects on Earth materials (HS-ESS2-5).	Unit 1: Earth's spheres and biogeochemical cycles (Ch. 3, HS-ESS2-6).	Connect water and nutrient cycling to soil formation and watershed function through investigation.
Human demand for and impact on resources (HS-ESS3-1).	Unit 2: population growth and per-capita consumption (Ch. 8, HS-ESS3-3).	Tie the resource demands studied here to the population and consumption drivers from Unit 2.

Key Resources

Primary text and platform: Savvas Environmental Science (Withgott & Laposata) — Unit 4 (Earth's Resources), Chapters 11–15. Engagement note: the soil and mining chapters are launched with their highest-interest Savvas hooks (terra preta, cell-phone mining, and the Retsof, NY salt-mine debate) to make this content compelling in place.

- Central Cases: “Battling Over Clayoquot's Big Trees” (Ch. 11), “Possible Transgenic Maize in Oaxaca, Mexico” (Ch. 12), “Mining for… Cell Phones?” (Ch. 13), “Looking for Water… in the Desert” (Ch. 14), “Charging Toward Cleaner Air in London” (Ch. 15).
- Features: “Reforesting Africa” (Ch. 11), “Dark Earth in the Amazon” (Ch. 12), “Is It Safe to Mine Salt in Retsof, NY?” Point Counterpoint (Ch. 13), “Wastewater Treatment” (Ch. 14), “The Clean Air Act and Acid Rain” (Ch. 15).
- Labs, Real Data, and Modeling: “Making Recycled Paper,” “Classifying Soil,” “Testing Soil Properties,” “Combating Erosion,” “Mineral Identification,” “Distribution of Minerals,” watershed mapping, “The Water You Drink,” “Is the Rainwater Acidic?,” and “Effects of the Clean Air Act.”
- Savvas online course: investigative-phenomenon videos, interactive simulations, and the Unit 4 Anchoring Phenomenon Project.
- Supplemental: an online ecological-footprint or resource-use calculator to quantify personal and community resource demand.

Career Readiness, Life Literacies, & Key Skills

9.4.12.CT.3	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).

9.4.12.GCA.1	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political. economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).
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 (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).
9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change (e.g., NJSLSA.W1, 7.1.AL.PRSNT.4).

Interdisciplinary Connections/Companion Standards

Standard	Companion Standard Description
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions and gaps or inconsistencies in the account.
RST.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, charts) to address an environmental question or problem.
WHST.11-12.1	Write arguments focused on discipline-specific content, supporting a claim with reasoning and evidence (e.g., a policy or cost-benefit position).
WHST.11-12.7	Conduct short and sustained research projects to answer a question or solve a problem, synthesizing multiple sources on an environmental topic.
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 environmental data.
HSS-ID.B.6	Represent data on two quantitative variables on a scatter plot and describe how the variables are related.