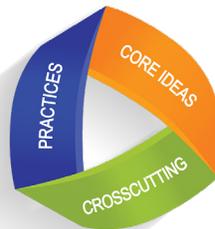


MAKING SENSE OF SCIENCE



CONNECTING PLT'S GREEN JOBS: EXPLORING FOREST CAREERS TO NGSS

The Next Generation Science Standards (NGSS) define what students should know or be able to do at the end of instruction. To demonstrate student learning, NGSS identifies Performance Expectations (PEs) that may be used to assess a student's knowledge and proficiency. In order to meet these benchmarks, students must engage in the three dimensions of science— Science & Engineering Practices, Disciplinary Core Ideas, and Crosscutting Concepts—to explain a phenomenon or design a solution.

The pages that follow detail how *Green Jobs: Exploring Forest Careers* can be used not only to support three-dimensional teaching and learning of science, but to advance a specific middle school PE:

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (Note: Keep in mind that no single lesson can fully meet a PE.)

The NGSS Correlations page for each activity includes a guiding question, a list of science connections, and explicit NGSS correlations. Each is organized around the three dimensions of science, making it useful for educators even if their state has not adopted NGSS.

GUIDING QUESTION: GROUNDED IN PHENOMENA

The work of scientists and engineers involves making sense of real-world questions, systems, events, and design problems. Observable phenomena like these can—and should—be used to ground science learning. Phenomenon-based instruction is directly connected to students' homes, communities, and cultures, thus making teaching and learning more diverse, inclusive, and relevant. PLT identifies Guiding Questions that drive phenomenon-based, three-dimensional learning in each of the four Green Jobs activities.

SCIENCE CONNECTIONS

This section details where science connections can be found in the PLT activity and is organized by practices and concepts.

PRACTICES

Engaging in the practices of science helps students understand how scientific knowledge develops. This direct involvement helps them gain skill in the wide range of approaches that are used to investigate, model, and explain the world.

CONCEPTS

These core ideas have broad importance within or across science disciplines, providing tools for understanding or investigating complex ideas and solving problems, and can be taught over multiple grade levels at progressive levels of depth and complexity. Content includes Crosscutting Concepts and Disciplinary Core Ideas from NGSS, where appropriate.

NGSS CORRELATIONS

This section identifies correlations to specific NGSS standards, including references to the relevant PE. It offers details for how the activity supports students' journey toward the PE and is organized by the three dimensions of science instruction.

SCIENCE & ENGINEERING PRACTICES

The practices are what students do to make sense of phenomena and reflect how scientists and engineers investigate the world and design solutions.

DISCIPLINARY CORE IDEAS

These foundational ideas of science are grouped into four domains: physical sciences; life sciences; Earth and space sciences; and engineering, technology and applications of science.

CROSSCUTTING CONCEPTS

These concepts hold true across the natural and engineered world. Students use them to make connections across disciplines, connect to prior experiences, and engage with material in other dimensions.

NGSS CORRELATIONS

GREEN JOBS: EXPLORING FOREST CAREERS 1. WHO WORKS IN THIS FOREST?



GUIDING QUESTION

What are some forest-related careers and the job responsibilities of the people in those positions?

PRACTICES

ASKING QUESTIONS AND DEFINING PROBLEMS

In Enrichment, the first bullet supports asking questions about the need to solve this problem, followed by a proposed solution that balances competing criteria, feasibility, cost, safety, and more.

DESIGNING SOLUTIONS

In Enrichment, the first bullet supports students in applying the science they've learned and extending it to an engineering problem. To do this, students research the problem, design and create a tool, test it, and collect data on its effectiveness. Based on the data, students should work to modify their tool, as redesign is a crucial part of the engineering process.

COMMUNICATING INFORMATION

In Step 6, learners are asked to share their findings. To strengthen the connection, encourage students to use more than one of the multiple formats offered and to communicate scientific or technical information and ideas involved in these jobs.

CONCEPTS

INTERDEPENDENT RELATIONSHIPS

Students discuss how humans benefit from ecosystem services provided by forests and how overexploitation of forests can lead to the loss of those services.

HUMAN IMPACTS

Students discuss how responsible management of ecosystem services provided by forests can help mitigate some of the negative effects of human activities.

SCIENCE & ENGINEERING PRACTICES

- Asking Questions and Defining Problems*
- Designing Solutions*
- Communicating Information

DISCIPLINARY CORE IDEAS

LS4.D: Interdependent Relationships, Biodiversity and Humans

- Changes in biodiversity can influence humans' resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling. (Note, a robust discussion on ecosystem services and effects of their loss is required to make this connection.)

ESS3.C: Human Impacts on Earth Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (Note, a focus on how responsible ecosystem management can help mitigate negative effects of human activity is required to make this connection.)

CROSCUTTING CONCEPTS

- Can be addressed with modification

*Can be met with slight modification to the procedure, as detailed in the practices and concepts section.

NGSS CORRELATIONS

GREEN JOBS: EXPLORING FOREST CAREERS 2. IF YOU WERE THE BOSS



GUIDING QUESTION

How can we manage a forest sustainably, considering the needs of people, wildlife, trees, and the forest ecosystem?

PRACTICES

COMMUNICATING INFORMATION

In Step 10, student teams share their plans. Ensure use of multiple formats such as a visual (a map, in this case), potential digital tools, graphs, etc, to communicate scientific and/or technical information.

DESIGNING SOLUTIONS

Learners are charged with examining competing criteria as they conduct a cost–benefit analysis. Adding more science content to support these considerations would strengthen the connection to this practice.

CONCEPTS

HUMAN IMPACTS

Learners address how responsible forest management can help mitigate the negative effects of human activities (such as timber harvest and creating campgrounds) while still providing for wildlife conservation, cultural site protection, and more.

CAUSE AND EFFECT

In Step 11, the discussion questions offer opportunities to explore the causes and effects in the students' plans. (Note that there can be more than one cause per effect and vice versa.)

In Enrichment, the second bullet directs learners to calculate the effect on wildlife conservation, forest cover, and more.

In the “You Decide” Worksheet, several effects are offered for various forest uses. Student teams evaluate these effects and their corresponding causes.

STABILITY AND CHANGE

In the “You Decide” Worksheet, students evaluate their plan's total effect based on five priority interests. To address this concept, ask students how negative or positive feedback could stabilize or destabilize a system over time. or discuss how small changes in one part of the forest might cause large changes in another part.

SCIENCE & ENGINEERING PRACTICES

- Communicating Information
- Designing Solutions

DISCIPLINARY CORE IDEAS

ESS3.C Human Impacts on Earth Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.
- Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise.

Performance Expectation* (PE)

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (Note, keep in mind that no single lesson can fully meet a PE, but “If You Were the Boss” can be used to support this one.)

CROSSCUTTING CONCEPTS

- Cause and Effect
- Stability and Change*

*Can be met with slight modification to the procedure, as detailed in the practices and concepts section.

NGSS CORRELATIONS

GREEN JOBS: EXPLORING FOREST CAREERS 3. MONITORING FOREST HEALTH



GUIDING QUESTION

How do people determine the health of a forest?

PRACTICES

PLANNING AND CARRYING OUT INVESTIGATIONS

In Step 3, students can suggest an indicator beyond the given parameters of the preplanned investigation. Students would need to select appropriate tools to collect and record data, including design of data sheets.

COMMUNICATING INFORMATION

In Steps 8 and 10, when sharing results, teams should prepare a presentation with graphs of data and be able to answer scientific questions from the “audience.”

ANALYZING AND INTERPRETING DATA

In the final “Forest Health Summary” Worksheet, students are asked to explain their reasoning for their overall forest health assessment. Step 9 offers an invitation for students to distinguish between quantitative and qualitative data and to explain relationships between variables.

CONSTRUCTING EXPLANATIONS

Step 9 provides opportunities for students to construct scientific explanations based on their observations and data collection.

CONCEPTS

CAUSE AND EFFECT

In Step 9, explicitly ask: Where do you see evidence of cause and effect in the data you collected?

The “Forest Health Indicator” Worksheets offer analysis of many effects (soil condition, etc.). Discuss the environmental causes that yield the observed effects (air pollution, etc.).

PATTERNS

Ask students to identify patterns observed in the data collected. E.g., in “Tree and Crown Condition” Worksheet, ask if there are signs of disease in clusters. If so, why might that be?

HUMAN IMPACTS

Learners discuss how human activities can either degrade or enhance the health of the forest.

SCIENCE & ENGINEERING PRACTICES

- Planning and Carrying Out Investigations*
- Communicating Information
- Analyzing and Interpreting Data
- Constructing Explanations

DISCIPLINARY CORE IDEAS

ESS3.C: Human Impacts on Earth Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things.
- Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise.

Performance Expectation* (PE):

- **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (Note, keep in mind that no single lesson can fully meet a PE. In “Monitoring Forest Health,” students examine human impacts on the forest, but they do not design methods for monitoring and minimizing their effects. When students are asked what people could do to improve forest health [in Step 9], they would need to investigate and evaluate those solutions.)

CROSSCUTTING CONCEPTS

- Cause and Effect*
- Patterns*

*Can be met with slight modification to the procedure, as detailed in the practices and concepts section.

NGSS CORRELATIONS

GREEN JOBS: EXPLORING FOREST CAREERS 4. SEEKING SUSTAINABILITY



GUIDING QUESTION

How can we use the United Nations Sustainable Development Goals to inform sustainable forest management decisions?

PRACTICES

COMMUNICATING INFORMATION

In Step 7, groups present their displays. Ensure students use multiple formats (as mentioned in Step 5) while also communicating scientific information.

ANALYZING AND INTERPRETING DATA

In STEM It Up!, learners describe observed data trends. Encourage students to analyze the data, including interpreting what those trends might indicate in terms of forest sustainability.

DESIGNING SOLUTIONS

In Career Connection, students refine their solutions, which are based on scientific knowledge, tradeoff considerations, and prioritized criteria. Encourage students to come up with their own designs that work toward sustainability.

CONCEPTS

PATTERNS

In Enrichment, the sixth bullet asks learners to identify patterns in world forest maps.

In STEM It Up!, learners describe data trends related to the Sustainable Development Goals.

CAUSE AND EFFECT

Consider the goals on the “Sustainable Development Goals of the United Nations” Worksheet as causes. Ask learners about the effects that achieving a particular goal would have on forests.

STABILITY AND CHANGE

Use the discussion questions in Step 1 to make elements of stability and change explicit.

HUMAN IMPACTS

As learners examine the United Nation’s Sustainable Development Goals, they examine ways to reduce negative human impacts on the environment.

SCIENCE & ENGINEERING PRACTICES

- Communicating Information
- Analyzing and Interpreting Data
- Designing Solutions*

DISCIPLINARY CORE IDEAS

ESS3.C Human Impacts on Earth Systems

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things.
- Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth, unless the activities and technologies involved are engineered otherwise.

Performance Expectation* (PE):

- **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (Note, keep in mind that no single lesson can fully meet a PE. In “Seeking Sustainability,” learners would need to assess and evaluate feasible solutions for reduced human impacts. For example, after identifying how forests are connected to a particular goal, learners could be asked to prepare detailed plans for how a country would monitor progress toward that goal, with a focus on forests.)

CROSCUTTING CONCEPTS

- Can be addressed with modification

*Can be met with slight modification to the procedure, as detailed in the practices and concepts section.