★ PREMIUM RESOURCE ★

Environmental Science Project-Based Learning Unit

Investigate a Local Environmental Issue & Design a Solution

Grades 6 – 8 | NGSS-Aligned | 4-Week Unit

- 4-Week Project Guide with Daily Plans
- Student Research Packet
- Field Observation Journal
- Solution Design Template
- Presentation Rubric
- Teacher Facilitation Notes

Ecosystems • Human Impact • Data Collection • Solution Design • Public Speaking

UM Printables — Premium Educational Resources

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- Solution Blueprint
- Implementation Plan
- Impact Prediction Worksheet

6. Presentation Rubric & Resources

- Presentation Planning Guide
- NGSS-Aligned Rubric
- Peer Evaluation Form
- Self-Reflection Sheet
- Vocabulary Reference Sheet
- Additional Resources

Teacher Facilitation Notes

Comprehensive Guide for Implementing the PBL Unit

Unit Overview

This Project-Based Learning (PBL) unit empowers students in grades 6–8 to investigate a real environmental issue in their local community and design a viable solution. Over four weeks, students progress from understanding fundamental ecosystem dynamics to conducting field research, analyzing data, proposing solutions, and presenting their findings to an authentic audience.

The unit is designed around the principles of authentic learning, student agency, and collaborative problem-solving. Rather than studying environmental science in the abstract, students engage with issues that directly affect their communities—whether that means investigating water quality in a local stream, examining the impact of urban development on wildlife habitats, analyzing air quality near busy roadways, or assessing soil contamination in community gardens.

Essential Questions

1. How do living and non-living components of an ecosystem interact and depend on each other?
2. What are the most significant ways humans impact local ecosystems, and how can those impacts be measured?
3. How can scientific data be collected, analyzed, and used to inform environmental decision-making?
4. What makes an environmental solution both effective and sustainable?
5. How can we communicate scientific findings persuasively to inspire community action?

Learning Objectives

By the end of this unit, students will be able to:

- **Analyze ecosystem interactions:** Identify and describe the biotic and abiotic factors in a local ecosystem and explain how they interact.
- **Evaluate human impact:** Investigate and assess how human activities have altered a specific local ecosystem, using evidence from multiple sources.
- **Design data collection methods:** Develop and implement a systematic plan for collecting environmental data in the field, including quantitative measurements and qualitative observations.
- **Interpret and communicate data:** Organize, analyze, and present environmental data using appropriate graphs, charts, and visual representations.
- **Engineer a solution:** Apply the engineering design process to develop a feasible, evidence-based solution to a local environmental problem, considering criteria and constraints.
- **Advocate through public speaking:** Deliver a clear, compelling presentation that communicates the environmental issue, supporting evidence, and proposed solution to an authentic audience.

NGSS Alignment

This unit is aligned with the following Next Generation Science Standards for Middle School:

Standard	Description	Unit Connection
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	Students design solutions to minimize local environmental impacts and propose monitoring methods.
MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per-capita consumption impact Earth's systems.	Students build evidence-based arguments about local environmental impacts during research and presentations.
MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations.	Students analyze field data to determine how environmental changes affect local organisms.
MS-LS2-4	Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.	Students use observations and data to argue how human-caused changes impact local ecosystem populations.
MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution.	Students define criteria and constraints for their environmental solution design.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet criteria and constraints.	Students compare multiple solution ideas and evaluate which best meets identified criteria.
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions.	Students analyze results from solution testing and refine designs based on evidence.

Cross-Disciplinary Connections

Subject	Standard	Application
ELA	CCSS.ELA-LITERACY.WHST.6-8.7: Conduct short research projects to answer a question.	Student research packet guides structured investigation.
ELA	CCSS.ELA-LITERACY.SL.6-8.4: Present claims with relevant evidence and well-chosen details.	Final presentation requires evidence-based argumentation.
Math	CCSS.MATH.CONTENT.6.SP.B.5: Summarize numerical data sets in relation to their context.	Students organize and summarize environmental data collected in the field.

Math	CCSS.MATH.CONTENT.7.RP.A.2: Recognize and represent proportional relationships.	Students analyze proportional data in environmental measurements.

Materials & Preparation

Getting Ready for a Successful Unit

Required Materials

Student research packets (1 per student)	Digital cameras or tablets for documentation
Field observation journals (1 per student)	Water testing kits (if water quality focus)
Solution design templates (1 per student)	Soil testing kits (if soil focus)
Clipboards for field work	Thermometers
Science notebooks or folders	pH paper or pH meters
Graph paper	Magnifying glasses
Colored pencils and markers	Field identification guides (local species)
Rulers and measuring tapes	Computers/tablets with internet access

Optional Enrichment Materials

- Guest speaker: local environmental scientist, park ranger, or conservation officer
- Google Earth or ArcGIS for mapping environmental data
- Spreadsheet software (Google Sheets or Excel) for data analysis
- Poster board or trifold display boards for presentations
- Video recording equipment for documentary-style presentations
- Community partner contacts for authentic audience

Pre-Unit Preparation Checklist

- [ ] Print all student packets (research, observation journal, solution design, rubric)
- [ ] Identify 3–5 potential field study sites near the school (walkable if possible)
- [ ] Obtain necessary permissions for field trips or outdoor excursions
- [ ] Recruit community panel members for presentation day (Week 4)
- [ ] Set up a classroom "Environmental Science Lab" area with reference materials
- [ ] Create a resource bookmark folder with local environmental data websites
- [ ] Prepare example data sets for modeling data collection and analysis
- [ ] Arrange for access to computers/tablets during research sessions
- [ ] Review school safety protocols for outdoor field work

☐ Send home parent information letter about the unit and any outdoor activities

D Differentiation Strategies

Supporting All Learners in PBL

For Students Who Need Additional Support

- **Scaffolded Research:** Provide pre-selected articles and data sources at appropriate reading levels. Offer a research template with guiding questions already partially completed.
- **Structured Data Collection:** Use pre-formatted data sheets with clear measurement units and examples. Pair with a peer mentor during field observations.
- **Visual Supports:** Provide vocabulary cards with images and definitions. Use graphic organizers for ecosystem mapping. Offer sentence starters for written reflections.
- **Modified Presentations:** Allow students to present in small groups rather than individually. Provide a presentation template with slide structure pre-built. Permit use of notes during the presentation.
- **Extended Time:** Offer additional work sessions during study hall or after school. Break larger tasks into smaller, more manageable chunks with individual deadlines.

For Advanced Learners & Early Finishers

- **Independent Research:** Encourage students to contact local experts for interviews. Have them find and analyze peer-reviewed journal articles related to their issue.
- **Advanced Data Analysis:** Introduce statistical concepts such as mean, median, mode, and range. Challenge students to create multiple representations of the same data set.
- **Community Action:** Support students in writing letters to local officials or organizations. Help them organize a school awareness campaign or community event.
- **Cross-Curricular Extension:** Connect to social studies by examining environmental policy. Integrate technology by having students create websites, podcasts, or videos.
- **Mentoring Role:** Assign advanced students as peer consultants who help guide other groups through the research and design process.

English Language Learner Support

- **Visual Vocabulary:** Create a word wall with images alongside environmental science terms. Provide bilingual glossaries where available.
- **Sentence Frames:** Offer structured sentence frames for observations, analysis, and presentations (e.g., "The data shows that ___ because ___").
- **Partner Work:** Pair ELL students with bilingual peers when possible. Encourage the use of drawings and diagrams as communication tools alongside writing.
- **Multimedia Resources:** Provide access to videos and interactive simulations in both English and the student's home language when available.

A Assessment Overview

Formative & Summative Assessment Strategies

Assessment in this PBL unit is ongoing and multi-dimensional. Rather than relying solely on a final test, the unit incorporates formative check-ins, process assessments, and a culminating summative presentation. This approach values the learning process as much as the final product and provides multiple entry points for students to demonstrate understanding.

Assessment Type	When	Tool / Method	Weight
Formative: Daily Participation	Daily	Observation checklist, exit tickets	10%
Formative: Research Packet	Weeks 1–2	Research packet review	15%
Formative: Field Journal	Week 2	Journal rubric	15%
Formative: Solution Design	Week 3	Design template review	15%
Summative: Final Presentation	Week 4	Presentation rubric (provided)	30%
Summative: Self-Reflection	Week 4	Reflection sheet (provided)	15%

Weekly Pacing Guide at a Glance

Week	Focus	Key Activities	Deliverable
1	Ecosystems & Issue Selection	Ecosystem mapping, issue brainstorming, topic selection, initial research	Selected issue with rationale
2	Research & Field Observations	Background research, field site visits, data collection, observation journaling	Completed field journal & research notes
3	Data Analysis & Solution Design	Data organization, pattern identification, engineering design process, solution blueprint	Solution design with criteria/constraints
4	Refinement & Presentations	Solution refinement, presentation preparation, rehearsal, community presentation	Final presentation & self-reflection

Tips for PBL Success

★ **Embrace the Mess:** PBL can feel less structured than traditional teaching. Trust the process—students need time to explore, make mistakes, and discover solutions.

★ **Be a Facilitator, Not a Lecturer:** Your role shifts from delivering content to guiding inquiry. Ask probing questions rather than providing answers.

★ **Build Community Partnerships:** Invite local experts to speak, visit field sites, or serve on the presentation panel. Authentic audiences transform student motivation.

★ **Norm Field Behavior:** Before going outside, establish clear expectations for field work safety, respect for living things, and data collection procedures.

★ **Document the Journey:** Take photos of students working in the field, collaborating on designs, and presenting. These are invaluable for student portfolios and program advocacy.

★ **Celebrate the Process:** Acknowledge that "failed" solutions are valuable learning. Create a classroom culture where iteration and improvement are celebrated.

4 4-Week Project Guide

Daily Plans for Environmental Science PBL

This section provides a detailed day-by-day pacing guide for the entire 4-week unit. Each day includes an objective, suggested time allocations for a 45–50 minute class period, step-by-step procedures, and formative assessment strategies. Adjust timing and activities as needed to fit your school schedule and student needs.

Week 1: Ecosystems & Issue Selection

Focus: Students build foundational knowledge of ecosystem interactions and human impacts, then identify and select a local environmental issue to investigate.

Day	Focus	Key Activity	Deliverable
1	Ecosystem Fundamentals	Biotic/abiotic sort, ecosystem mapping	Ecosystem map draft
2	Local Ecosystems	Local habitat identification, food web construction	Local food web diagram
3	Human Impact Analysis	Case studies, cause/effect mapping	Human impact chart
4	Local Issue Brainstorm	Community walk, issue brainstorm, preliminary research	Issue brainstorm list
5	Issue Selection	Topic narrowing, team formation, project proposal	Issue Selection Worksheet

Day 1: Ecosystem Fundamentals

■ Objective

Students will identify and describe the biotic and abiotic factors in an ecosystem and explain how they interact. (Aligns with MS-LS2-1)

Time Allocation: 50 minutes

- **Warm-Up (5 min):** Display an image of a local outdoor scene (park, stream, schoolyard). Ask: "What living and non-living things do you see? How might they depend on each other?" Students write responses in science notebooks.
- **Mini-Lesson: Ecosystem Interactions (12 min):** Define ecosystem, biotic factors (living: plants, animals, fungi, bacteria), and abiotic factors (non-living: sunlight, water, soil, temperature). Emphasize that ecosystems are defined by the interactions between these components. Use a local example (e.g., a nearby pond or forest edge).
- **Activity: Biotic/Abiotic Sort & Ecosystem Map (20 min):** Students work in pairs. Provide a set of cards with various organisms and environmental factors. Students sort into biotic/abiotic categories, then

arrange them into a visual "ecosystem map" showing at least 3 interactions (e.g., sun → plant growth, animal → soil nutrients). Students sketch their map on poster paper.

■ **Share & Discuss (8 min):** Two pairs share their ecosystem maps. Class discusses: "What would happen if one of these factors changed or was removed?"

■ **Closure/Exit Ticket (5 min):** Students complete exit ticket: "Name one biotic and one abiotic factor in a local ecosystem. Describe one way they interact."

★ **Teacher Tip**

Use images of YOUR specific local area for the warm-up. The more students recognize the environment, the more invested they become. If card sets are unavailable, have students generate their own factors from the projected image.

Day 2: Exploring Local Ecosystems

■ **Objective**

Students will construct a food web for a local ecosystem and analyze how resource availability affects organisms. (Aligns with MS-LS2-1)

Time Allocation: 50 minutes

■ **Warm-Up (5 min):** "Think of an animal that lives near our school. What does it eat? What eats it?" Students draw a quick food chain in their notebooks.

■ **Mini-Lesson: From Food Chains to Food Webs (10 min):** Review food chains (producer → primary consumer → secondary consumer). Explain that most organisms eat multiple things, creating a food web. Introduce the concept of resource availability—how the presence/absence of food, water, and shelter limits populations.

■ **Activity: Local Food Web Construction (25 min):** Provide students with a list of common local organisms (e.g., oak tree, grass, rabbit, hawk, deer, earthworm, robin, fox, insect). Students work in groups of 3–4 to construct a food web on large paper, using arrows to show energy flow. Groups must identify at least 2 producers, 3 primary consumers, 2 secondary consumers, and 1 decomposer. Label the flow of energy.

■ **Scenario Analysis (5 min):** Each group receives a "Disruption Card" (e.g., "A disease kills 80% of the rabbits" or "A drought reduces grass by 50%"). Groups trace the impact through their food web and write a 1-sentence prediction.

■ **Closure/Exit Ticket (5 min):** "Explain how a change in one abiotic factor (like water availability) can affect multiple biotic factors in an ecosystem."

Day 3: Human Impact on Ecosystems

Objective

Students will analyze case studies to identify how human activities alter ecosystems and construct an argument about impacts on populations. (Aligns with MS-LS2-4, MS-ESS3-4)

Time Allocation: 50 minutes

- **Warm-Up (5 min):** "What is the biggest way humans have changed the environment in our town/city? Is it positive or negative? Why?"
- **Mini-Lesson: Categories of Human Impact (10 min):** Introduce the main categories of human environmental impact: Habitat Destruction (deforestation, urban development), Pollution (water, air, soil, noise, light), Resource Depletion (overfishing, water use, mining), and Invasive Species introduction. Provide 1–2 concrete examples for each.
- **Activity: Case Study Jigsaw (25 min):** Divide the class into 4 expert groups. Each group reads a different 1-page case study: (A) Urban runoff polluting a stream, (B) Highway construction fragmenting a forest, (C) Agricultural fertilizers causing algal blooms, (D) Invasive species outcompeting native plants. Expert groups answer: What is the human activity? What ecosystem components are affected? What are the long-term consequences? Then, regroup so each new group has one expert from each case study. Experts share their findings.
- **Human Impact Chart (5 min):** Students create a T-chart in notebooks: "Positive Human Impacts" vs. "Negative Human Impacts." Add at least 2 examples from the jigsaw.
- **Closure/Exit Ticket (5 min):** Choose one human impact from today. Construct a 1-paragraph argument explaining how it affects populations in the ecosystem, supported by evidence from the case study.

Day 4: Identifying Local Environmental Issues

Objective

Students will identify and brainstorm local environmental issues through observation and begin preliminary research. (Aligns with MS-ESS3-3)

Time Allocation: 50 minutes

- **Warm-Up (5 min):** "If you could fix one environmental problem in our community, what would it be and why?"
- **Activity: Schoolyard/Community Observation Walk (20 min):** Take students on a guided walk around the school grounds or nearby area. Students carry notebooks and record observations of: Water (puddles, drainage, streams), Land (litter, erosion, paving, plant health), Air (traffic, idling cars, industrial odors), Wildlife (presence/absence of birds, insects). Prompt them to look for evidence of human impact.
- **Brainstorming Session (15 min):** Return to class. In groups, students brainstorm a list of local environmental issues they have noticed or know about. Groups write each issue on a sticky note. Post all sticky notes on a class "Issue Board." Cluster similar issues together (e.g., water quality, waste, habitat loss).

- **Preliminary Research (5 min):** Each student selects their top 2 issues of interest and does a quick internet search to see if there is available data or information about the issue locally.
- **Closure (5 min):** Students submit their top 2 issue choices to the teacher (on paper or via digital form) to help with grouping for tomorrow.

Logistics Note

If a physical walk is impossible due to weather or location, use Google Earth street view for a "virtual walk" of the community, or provide recent local news articles about environmental issues in the area.

Day 5: Issue Selection & Team Formation

Objective

Students will evaluate potential issues, select a focus topic, form project teams, and define the initial project problem statement. (Aligns with MS-ETS1-1)

Time Allocation: 50 minutes

- **Warm-Up (5 min):** "What makes an environmental problem worth investigating? What criteria should we use to choose our project topics?"
- **Criteria for Selection (8 min):** As a class, establish criteria for a good project topic: (1) It is a real problem in our community. (2) We can collect data about it. (3) It is narrow enough to study in 4 weeks. (4) We can propose a realistic solution. Review the clustered issues from Day 4 through this lens.
- **Team Formation & Selection (15 min):** Announce project teams based on yesterday's interest surveys (groups of 3–4). Teams meet and select their top issue. They complete the "Issue Selection Worksheet" (Section 3, Student Research Packet) which requires them to name the issue, explain why it matters, and identify what they already know and need to find out.
- **Initial Problem Statement (12 min):** Introduce the concept of a problem statement: a clear, specific description of the issue to be addressed. Provide the formula: "In our community, [specific problem] is occurring, which is causing [negative effect] on [ecosystem component/population]." Teams draft their statement.
- **Closure: Team Check-In (10 min):** Each team shares their chosen issue and draft problem statement with the class for quick feedback and teacher approval.