1: What Is Environmental Science?

Unit 1: Earth's Systems and Interactions
Standard: HS-ESS3-1

Lesson Objective: You will understand how environmental science connects different fields of study to solve real-world problems that affect your future. You will identify the ways human activities change natural systems and recognize how these changes impact communities like yours. Through this foundation, you will build the skills needed to think critically about environmental challenges and the career paths that address them.

Understanding Environmental Science: The Foundation You Need

1. Environmental Science is Like a Team Sport

Environmental science brings together chemistry, biology, physics, and social studies to tackle big problems. Just like a sports team needs different players with different skills, environmental scientists need experts from many fields working together.

2. Everything in Nature is Connected

When you change one part of an environmental system, it affects everything else in unexpected ways. Understanding these connections helps you predict what might happen when humans make changes to the environment.

3. Your Actions Have Real Consequences

The choices you make every day add up to create measurable changes in Earth's systems. These aren't just small, invisible effects - they show up in data that scientists can track and measure.

Why This Matters to You

Environmental science gives you the tools to understand the world around you and make informed decisions about your future. The problems we're solving today will shape the opportunities available to you tomorrow.

Environmental science gives you superpowers for understanding how the world really works.

What is Environmental Science? Building Your Future on Solid Ground

Every morning when you check the weather app on your phone, you're seeing environmental science in action. That forecast comes from understanding how air pressure, temperature, and water cycles work together across thousands of miles. Environmental science is the study of how the natural world operates and how human activities fit into that bigger picture. It's not just about saving trees or recycling – it's about understanding the systems that keep our planet working so you can make smart decisions about your life and career.

Pollution from one location can travel hundreds of miles through the atmosphere before causing damage.

Environmental Science: The Ultimate Team Project

Environmental science works like the best group projects you've ever been part of, except the team includes chemists, biologists, geologists, economists, and social scientists all working on the same problem. When a coastal town deals with flooding, chemists study water pollution, biologists look at ecosystem damage, geologists examine soil erosion, and economists calculate the costs. Each expert brings different tools and knowledge, but they need each other to see the complete picture.

This collaborative approach becomes especially important when tackling today's environmental challenges. Climate change, for example, requires meteorologists to track weather patterns, marine biologists to study ocean changes, agricultural scientists to understand crop impacts, and urban planners to design resilient cities. No single expert could handle all these interconnected pieces alone.

This teamwork approach makes environmental science different from other subjects. In chemistry class, you might study how acids and bases react. In environmental science, you'd study how acid rain forms in the atmosphere, travels hundreds of miles, and then damages buildings and forests when it falls. The chemistry matters, but so does the weather that moves the acid rain, the biology of the trees it harms, and the economics of the damage it causes. No single field of study could handle all these pieces alone.

The interdisciplinary nature of environmental science means you get to use knowledge from many subjects to solve real problems. If you're good at math, you might calculate pollution levels. If you prefer biology, you might study how wildlife adapts to changes. If economics interests you, you might figure out the costs and benefits of different solutions. This variety makes environmental science a field where almost any interest or skill can find a place.

The word "ecosystem" wasn't invented until 1935.

Everything is Connected: Understanding Environmental Systems

Environmental systems work like a giant web where everything connects to everything else, often in surprising ways. When farmers in Iowa use fertilizer on their crops, some of that fertilizer runs off into streams during rainstorms. Those streams flow into rivers, which eventually reach the Gulf of Mexico. There, the extra nutrients from the fertilizer feed algae blooms that use up oxygen in the water, creating dead zones where fish can't survive. A farming decision in Iowa affects fishing communities in Louisiana.

Environmental engineers have designed living buildings that clean air while producing energy.

This interconnectedness means that environmental problems rarely have simple, single causes or easy fixes. What looks like a local issue often has roots stretching across states or even continents. Understanding these connections helps environmental scientists predict where problems might occur next and design solutions that address root causes rather than just symptoms.

These connections happen at every scale, from your backyard to the entire planet. Cut down a forest, and you change local rainfall patterns, soil stability, and wildlife habitats. The forest also stored carbon dioxide, so removing it affects global climate patterns. Plant trees in a city, and you reduce air temperatures, filter air pollution, and provide habitat for birds and insects. The tree's roots also help manage stormwater, preventing floods.

Understanding these connections helps you predict consequences before they happen. If a company wants to build a new factory, environmental scientists can study how it might affect air quality, water supplies, wildlife, and human health. They can suggest changes to reduce negative impacts or recommend better locations. This systems thinking approach prevents costly mistakes and protects both people and nature.

Human Impact: Your Choices Add Up

Human activities now influence nearly every major environmental system on Earth, from the deepest ocean trenches to the highest layers of the atmosphere. This isn't about blame or guilt – it's about recognizing the power you have to shape the world around you. Every choice you make, from what you eat to how you travel, becomes part of larger patterns that scientists can measure and track.

Consider your smartphone. Creating that device required mining metals from around the world, manufacturing components in factories, and shipping materials across continents. Each step used energy and produced waste. When you upgrade to a new phone, the old one needs to be

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Environmental science became an official field of study only in the 1960s.

recycled or disposed of safely. Multiply your phone by the billions of phones people buy each year, and you can see how individual choices create global environmental impacts.

The good news is that understanding these impacts gives you the power to make better choices. You can choose products made with recycled materials, support companies with strong environmental practices, or pursue careers that help solve environmental problems. Environmental science helps you see how your personal decisions connect to bigger systems, so you can align your values with your actions.

The Amazon rainforest creates its own weather patterns that influence rainfall in the American Midwest.

Young people today will make career decisions in a world shaped by climate change, resource scarcity, and new technologies for addressing environmental challenges. The jobs available to you – from environmental engineers designing clean energy systems to urban planners creating sustainable cities to policy analysts developing new environmental regulations – depend on understanding how human activities affect natural systems and how to minimize negative impacts while meeting people's needs.

Chesapeake Bay: A Living Laboratory

The Chesapeake Bay region demonstrates all these environmental science concepts in one place. This massive estuary stretches across six states and supports millions of people, countless businesses, and diverse ecosystems. The bay receives water from rivers that drain an area twice the size of South Carolina, carrying pollution from cities, farms, and forests. Over the past fifty years, excess fertilizer runoff has caused massive algae blooms that block sunlight and kill underwater grass beds where blue crabs once thrived.

Scientists studying the Chesapeake Bay need chemistry to understand water quality, biology to track wildlife populations, geology to study sedimentation, and economics to balance environmental protection with jobs and development. The bay's problems – from algae blooms to declining fish populations – result from activities throughout its huge watershed. Solutions require cooperation between states, industries, and communities. The Chesapeake Bay shows how environmental science works in the real world, where science, policy, and human needs intersect.

Understanding environmental science prepares you to tackle the challenges and opportunities that will define your generation. The systems thinking skills you develop here apply to any field you choose, from business and technology to medicine and law.

Microplastics from shopping bags appear in raindrops on remote mountain peaks thousands of miles from cities.

1: What Is Environmental Science? - Guided Notes

Three Most Important Concepts

Identify and explain the three most important topics you learned from the article.

Concept 1: _____

Concept 2: _____

Concept 3: _____

Main Concept Overview

Complete the sentences below using the word bank:

Word Bank: team, human, interdisciplinary, connections, systems

Environmental science is an _____ field that combines multiple areas of study to understand how _____ activities interact with natural _____. Scientists from different backgrounds work together like a _____ to solve complex environmental problems. Understanding these _____ helps you make informed decisions about your future and career.

Matching Section

Match each term from the article with its correct description.

_____ Environmental Systems	A. The study that combines multiple scientific fields to solve environmental problems
_____ Interdisciplinary	B. When one change in nature affects many other parts of the environment
_____ Chesapeake Bay	C. Connected networks in nature where everything affects everything else
_____ Human Impact	D. North America's largest estuary that demonstrates environmental science concepts
_____ Fertilizer Runoff	E. How people's daily choices create measurable changes in Earth's systems

True/False Questions

Write T for True or F for False for each statement.

1. _____ Environmental science only uses biology to solve environmental problems.
2. _____ The Chesapeake Bay receives water from rivers that drain an area twice the size of South Carolina.
3. _____ Individual choices like buying a smartphone have no measurable environmental impact.
4. _____ Fertilizer used on farms in Iowa can affect fishing communities in Louisiana through water systems.
5. _____ Environmental systems work independently without affecting each other.

Fill in the Table

Complete the table by identifying how different scientific fields contribute to solving environmental problems.

Scientific Field	How It Helps Solve Environmental Problems
Chemistry	
Biology	
Economics	
Geology	

Application Questions

1. **Career Connection:** Based on what you learned about environmental science being interdisciplinary, explain how this approach could help you in any career you choose, even if it's not directly environmental.

_____

_____

2. **Systems Thinking:** Choose one environmental issue mentioned in the article and explain how it demonstrates the connected nature of environmental systems.

_____

_____

1: What Is Environmental Science? - Hypotheticals

Scenario 1: The New Development Project

Your town council is considering approving a new shopping center that would be built on 50 acres of currently undeveloped land near a stream. The developer promises 200 new jobs and increased tax revenue. However, environmental groups are concerned about potential impacts on water quality and local wildlife habitat. The stream eventually flows into the region's main water supply reservoir.

Questions:
A. How would environmental scientists from different fields contribute to studying this project?
B. What connections between the development and other environmental systems should be considered?
C. What types of human impacts might result from this decision, both positive and negative?

Scenario 2: The Smartphone Recycling Dilemma

Your school is starting a program to collect old smartphones for recycling. The program coordinator explains that smartphones contain valuable metals like gold and rare earth elements, but also toxic materials that can harm the environment if not disposed of properly. Students are debating whether individual actions like recycling phones really make a difference on a global scale.

Questions:
A. How does this scenario demonstrate the interdisciplinary nature of environmental science?
B. What environmental system connections can you identify in the smartphone lifecycle?
C. How do individual choices about phone recycling connect to larger environmental impacts?

Data Analysis Activity: Global Environmental Indicators

Data Table: Global Environmental Indicators (1970-2020)					
Year	Atmospheric CO_2 (ppm)	Global Temperature Change (°C / °F)	Forest Cover (Million km²)	Ocean pH	World Population (Billions)
1970	325	-0.02 °C / 31.96 °F	41.2	8.15	3.7
1980	339	+0.26 °C / 32.47 °F	40.6	8.13	4.5
1990	354	+0.43 °C / 32.77 °F	40.1	8.11	5.3
2000	369	+0.61 °C / 33.10 °F	39.4	8.09	6.1
2010	389	+0.72 °C / 33.30 °F	38.8	8.07	6.9
2020	414	+1.02 °C / 33.84 °F	38.2	8.05	7.8
Note: Temperature change compared to 1900-1930 average; Ocean pH measured on logarithmic scale					

Background

Environmental scientists collect data from around the world to understand how Earth's systems are changing over time. This data helps them identify patterns, make predictions, and develop solutions. The table below shows key environmental indicators that scientists monitor to understand global environmental health.

Analysis Questions

1. Basic Interpretation Question

What was the atmospheric CO_2 concentration in 2010, and what was the world population in that same year?

_____

_____

2. Pattern Identification Question

Describe the overall trends you observe in atmospheric CO_2 levels and global temperature change from 1970 to 2020. How do these two variables appear to be related?

_____

_____

3. Application Question

Based on this data, what connections can you make between human population growth and the other environmental indicators? How might these changes affect the types of environmental challenges your generation will face?

_____

_____

Environmental Case Study: Chesapeake Bay Blue Crab Recovery

Background

The Chesapeake Bay is home to one of America's most important blue crab fisheries, supporting thousands of jobs and supplying about one-third of the nation's blue crab harvest. However, by the early 2000s, crab populations had dropped to dangerously low levels due to overfishing, habitat loss, and poor water quality. Scientists warned that without immediate action, this important species and the communities that depend on it could face serious long-term problems.

What Was Done

In 2008, Maryland and Virginia implemented strict new fishing regulations, including seasonal closures during crab mating season and limits on harvests. Environmental scientists worked with farmers throughout the watershed to reduce fertilizer runoff that was creating algae blooms and destroying underwater grass beds where young crabs live. The restoration effort included replanting underwater grasses and improving water treatment systems. Multiple state governments, watermen, and environmental groups coordinated these efforts across the bay's huge watershed.

Results

By 2012, blue crab populations had rebounded to healthy levels for the first time in decades. The underwater grass beds that serve as crab nurseries showed significant recovery in many areas. Water quality improvements allowed better underwater visibility, helping both crabs and grass beds. The fishing industry sustainably increased harvests while maintaining healthy populations. However, the recovery remains fragile and requires continued cooperation and sustained commitment from all watershed communities.

Student Conclusion Questions

1. How do the concepts from this lesson help explain what happened in this case?

_____

_____

2. Was the response successful? Why or why not?

_____

_____

3. What could other communities learn from this example?

_____

_____

How You Can Make an Impact Now: Your Choices Shape Tomorrow's World

The choices you make today aren't just personal decisions – they're part of a larger web of connections that shape the world around you. Every time you choose how to get to school, what to eat for lunch, or which products to buy, you're participating in environmental systems that extend far beyond your immediate surroundings.

When you decide to walk or bike instead of getting a ride, you're reducing air pollution that affects not just your neighborhood, but also contributes to larger regional air quality patterns. That cleaner air helps local ecosystems stay healthier, which supports the wildlife and plants that make your community more livable. Your transportation choice connects to energy systems, air quality, and community health in ways that add up when combined with similar decisions by your friends, classmates, and neighbors.

The products you choose to support send signals through complex economic and environmental networks. When you buy items made from recycled materials or choose companies with strong environmental practices, you're voting with your money for the kind of future you want to see. Those purchasing decisions influence how companies design products, source materials, and invest in new technologies.

Your daily habits around energy and water use at home connect to much larger resource systems. The electricity powering your devices comes from power plants that may burn fossil fuels or harness renewable energy. These connections mean that your personal choices about consumption ripple outward through infrastructure systems that serve entire regions.

Understanding these connections gives you real power to influence outcomes. You're not just a passive consumer – you're an active participant in environmental systems. The more you understand about how your choices connect to larger patterns, the more intentional you can be about aligning your actions with your values and creating positive change.

Think about your future career and how environmental knowledge might make you more effective in any field. Companies increasingly value employees who can think about sustainability and long-term impacts.

What type of impact do you want to have on the environmental systems you're part of, and how might the choices you make now prepare you to contribute to solutions for the challenges your generation will inherit?

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1: What Is Environmental Science? - Reflection Questions

1

What environmental connections in your own community surprise you most after reading about systems thinking?

Think about your local area - your school, neighborhood, or region. Consider how different activities might be connected in ways you hadn't noticed before. What relationships between human activities and environmental systems can you now identify around you?

2

How might the environmental challenges discussed in the article affect the world you'll live and work in as an adult?

Consider the changes happening in environmental systems and how they might create new opportunities or challenges. Think about the types of problems your generation might need to solve. How might this influence your educational or career planning?

3

What role do you think individual actions should play in addressing environmental problems, given what you learned about systems and scale?

Consider the smartphone example and other individual choices mentioned in the article. Think about the balance between personal responsibility and larger systemic changes. How can individual actions be meaningful while recognizing the need for broader solutions?

1: What Is Environmental Science? - Vocabulary

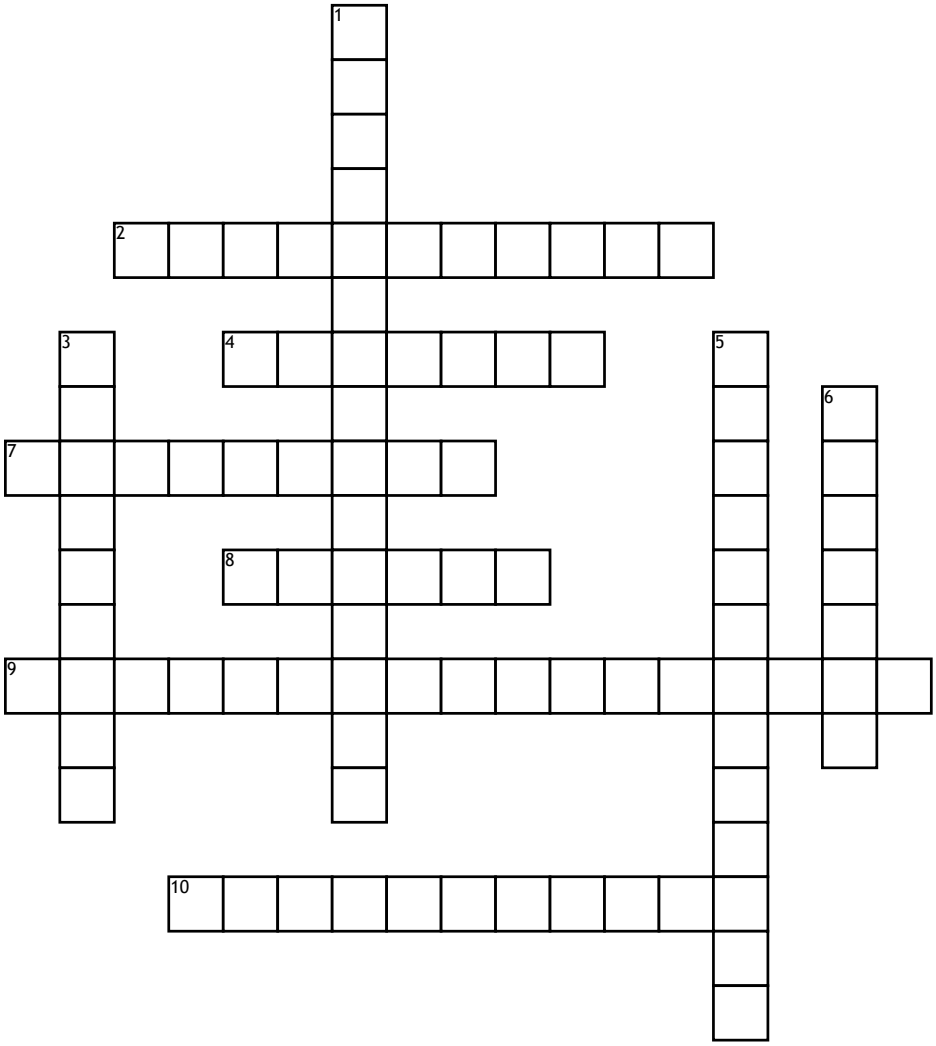
TERM	DEFINITION
Algae Blooms	
Dead Zones	
Environmental Science	
Environmental Systems	
Estuary	
Fertilizer Runoff	
Human Impact	
Interdisciplinary	
Systems Thinking	
Watershed	

What Is Environmental Science?

E N V I R O N M E N T A L S C I E N C E H M E Z
R I U C D P M T M Z H H E G A V W Z F X U F Z F
K K N Z T V G F E Y V G P D N Y H Y C Q M I J S
E Z P T U I V G A B X B G G C U R E I R A N K W
J J V L E T C S K V P U L X W F W W A H N J K C
H H I M G R I W I T U J G W L K U I I F I G B A
V D G C L E D X A U R F G P U K M U M E M Y I F
B E W K V O W I K T Q N V H K G E H M G P O J E
L S I N L G P R S Y E V P A G X B B M Q A B Z R
P Y Y G C N R N Q C L R F B P V W D C D C A U T
W S B E V W Y V X W I U S Q Z S L U Y G T F B I
S T C F O Z T C U K I P A H L T S S Q Q W F E L
E E U B U Q V V N X V Y L O E J H P X V Q N I I
T M C M A X K Y T T Z A U I C D X V V C C B D Z
L S N H X G E K X T O S L I N R T I M O E O T E
W T R D R P H K D A T P L G G A N U M O S A D R
D H R L N Y S I B N H Q C D A A R Z Q Z N T F R
H I Y Q B G F K I S A C Y I P E T Y V U Z X B U
Q N I Q M D E A D Z O N E S K R B W A M J Q B N
J K Y J P R K B B C T R I P B A D L U S F Y V O
L I B H S M Y Y E G F Q W H X J V K O S Y X K F
Z N H C D Y M H E S T U A R Y L U X W O U C B F
F G E N V I R O N M E N T A L S Y S T E M S J S
R X L V E B X R U N O F F U V V V O N P O S W O

Fertilizer Runoff
Environmental Systems
Environmental Science
Watershed
Systems Thinking
Interdisciplinary
Human Impact
Estuary
Dead Zones
Algae Blooms

What Is Environmental Science?



Across

2. Rapid growth of algae in water bodies, often caused by excess nutrients from fertilizer runoff, that can block sunlight and use up oxygen in the water. (Two words)

4. Connected networks in nature where all components interact with and influence each other, creating complex relationships and feedback loops. Environmental ____

7. The entire area of land that drains water into a particular river, lake, or bay, often spanning multiple states or regions like the Chesapeake Bay watershed.

8. When excess nutrients from agricultural fertilizers wash into waterways during storms, potentially causing pollution and ecosystem disruption downstream. Fertilizer ___

9. An approach that combines knowledge and methods from multiple fields of study to understand and solve complex problems that no single field could address alone.

10. The measurable effects of human activities on natural systems, ranging from local changes to global environmental patterns. (Two words)

Down

1. A way of understanding problems by looking at connections and relationships between different parts rather than focusing on individual components alone. (Two words)

3. Areas in water bodies where oxygen levels are so low that fish and other marine life cannot survive, often caused by nutrient pollution. (Two words)

5. An interdisciplinary field that combines physical, biological, and social sciences to study environmental problems and develop solutions. ____ Science

6. A coastal area where freshwater from rivers meets and mixes with saltwater from the ocean, creating unique and productive ecosystems like the Chesapeake Bay.