Chapter 1 - Guided Notes Answer Key

Three Most Important Concepts

Concept 1: Environmental science combines multiple fields like chemistry, biology, and economics to solve complex problems
Concept 2: Environmental systems are connected so changes in one area affect many other areas
Concept 3: Human activities create measurable impacts on Earth's systems through daily choices

Main Concept Overview

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

Matching Section

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

True/False Questions

1. **F** - Environmental science uses many fields, not just biology
2. **T** - This fact is stated directly in the article
3. **F** - Individual choices do create measurable impacts
4. **T** - The article explains this connection through water systems
5. **F** - Environmental systems are interconnected

Fill in the Table (Sample Answers)

Scientific Field	How It Helps Solve Environmental Problems
Chemistry	**Studies pollution levels and chemical reactions**
Biology	**Tracks wildlife populations and ecosystem health**
Economics	**Calculates costs and benefits of solutions**
Geology	**Examines soil erosion and sedimentation**

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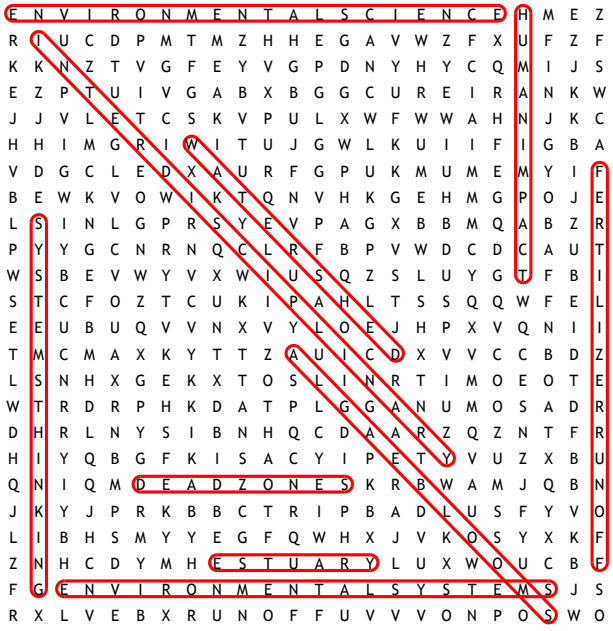
Application Questions (Sample Answers)

1. **Career Connection:** Systems thinking helps in any career because it teaches you to see how different parts of problems connect, whether in business, technology, or other fields.

2. **Systems Thinking:** Fertilizer runoff shows connections - farming decisions in Iowa affect water quality, which flows to rivers, then to the Gulf of Mexico, affecting fishing communities.

What Is Environmental Science?



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

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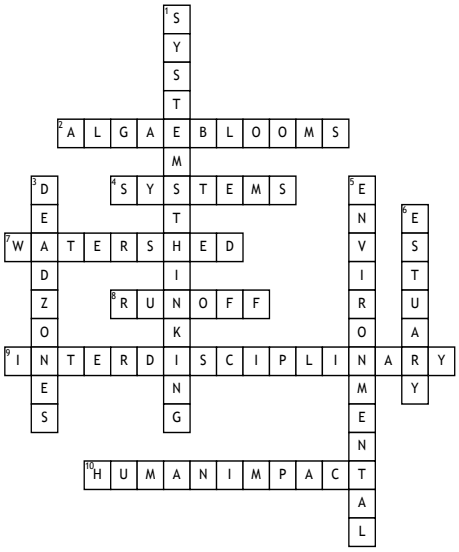

Across

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.

Answer Key: Hypothetical Scenarios

Scenario 1: The New Development Project

A. Different fields would contribute: biologists (wildlife impacts), chemists (water quality), economists (cost-benefits), geologists (soil/erosion).
B. Connections include stream to reservoir, habitat effects, traffic pollution, drainage changes.
C. Positive: jobs, economic growth. Negative: habitat loss, water pollution, resource use.

Scenario 2: The Smartphone Recycling Dilemma

A. Shows interdisciplinary nature through chemistry (materials), economics (costs), biology (health impacts), social science (behavior).
B. Connections: mining impacts, manufacturing pollution, transportation energy, waste disposal effects.
C. Individual recycling reduces mining demand, prevents toxic waste, supports recycling industry.

Answer Key: Environmental Case Study - Chesapeake Bay Blue Crab Recovery

1. Understanding Question

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

Sample Answer: The Chesapeake Bay case demonstrates all three main concepts: interdisciplinary approach (biologists, chemists, economists, and policy experts worked together), environmental systems (problems in the watershed affected the entire bay ecosystem), and human impact (both negative impacts from overfishing and pollution, and positive impacts from coordinated restoration efforts).

2. Evaluation Question

Was the response successful? Why or why not?

Sample Answer: The response was successful because crab populations recovered to healthy levels by 2012, underwater grass beds improved, and water quality got better. However, success requires ongoing effort and cooperation because environmental systems need continuous management to stay healthy.

3. Application Question

What could other communities learn from this example?

Sample Answer: Other communities can learn that environmental problems require cooperation across multiple states and stakeholder groups, that solutions must address root causes (like fertilizer runoff) not just symptoms, and that combining scientific research with policy changes and community action can achieve positive results.

Answer Key: Data Analysis Activity

Question 1: Basic Interpretation

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

Answer: CO_2 was 389 ppm and world population was 6.9 billion in 2010.

Question 2: Pattern Identification

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?

Answer: Both CO_2 and temperature show steady increases over time. As CO_2 levels rise, temperatures also rise, suggesting a positive correlation between these variables.

Question 3: Application

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?

Answer: As population grows, CO_2 increases, temperatures rise, forest cover decreases, and ocean pH drops. These changes suggest your generation will face challenges like climate change, resource scarcity, and ecosystem disruption that require systems thinking to solve.

Answer Key: How You Can Make an Impact Now

Reflection Question Answer Key

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?

Sample Answer:

"I want to make positive choices about transportation, products, and energy use that connect to larger environmental systems. Understanding these connections helps me see how individual actions add up with others to create change. The systems thinking skills I'm learning will help me in any career and prepare me to contribute to solving environmental challenges my generation will face."

Key Points Students Should Include:

- Personal choices that connect to larger systems
- Recognition that individual actions matter
- Connection between current learning and future problem-solving
- Understanding of environmental systems connections

Teaching and Lecture Notes: What is Environmental Science?

Example Lecture Outline

Introduction

• Define environmental science as an interdisciplinary field combining multiple sciences
• Explain importance in understanding human-environment interactions
• Connect to students' daily experiences and future career decisions

Key Components of Environmental Science

Interdisciplinary Approach
• Chemistry, biology, physics, geology, economics, and social sciences work together
• Each field contributes different tools and perspectives to solve problems
• Real-world problems require multiple types of expertise
• Like a team sport where different players have specialized skills

Systems Thinking
• Everything in nature connects to everything else
• Changes in one area create effects throughout the system
• Examples: fertilizer runoff from Iowa affecting Gulf of Mexico fishing
• Understanding connections helps predict consequences of human actions

Human-Environment Interactions
• Human activities influence nearly every major environmental system
• Individual choices accumulate to create measurable global impacts
• Technology and consumption patterns affect resource use and waste production
• Understanding impacts empowers better decision-making

Real-World Applications

• Weather forecasting uses environmental science principles
• Urban planning requires understanding of multiple environmental systems
• Environmental engineers design solutions for pollution and resource management

Impact and Implications

• Environmental challenges create new career opportunities across many fields
• Systems thinking skills apply to business, technology, healthcare, and policy
• Today's environmental decisions will shape tomorrow's opportunities

Conclusion

• Environmental science provides tools for understanding complex world
• Skills learned apply broadly to many career paths and life decisions

Class Discussion Prompts

1. **Opening Engagement:** What examples of environmental science do you encounter in your daily life without realizing it?

2. **Systems Connections:** Can you think of a local example where one environmental change affected multiple other things in your community?

3. **Career Exploration:** How might environmental science skills be useful in careers that aren't specifically "environmental" jobs?

4. **Personal Relevance:** What environmental issue are you most curious about, and what different types of experts might need to work together to address it?

5. **Future Focus:** How do you think environmental challenges might create new job opportunities by the time you enter the workforce?

Supplementary Activities

Activity 1: Environmental Science Detective

Materials: Local newspaper articles, internet access
Instructions: Students find three current news stories that involve environmental issues. For each story, they identify what different types of scientists (chemist, biologist, economist, etc.) would be needed to fully understand the problem. Groups present their findings showing how each story demonstrates interdisciplinary approaches.
Expected Outcomes: Students recognize environmental science in current events and understand why multiple fields must collaborate.
Safety Considerations: Ensure internet access is supervised and appropriate
Assessment Criteria: Students identify at least 3 different scientific fields per story and explain each field's contribution

Activity 2: Systems Web Building

Materials: Yarn or string, index cards, markers
Instructions: Students create a physical web showing connections between local environmental factors (air quality, water supply, wildlife, agriculture, transportation). Each student holds a card representing one factor and yarn shows connections. Pull one string to show how changes affect the whole system.
Expected Outcomes: Visual understanding of environmental system interconnections
Safety Considerations: Ensure adequate space for web construction
Assessment Criteria: Students can explain at least 2 connections their factor has to others in the web

Activity 3: Career Connection Mapping

Materials: Career research sheets, poster paper, markers
Instructions: Students research environmental science careers and create visual maps showing how different careers connect to the three main concepts (interdisciplinary approach, systems thinking, human impact). Present career maps to class.
Expected Outcomes: Students see diverse career applications of environmental science concepts
Safety Considerations: Standard classroom safety
Assessment Criteria: Career map clearly connects chosen career to all three main concepts with specific examples