CAREER PATHS

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ENVIRONMENTAL ENGINEERING

Express Publishing

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Book 1

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Scope and Sequence

Unit	Topic	Reading context	Vocabulary	Function
1	The Environmental Engineer	Article	advise, apply, conservation, environment, environmental engineer, evaluate, impact, monitor, pollution, prevent, resources	Asking about interests
2	The Earth	Course description	atmosphere, biosphere, core, crust, geosphere, hydrosphere, lithosphere, mantle, stratosphere, troposphere	Describing order
3	Ecosystems	Letter	abiotic, biotic, community, component, ecosystem, genetic diversity, habitat, organism, population, species	Describing positive changes
4	Biomes and Aquatic Systems	Webpage	aquatic life zone, biome, coastal zone, coral reef, desert, grassland, inter-tidal zone, ocean, open sea, rainforest, saltwater, savanna, tundra	Expressing excitement
5	Weather	Blog	cloud cover, humidity, meteorology, moisture, precipitation, pressure, short-term, temperature, weather, wind speed	Asking for repetition
6	Climate	Textbook	average, climate, current, elevation, Equator, latitude, pattern, pole, prevailing wind, range, rotation, terrain	Talking about averages
7	Basic Units of Life	Textbook	cell, chromosome, DNA, eukaryotic, gene, genetic information, multicellular, nucleus, prokaryotic, unicellular	Making a comparison
8	Measurements 1	Chart	acre, Celsius, Fahrenheit, gallon, hectare, imperial, kilogram, kilometer, liter, meter, metric, mile, pound, yard	Making a request
9	Basic Numbers and Math	Chart	add, divide by, equal, hundred, less, minus, multiply by, over, plus, subtract, times	Giving a reminder
10	Measurements 2	Employee guide	amount, area, base unit, concentration, cubic meter, derived unit, Kelvin, mole, SI, square meter, thermodynamic temperature, volume	Asking for clarification
11	Tables and Graphs	Email	bar graph, column, legend, line graph, pie chart, row, scatter diagram, table, x-axis, y-axis	Correcting an error
12	Describing Change	Article	decline, decrease, expand, fluctuate, increase, plummet, rise, shrink, skyrocket, stabilize	Describing changes
13	Presentations	Letter	body language, cue card, eye contact, handout, presentation, project, review, signpost, summarize, visual aid	Giving a compliment
14	Properties of Matter	Textbook	atom, atomic number, compound, electron, element, ion, mass number, matter, molecule, neutron, proton	Correcting yourself
15	Energy	Information excerpt	conserve, electromagnetic radiation, energy, energy efficiency, energy quality, heat, kinetic energy, potential energy, transfer, work	Giving a summary

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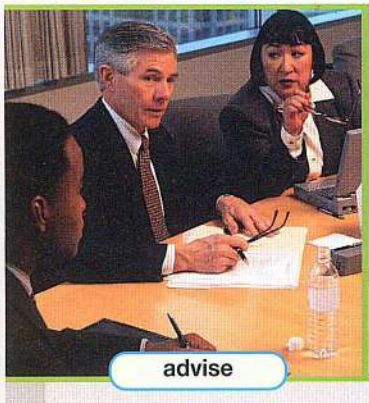
1 The Environmental Engineer

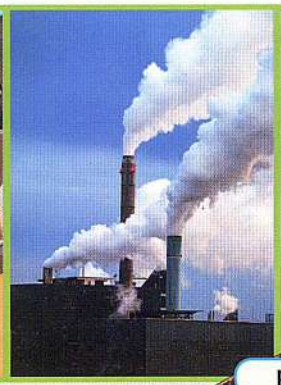
Is Environmental Engineering Right for You?

Many people want to help the **environment**. **Environmental engineers** make it their career. They **apply** engineering skills to environmental problems. Here are some common duties of environmental engineers:

- **Evaluate** the **impact** of proposed projects. The goal is to **prevent** or minimize any harm to the environment.
- **Monitor** air and water **pollution** levels. They may **advise** authorities about how to reduce them.
- Design systems to increase **conservation** of **resources**. A typical project might be a waste water system.

Environmental engineers work with various organizations. Working together, they try to protect our environment. If this sounds interesting, consider learning more!





Get ready!

1 Before you read the passage, talk about these questions.

1 What are some problems that the environment is facing?

2 What kinds of skills does a person need to be an environmental engineer?

Reading

2 Read the article. Then, choose the correct answers.

1 What is the purpose of the article?

A to recruit environmental engineers

B to list a job opening for an environmental engineer

C to describe what an environmental engineer does

D to describe how to become an environmental engineer

2 Which of the following is NOT listed as a duty of an environmental engineer in the article?

A monitoring air pollution levels

B evaluating soil conditions

C designing waste water systems

D assessing future projects

3 What is the main goal when evaluating potential projects?

A to reduce air pollution

B to improve water quality

C to safely deal with solid waste

D to prevent harm to the environment

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ apply
2 __ advise
3 __ impact
4 __ evaluate
5 __ resources
6 __ environment
7 __ pollution
8 __ conservation

A the act of trying to save resources
B to give an expert opinion
C the area in which a person or thing lives
D to look at something closely and critically
E a large change
F things that people use for fuel, food, or shelter
G damage caused to water, air, and land by harmful substances
H to use something for a particular purpose

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **environmental engineer / pollution**
A The _____ came up with a new water cleaning system.
B Cars can cause a lot of _____ in the air.

2 **monitor / prevent**
A If we are careful we can _____ environmental degradation.
B It is our duty to _____ our water consumption.

5 Listen and read the article again. What are some duties of an environmental engineer?

Listening

6 Listen to a conversation between an interviewer and an interviewee. Mark the following statements as true (T) or false (F).

1 __ The man will study environmental engineering this year.
2 __ The man has experience in wastewater management.
3 __ The man has not worked in soil remediation.

7 Listen again and complete the conversation.

Interviewer: I'm glad to hear that. What kind of **1** _____ do you have?
Interviewee: I have a degree in environmental engineering. I also have **2** _____ _____ of experience in my current position.
Interviewer: What exactly **3** _____ _____ _____?
Interviewee: Mainly wastewater and solid **4** _____ _____.
Interviewer: I see. Do you have any experience with **5** _____ _____?
Interviewee: **6** _____ _____, yes.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

What brought you to environmental engineering?
What kind of experience do you have?
Do you have any experience with ...?

Student A: You are an interviewer. Talk to Student B about:

- why he or she chose the field of environmental engineering
- his or her experience in the field
- a specific skill you're looking for

Student B: You have an interview for an environmental engineer position. Talk to Student A about the position.

Writing

9 Use the conversation from Task 8 to complete the interview sheet.

GREEN TECHNOLOGIES
INTERVIEW SHEET

CANDIDATE NAME: _____
INTERVIEWER NAME: _____

MOTIVATION FOR ENTERING THE FIELD:
_____
_____
_____.

EXPERIENCE:
_____
_____
_____.

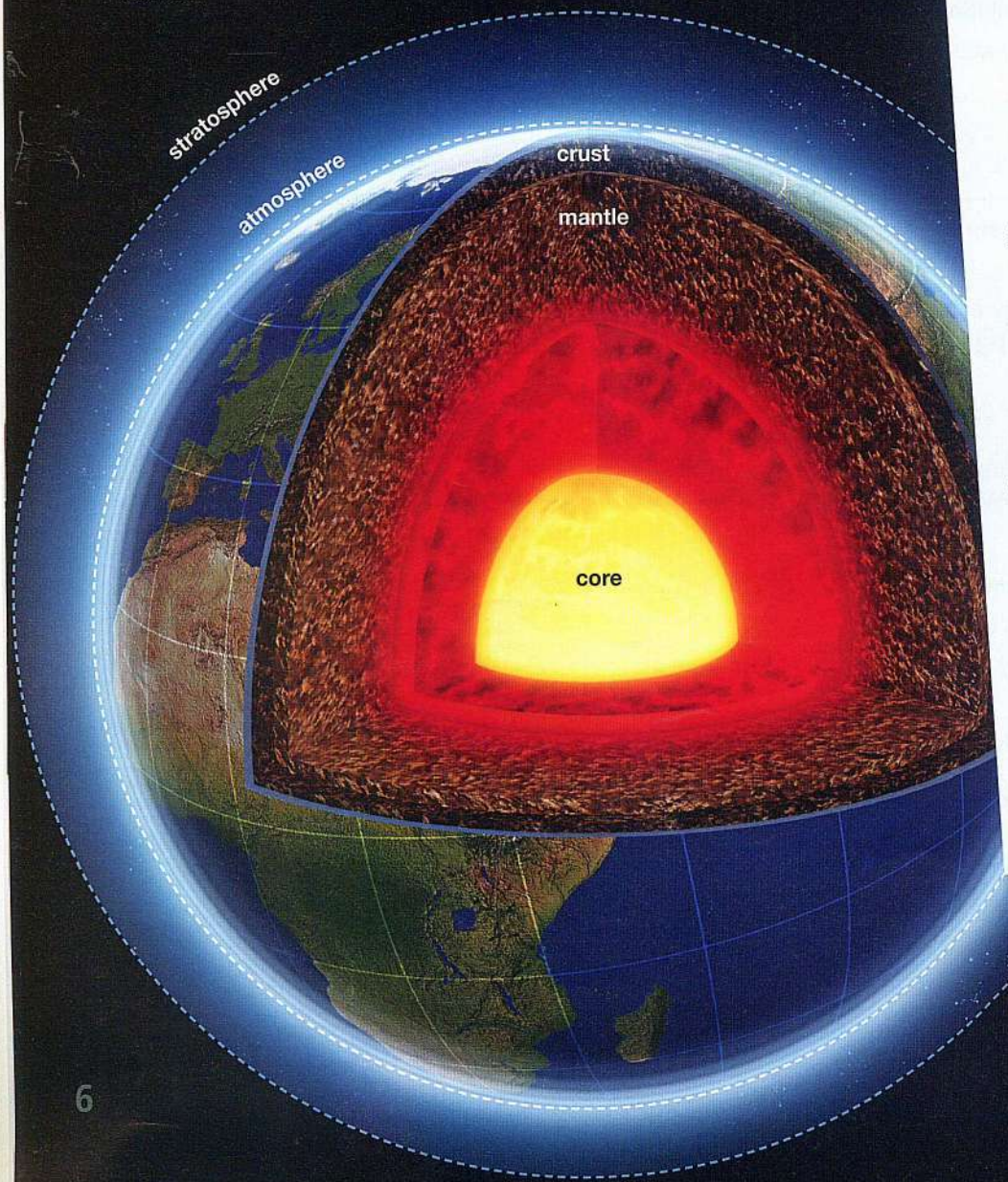
EPS 101

INTRO TO EARTH SCIENCES

This course introduces students to the different Earth layers. We begin with the **geosphere**. Students identify the **mantle** and **crust**. These make up the **lithosphere**. We also discuss the Earth's **core**.

Next, we move above the Earth's surface. We'll talk about the layers of the **atmosphere**. These are the **troposphere** and the **stratosphere**. The last topic we cover is the **hydrosphere**. The hydrosphere includes all water on Earth. It also includes water vapor in the atmosphere.

The **biosphere** is of interest throughout the course. We'll learn how each sphere contributes to life. This is the overarching theme of the course.



Get ready!

1 Before you read the passage, talk about these questions.

1 What are the layers of the Earth's surface?

2 In which layer of the Earth is life found?

Reading

2 Read the course description. Then, choose the correct answers.

1 What is the purpose of the class?

- **A** to compare how pollution impacts different layers of the Earth
- **B** to examine life and the layers of the Earth
- **C** to introduce students to the field of environmental engineering
- **D** to show the impact of one layer of the Earth on the others

2 Which of the following make up the lithosphere?

- **A** the geosphere and the crust
- **B** the core and the mantle
- **C** the crust and the core
- **D** the mantle and the crust

3 Which of the following is part of Earth's surface and the atmosphere?

- **A** the stratosphere
- **B** the hydrosphere
- **C** the lithosphere
- **D** the troposphere

Vocabulary

3 Place the words from the word bank under the correct headings.

WORD BANK

lithosphere hydrosphere mantle troposphere
atmosphere geosphere biosphere stratosphere

At or below Earth's surface	Above Earth's surface	Can be above Earth's surface
_____	_____	_____
_____	_____	_____
_____	_____	_____

4 Read the sentences and choose the correct words.

1 The **biosphere/core** is at the center of the Earth.
2 The surface of the Earth, made of rock and soil, is called its **crust/hydrosphere**.
3 The **atmosphere/mantle** is a layer below Earth's crust.

5 Listen and read the course description again. What is the unifying theme of the course?

Listening

6 Listen to a conversation between a student and a professor. Mark the following statements as true (T) or false (F).

1 __ The woman is confused about the order of the spheres.
2 __ The man recommends starting at the top of the atmosphere.
3 __ The woman states the order of the spheres incorrectly.

7 Listen again and complete the conversation.

Student: I'm confused about the **1** _____ of the spheres.
Professor: Okay, let's start with the geosphere. Starting at the surface, which layer **2** _____ _____?
Student: First is the **3** _____, right? And then comes the **4** _____?
Professor: Not quite. Those two make up the **5** _____. But the crust comes first.
Student: Oh, I see. And then the core is next.
Professor: Exactly. That's the geosphere. But the **6** _____ has more layers.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

The ... comes first, right?
Then the ...
What's next?

Student A: You are a student. Talk to Student B about:

- a problem you're having with the Earth's atmosphere
- which sphere comes first
- which sphere comes after

Student B: You are a professor. Talk to Student A about the Earth's spheres.

Writing

9 Use the course description and the conversation from Task 8 to complete the worksheet.

EPS 101

Earth's Spheres Worksheet

Name: _____
Date: _____

Name 3 layers in the geosphere:

_____
_____
_____

Name 2 spheres that can be found in the Earth's atmosphere:

_____
_____

3 Ecosystems

Get ready!

1 Before you read the passage, talk about these questions.

1 How are the species in an ecosystem connected?

2 Why is genetic diversity important?

Sunday Edition

JACKSON TIMES

Letter to the Editor

I am concerned about the Darby River. The river is home to a rare **species** of fish. They are called southern pygmy perch. This particular **population** is shrinking quickly.

Their **habitat** is in danger. Industrial waste negatively impacts the **ecosystem**. The fish are running out of food. Waste in the water kills plant life. Without those plants, these **organisms** have fewer food options.

As fish numbers dwindle, other **biotic** creatures suffer. Birds that eat the perch will starve and die.

The whole **community** is connected. Even if an **abiotic component** is compromised, it will affect everyone.

We must put a stop to this. We must preserve the **genetic diversity** of the Darby River!

Respectfully,
Edwin Jace
Environmental Engineer

Reading

2 Read the letter to the editor. Then, choose the correct answers.

1 What is the main purpose of the letter?

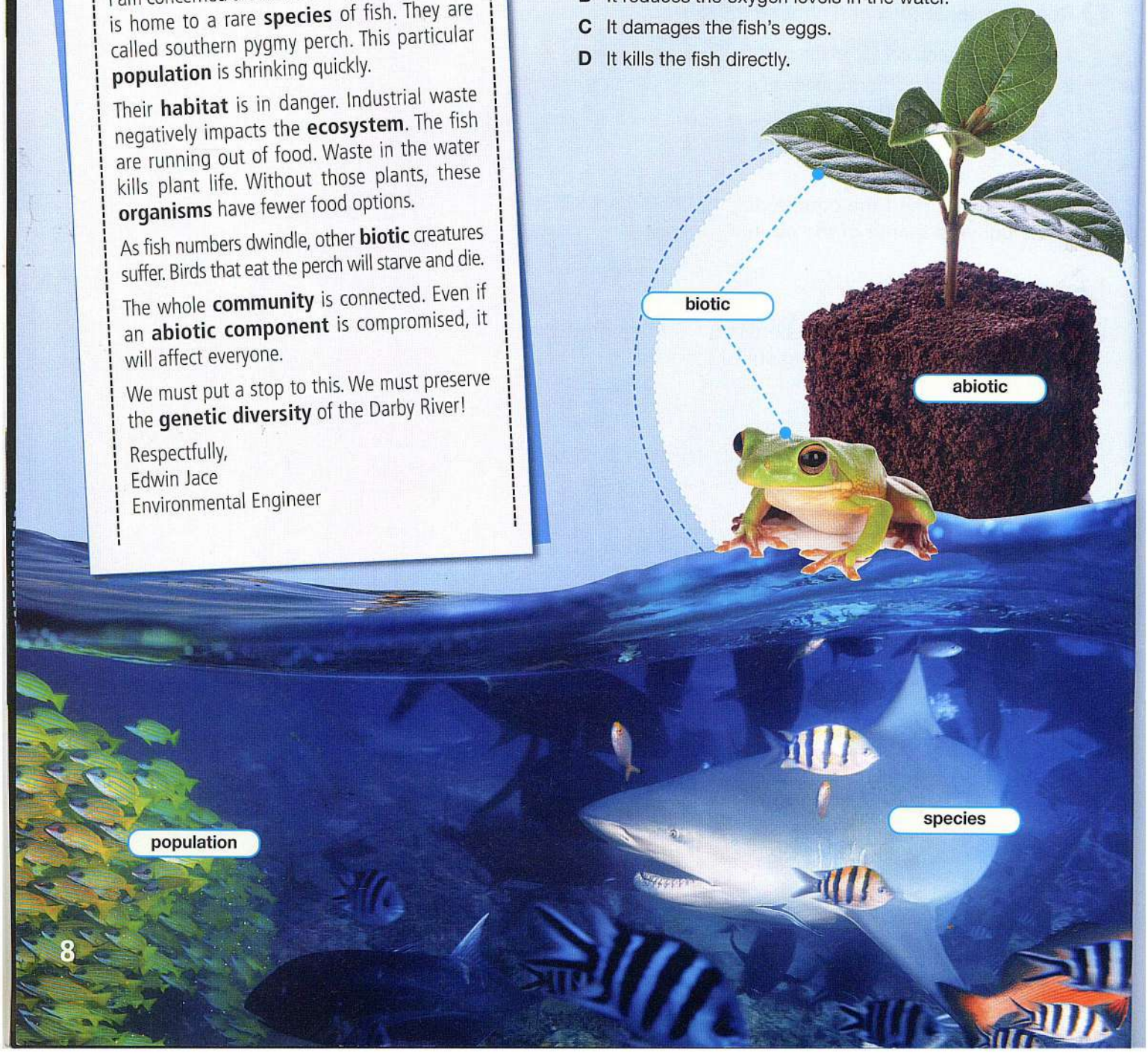
A to describe genetic diversity at the Darby River
B to classify the Darby River ecosystem
C to give information about the southern pygmy perch
D to explain a threat to the Darby River ecosystem

2 Which is NOT a part of the Darby River ecosystem?

A fish **B** birds **C** plants **D** humans

3 How is the toxic waste affecting the fish?

A It kills a plant they rely on for food.
B It reduces the oxygen levels in the water.
C It damages the fish's eggs.
D It kills the fish directly.



Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ biotic
2 __ abiotic
3 __ species
4 __ habitat
5 __ community
6 __ organism
7 __ ecosystem
8 __ genetic diversity

A the area where a population lives
B a group of all living things in an area
C a group of organisms that are biologically similar
D an individual living thing
E living
F not living
G the degree of biological variation among individuals of a species
H the living and nonliving things in a particular environment

4 Write a word that is similar in meaning to the underlined part.

1 Water is an important <u>part</u> of any ecosystem. _ _ m _ _ n _ _ t
2 This <u>group of the same species</u> is very healthy. p _ _ u _ _ t _ _ _
3 Soil and rocks are <u>not living</u> things of an ecosystem. a _ _ o _ _ c

5 Listen and read the letter again. What is the impact of the toxic waste on bird populations?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ The chemical plant stopped dumping in the river.
2 __ The Cadell fish population is back to normal levels.
3 __ The birds have not returned to Darby River.

7 Listen again and complete the conversation.

Engineer 1: Hey, did you look at **1** _____ _____ from the Darby River?
Engineer 2: I did! Things are looking a **2** _____ _____, aren't they?
Engineer 1: Definitely! I'm glad the **3** _____ _____ stopped dumping.
Engineer 2: Me too. The perch population is already up by twenty five percent. They'll be **4** _____ _____ _____ in no time.
Engineer 1: Yeah, and **5** _____ _____ are coming back, too.
Engineer 2: And all because of one **6** _____ _____ the fish need for survival.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Things are looking a lot better.
The ... population has risen by ...
The ... are coming back.

Student A: You are an environmental engineer. Talk to Student B about:

- a positive change in a local ecosystem
- what caused the change
- a population increase in one species

Student B: You are an environmental engineer. Talk to Student A about a change in a local ecosystem.

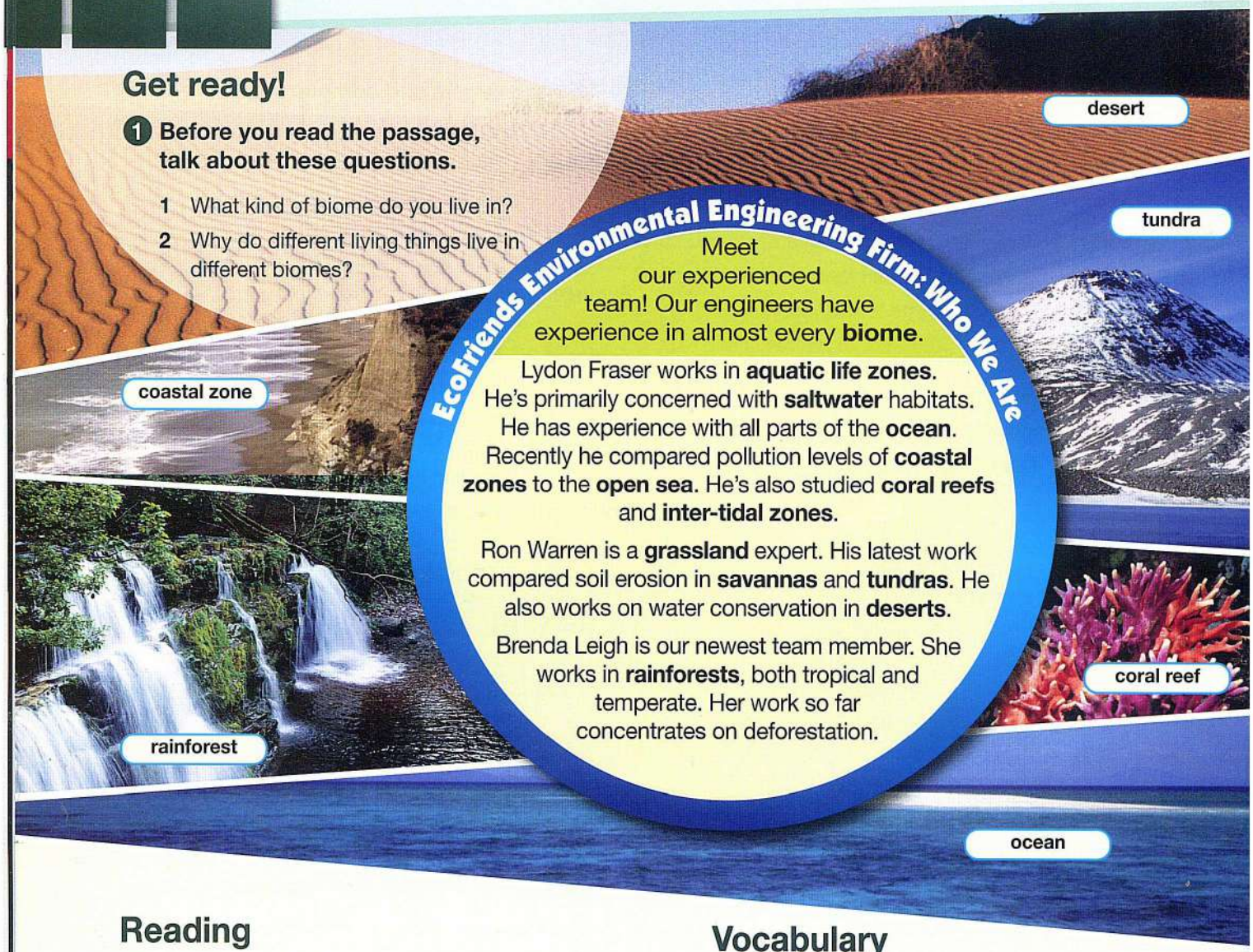
Writing

9 Use the letter to the editor and the conversation from Task 8 to complete the report.

Darby River: Status report

Perch: The population has _____.
This is likely due to the _____.
Herons: We have seen _____.
This is related to _____.

4 Biomes and Aquatic Systems



Get ready!

1 Before you read the passage, talk about these questions.

1 What kind of biome do you live in?
2 Why do different living things live in different biomes?

EcoFriends Environmental Engineering Firm: Who We Are

Meet our experienced team! Our engineers have experience in almost every **biome**.

Lydon Fraser works in **aquatic life zones**. He's primarily concerned with **saltwater** habitats. He has experience with all parts of the **ocean**. Recently he compared pollution levels of **coastal zones** to the **open sea**. He's also studied **coral reefs** and **inter-tidal zones**.

Ron Warren is a **grassland** expert. His latest work compared soil erosion in **savannas** and **tundras**. He also works on water conservation in **deserts**.

Brenda Leigh is our newest team member. She works in **rainforests**, both tropical and temperate. Her work so far concentrates on deforestation.

Reading

2 Read the webpage. Then, choose the correct answers.

1 What is the main purpose of the webpage?
- **A** to provide information about the firm's different locations
- **B** to recruit new customers for an engineering firm
- **C** to introduce members of an engineering firm
- **D** to describe threats to various biomes and aquatic areas

2 Which of the following has Ron Warren NOT worked in?
- **A** a desert
- **B** a rainforest
- **C** a tundra
- **D** a savanna

3 What does the most recently hired employee work on?
- **A** deforestation
- **B** soil erosion
- **C** water conservation
- **D** pollution levels

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ tundra
2 __ ocean
3 __ biome
4 __ desert
5 __ savanna
6 __ grassland
7 __ aquatic life zone
8 __ saltwater

- **A** a warm grassland with distinct wet and dry seasons
- **B** a liquid with high concentrations of salt
- **C** a hot, dry region with little plant life
- **D** a cold grassland, usually covered in snow
- **E** an area in a body of water with a particular set of characteristics
- **F** a large body of water
- **G** a region with abundant grass, but not much other vegetation
- **H** an area of the planet with a specific set of characteristics

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **rainforest / open sea**

A Many primates live in the _____.

B Large mammals, like whales, can live in the _____.

2 **inter-tidal zone / coral reef**

A A(n) _____ is made up of mineral structures and is host to many different species of marine life.

B When the tide is low, many people like to visit the _____ to see the tide pools.

3 **coastal zone / desert**

A In the _____ it is hot and dry.

B Sometimes, dolphins visit the _____ often to the delight of tourists.

5 Listen and read the webpage again. What was the latest work done in aquatic life zones?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ The woman is going to a savanna.

2 __ The woman has been to the area before.

3 __ The woman will work on logging programs.

7 Listen again and complete the conversation.

Engineer 1: Hi Brenda. I heard you got a new **1** _____ _____. Where are you headed?

Engineer 2: Oh yeah, they're sending me to the Fiera **2** _____.

Engineer 1: Really? Wow, that **3** _____ _____.

Engineer 2: I know, **4** _____ _____ _____. I've always wanted to go there.

Engineer 1: What are you going to **5** _____ _____?

Engineer 2: We'll implement more **6** _____ _____ practices.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Where are you headed?

I can't wait.

I'm going to be ...

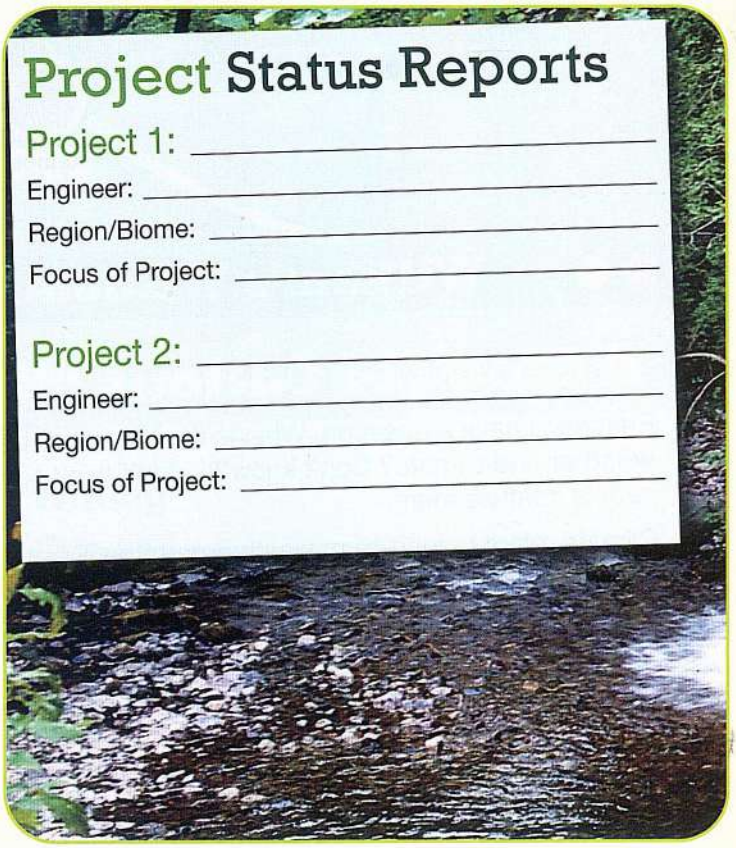
Student A: You are an environmental engineer. Talk to Student B about:

- where his or her next assignment is
- how excited he or she is to go there
- what he or she is going to do there

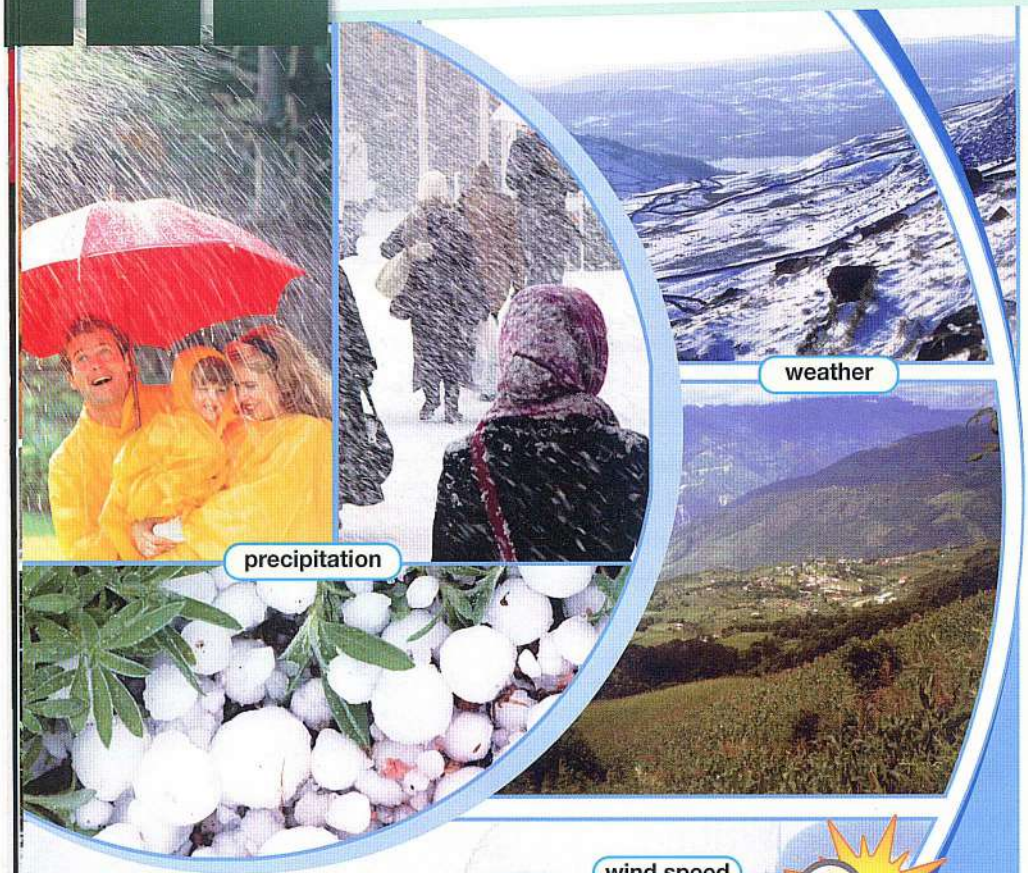
Student B: You are an environmental engineer. Talk to Student A about your new field assignment.

Writing

9 Use the webpage and the conversation from Task 8 to complete the status reports.



5 Weather



William's Wisdom

A Blog for Curious Minds

Readers, I have a question. What is the difference between **weather** and climate? Don't know? I didn't think so. A lot of people confuse them.

Climate refers to long-term weather patterns. Weather refers to **short-term** atmospheric conditions. Both include information about **temperatures** and **moisture** levels. The difference is the time frame.

Still not clear? Think about watching **meteorology** reports on TV. What kind of information do you get? Things like **precipitation**, **cloud cover**, and **wind speed** for the day. You hear about **pressure** and **humidity**. What about when you read about an area's climate? You learn about the average weather conditions of that specific area over many years.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some factors that affect the weather?

2 What are some different forms of precipitation?

Reading

2 Read the blog entry. Then, choose the correct answers.

1 What is the main purpose of the blog entry?

A to describe the difference between climate and weather

B to explain how to understand a meteorology report

C to define changes in climate over time in an area

D to state which factors have the strongest impact on weather

2 How is climate different to weather?

A Climate does not take temperature into account.

B Weather is only concerned with changes in precipitation.

C Climate is long-term and weather is short term.

D Weather does not deal with pressure changes.

3 Which of the following would most likely NOT appear on a weather report?

A current wind speeds

B the expected high temperature

C the amount of precipitation received that day

D the average temperature for the year

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ weather
2 __ pressure
3 __ moisture
4 __ humidity
5 __ temperature
6 __ precipitation
7 __ wind speed
8 __ short-term

A a measure of how hot or cold something is
B a slight amount of liquid that makes something a little damp
C a measure of how quickly air is moving
D water that falls from clouds to the Earth
E condition of the atmosphere during a given point in time
F a measure of the amount of moisture in the air
G the force or weight of air in the atmosphere
H happening for a small period of time

4 Read the sentence pairs. Choose the sentence that uses the underlined part correctly.

1 A The weatherman on channel 5 studied <u>meteorology</u> at college.
B A thermometer measures <u>pressure</u>.

2 A It was so damp today because the <u>wind speed</u> was so high.
B The <u>cloud cover</u> was thick enough to keep it from getting too hot.

3 A The heat wave was only a <u>short-term</u> inconvenience.
B <u>Pressure</u> measures the wind's speed.

5 Listen and read the blog again. What is the main difference between weather and climate?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ The temperature at the site seems high.
2 __ The man is asked to repeat the humidity level.
3 __ The site hasn't had any precipitation for days.

7 Listen again and complete the conversation.

Engineer 1: Hi, Darryl. Could I get the **1** _____ _____ for site 13 from you?
Engineer 2: **2** _____ _____, Holly. Let's see, it's 32 degrees.
Engineer 1: Wait, could **3** _____ _____ _____ please?
Engineer 2: Of course. The **4** _____ here is 32 degrees.
Engineer 1: Wow, **5** _____ _____ for this time of year. Okay, go ahead.
Engineer 2: All right. **6** _____ is sixty five percent. Winds are from the southeast at twenty miles per hour.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Can I get the weather report for ...?
Wait, can you repeat that?
That's ... for this time of year.

Student A: You are an environmental engineer. Talk to Student B about:

- the weather conditions at a site
- a figure you didn't hear
- your reaction to conditions

Student B: You are an environmental engineer. Talk to Student A about a weather report.

Writing

9 Use the conversation from Task 8 to complete the report.

EnviroCorp Weather Report
Site #: _____
Date: _____
Time: _____
Weather conditions: _____
_____
_____

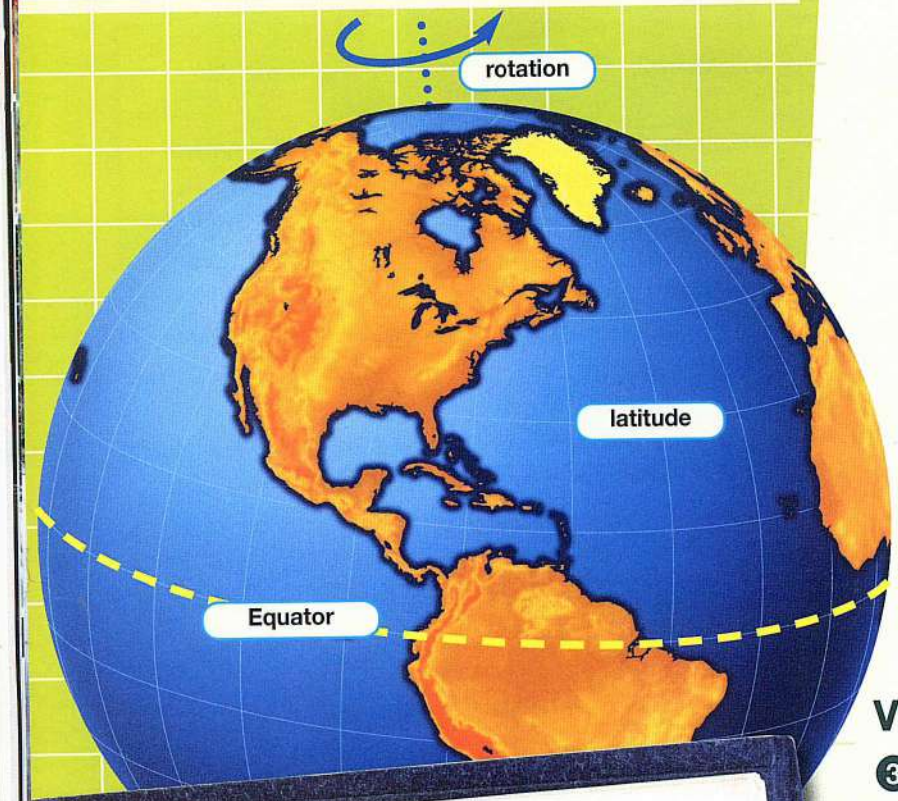
6 Climate

Get ready!

1 Before you read the passage, talk about these questions.

1 What is the climate like where you live?

2 Why should we be concerned about changes in climate?



CHAPTER 10

INTRODUCTION TO CLIMATE

Climate refers to long-term **patterns** in weather. Every region experiences a **range** of weather conditions. Climate tells us what the **average** weather conditions are.

Different regions have different climate. There are several reasons for this. One is **elevation**. Higher areas tend to be cooler and dryer. Another is surrounding **terrain**. Mountain ranges can block air. This impacts the climate on both sides of the mountain. A final factor is **latitude**. Regions nearer the **Equator** are generally warmer. Regions closer to the **poles** are generally colder.

Furthermore, climates change seasonally. This is due to the Earth's **rotation**, primarily. Seasonal changes in ocean **currents** and **prevailing winds** also play a role.

Reading

2 Read the textbook chapter. Then, choose the correct answers.

1 What is the main purpose of the passage?

- **A** to explain how the Earth's rotation influences climate
- **B** to describe the climate of a particular region
- **C** to define what climate is and what affects it
- **D** to give examples of types of climates

2 Which of the following does NOT influence climate?

- **A** a region's distance from the Equator
- **B** the elevation and terrain of an area
- **C** the weather conditions at a given moment
- **D** the changes in ocean currents

3 Which is a way that terrain can influence climate?

- **A** Mountain ranges can block air flow to and from an area.
- **B** Prevailing winds can bring warm air to an area.
- **C** Being closer to the Equator makes regions warmer.
- **D** Ocean currents can bring cold water to an area.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1	__ pole	5	__ climate
2	__ range	6	__ terrain
3	__ Equator	7	__ rotation
4	__ current	8	__ average

- **A** an imaginary line that circles the globe and is equidistant from both poles
- **B** the act of spinning around an axis
- **C** the pattern of weather conditions in an area
- **D** the movement of water in a particular direction
- **E** land with particular characteristics
- **F** having qualities that are typical or most common in a category
- **G** one of two points furthest from the Equator on the globe
- **H** a set of values in a category

4 Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

latitude pattern elevation
prevailing wind climate

1 When things happen the same way over and over again, we can often see a(n) _____.
2 A(n) _____ is the way the wind usually blows in a particular time and place.
3 Somewhere that is close to sea level has a low _____.
4 Many people would like to live in a temperate _____.
5 _____ measures how far places are from the Equator.

5 Listen and read the textbook chapter again. What are some seasonal factors that can affect climate?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ The woman wrote a report on the climate of Gilbert Valley.
2 __ Precipitation levels in Gilbert Valley have gone down.
3 __ Average temperatures in Gilbert Valley increased.

7 Listen again and complete the conversation.

Engineer 1: I can't believe **1** _____ _____ changed that much in just 50 years!
Engineer 2: I know. It's really amazing, **2** _____ _____?
Engineer 1: I'll say! What were **3** _____ _____ differences, again?
Engineer 2: Well, the last five years **4** _____ _____ about 16 inches of precipitation annually. But in the past it was around 30 inches.
Engineer 1: That's a **5** _____ _____.
Engineer 2: I know. And the **6** _____ _____ dropped by five degrees.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

I can't believe ...
They averaged ...
That's a significant ...

Student A: You are an environmental engineer. Talk to Student B about:

- changes in a climate
- the average weather in the past
- the average conditions now

Student B: You are an environmental engineer. Talk to Student A about a change in a climate.

Writing

9 Use the conversation from Task 8 to complete the memo.

ATTN: SIGNIFICANT CLIMATE CHANGE IN GILBERT VALLEY

While monitoring Gilbert Valley I noticed these trends:

_____

_____

_____

_____.

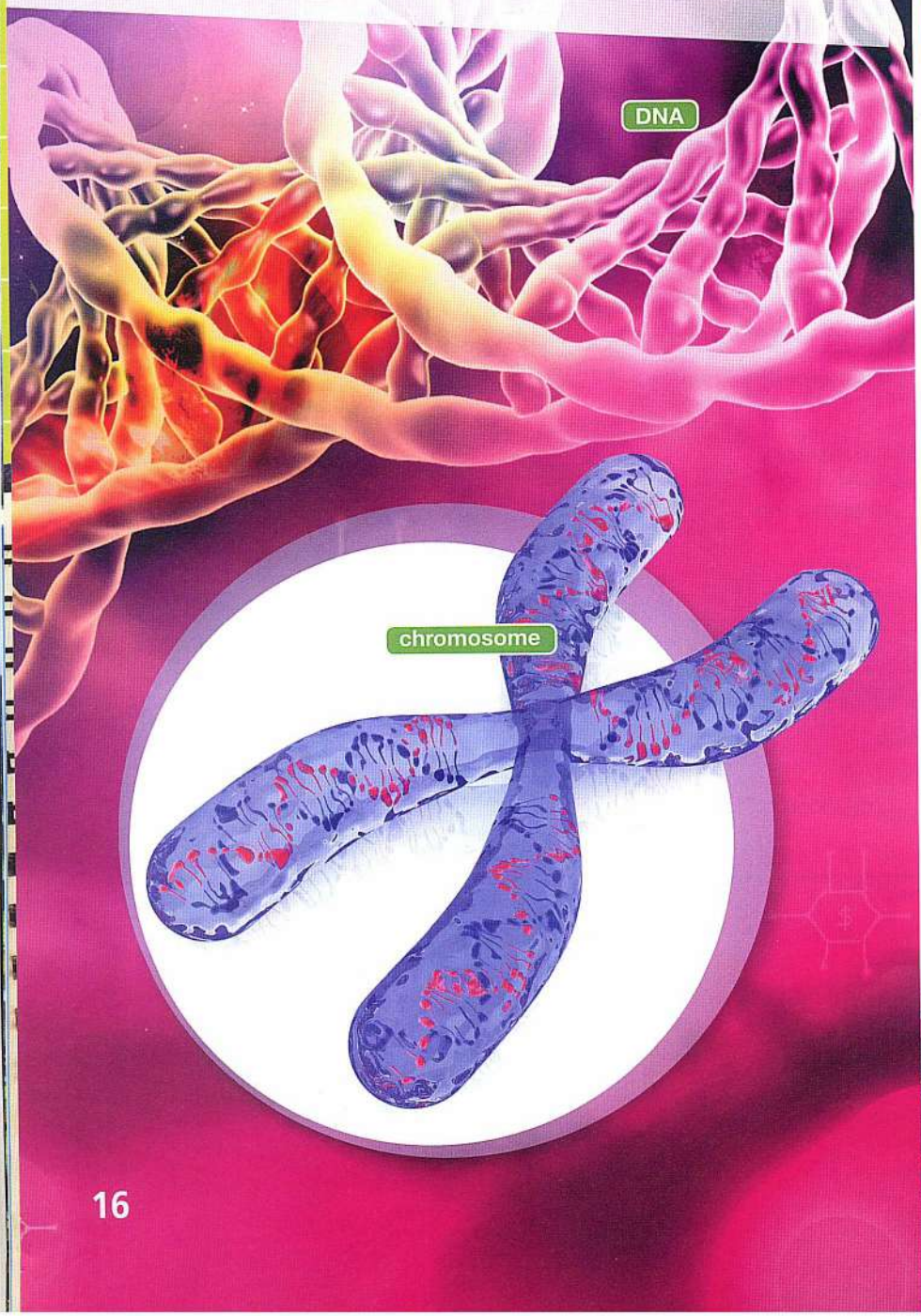
This is significant and we need to research these changes further.

7 Basic Units of Life

The Cell

CHAPTER 7

Cells are the building blocks of life. They hold all of an organism's **genetic information**. This material, called **DNA**, makes us what we are. For example, **genes** are DNA sequences. These genes code for things such as height and hair color. In **multicellular** organisms, the DNA is coiled into **chromosomes**. These reside in the cell's **nucleus**. Cells with a nucleus are called **eukaryotic** cells. Eukaryotic cells also include other membrane bound organelles. These perform various functions. Mitochondria, for example, create energy for the cell. Human cells are eukaryotes. Simpler **unicellular** organisms are **prokaryotic** cells. These cells do not have nuclei. They do, however, still have DNA. Many bacteria are prokaryotes.



Get ready!

1 Before you read the passage, talk about these questions.

1 What are some examples of unicellular and multicellular organisms?

2 Where is genetic information found?

Reading

2 Read the textbook chapter. Then, choose the correct answers.

1 What is the main purpose of the passage?

A to explain the difference between prokaryotic and eukaryotic cells

B to compare human cells to bacteria cells

C to explain what cells are and what's inside of them

D to describe how genes are expressed

2 Which of the following do NOT contain genetic information?

A mitochondria

B DNA molecules

C chromosomes

D nuclei

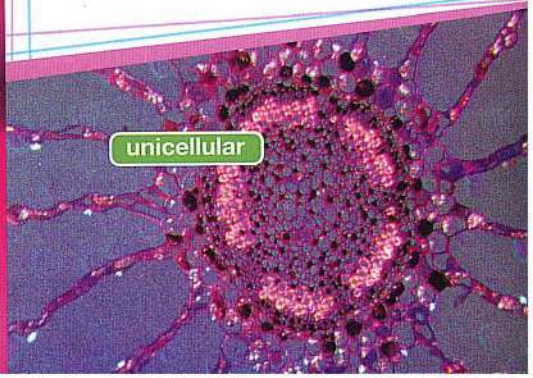
3 What can you infer about prokaryotic cells?

A They have longer chromosomes.

B They do not contain any genes.

C They are unable to produce energy by themselves.

D They store their DNA somewhere other than a nucleus.



Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __ cell
2 __ gene
3 __ DNA
4 __ nucleus
5 __ multicellular
6 __ unicellular
7 __ chromosome
8 __ prokaryotic

A having no nucleus or other membrane bound organelles
B made up of multiple cells
C the smallest unit of life
D the central part of a cell containing its DNA
E made up of one cell
F a piece of coiled DNA
G a sequence of DNA that codes for a particular trait
H the substance that carries genetic information

4 Read the sentences and choose the correct words or phrases.

1 Mammals have **prokaryotic/ eukaryotic** cells.
2 DNA contains **genetic information/nuclei**.
3 People have a specific **gene/cell** for hair color.

5 Listen and read the chapter again. What is the main difference between prokaryotic and eukaryotic cells?

Listening

6 Listen to a conversation between a student and a professor. Mark the following statements as true (T) or false (F).

1 __ The man thinks bacteria are eukaryotic.
2 __ The woman provides examples of unicellular organisms.
3 __ The man cannot think of an example of a prokaryotic cell.

7 Listen again and complete the conversation.

Student: Well, I'm still kind of confused. I don't get the difference between prokaryotic and **1** _____ _____.
Professor: That's **2** _____ _____. Do you remember what kinds of organisms usually have prokaryotic cells?
Student: **3** _____ organisms, like bacteria, right?
Professor: Right. **4** _____ _____ _____ _____, what has eukaryotic cells?
Student: **5** _____ and animals?
Professor: Exactly. So, what does **6** _____ _____?
Student: That prokaryotic cells are less complex than eukaryotic cells.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

I'm still confused about ...
On the other hand ...
Oh yeah, I remember.

Student A: You are a professor. Talk to Student B about:

- prokaryotic cells
- eukaryotic cells
- how the two are different

Student B: You are a student. Talk to Student A about different kinds of cells.

Writing

9 Use the textbook chapter and the conversation from Task 8 to complete the worksheet.

Bio 110
CELLS WORKSHEET
Please compare and contrast prokaryotic cells and eukaryotic cells. Make sure to give an example of each.

_____
_____
_____
_____
_____

cell
nucleus

8 Measurements 1

Get ready!

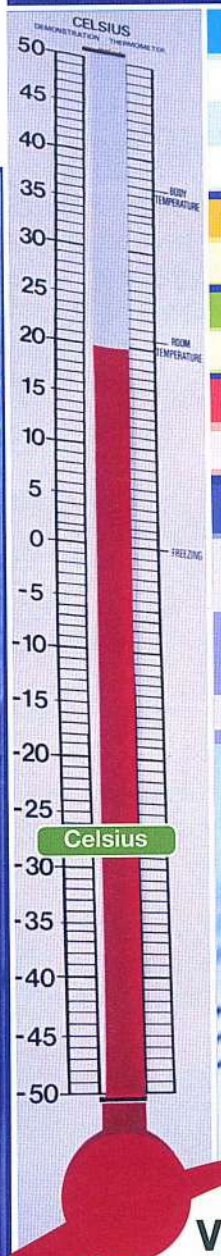
1 Before you read the passage, talk about these questions.

1 What are some different measurement systems?

2 What are examples of units from different measurement systems?

Essential Conversions

The following are conversions that everyone should know. It is often necessary to convert between **metric** and **imperial** measurements.



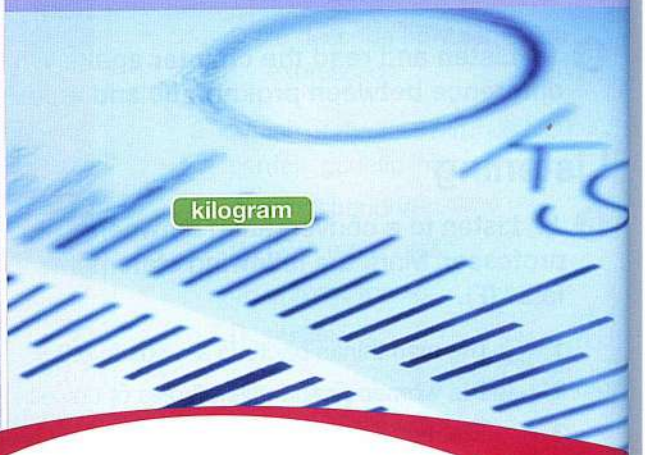
DISTANCE	1 **kilometer** = 0.62 **miles**
	1 mile = 1.61 kilometers
	1 **meter** = 1.09 **yards**
	1 yard = 0.92 meters
AREA	1 **hectare** = 2.47 **acres**
	1 acre = 0.4 hectares
VOLUME	1 **liter** = 0.26 **gallons**
	1 gallon = 3.78 liters
MASS	1 **kilogram** = 2.2 **pounds**
	1 pound = 0.45 kilograms

TEMPERATURE

To convert from **Celsius** to **Fahrenheit**, follow this formula: °F = (°C x 9/5) + 32

To convert from Fahrenheit to Celsius, follow this formula: °C = (°F-32) x 5/9

Thus, 0° C = 32°F



Reading

2 Read the chart. Then, mark the following statements as true (T) or false (F).

1 __ A meter and a mile both measure length.

2 __ A liter is a larger amount than a gallon.

3 __ One pound is the same as about half a kilometer.

Vocabulary

3 Match the words (1-6) with the definitions (A-F).

1	__ kilometer	3	__ hectare	5	__ gallon
2	__ mile	4	__ Celsius	6	__ liter

A a unit of volume used in the imperial system

B a metric measure of distance

C a unit of temperature

D a unit of volume used in the metric system

E a unit of area used in the metric system

F an imperial measure of distance

4 Read the sentence pairs. Choose which word best fits each blank.

1 **kilograms / acres**

A This field is 3.5 _____.

B The box weighs two _____.

2 **meter / yard**

A A _____ is an imperial measurement.

B A _____ is a metric measurement.

3 **imperial / metric**

A The system that uses the mile and gallon is the _____ system.

B The _____ system uses the kilometer and liter.

4 **Fahrenheit / hectares**

A To measure an area, you can use _____.

B To measure a temperature, you can use degrees _____.

5 Listen and read the chart again. How can you convert kilometers to miles?

Listening

6 Listen to a conversation between two environmental engineers. Choose the correct answers.

1 What is the conversation mainly about?

A an error in a measurement conversion

B which measurement system to use

C the size of a contaminated site

D the best way to measure a site

2 What will the man most likely do next?

A convert the measurement to metric units

B measure the volume of the contaminant

C correct the error in his conversion

D take a measurement of the area's temperature

7 Listen again and complete the conversation.

Engineer 1: Hi, Jim. We've finished **1** _____ the site.

Engineer 2: Oh great! What did you **2** _____ _____ _____?

Engineer 1: The contamination covers a **3** _____ _____. It's thirty-five miles by twelve miles.

Engineer 2: That's **4** _____ _____ I thought. So what's the area, then?

Engineer 1: It's 268,800 **5** _____.

Engineer 2: Okay. Thanks for doing that. Could you get that in **6** _____ _____ _____, too?

Engineer 1: Oh sure, of course. It's a simple conversion. I'll get right on it.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

We finished measuring ...

What is the area?

Could you get that in ... too?

Student A: You are an environmental engineer. Talk to Student B about:

- the measurements of a site
- which measurements to use
- how to convert the measurements

Student B: You are a student. Talk to Student A about the measurements of a site.

Writing

9 Use the chart and conversation from Task 8 to complete the table.

Important conversions

Weight: 1 _____ = _____

Distance: 1 _____ = _____

Volume: 1 _____ = _____

9 Basic Numbers and Math

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some common mathematical operations?

2 What kinds of things would environmental engineers need to use math for?

Reading

2 Read the chart. Then, mark the following statements as true (T) or false (F).

1 __ Ten minus four is fourteen.

2 __ Fifteen divided by three equals five.

3 __ Two times six comes to twelve.

Vocabulary

3 Place the words or phrases from the word bank under the correct headings.

word BANK

subtract multiplied by less
times add minus plus

+	x	–

How do we say it?

Symbol	In words	Example
=	is, **equals**, comes to	0.125 = 1/8 Point one two five equals one eighth.
+	and, **plus, add**	5 + 3 = 8 Five plus three equals eight.
–	**minus, less, subtract**	5 – 3 = 2 Five minus three is two.
x, *	**times, multiplied by**	5 x 3 = 15 Five times three comes to fifteen.
÷, /	**over, divided by**	10 / 2 = 5 Ten over two is five.
2500	two thousand five hundred or twenty-five **hundred**	The pond holds twen five hundred liters of water.

4 Read the sentences and choose the correct words or phrases.

1 Twenty **multiplied by/divided by** four is five.
2 Nine minus five **equals/subtract** four.
3 Eleven **plus/hundred** is the same as one thousand one hundred.
4 Sixteen **over/times** four is four.
5 Seven plus three **comes to/less** ten.

5 Listen and read the chart again. What are the different ways to say to take one number away from another?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ The man and woman need to visit twenty sites this month.
2 __ The speakers missed visits to several sites last month.
3 __ The speakers should visit four sites a week.

7 Listen again and complete the conversation.

Engineer 1: Hey, Julie, **1** _____ _____ sites do we have to visit this month?
Engineer 2: **2** _____ _____ sixteen.
Engineer 1: Don't forget to add the ones we missed **3** _____ _____.
Engineer 2: Oh, yeah. There were four we **4** _____ _____ _____. Sixteen plus four is twenty.
Engineer 1: Okay, there are **5** _____ _____ in the month. So how many do we need to get to each week?
Engineer 2: Let's see. Twenty **6** _____ _____ four equals five sites a week.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

How many sites do we need to visit?
Don't forget to add ...
... plus ... equals ...

Student A: You are an environmental engineer. Talk to Student B about:

- how many sites you need to visit this month
- how many sites you missed last month
- adding the two together

Student B: You are an environmental engineer. Talk to Student A about the number of sites you need to visit.

Writing

9 Use the conversation from Task 8 to complete the email.

To: Julie.K@WesleyEngineering.com
From: James.R@WesleyEngineering.com
Subject: Visits this month

Hi Julie,

Here's a recap of what we talked about today regarding the number of sites we need to visit this month: _____

_____

_____

_____

_____

10 Measurements 2

Get ready!

1 Before you read the passage, talk about these questions.

1 What are base units of the SI system?

2 Why are there different ways to measure the same property or substance?

Reading

2 Read the employee guide. Then, choose the correct answers.

1 What is the main purpose of the guide?

A to define base units and derived units

B to introduce different units and when to use them

C to explain how to measure concentrations

D to demonstrate the superiority of SI

2 Which of the following is NOT a base unit?

A a mole **B** a meter **C** Kelvin **D** a concentration

3 Which is used to measure amount?

A square meters **B** moles **C** cubic meters **D** kg/m³

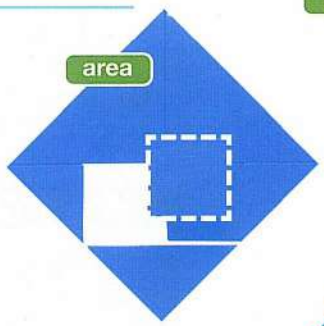
EnviroLab Employee Guide:

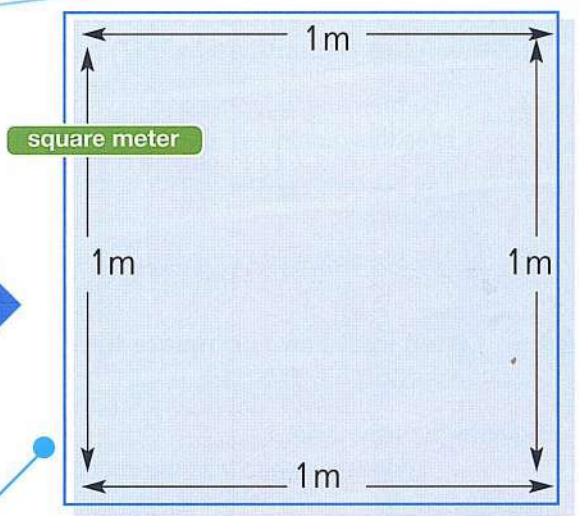
Measurements

Here at EnviroLab, we use **SI** for official purposes. SI is based on **base units**. From these, we get **derived units**. A meter is a base unit. When we measure **area**, we use **square meters**. When we measure **volume**, we use **cubic meters**. These are derived from the base unit of a meter.

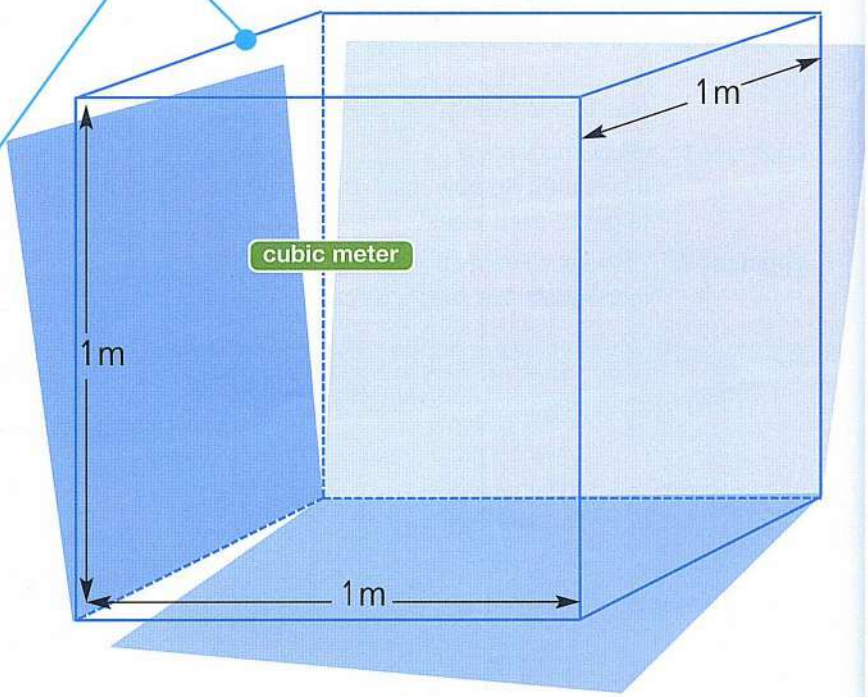
Here are some more examples.

Degrees **Kelvin** is the base unit for **thermodynamic temperature**. A **mole** is the base unit for measuring **amount**. There are different units for **concentrations**. For example, kg/m³ is the SI unit of mass concentration.





base unit



Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ SI
2 __ volume
3 __ mole
4 __ area
5 __ base unit
6 __ derived unit
7 __ cubic meter
8 __ square meter

A a unit that describes the amount of space of an area one meter by one meter
B a measure of how much three dimensional space something occupies
C a unit that measures the amount of a substance expressed in grams
D an abbreviation for the SI units
E a unit from which other units are derived
F a unit of volume that is equal to a cube with sides of one meter
G a unit that is calculated from a base unit
H a measure of how much two dimensional space something occupies

4 Read the sentences and choose the correct words or phrases.

1 The base unit of temperature is **mole/Kelvin**.
2 An absolute measure of how warm or cold something is, is called **thermodynamic temperature/volume**.
3 A mole measures the **area/amount** of something.
4 If you need to know how much of a substance is dissolved in a solution, you need to measure its **concentration/base unit**.

5 Listen and read the guide again. What are the derived units of a meter?

Listening

6 Listen to a conversation between an environmental engineer and an assistant. Mark the following statements as true (T) or false (F).

1 __ The man obtained the water sample from the surface of the pond.
2 __ The man recorded the temperature in the wrong temperature scale.
3 __ The woman asked for a new sample.

7 Listen again and complete the conversation.

Engineer: Did you get the **1** _____ _____ I asked for?
Assistant: Yes. I obtained 0.5 **2** _____ _____ from Grenville Pond. I have all the data right here.
Engineer: Great, thanks. Was that straight from **3** _____ _____?
Assistant: Yes, and the **4** _____ was 15.6 degrees.
Engineer: 15.6? Wait, is that in Celsius? I need it **5** _____ _____.
Assistant: Oh, I'm sorry. Let me see, how **6** _____ _____ _____ that again?

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Did you get the water sample?
Is that in ...?
I need it in ...

Student A: You are an environmental engineer. Talk to Student B about:
- data from a water sample
- what unit he or she used
- how to convert to the unit you need

Student B: You are an assistant. Talk to Student A about a water sample.

Writing

9 Use the conversation from Task 8 to complete the report.

Water sample report: Grenville Pond

I obtained _____.
The temperature was _____.
I converted to _____ by _____.
This came out to _____.

11 Tables and Graphs

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some different kinds of tables and graphs?

2 Why are tables and graphs useful?

Reading

2 Read the email. Then, choose the correct answers.

1 What is the main purpose of the email?

A to explain what information to remove from graphs and charts

B to provide data to be placed in graphs and charts

C to ask for changes to several graphs and charts

D to offer feedback on a presentation using charts and graphs

2 Which of the following is NOT requested?

A change the bar graph to a pie chart

B add a row to the table

C label the x axis of the line graph

D add a legend to the scatter plot

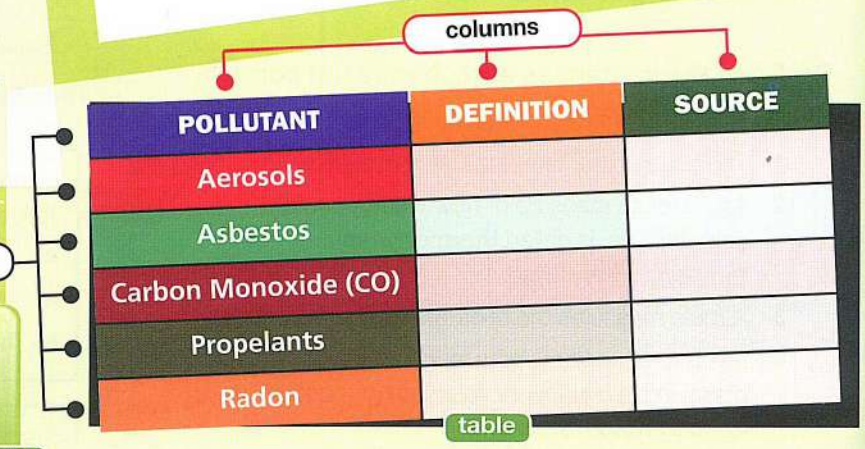
3 Why does the woman want a pie chart?

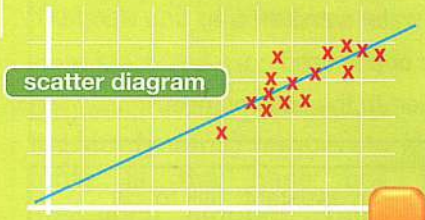
A The bar graph is unclear.

B More data will fit on the pie chart.

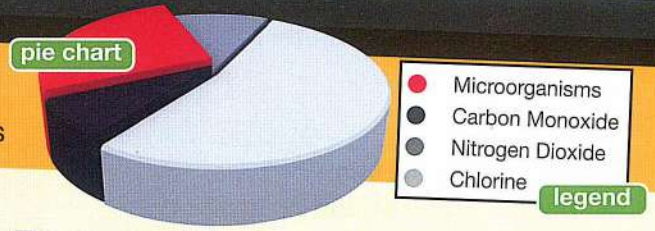
C Pie charts are easier to create.

D The bar graph doesn't have enough detail.





TO: n_hutter@globalsolutions.com
FROM: p_erickson@globalsolutions.com
Subj: Changes needed for charts/graphs



Hi Nelson,

Thank you for making all those charts for me. The **scatter diagram** for the soil data looks great. Excellent job on that one! Some need a few changes, though. The water pollutant **table** is missing information. Please make a **row** for mercury. Also add a **column** for percentages. The soil composition **bar graph** looks nice, but it's a little unclear. Can you change it to a **pie chart**? I think that will make more sense. Also, the **line graph** about the bird population needs more detail. Please label the **x-axis** and the **y-axis**. Oh, and add a **legend** to the pie chart.

Thanks again for your help.
Phoebe Erickson

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ table
2 __ row
3 __ column
4 __ legend
5 __ line graph
6 __ scatter diagram
7 __ pie chart
8 __ x-axis

A a chart that uses a circle to show proportions of a whole
B a visual representation of data with rows and columns
C a horizontal section of data in a table
D a part of a graph or chart that tells how to read it
E the horizontal axis
F a vertical section of data in a table
G a chart that connects data points with a straight line
H a chart that shows data points on a graph not connected

4 Write a word or phrase that is similar in meaning to the underlined part.

1 The values along the <u>vertical side of the graph</u> represent the number of trees in the forest. _ - _ x _ s
2 The <u>chart with all the bars</u> gives information about a fish population over time. b _ _ _ r _ p _
3 If you can't understand the chart, look at the <u>box in the corner that has instructions in it</u>. _ e _ e _ d

5 Listen and read the email again. Which chart doesn't need to be changed?

Listening

6 Listen to a conversation between an engineer and an assistant. Mark the following statements as true (T) or false (F).

1 __ The man added rows and columns to a table.
2 __ The man incorrectly labeled the x and y-axes.
3 __ The woman wants more data in the pie chart.

7 Listen again and complete the conversation.

Assistant: I added the rows **1** _____ _____ you needed to the table.
Engineer: Great, that **2** _____ _____. What else?
Assistant: I did the pie chart and labeled the axes on the **3** _____ _____.
Engineer: You did, but, look, you labeled them backwards. **4** _____ _____ _____ should be the dates.
Assistant: Oh, sorry, I totally **5** _____ _____!
Engineer: That's all right. It's an **6** _____ _____.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

I added the ...
Look, you ...
The ... should be ...

Student A: You are an assistant. Talk to Student B about:

- changes you made to a chart
- a mistake you made
- correcting the mistake

Student B: You are an environmental engineer. Talk to Student A about a chart.

Writing

9 Use the email and the conversation from Task 8 to complete the email.

TO: d_darr@globalsolutions.com
FROM: e_brosam@globalsolutions.com
Subj: Changes needed for charts/graphs

Hi David,

Please make the following changes to the charts you made: _____

_____

_____

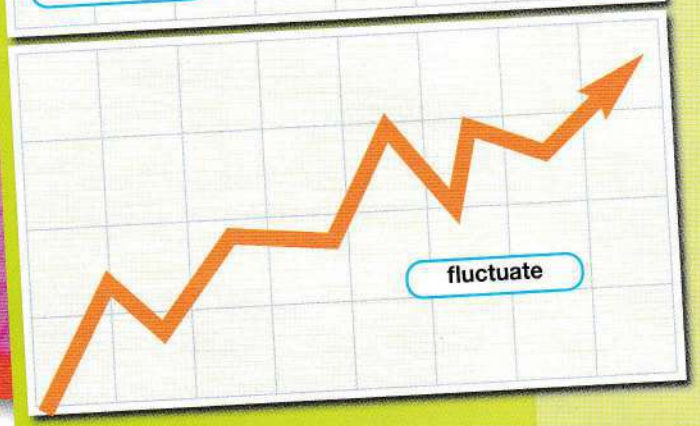
_____

_____.

Thanks again!

Eric

12 Describing Change



CFCs:

Then and Now

In the 1970s, scientists found a hole in the ozone layer. Researchers connected a **rise** in the use of CFCs (chlorofluorocarbons) to the ozone hole. Still, CFC use **skyrocketed** during the 1980s. The hole was **expanding**. Researchers' concern **increased**. In 1987, the Montreal Protocol passed. CFC production **plummeted** as a result. In turn, the hole **stabilized**. It eventually began to **shrink**.

This is good news, but the story isn't over yet. We have seen a **decline** in CFC use, however the size of the ozone hole still **fluctuates**. People still need to **decrease** their CFC use.

Get ready!

❶ Before you read the passage, talk about these questions.

1 What are some ways to talk about change?

2 Do you think the environment is changing positively or negatively? Why?

Reading

❷ Read the article. Then, mark the following statements as true (T) or false (F).

1 __ CFC use was higher in the 1980s than the 1970s.

2 __ CFC use has gone down since the Montreal Protocol passed.

3 __ The size of the ozone hole is shrinking steadily.

Vocabulary

❸ Match the words (1-6) with the definitions (A-F).

1 __ rise		4 __ shrink	
2 __ decline		5 __ plummet	
3 __ expand		6 __ skyrocket	

A to go very high very rapidly

B an upward trend

C to get smaller in size

D to grow larger in size

E to go very low very quickly

F a downward trend

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **fluctuate / shrink**

A As development continues, the animals' habitat will _____.

B During this time of change, I expect values will _____ until they reach a level of stability.

2 **stabilize / increase**

A Pollution levels will continue to _____ until we put more restrictions in place.

B The numbers of fish in the pond will _____ once they recover from this setback.

3 **plummet / decrease**

A The fire caused deer population numbers to _____ last summer.

B I hope that recycling will _____ the amount of trash we produce.

5 **Listen and read the article again. Why is CFC use still a concern?**

Listening

6 **Listen to a conversation between a city official and an environmental engineer. Choose the correct answers.**

1 What is the conversation mainly about?

A changes in recycling following a new program

B how to get people to recycle more often

C what kinds of waste are most problematic

D how to get a recycling program started

2 What does the woman say about paper waste?

A It is fluctuating.

B It increased slightly.

C It declined recently.

D It skyrocketed this year.

7 **Listen again and complete the conversation.**

City Official: Hi Jan, thanks **1** _____ _____ with me.

Engineer: Of course Mr. Paulson. I'm excited about the **2** _____ _____ progress.

City Official: That's great. What can you **3** _____ _____ about it?

Engineer: Recycling increased **4** _____ _____ since it started.

City Official: Wow, that's impressive! Are there any other **5** _____ _____ ?

Engineer: Yes. There is a decline in **6** _____ _____ at the landfills.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Recycling increased ...

Wow, that's great!

Are there any other ...?

Student A: You are a city official. Talk to Student B about:

- a new recycling program
- increase in recycling
- other positive changes

Student B: You are an environmental engineer. Talk to Student A about a recycling program.

Writing

9 **Use the conversation from Task 8 to complete the report.**

Wilson County Recycling Program Update

Since we implemented the program, we have seen the following changes:

_____

_____.

Thanks to all for your cooperation.

Jan Richards

13 Presentations

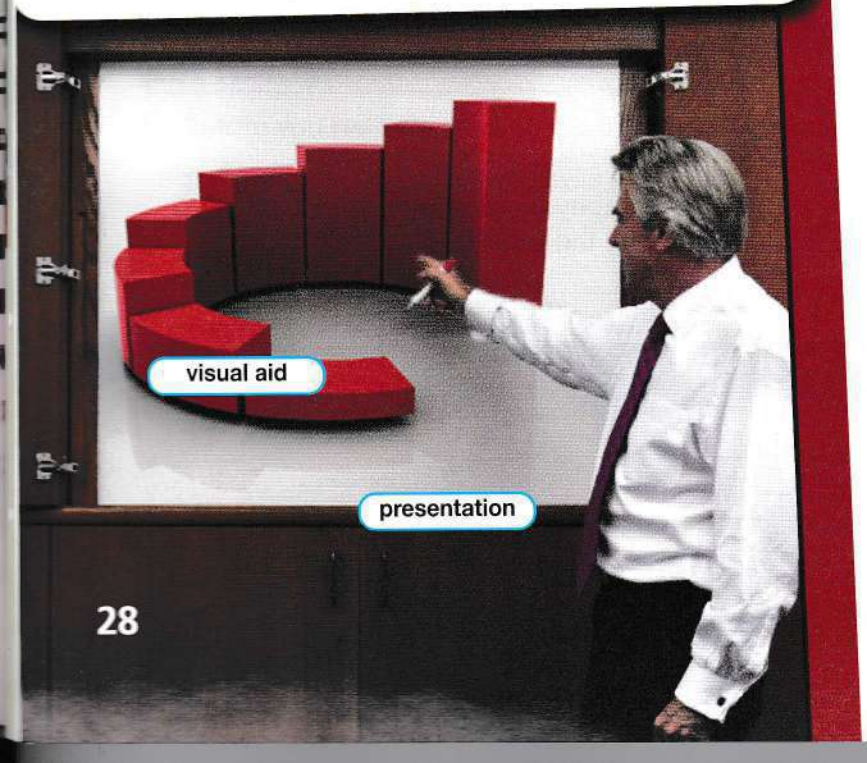
Carol,

You asked me to **review** your latest **presentation**. Here are my notes.

- Your **body language** was great. You maintained excellent **eye contact**. You looked confident throughout. Also, you **projected** your voice well.
- Your **handouts** were helpful. They made a nice addition to the presentation.
- The **visual aids** had some problems. For example, the chart on soil erosion was redundant. You gave that information in the handout.
- Sometimes it seemed that you lost your train of thought. Consider **signposting** so your audience knows exactly where you're going. **Cue cards** can also help if you find yourself lost.

To **summarize**, the presentation was fairly strong. Your visual aids and organization are your two weak points.

Best,
Tim



Get ready!

1 Before you read the passage, talk about these questions.

1 What are some tips for giving a presentation?
2 When have you had to give presentations?

Reading

2 Read the letter. Then, choose the correct answers.

1 What is the main purpose of the letter?
- **A** to provide feedback on a presentation
- **B** to explain company procedures for presentations
- **C** to suggest a topic for a presentation
- **D** to give an outline for an upcoming presentation

2 Which of the following is NOT a strength of the presenter?
- **A** her eye contact
- **B** her handouts
- **C** her visual aids
- **D** her voice

3 Why should the woman consider signposting?
- **A** It can help her maintain better eye contact.
- **B** It would replace the need for visual aids.
- **C** It can make her more confident.
- **D** It would help her be more organized.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ review
2 __ project
3 __ presentation
4 __ summarize
5 __ signpost
6 __ handout
7 __ visual aid
8 __ eye contact

- **A** the act of looking someone in the eyes
- **B** to go over carefully and provide feedback
- **C** to briefly recap important points of something
- **D** to guide listeners through a speech
- **E** a tool distributed to an audience to support a presentation
- **F** to speak loudly and clearly
- **G** a speech given to an audience
- **H** a graphical element of a presentation to support the information

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **body language / visual aid**

A The poster was a great _____ for her presentation.

B He needs to work on his _____. He kept fidgeting and playing with his notes.

2 **project / summarize**

A This presentation will _____ all the data that I have collected over the past two years.

B People would be able to hear you better if you would _____ your voice.

3 **cue cards / handouts**

A Can you distribute these _____ for me, please?

B Don't be afraid to use _____ to help you keep your pace.

5 Listen and read the letter again. What was wrong with the visual aids?

Listening

6 Listen to a conversation between an environmental engineer and a supervisor. Mark the following statements as true (T) or false (F).

1 __ The woman needed to work on her body language.

2 __ The man is most impressed with the woman's visual aids.

3 __ The woman still needs to work on her organization skills.

7 Listen again and complete the conversation.

Engineer: Hi, Tim. How do you think I did on **1** _____ _____?

Supervisor: You showed a lot **2** _____ _____.

Engineer: Thanks. I tried to work on my **3** _____ _____.

Supervisor: It shows. I'm impressed, especially with **4** _____ _____.

Engineer: Thank you. I know that was one of **5** _____ _____ before.

Supervisor: Yes, and you overcame it beautifully in this presentation. **6** _____ _____. You see how it led the way?

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

You showed a lot of improvement!

I'm impressed with ...

Great ...

Student A: You are an environmental engineer. Talk to Student B about:

- your latest presentation
- how you improved
- specific things you worked on

Student B: You are a supervisor. Talk to Student A about his or her latest presentation.

Writing

9 Use the conversation from Task 8 to complete the report.

Notes from presentation:

Kate,

Here are my notes from this morning's presentation.

_____

_____

_____.

Overall, great job!

Tom

14 Properties of Matter

Get ready!

1 Before you read the passage, talk about these questions.

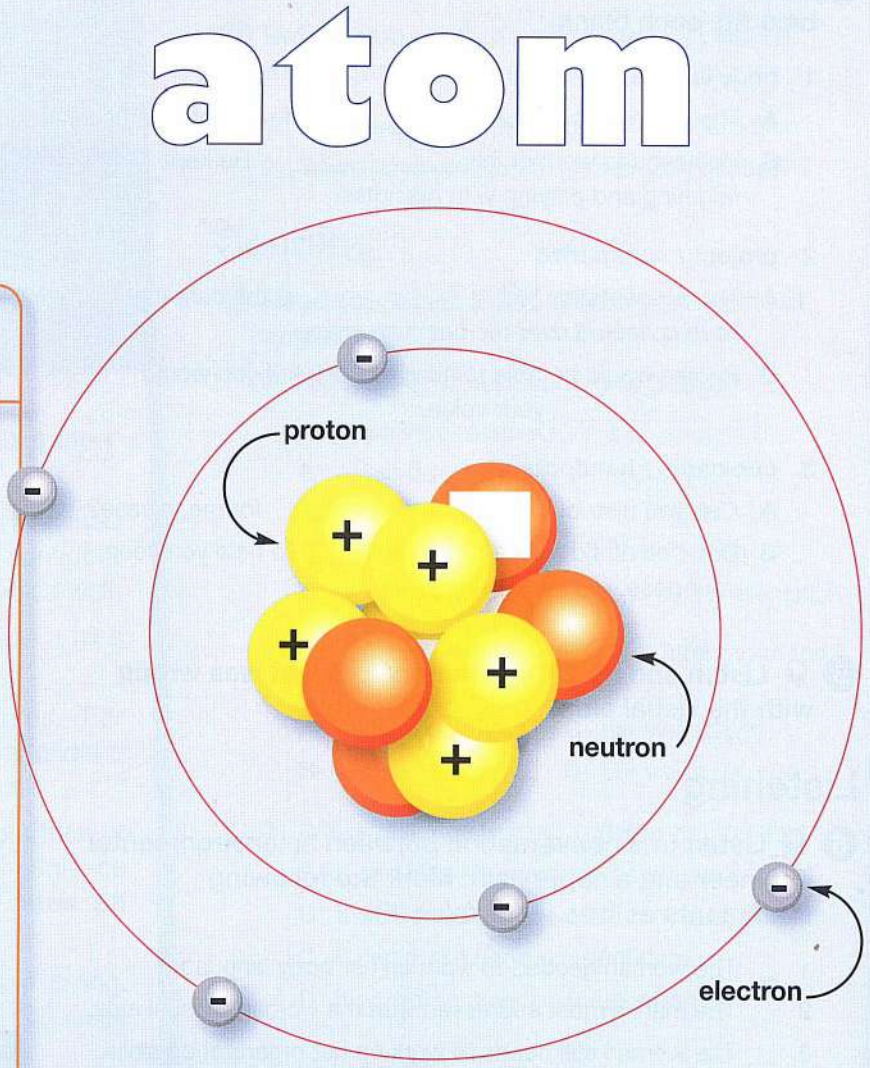
1 What are the basic components of matter?

2 What are some common compounds?

THE WATER MOLECULE

All **matter** is made from the same basic materials. For example, water is one of the most important **compounds** on Earth. Water **molecules** are made up of two **elements**: hydrogen and oxygen. There are two hydrogen **atoms** and one oxygen atom in every water molecule.

The atomic number is the total number of protons of an atom. Hydrogen's **atomic number** is one. This means it has one **proton** and one **electron**. If an electron were absent, it would be an **ion**. The **mass number** includes the number of **neutrons** as well as protons. Oxygen atoms have eight protons and eight electrons, therefore its atomic number is eight.



Reading

2 Read the textbook chapter. Then, mark the following statements as true (T) or false (F).

1 __ Hydrogen atoms have more electrons than oxygen atoms.

2 __ The mass number of oxygen is eight.

3 __ There are two oxygen atoms and one hydrogen atom in a water molecule.

Vocabulary

3 Match the words (1-8) with the definitions (A-H).

1 __	matter	4 __	element	7 __	neutron
2 __	atom	5 __	compound	8 __	electron
3 __	ion	6 __	proton		

A a neutral particle in an atom

B a positively or negatively charged atom

C a combination of two or more elements

D the smallest piece of matter that can exist by itself

E anything that contains material and takes up space

F a negatively charged particle in an atom

G a basic substance made up of one type of atom

H a positively charged particle in an atom

4 Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

atomic number molecule ion
mass number element matter

1 The _____ measures how many protons and neutrons are in an element.
2 _____ is anything that occupies space and has mass.
3 If an atom has become electrically charged, we call it a(n) _____.
4 The _____ tells how many protons are in an atom.
5 If something is a(n) _____ it can be found on the periodic table.
6 A(n) _____ can have more than one type of atom in it.

5 Listen and read the chapter again. What is the difference between the atomic and mass number of an atom?

Listening

6 Listen to a conversation between a student and a professor. Choose the correct answers.

1 What is the conversation mainly about?
A the difference between hydrogen and helium
B what makes up a water molecule
C how to understand scientific formulas
D how to classify different elements

2 What are the speakers going to do next?
A discuss the structure of oxygen atoms
B review the elements in table salt
C learn about a new element
D talk about other properties of water

7 Listen again and complete the conversation.

Professor: Let's go over it again. What are the **1** _____ _____ in water?
Student: Oxygen and helium? No, wait, I mean oxygen **2** _____ _____.
Professor: There you go! Now how many atoms of each element does a **3** _____ _____ contain?
Student: Let's see. Two **4** _____ _____ and one hydrogen atom?
Professor: Not quite. Remember the **5** _____ H_2O?
Student: Oh yeah, I forgot. So it's two **6** _____ _____ and one oxygen atom.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

No wait, I mean ...
How many atoms of each ...?
Do you remember the formula ...?

Student A: You are a professor. Talk to Student B about:
- the structure of a water molecule
- a mistake he or she makes
- what to work on

Student B: You are a student. Talk to Student A about the structure of a water molecule.

Writing

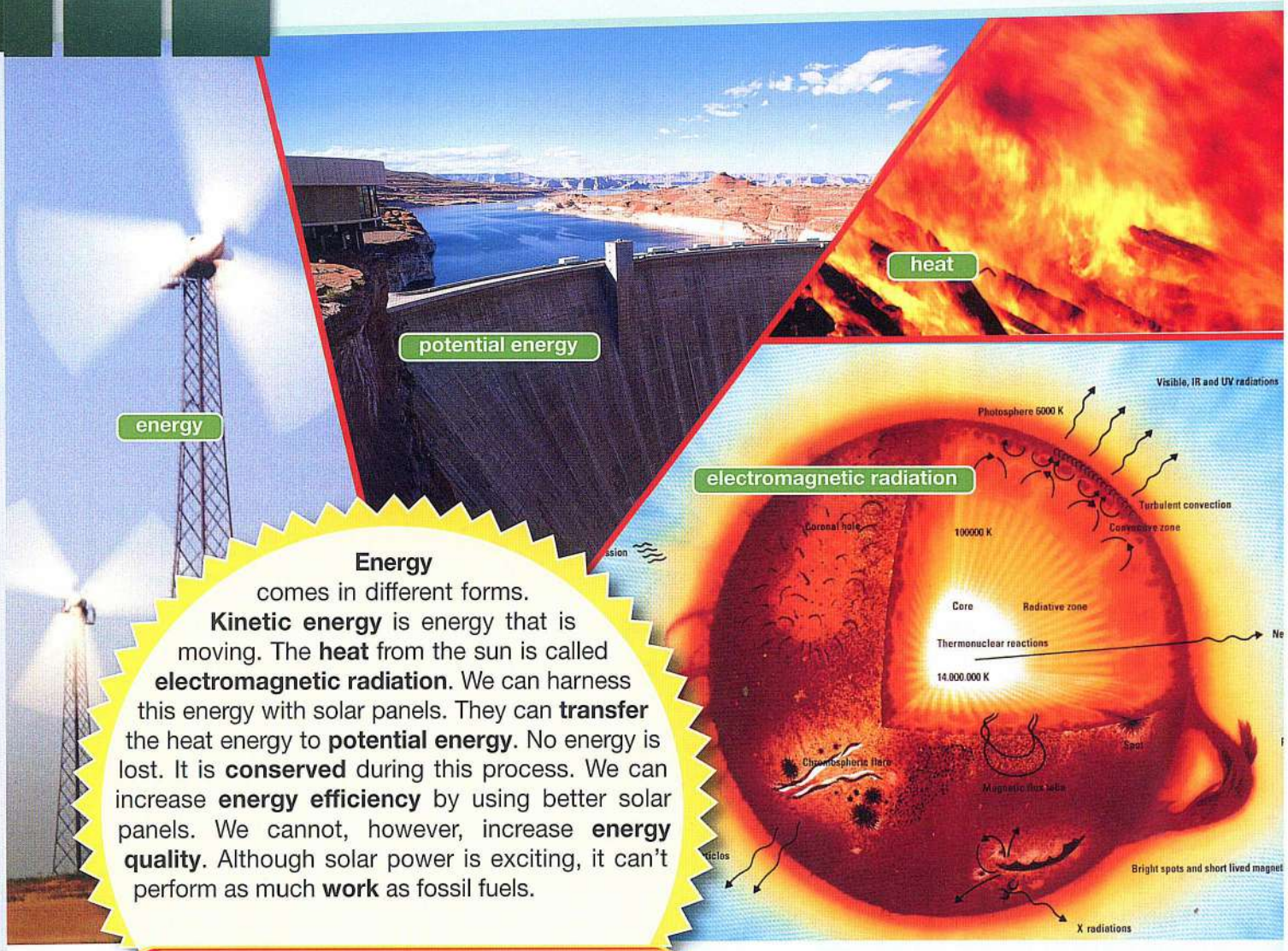
9 Use the conversation from Task 8 to complete the homework assignment.

homework assignment

Chem 101

Describe a water molecule: _____
_____
_____
_____.

15 Energy



Energy comes in different forms. **Kinetic energy** is energy that is moving. The **heat** from the sun is called **electromagnetic radiation**. We can harness this energy with solar panels. They can **transfer** the heat energy to **potential energy**. No energy is lost. It is **conserved** during this process. We can increase **energy efficiency** by using better solar panels. We cannot, however, increase **energy quality**. Although solar power is exciting, it can't perform as much **work** as fossil fuels.

Sustainable Living Energy

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some different sources of energy?
2 What is the difference between kinetic energy and potential energy?

Reading

2 Read the information excerpt. Then, mark the following statements as true (T) or false (F).

1 __ Electromagnetic radiation is potential energy.
2 __ A windmill turning would be an example of kinetic energy.
3 __ Energy can be converted from potential to kinetic and back again.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ energy
2 __ transfer
3 __ conserve
4 __ work
5 __ kinetic energy
6 __ heat
7 __ potential energy
8 __ energy efficiency

A energy that is not moving
B energy that is moving
C action or movement caused by energy
D a measure of how much energy is required to do work without wasting a lot of it
E to move from one place to another
F the ability to cause movement or action or produce heat
G to use a little or none of something so it will last longer
H a form of energy that produces high temperatures

4 Choose the sentence that uses the underlined part correctly.

1 **A** The sun gives out <u>electromagnetic</u> radiation.
B Many people try to <u>transfer</u> energy so we use less.

2 **A** Gasoline in a gas can has <u>kinetic energy</u>.
B A measurement of an energy's potential to do useful work is <u>energy quality</u>.

3 **A** A fire gives off <u>heat</u>.
B When you cook, heat from the stove is <u>conserved</u> to the pot.

5 Listen and read the excerpt again. How can we conserve energy?

Listening

6 Listen to a conversation between an environmental engineer and a city official. Choose the correct answers.

1 What is the conversation mainly about?
A the difference between potential and kinetic energy
B why the city should build a hydroelectric dam
C how a hydroelectric dam works
D the benefits of hydroelectric power

2 What is the last step of the process the speakers discuss?
A The water is stored.
B The generator creates electricity.
C The water flows through the dam.
D The water turns a turbine.

7 Listen again and complete the conversation.

City Official: How exactly **1** _____ _____ _____?
Engineer: Well, here's the basic idea. **2** _____ _____ is converted into kinetic energy.
City Official: How does **3** _____ _____?
Engineer: The potential energy of water in a reservoir **4** _____ _____ when it flows through the dam.
City Official: Okay, then what?
Engineer: The kinetic energy of the **5** _____ _____ turns a turbine. The turbine then turns a generator, which **6** _____ _____.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Well, here's the basic idea.
The ... becomes ... when ...
The ... creates more energy.

Student A: You are an environmental engineer. Talk to Student B about:

- a hydroelectric dam
- potential energy
- kinetic energy

Student B: You are a city official. Talk to Student A about a hydroelectric dam.

Writing

9 Use the conversation from Task 8 to complete the email.

To: David.P@CityofLakeshore.gov
From: Lauren.G@HydroSystems.com
Subject: Hydroelectric dams

Mr. Park,

As you requested, I'm sending you a basic overview of how hydroelectric dams work.

_____
_____
_____
_____
_____.

I hope you will consider building one for the city's energy needs.

Respectfully,

Lauren

Glossary

abiotic [ADJ-U3] If something is **abiotic**, it is not a living thing.

acre [N-COUNT-U8] An **acre** is an imperial unit of area equal to about 0.002 square miles or about 0.40 hectares.

add [V-T-U9] To **add** a number to another number is to increase it by that amount.

advise [V-T-U1] To **advise** is to give an expert opinion about something.

amount [N-COUNT-U10] An **amount** is a quantity of something.

apply [V-T-U1] To **apply** something is to use it for a particular purpose.

aquatic life zone [N-COUNT-U4] An **aquatic life zone** is an area in a body of water with a particular set of characteristics.

area [N-COUNT-U10] An **area** is a measure of how much two-dimensional space something occupies.

atmosphere [N-COUNT-U2] The **atmosphere** is the thin layer of air around the Earth.

atom [N-COUNT-U14] An **atom** is the smallest piece of matter that can exist by itself.

atomic number [N-COUNT-U14] An **atomic number** is a measure of the number of protons in an atom, and is used to identify atoms from different elements.

average [ADJ-U6] If something is **average**, it has qualities that are typical or most common in a particular group or category.

bar graph [N-COUNT-U11] A **bar graph** is a graph in which the heights of different bars represent differing frequencies of particular variables.

base unit [N-COUNT-U10] A **base unit** is a basic unit of measurement from which all other units are obtained.

biome [N-COUNT-U4] A **biome** is an area of the planet with a particular set of characteristics, including levels of temperature and precipitation.

biosphere [N-COUNT-U2] The **biosphere** is all of the living organisms on the Earth.

biotic [ADJ-U3] If something is **biotic**, it is a living thing.

body language [N-UNCOUNT-U13] **Body language** is any kind of communication that is not expressed verbally, including posture, eye contact, and hand gestures.

cell [N-COUNT-U7] A **cell** is the smallest unit of organization and function in an organism.

Celsius [N-UNCOUNT-U8] **Celsius** is a scale for measuring temperatures and establishes the freezing point of water at 0°C.

chromosome [N-COUNT-U7] A **chromosome** is a thread-like strand of DNA.

climate [N-COUNT-U6] A **climate** is the pattern of weather conditions over a long period of time.

cloud cover [N-COUNT-U5] **Cloud cover** is a measure of how dense the clouds are in a particular area.

coastal zone [N-COUNT-U4] A **coastal zone** is a warm, shallow area in an ocean that is along the edge of land.

column [N-COUNT-U11] A **column** is a vertical section of data in a table.

community [N-COUNT-U3] A **community** is a group of all the living things in a particular area.

component [N-COUNT-U3] A **component** is an important piece or part of something.

compound [N-COUNT-U14] A **compound** is a combination of two or more elements.

concentration [N-COUNT-U10] A **concentration** is a measure of the amount of some substance in a solution.

conservation [N-UNCOUNT-U1] **Conservation** refers to efforts made to reduce the amount of resources consumed by a person or population.

conserve [V-T-U15] To **conserve** something is to use little or none of something so that it will be available at a later time.

coral reef [N-COUNT-U4] A **coral reef** is an area in an ocean that is made up of a network of mineral structures and supports various types of marine life.

core [N-COUNT-U2] The **core** is the center part of the Earth that is very hot.

crust [N-COUNT-U2] The **crust** is the surface of the Earth, made up of rock and soil.

cubic meter [N-COUNT-U10] A **cubic meter** is a unit of volume that is equal to the volume of a cube with sides of one meter in length.

cue card [N-COUNT-U13] A **cue card** is an aid used to help a speaker remember what he or she is supposed to say next while giving a speech.

current [N-COUNT-U6] A **current** is the movement of water in a particular direction.

decline [N-COUNT-U12] A **decline** is a downward trend.

decrease [V-I-U12] To **decrease** is to get smaller in terms of number, size, or amount.

derived unit [N-COUNT-U10] A **derived unit** is a unit that is derived from a base unit.

desert [N-COUNT-U4] A **desert** is a hot, dry region with small plant life that is far apart.

divide by [V-PHRASE-U9] To **divide** a number (x) **by** another number (y) is to split x into y equal groups.

DNA [N-UNCOUNT-U7] **DNA** is a molecule that carries genetic information.

ecosystem [N-COUNT-U3] An **ecosystem** is a set of living and nonliving things that exist in a particular environment or area together.

electromagnetic radiation [N-UNCOUNT-U15] **Electromagnetic radiation** is a type of kinetic energy that travels in waves and often gives off light.

electron [N-COUNT-U14] An **electron** is a part of an atom with a negative electrical charge.

element [N-COUNT-U14] An **element** is a basic substance that is made up of one particular type of atom.

elevation [N-COUNT-U6] An **elevation** is the height of an area of land, usually measured against the level of the sea.

energy [N-UNCOUNT-U15] **Energy** is the ability to cause movement or action, or to transfer heat.

energy efficiency [N-UNCOUNT-U15] **Energy efficiency** is a measurement of how much energy is required to accomplish a particular amount of work without wasting a lot of it.

energy quality [N-UNCOUNT-U15] **Energy quality** is a measurement of an energy's potential to do useful work.

environment [N-UNCOUNT-U1] The **environment** is the natural area in which people live including the water, air, soil, and plant and animal life.

environmental engineer [N-COUNT-U1] An **environmental engineer** is a person who uses engineering skills from various disciplines to solve environmental problems.

equal [V-T-U9] To **equal** something is to be the same as something.

Equator [N-COUNT-U6] The **Equator** is an imaginary line around the middle of the Earth with a latitude of zero degrees that is equal distance from the north and south poles.

eukaryotic [ADJ-U7] If something is **eukaryotic**, it has complex cells with nuclei and may be either unicellular or multicellular.

evaluate [V-T-U1] To **evaluate** something is to look at it closely and critically.

expand [V-I or T-U12] To **expand** is to grow larger.

eye contact [N-UNCOUNT-U13] **Eye contact** is the act of looking members of an audience in the eyes.

Fahrenheit [N-UNCOUNT-U8] **Fahrenheit** is a scale for measuring temperatures and establishes the freezing point of water at 32°F.

fluctuate [V-I-U12] To **fluctuate** is to alternate between increasing and decreasing with no clear pattern.

gallon [N-COUNT-U8] A **gallon** is an imperial unit of volume equal to 128 fluid ounces or about 3.78 liters.

gene [N-COUNT-U7] A **gene** is a part of a DNA molecule that determines a particular trait.

genetic diversity [N-UNCOUNT-U3] **Genetic diversity** is the degree of biological variation among individuals in a population.

Glossary

genetic information [N-UNCOUNT-U7] **Genetic information** is a sequence of codes that establishes which traits a particular organism has.

geosphere [N-COUNT-U2] The **geosphere** is the solid part of the Earth.

grassland [N-COUNT-U4] A **grassland** is a region where grass grows abundantly but large numbers of trees and shrubs do not.

habitat [N-COUNT-U3] A **habitat** is an area where a particular population lives.

handout [N-COUNT-U13] A **handout** is an aid distributed to members of the audience of a presentation or speech designed to help them follow along.

heat [N-UNCOUNT-U15] **Heat** is a form of energy that produces high temperatures and includes the kinetic energy of atoms and ions within an object.

hectare [N-COUNT-U8] A **hectare** is a metric unit of area equal to 0.01 square kilometers or about 2.47 acres.

humidity [N-UNCOUNT-U5] **Humidity** is a measure of the amount of moisture in the air.

hundred [N-COUNT-U9] **Hundred** is combined with another number to abbreviate numbers in the thousands. For example, the number 1,400 could be said "fourteen hundred."

hydrosphere [N-COUNT-U2] The **hydrosphere** is all of the Earth's water.

impact [N-COUNT-U1] An **impact** is a large change.

imperial [ADJ-U8] If a measurement is **imperial**, it uses the system that is based on the pound and the gallon.

increase [V-I-U12] To **increase** is to get larger in terms of number, size, or amount.

inter-tidal zone [N-COUNT-U4] An **inter-tidal zone** is an area along a coast that is underwater when the tide is high and exposed to the air when the tide is low.

ion [N-COUNT-U14] An **ion** is an atom or combination of atoms that has a positive or negative electrical charge.

Kelvin [N-UNCOUNT-U10] **Kelvin** is a unit that measures temperature.

kilogram [N-COUNT-U8] A **kilogram** is a metric unit of weight equal to 1000 grams or about 2.2 pounds.

kilometer [N-COUNT-U8] A **kilometer** is a metric unit of distance equal to 1000 meters or about 0.62 miles.

kinetic energy [N-UNCOUNT-U15] **Kinetic energy** is energy that is actively moving.

latitude [N-COUNT-U6] A **latitude** is a particular distance from the Earth's equator, measured in degrees.

legend [N-COUNT-U11] A **legend** is a part of a chart or graph that gives instructions on how to read the chart or graph.

less [PREP-U9] If one number is **less** another number, it is reduced by that amount.

line graph [N-COUNT-U11] A **line graph** is a graph that connects data points on x and y-axis with a straight line.

liter [N-COUNT-U8] A **liter** is a metric unit of volume equal to 1000 milliliters or about 0.26 gallons.

lithosphere [N-COUNT-U2] The **lithosphere** is the crust, or surface of the Earth, and mantle, or layer below the surface.

mantle [N-COUNT-U2] The **mantle** is the rocky layer between the Earth's crust and core.

mass number [N-COUNT-U14] A **mass number** is a measure of the number of protons and neutrons in an atom, and may differ among atoms of the same element.

matter [N-UNCOUNT-U14] **Matter** is anything that contains material and takes up space.

meteorology [N-UNCOUNT-U5] **Meteorology** is the science of weather and atmospheric changes.

meter [N-COUNT-U8] A **meter** is a metric unit of measurement equal to about 1.09 yards.

metric [ADJ-U8] If a measurement is **metric**, it is uses the system that is based on the kilogram and the liter.

mile [N-COUNT-U8] A **mile** is an imperial unit of distance equal to 5280 feet or about 1.61 kilometers.

minus [PREP-U9] If one number is **minus** a second number, the second number is subtracted from the first.

moisture [N-UNCOUNT-U5] **Moisture** is an amount of liquid that makes something just slightly wet.

mole [N-COUNT-U10] A **mole** is a unit that measures the amount of a substance, expressed in grams.

molecule [N-COUNT-U14] A **molecule** is the smallest piece of a substance that contains all the elements in the substance.

monitor [V-T-U1] To **monitor** something is to watch it closely and note how it changes.

multicellular [ADJ-U7] If something is **multicellular**, it is made up of more than one cell.

multiply by [V PHRASE-U9] To **multiply** a number (x) **by** another number (y), means x is added to itself y number of times.

neutron [N-COUNT-U14] A **neutron** is a part of an atom with no electrical charge.

nucleus [N-COUNT-U7] A **nucleus** is the central part of a cell that contains DNA.

ocean [N-COUNT-U4] An **ocean** is a saltwater body of water that covers a very large area.

open sea [N-UNCOUNT-U4] **Open sea** is the vast area of deep water away from land.

organism [N-COUNT-U3] An **organism** is an individual living thing.

over [PREP-U9] If a number is **over** another number, it is divided by that number.

pattern [N-COUNT-U6] A **pattern** is a way that something happens repeatedly.

pie chart [N-COUNT-U11] A **pie chart** is a chart that shows percentages of a whole by shading corresponding fractions of a circle.

plummet [V-I-U12] To **plummet** is to fall very low very quickly.

plus [PREP-U9] If one number is **plus** another number, the two numbers are added together.

pole [N-COUNT-U6] A **pole** is one of two points that are furthest from the Equator and are based on the axis on which the Earth spins.

pollution [N-UNCOUNT-U1] **Pollution** is any kind of harmful foreign matter in a substance such as air or water.

population [N-COUNT-U3] A **population** is a group of organisms of the same species in a particular area.

potential energy [N-UNCOUNT-U15] **Potential energy** is energy that is not active or moving, and is stored for possible future use.

pound [N-COUNT-U8] A **pound** is an imperial measurement of weight equal to 16 ounces or about 0.45 kilograms.

precipitation [N-UNCOUNT-U5] **Precipitation** is water that falls from clouds to the Earth, usually in the form of rain or snow.

presentation [N-COUNT-U13] A **presentation** is a process of formally introducing or demonstrating an idea to a group of people.

pressure [N-UNCOUNT-U5] **Pressure** is the force or weight of air in the atmosphere.

prevailing wind [N-COUNT-U6] A **prevailing wind** is the typical direction that wind blows in a particular area or during a particular time.

prevent [V-T-U1] To **prevent** something is to keep it from occurring.

project [V-T-U13] To **project** one's voice is to cause it to be louder and carry further than normal.

prokaryotic [ADJ-U7] If something is **prokaryotic**, it has very simple cells that do not contain nuclei, and is typically a unicellular organism.

proton [N-COUNT-U14] A **proton** is a part of an atom with a positive electrical charge.

rainforest [N-COUNT-U4] A **rainforest** is a hot, wet region with many tall trees.

range [N-COUNT-U6] A **range** is set of things that belong to the same category but have different values.

resources [N-COUNT-U1] **Resources** are things that people use, such as water, mineral deposits, or oil.

review [V-T-U13] To **review** something is to go over it closely and provide feedback.

rise [N-COUNT-U12] A **rise** is an upward trend.

rotation [N-UNCOUNT-U6] **Rotation** is the process of turning around a central point.

row [N-COUNT-U11] A **row** is a horizontal section of data in a table.

Glossary

saltwater [ADJ-U4] If something is **saltwater**, it is related to a body of water that contains salt, such as an ocean or estuary.

savanna [N-COUNT-U4] A **savanna** is a type of grassland with warm temperatures and distinct wet and dry seasons.

scatter diagram [N-COUNT-U11] A **scatter diagram** is a chart that shows data points on an x and y-axis not connected by any lines.

short-term [ADJ-U5] If something is **short-term**, it happens for a brief time.

shrink [V-I-U12] To **shrink** is to get smaller.

SI [N-UNCOUNT-U10] **SI** is the abbreviation for the International System of Units, the modern form of the metric system.

signpost [V-I-U13] To **signpost** is to guide listeners through your ideas using clear directional wording.

skyrocket [V-I-U12] To **skyrocket** is to go very high very quickly.

species [N-COUNT-U3] A **species** is a group of organisms that share the same biological structure.

square meter [N-COUNT-U10] A **square meter** is a unit of measurement that describes the area of a space 1 meter by 1 meter.

stabilize [V-I-U12] To **stabilize** is to become more regular.

stratosphere [N-COUNT-U2] The **stratosphere** is an outer layer of the atmosphere, farther from the Earth than the troposphere, which filters out harmful rays from the sun.

subtract [V-T-U9] To **subtract** one number from another number is to reduce it by that amount.

summarize [V-T-U13] To **summarize** something is to briefly present its main points.

table [N-COUNT-U11] A **table** is a visual representation of data made up of rows and columns.

temperature [N-COUNT-U5] A **temperature** is a measure of how hot or cold something is.

terrain [N-COUNT-U6] A **terrain** is land that has particular characteristics.

thermodynamic temperature [N-UNCOUNT-U10] **Thermodynamic temperature** is the absolute measure of temperature.

times [PREP-U9] If one number is **times** another number, it is multiplied by that number.

transfer [V-T-U15] To **transfer** something is to change the location of something.

troposphere [N-COUNT-U2] The **troposphere** is the inner layer of the atmosphere, closer to the Earth than the stratosphere, which contains most of the planet's air.

tundra [N-COUNT-U4] A **tundra** is a type of grassland that is very cold and is typically covered with ice and snow.

unicellular [ADJ-U7] If something is **unicellular**, it is made up of only one cell.

visual aid [N-COUNT-U13] A **visual aid** is some kind of graphical representation of an important part of a speech or presentation designed to support the speaker's ideas.

volume [N-COUNT-U10] A **volume** is a measure of how much three-dimensional space something occupies.

weather [N-UNCOUNT-U5] **Weather** is the condition of the atmosphere, including the levels of temperature and precipitation.

wind speed [N-COUNT-U5] **Wind speed** is a measure of how fast air is moving through the atmosphere.

work [N-UNCOUNT-U15] **Work** is action or movement that is produced by kinetic energy.

x-axis [N-COUNT-U11] The **x-axis** is the horizontal axis on a line graph.

y-axis [N-COUNT-U11] The **y-axis** is the vertical axis on a line graph.

yard [N-COUNT-U8] A **yard** is an imperial unit of measurement equal to three feet or about .91 meters.

CAREER PATHS

ENVIRONMENTAL ENGINEERING

Book 2

Virginia Evans
Jenny Dooley
Kenneth Rodgers

Express Publishing

Scope and Sequence

Unit	Topic	Reading context	Vocabulary	Function
1	Traits of an Environmental Engineer	Job posting	ability, commitment, critical thinking, curious, dedicated, expertise, focus, goal-oriented, innovative, logical, outside the box, team player	Giving an example
2	Education	Webpage	ABET, accredited, bachelor's degree, doctorate, EAB, master's degree, PhD, postgraduate degree, prerequisite, undergraduate degree	Asking for advice
3	The Scientific Method	Journal article	conclusion, control group, evaluate, experiment, experimental group, hypothesis, independent variable, observation, problem, result, scientific method, testable	Requesting more information
4	Problem Solving	Employee guidelines	analysis, approach, attack, iteration, iterative procedure, problem identification, problem solving, redefine, solution, solve, synthesis	Talking about future events
5	Working with Numbers	Employee manual	cubed, exponent, hundredths, leading zero, order of magnitude, rounding error, scientific notation, significant figure, squared, tenths, thousandths, to the nth power, trailing zero	Checking for correctness
6	Analyzing Quantities	Textbook excerpt	convert, decimal number, denominator, fraction, mixed number, numerator, -out of-, percent, percentage, point, ppm, quantity, reduce, whole number	Describing quantities
7	Accounting	Email	closed system, consumption, extensive quantity, final, generation, initial, input, intensive quantity, open system, output, system, universal accounting equation	Giving advice
8	Water Cycle	Report	advection, aquifer, condensation, evaporation, hydrologic cycle, infiltration, liquid, residence time, sublimation, transpiration, vapor, water cycle	Defining a term
9	Carbon Cycle	Pamphlet	aerobic respiration, break down, carbohydrates, carbon, carbon cycle, circulate, CO_2, convert, diffuse, dissolve, oxygen, photosynthesis	Redirecting a conversation
10	Energy Cycle	Report	biomass, consumer, ecological efficiency, endangered species, energy flow, food chain, food web, primary consumer, producer, secondary consumer, solar energy, trophic level, trophic transfer	Delivering bad news
11	Biodiversity and Extinctions	Webpage	background extinction, biodiversity, biological extinction, ecological extinction, ecosystem diversity, extinct, extinction, Holocene extinction, local extinction, mass extinction, species diversity, variation	Stating a concern
12	Environmental Chemistry	Course description	acid, balance, base, chemistry, endothermic, enthalpy, equation, exothermic, organic chemistry, Periodic Table, pH scale, solubility, stoichiometry	Expressing doubt
13	Resources	Webpage	coal, extract, fishery, hydrogen, log, mine, natural gas, oil, ore, petroleum, potential resource, stock resource, sustainable yield, timber, uranium	Talking about capabilities
14	Resource Recovery	Newspaper article	combustion, compost, discard, energy recovery, fly ash, municipal solid waste, postconsumer, preconsumer, primary recycling, recycle, remanufacturing, secondary recycling, waste-to-energy combustion	Describing mixed results
15	Atmospheric Change	Journal article	carbon dioxide, CFC, climate change, Copenhagen Protocol, Freon, glacial, greenhouse effect, Kyoto Protocol, methane, ozone thinning, permafrost, sea level, thermohaline circulation, tipping point, ultraviolet radiation	Disagreeing with an opinion

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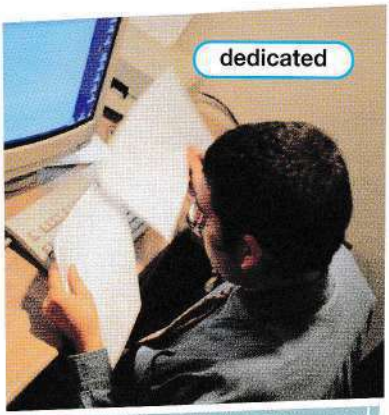
1 Traits of an Environmental Engineer

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some traits of a good environmental engineer?

2 Why is it important for environmental engineers to be creative thinkers?



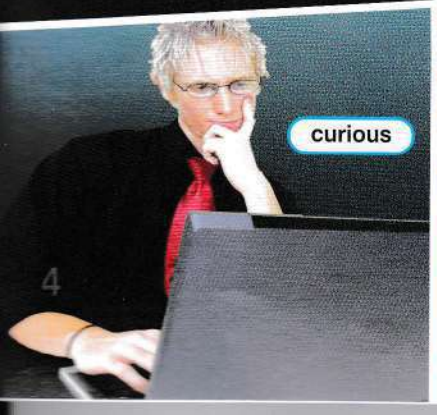
Job Listing:

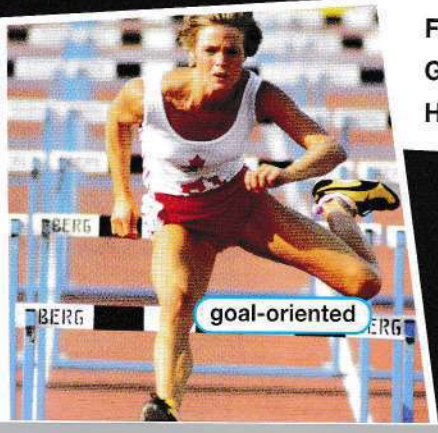
Environmental Engineering

Jarman Environmental Planning provides environmental planning services for corporate and government agencies. We are looking for a new member for our team. Applicants should have the following qualifications.

- They should show a clear record of **innovative** thinking. Applications should include a cover letter demonstrating this. Give examples of **outside the box** solutions to problems you've faced.
- Applicants should be **dedicated team players**. The success of our company depends on the **commitment** of our engineers. Our team members are **goal-oriented**. They work together to accomplish Jarman's objectives of sustainability and responsibility.
- Applicants must demonstrate **critical thinking** skills. They should be able to provide **logical** solutions to complex problems. And they must be able to **focus** on the task at hand.

*At Jarman EP, we value **ability** and **expertise**. We require that applicants have a four-year degree in Environmental Studies or a related field. But, more importantly, we seek applicants who are **curious** about the natural world and our place in it.*





Reading

2 Read the job listing. Then, choose the correct answers.

1 What is the purpose of the listing?
- **A** to explain the objectives of the company
- **B** to describe the qualities of the ideal job candidate
- **C** to provide instructions for applying for a position
- **D** to explain the responsibilities of the position

2 How should applicants demonstrate innovative thinking?
- **A** give examples in a cover letter
- **B** provide a letter of recommendation
- **C** complete a four-year degree
- **D** provide logical solutions to problems

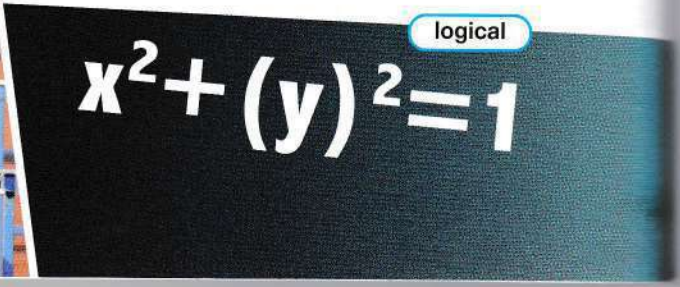
3 Which is NOT a desired qualification described in the listing?
- **A** commitment to the company's goals
- **B** previous experience as an environmental engineer
- **C** creative thinking and problem solving skills
- **D** a college degree in an appropriate field

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1	__ expertise	5	__ commitment
2	__ logical	6	__ team player
3	__ focus	7	__ goal-oriented
4	__ curious	8	__ outside the box

- **A** to concentrate on something
- **B** innovative or unexpected
- **C** loyalty or dedication
- **D** one who puts the group first
- **E** skill or familiarity with something
- **F** directed towards an accomplishment
- **G** well-reasoned or rational
- **H** interested or questioning



4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **innovative / dedicated**

A _____ engineers always think outside the box.

B A(n) _____ employee will often work longer hours.

2 **critical thinking / ability**

A _____ is an important skill in many professions.

B The applicant should have the _____ to adapt to new tasks.

5 🎧 **Listen and read the job listing again. Which two qualities are valued by Jarman EP?**

Listening

6 🎧 **Listen to a conversation between a candidate and an interviewer. Mark the following statements as true (T) or false (F).**

1 __ The woman admires the company's financial success.

2 __ The man is concerned about the woman's lack of expertise.

3 __ The woman graduated from college a year early.

7 🎧 **Listen again and complete the conversation.**

Interviewer: Why do you want to work for Jarman Environmental Planning?

Candidate: I admire your dedication to sustainable urban development. I think my skills would **1** _____ _____ _____ your goals.

Interviewer: What qualities do you have that would accomplish that?

Candidate: I am an excellent critical thinker.

Interviewer: Can you **2** _____ _____ an example of that?

Candidate: Sure. I successfully petitioned my school to restructure the environmental engineering degree plan. The plan I proposed clarified our **3** _____ _____ sustainability.

Interviewer: Good. That also shows a **4** _____ _____ Jarman's values.

Candidate: I can give many examples of that commitment, **5** _____ volunteer work.

Interviewer: Your qualifications are impressive, even without much experience. However, we also want **6** _____ _____ _____ of your ability to set your own goals and work toward them with limited supervision.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I am ...

Can you give me an example ...

I believe ...

Student A: You are a candidate. Talk to Student B about:

- why you want to work for his or her company
- your qualifications
- examples of those qualifications

Student B: You are an interviewer. Talk to Student A about his or her qualifications.

Writing

9 **Use the job listing and the conversation from Task 8 to complete the interviewer's report.**

Jarman Environmental Planning

INTERVIEWER'S REPORT FORM

Applicant Name: _____

For what position is she or he applying?

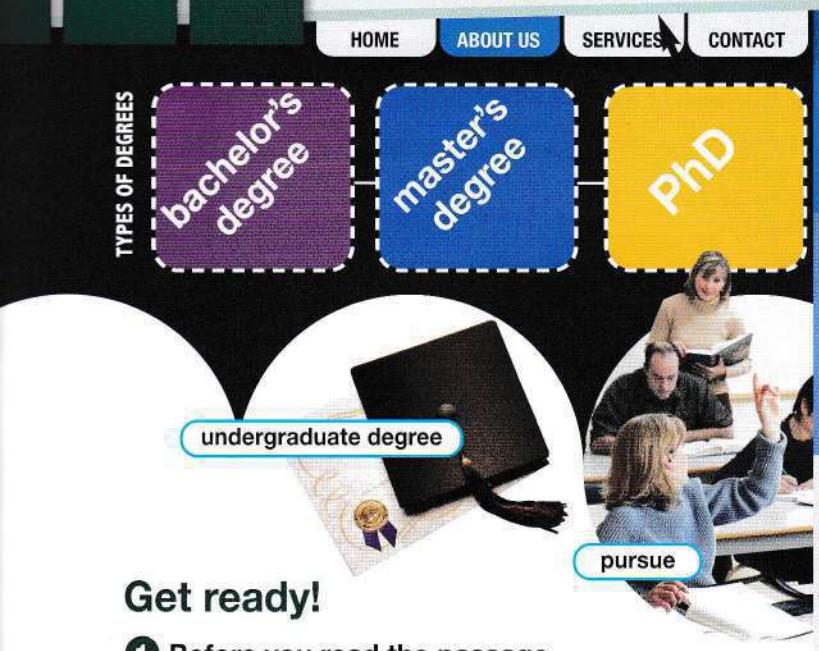
_____

Would the applicant be a valuable addition to our team? Why or why not?

_____

_____

2 Education



ENGINEERING DEPARTMENT AT SOUTHWESTERN UNIVERSITY

There are many reasons to pursue a degree in Engineering. But whatever your reason, Southwestern University is the place to do it. We are **accredited** by the **ABET** and the **EAB**. This means your degree can open doors for you all over the world.

Southwestern University offers both **undergraduate** and **postgraduate degrees**.

- BSc: Students pursuing a **bachelor's degree** in Engineering have several options. All students are required to take core engineering classes. In addition, they must choose a minor field. Options include Environmental Studies, Mathematics, Physics, and Biology. Students with associate's degrees may transfer those credits toward a minor.
- MA: There are several **prerequisites** for enrolling in the **master's degree** program at Southwestern. Students must hold a bachelor's degree or higher in Engineering or a related field. They must also show evidence of academic excellence.
- **PhD**: Students **pursuing** a **doctorate** in Engineering must be supported by a current Southwestern faculty member.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some educational options for engineering students?

2 Why is accreditation important for educational institutions?

Reading

2 Read the webpage. Then, choose the correct answers.

1 What is the purpose of the webpage?

A to explain the uses of a degree in Engineering

B to advertise institutions accredited by the ABET and EAB

C to explain prerequisites for the undergraduate degree

D to describe educational options for engineering students

2 Which is NOT a degree option for engineering students at Southwestern University?

A an undergraduate degree

B a master's degree

C an associate's degree

D a doctorate

3 Which of the following is listed as a prerequisite for the master's degree?

A a record of academic achievement

B courses in Mathematics and Physics

C the support of a current faculty member

D a postgraduate degree in Engineering

Vocabulary

3 Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

PhD master's degree EAB
prerequisite ABET accredited

1 After he got his _____, John considered pursuing a doctorate.

2 A(n) _____ is the highest academic degree.

3 The _____ certifies engineering programs in the United Kingdom.

4 Calculus is a(n) _____ for many advanced engineering courses.

5 In the United States, the _____ evaluates engineering programs.

6 The university was _____ by both state and national boards.

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **postgraduate degree / undergraduate degree**

A A(n) _____ typically takes four years to complete.

B A(n) _____ is more advanced than a bachelor's.

2 **bachelor's degree / doctorate**

A A _____ was only the beginning of my college education.

B After college, he began working toward a _____.

5 🎧 **Listen and read the webpage again. What options do students doing an undergraduate degree have?**

Listening

6 🎧 **Listen to a conversation between a student and an advisor. Mark the following statements as true (T) or false (F).**

1 __ The man asks for advice on how to finish his bachelor's degree.

2 __ The woman recommends pursuing a PhD.

3 __ The man asks for a recommendation letter.

7 🎧 **Listen again and complete the conversation.**

Student: Hi, Dr. Ford. Do you have a moment to talk with me?

Advisor: Of course. **1** _____ on graduating next month.

Student: Thank you. But I wanted to talk about **2** _____ _____ _____ next.

Advisor: Are you looking for work?

Student: I am, but I'm also thinking about pursuing a postgraduate degree. **3** _____ _____ you think?

Advisor: Well, there are definitely some benefits. First, a master's degree allows you to spend more time **4** _____ _____ the technical side of things.

Student: Is that **5** _____ _____ employers?

Advisor: Certainly. They **6** _____ _____ with technical experience, not just theoretical knowledge.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Congratulations on ...
I'm thinking about ...
What do you think ...?

Student A: You are an advisor. Talk to Student B about:

- options after graduating
- advantages of postgraduate study
- difficulties of postgraduate study

Student B: You are a student. Talk to Student A about options after graduating.

Writing

9 **Use the webpage and the conversation from Task 8 to answer a student's questions.**

Dear Prof. Ford,

I have a few questions about the engineering program at Southwestern.

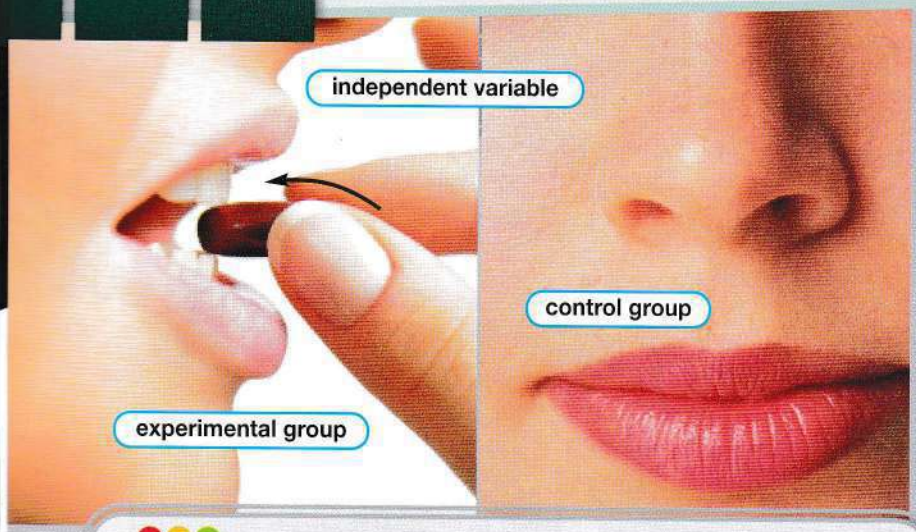
1 Do I need a bachelor's degree in engineering to apply for the PhD program?

2 Are there any special requirements for applying to the doctorate program?

3 What are some of the benefits of a postgraduate degree?

Thanks for your time,
Mark Taggart

3 The Scientific Method



Boro Labs Challenges AquaFirma's Scientific Method

AquaFirma announced the development of a new water filter last week. Company scientists claim that the filter offers significant improvements. Their **observation** is that it filters 45 percent more toxic materials than the earlier model. Further, it reduces disease-causing toxins by 80 percent. If verified, these **conclusions** will be significant. In particular, they will affect regions with limited water treatment options. Boro Labs is currently running an independent **experiment** to **evaluate** these **results**.

The Boro Labs experiment will consider a slightly different **problem** than AquaFirma's. They argue that the company's **hypothesis** was too broad to be **testable**. Boro Labs will not test for toxins in general. Instead, they will focus on a single disease-causing bacterium. They will filter bacteria-treated water using the old filter. This will establish a **control group**. For the **experimental group**, they will filter water with the same amount of bacteria. But they will introduce the new filter as an **independent variable**.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are the basic steps of the scientific method?

2 Why is it important for a hypothesis to be testable?

Reading

2 Read the journal article. Then, mark the following statements as true (T) or false (F).

1 __ Boro Labs is part of the AquaFirma company.

2 __ The Boro Labs experiment is more specific than AquaFirma's.

3 __ Bacteria will be introduced as an independent variable.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ result

2 __ testable

3 __ hypothesis

4 __ evaluate

5 __ problem

6 __ scientific method

7 __ observation

8 __ conclusion

A the outcome of something

B the issue considered in an experiment

C provable or disprovable by experiment

D something discovered through attention

E to judge or analyze

F a process for conducting experiments

G an unproven declaration

H the final discovery of an experiment

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **experiment / independent variable**

A Science students learn how to properly conduct an _____.

B We changed the _____ for each group.

2 **experimental group / control group**

A The _____ did not receive the medicine being tested.

B The _____ will undergo a new form of treatment.

5 🎧 **Listen and read the journal article again. Who will benefit from the new water filter when verified?**

Listening

6 🎧 **Listen to a conversation between two environmental engineers. Choose the correct answers.**

1 What is the conversation mainly about?

A results of an experiment

B feedback on a hypothesis

C an upcoming project

D how to change an experiment

2 Why is there a focus on bacteria?

A The lab is not equipped to handle industrial pollution.

B AquaFirma filters only work on bacteria.

C They are less dangerous than manmade toxins.

D They are a major problem for rural communities.

7 🎧 **Listen again and complete the conversation.**

Engineer: I'm really excited about this experiment we're starting next week.

Coworker: What are you **1** _____ _____?

Engineer: We're going to test the new AquaFirma filter. We **2** _____ _____ _____ how well it works on bacteria.

Coworker: Will you be testing **3** _____ _____ it filters manmade toxins as well?

Engineer: No. We're going to focus on natural toxins.

Coworker: Why? **4** _____ _____ that industrial pollutants were the most important thing to check for.

Engineer: Well, we want to see how well this filter **5** _____ _____ in rural communities.

Coworker: Don't they have to worry about industrial pollution, too?

Engineer: Yes, but the bacteria we're testing for is their **6** _____ _____.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

What are you ...?

We're going to focus on ...

I thought ...

Student A: You are an environmental engineer. Talk to Student B about:

- an experiment he or she is working on
- why he or she is doing the experiment
- what results he or she expects

Student B: You are an environmental engineer. Talk to Student A about your experiment.

Writing

9 **Use the journal article conversation from Task 8 to write an experiment proposal.**

Boro Labs

Experiment Proposal Form

What is the main problem the experiment will address?

_____

_____

What is your hypothesis?

_____

_____

Why is this experiment important for Boro Labs?

_____

_____

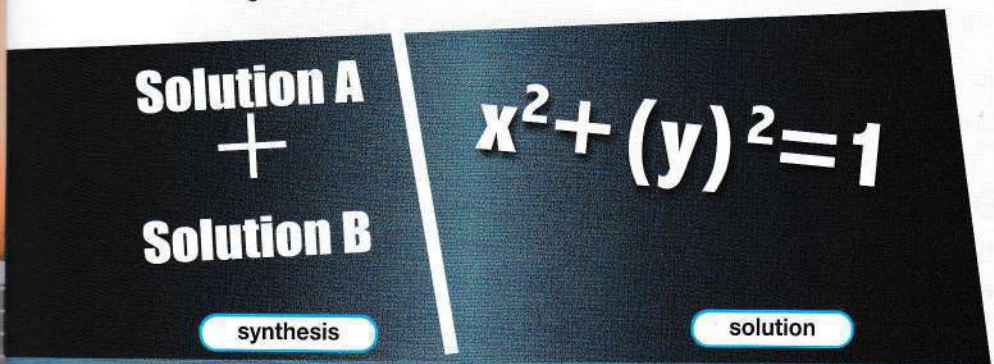
4 Problem Solving

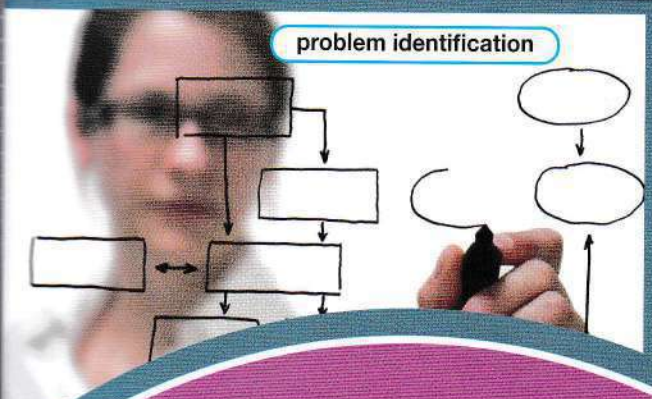
Get ready!

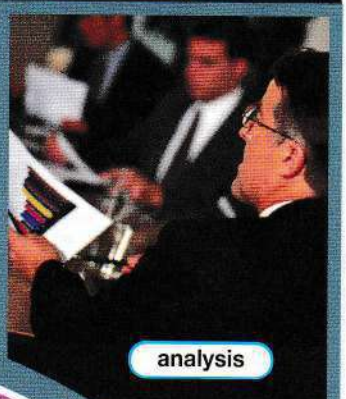
1 Before you read the passage, talk about these questions.

1 What are some key elements of effective problem solving?

2 Why is problem solving an important skill for environmental engineers?







AguaFirma
Employee Guidelines

Problem Solving

As employees of AguaFirma, we **attack** difficult problems every day. Over the years, we've learned a few things about how to **approach** such issues:

1 **Problem identification.** This is one of the key elements of effective problem solving. If you don't know exactly what the problem is, it is difficult to **solve**.

2 **Analysis**. Once you have identified the problem, analyze all aspects of the situation. Identify available resources and calculate the cost of further needs.

3 **Redefine** the problem. It is rare to find a **solution** on your first try. Often, you may need to consider the issue from a new angle.

4 **Iterative procedure**. Sometimes a solution almost works but leaves a few parts of the problem unsolved. In this case, you may change some small part of your plan and try again. If this next **iteration** still doesn't work, try again. You may also want to try a **synthesis** of various earlier solutions.

Reading

2 Read the employee guidelines. Then, mark the following statements as true (T) or false (F).

1 __ Employees should evaluate costs after identifying the problem.

2 __ Identifying resources is a key part of iterative procedure.

3 __ Each iteration in problem solving should avoid previous problem-solving methods.

Vocabulary

3 Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

synthesis iterative procedure
problem identification
solution problem solving
iteration solve

1 Difficulties often have more than one possible _____.

2 _____ is the process of determining what exactly the issue is.

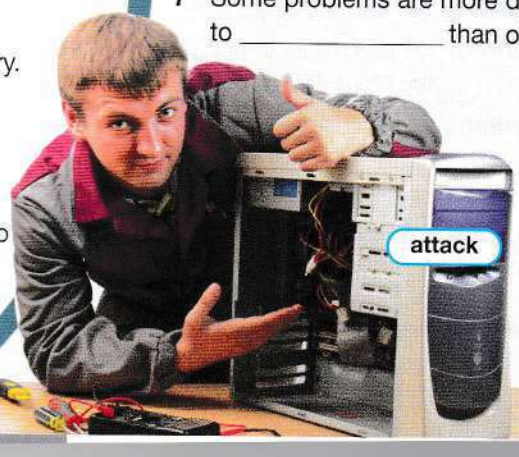
3 The first _____ of the plan failed, but it worked the second time.

4 _____ of two ineffective plans can often create one useful idea.

5 _____ perfects an idea by repeating it with small changes.

6 _____ is the process of settling issues or difficulties.

7 Some problems are more difficult to _____ than others.



4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **approach / analysis**

A If your solution fails, try a new _____ to the problem.

B A careful _____ of the problem can save time.

2 **attack / redefine**

A New information can sometimes _____ a problem.

B The manager decided to _____ the issue before it got worse.

5 Listen and read the employee guidelines again. Why is iterative procedure an important part of problem solving?

Listening

6 Listen to a conversation between an environmental engineer and a manager. Choose the correct answers.

1 What problem is the woman trying to solve?

A The lab does not have enough material for another filter layer.

B Bacteria are not being effectively filtered.

C The filter is functional but not cost effective.

D The filter does not work on manmade toxins.

2 What is the first solution the woman will try?

A using more layers of filtering material

B sending materials to the lab for analysis

C calling the lab to speed up the process

D using a new filtering material

7 Listen again and complete the conversation.

Manager: How are things **1** _____ _____ the new filter?

Engineer: Well, I've identified the problem. It's filtering manmade toxins, but it's letting bacteria through.

Manager: How are we **2** _____ _____ fix it?

Engineer: For the next iteration, we **3** _____ _____ increase the layers of filtering material.

Manager: That sounds like a reasonable approach.

Engineer: It should work, but it **4** _____ _____ too expensive.

Manager: Do you have more **5** _____ _____ solutions in mind?

Engineer: I would **6** _____ _____ _____ using a new material, but I'm not sure if it's feasible.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

How are things coming with ...?

We plan to ...

I would like to ...

Student A: You are an environmental engineer. Talk to Student B about:

- a problem you are trying to solve
- solutions you plan to try
- what you think the results will be

Student B: You are a manager. Talk to Student A about a problem he or she is trying to solve.

Writing

9 Use the conversation from Task 8 to write a problem identification report.

AguaFirma

Problem Identification

What problem or difficulty is your team addressing?

_____

_____

What approach do you plan to use?

_____

_____

What resources do you need to solve the problem?

_____

_____

5 Working with Numbers

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some common scientific numbering conventions?

2 Why is it important for people working together to use the same number styles?

Boro Labs
Employee Manual: Number Conventions

Boro Labs employs technicians and scientists from all over the world. Together, our employees speak 25 languages. But for us, numbers are often more important than words. We must be certain that we understand each other. Failing to follow our numbering conventions could cause significant problems. Even the smallest **rounding error** could lead to wasted time and resources. If a number is **squared** when it should be **cubed**, it could cost us thousands of dollars.

- **Significant figures**: Numbers should be written to the **thousandths** place. If you round to the **tenths** or **hundredths,** you lose precision.
- **Exponents**: Use superscript numbers to multiply numbers **to the nth power.**
- **Order of magnitude**: Always include a note for other team members if the calculation scale is altered.
- Zeros: We do not use **trailing zeros** or **leading zeros** as placeholders. Instead, all numbers should be expressed in **scientific notation.**

And remember, triple check your calculations.

Reading

2 Read the employee manual. Then, choose the correct answers.

1 What is the purpose of the passage?

A to report numbering problems that lead to waste
B to compare the numbering rules in different countries
C to describe changes to the company's numbering conventions
D to explain the company's rules for using numbers

2 When should employees leave a note for other team members?

A when they round numbers to the tenths or hundredths
B when they change the calculation scale
C when they use trailing zeros as placeholders
D when they suspect a rounding error

3 Which is NOT a numbering convention used at the lab?

A including leading zeros as placeholders
B using superscript numbers for exponents
C rounding to the thousandths place
D using scientific notation

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ squared
2 __ cubed
3 __ thousandths
4 __ tenths
5 __ scientific notation
6 __ to the nth power
7 __ rounding error

A determines how many times a number is multiplied by itself
B the third digit after the decimal point
C the first digit after the decimal point
D multiplied by itself once
E a miscalculation when simplifying numbers
F a way of representing large or small numbers
G multiplied by itself twice

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **orders of magnitude / significant figures**

A The number 25.4 has three _____.

B The number 50 is two _____ greater than the number 0.5.

2 **leading zero / trailing zero**

A The number 0.65 uses a _____ as a placeholder.

B The number 65.0 uses a _____ as a placeholder.

3 **exponents / hundredths**

A _____ are usually represented as superscript numbers.

B The manager asked us to round all numbers to the _____.

5 🎧 **Listen and read the employee manual again. What is one numerical error?**

Listening

6 🎧 **Listen to a conversation between an engineer and a coworker. Mark the following statements as true (T) or false (F).**

1 __ The woman found an error in the man's calculations.

2 __ The measurement does not include enough significant figures.

3 __ The woman suspects a rounding error occurred.

7 🎧 **Listen again and complete the conversation.**

Engineer: I think there may be a **1** _____ _____ your calculations.

Coworker: Why is that?

Engineer: Well, they don't **2** _____ _____ with my findings or with your report from yesterday.

Coworker: That's strange. Do you mind **3** _____ _____ the figures again with me?

Engineer: No problem. The error seems to be in data collection. What did you **4** _____ _____ toxin levels on the first round of filtering?

Coworker: **5** _____ _____ _____. It looks like I got 3.75.

Engineer: But you didn't include thousandths.

Coworker: You're right. **6** _____ _____ that's the problem.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

There may be a problem with ...

Do you mind ...?

But you didn't ...

Student A: You are an environmental engineer. Talk to Student B about:

- a problem with his or her calculations
- what caused the problem
- your company's numbering conventions

Student B: You are an environmental engineer. Talk to Student A about a calculation error.

Writing

9 **Use the conversation from Task 8 to complete the error report.**

BORO LABS

ERROR REPORT

Type of Error:

_____

_____

How did the error affect the experiment?

_____

_____

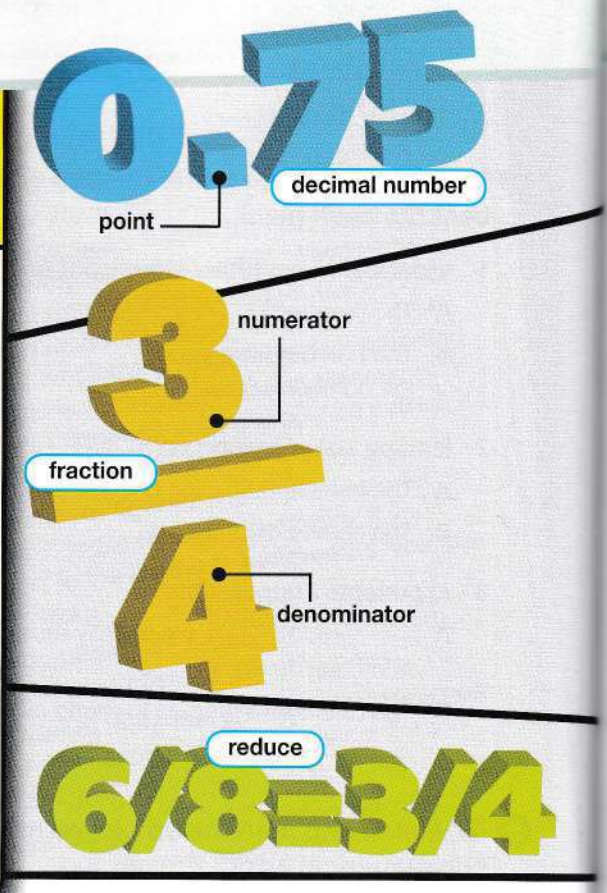
What steps will you take to prevent the error from occurring again?

_____

_____

6 Analyzing Quantities

CHAPTER 6: Expressing Quantities



Whole numbers are usually expressed as integers. But expression becomes more complicated for numbers smaller than one.

1 **Fractions**: Fractions use a **numerator** and **denominator.** They represent an amount as part of a whole. For instance, the fraction 3/4 represents an amount that is equal to three **out of** four parts of a whole. Fractions can also be combined with integers to form **mixed numbers**.

2 **Percentages**: A percentage represents an amount as a **percent** of the whole. One percent is one part out of a hundred. For very small amounts, percentages may be inconvenient. Instead, one might use the expression parts per million (**ppm**).

3 **Decimal Numbers**: Decimal numbers use a decimal **point** to separate whole numbers from percentages.

One can easily **convert** each of these forms of expression into the others. For example, half of something can be represented as the fraction 1/2. Dividing the numerator by the denominator converts this to the decimal number 0.5.

Get ready!

❶ Before you read the passage, talk about these questions.

1 What are some different ways that the same quantity can be expressed?

2 What is one useful way to express very small numbers?

Reading

❷ Read the textbook excerpt. Then, choose the correct answers.

1 What is the purpose of the passage?

A to explain the expression of non-integer numbers

B to describe the difference between whole numbers and fractions

C to teach students how to express very large numbers

D to define different types of whole numbers

2 Which is NOT a type of expression described in the passage?

A parts per million **C** points

B percentage **D** fractions

3 When is it appropriate to express numbers using ppm?

A when measuring very large amounts

B when converting fractions to decimal numbers

C when converting mixed numbers to percentages

D when measuring very small amounts

Vocabulary

❸ Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

percentage whole number
fraction denominator
decimal number quantity
mixed number numerator

1 75.643 is an example of a _____.

2 The _____ is the top number of a fraction.

3 98 4/5 is an example of a _____.

4 A _____ uses a line or a bar to separate its parts.

5 The _____ is the bottom number of a fraction.

6 109 is an example of a _____.

7 A _____ is any measurable amount.

8 A _____ is an amount expressed as parts out of a hundred.

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **percent / ppm**

A A quarter is 25 _____ of a dollar.

B 60 _____ can also be expressed as 0.006%.

2 **point / out of**

A The fraction 3/4 can also be said as "three _____ four."

B The number 3.4 is said as "three _____ four."

3 **convert / reduce**

A To _____ a fraction, divide the top number by the bottom.

B To _____ a fraction, divide the parts by a common factor.

5 Listen and read the textbook excerpt again. What are the parts of a fraction?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ All of the factories showed dangerous levels of toxins.

2 __ 600 ppm is an unhealthy amount of carbon monoxide.

3 __ The engineers will try to improve the filtering process.

7 Listen again and complete the conversation.

Engineer: We finally got **1** _____ _____ on those air quality tests.

Coworker: **2** _____ _____ they look?

Engineer: Unfortunately, two out of the three factories we tested show dangerous levels of toxins.

Coworker: How **3** _____ _____ it?

Engineer: One factory's carbon monoxide levels are at 600 ppm.

Coworker: That's 0.6 percent, right?

Engineer: Yeah. Levels that high are definitely not **4** _____ _____ the factory workers or the people living nearby.

Coworker: Do you think we'll be able to get it down to an **5** _____ _____?

Engineer: We've contacted managers at both factories **6** _____ _____ their filtering process.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

We got the results on ...

How bad ...?

Do you think ...?

Student A: You are an environmental engineer. Talk to Student B about:

- results of a test for toxins
- quantity of toxins found
- possible responses to test results

Student B: You are an environmental engineer. Talk to Student A about results of a test for toxins.

Writing

9 Use the conversation from Task 8 to write a toxin test report.

Jarman Environmental Planning

Factory Test Report Form

Substances tested for: _____

_____

Quantities found: _____

_____

Does the percentage of toxins exceed allowable amounts?

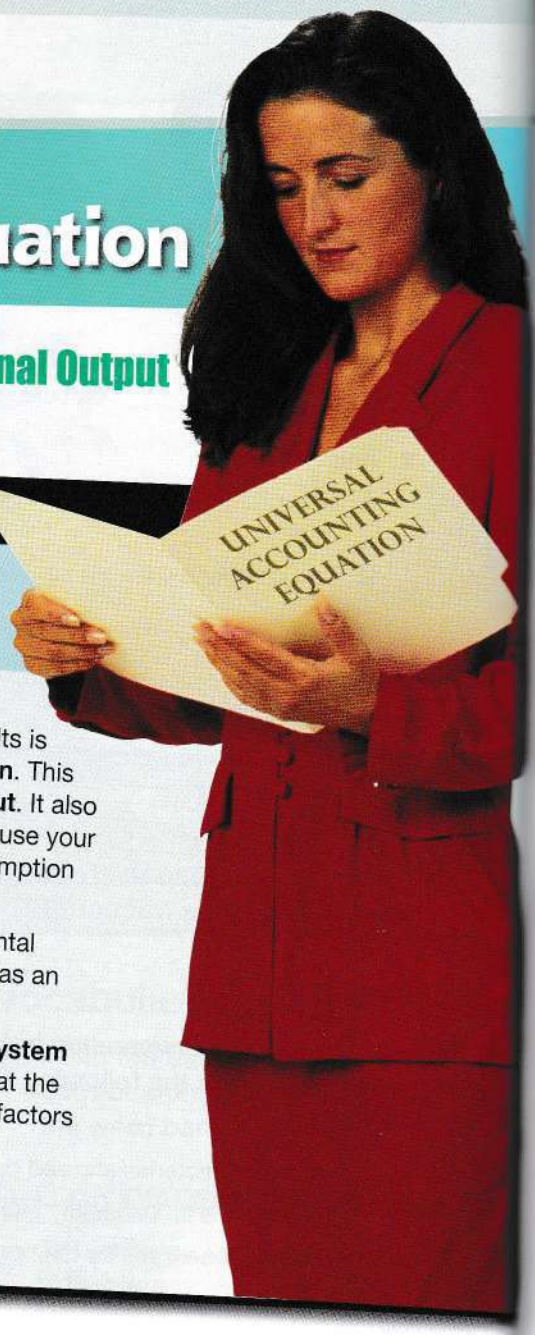
_____

_____

7 Accounting

Universal Accounting Equation

Initial Input + **Generation** - **Consumption** = **Final Output**



TO: Howard_Carter@carterfisheries.org
FROM: Marla_Nolan@jep.org
RE: Fish Production

Hello Mr. Carter,

I've finished my analysis of your fish production **system**. The chart with results is attached. To perform my analysis, I used the **Universal Accounting Equation**. This allows me to account for more than just **initial input** compared to **final output**. It also allows me to figure for **generation** and **consumption**. This is important because your initial input of fish multiplies in breeding season. You also lose input to consumption when fish die.

Checking over last year's numbers, I found an error. Your previous environmental engineer calculated feed costs as an **intensive quantity**. It should be figured as an **extensive quantity**. I've made that change in the new calculations.

I have performed these calculations assuming your operations are a **closed system** rather than an **open system**. However, this could change. Please be aware that the production numbers I've provided do not account for the influence of outside factors like natural disasters.

Sincerely,
Marla Nolan

Get ready!

1 Before you read the passage, talk about these questions.

1 How can an engineer analyze a system effectively?

2 What are some accounting challenges environmental engineers face?

Reading

2 Read the email. Then, mark the following statements as true (T) or false (F).

1 __ The Universal Accounting Equation does not include generation.

2 __ The engineer reused last year's formulas to make her calculations.

3 __ The engineer's calculations did not account for outside factors.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ system
2 __ input
3 __ output
4 __ final
5 __ initial
6 __ generation
7 __ consumption
8 __ Universal Accounting Equation

A something contributed to a system
B use or depletion of something
C creation or production of something
D formula for determining quantities
E the group of elements being analyzed
F happening at the beginning
G something produced or yielded
H happening at the end

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **extensive quantity / intensive quantity**

A An _____ does not change when the amount changes.

B An _____ changes when the amount changes.

2 **open system / closed system**

A A(n) _____ is affected by outside forces.

B A(n) _____ is not affected by outside forces.

5 Listen and read the email again. What factors does the Universal Accounting Equation consider?

Listening

6 Listen to an environmental engineer and a fishery owner. Choose the correct answers.

1 Why does the man want the woman's advice?

A to increase the size of his system

B to identify problems with his feeding schedule

C to reduce production costs

D to improve his fish production

2 What decision does the man make?

A to purchase more fish

B to research disease treatment

C to remove diseased fish

D to extend the breeding season

7 Listen again and complete the conversation.

Owner: I got your email about next year's projected fish production. I was hoping you might have **1** _____ _____ for improving those output numbers.

Engineer: Well, the **2** _____ _____ to increase output is to increase input. If you bought more fish at the beginning of the season, that would increase your yield.

Owner: That solution is too expensive.

Engineer: **3** _____ _____ _____, I would advise a longer breeding season to improve your generation.

Owner: That's a good idea, but I often lose many of the immature fish to disease.

Engineer: **4** _____ _____ you isolate and treat for the diseases that affect the newly hatched fish.

Owner: I'm **5** _____ _____ _____ to do that.

Engineer: I could have our lab **6** _____ _____ _____.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

I was hoping ...

In that case ...

I suggest ...

Student A: You are an environmental engineer. Talk to Student B about:

- how to improve production
- how to improve generation
- how to reduce consumption

Student B: You are a farm owner. Talk to Student A about improving production.

Writing

9 Use the conversation from Task 8 to write a request for lab work.

Boro Labs

LAB WORK REQUEST Form

Client: _____

Lab work requested: _____

_____

What is the purpose of the requested work?

_____

_____

8 Water Cycle

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some of the parts of the water cycle?
2 Why is the water cycle important for environmental engineers?

Reading

2 Read the report. Then, mark the following statements as true (T) or false (F).

1 ___ Toxins enter the aquifer through infiltration.
2 ___ Transpiration may contribute to the spread of the toxins.
3 ___ The toxins will have no effect if the residence time is short.

***Carbon** Environmental Planning*

Results of Elm Lake Testing

Recent testing of water from Elm Lake reveals high toxin content. These toxins are the result of waste from a nearby Dana plant. Immediate action by Dana Corp. is necessary. Because of the **water cycle,** toxins will not remain confined to Elm Lake.

Evaporation will cause **liquid** toxins to become **vapor**. Even frozen toxins can escape in the winter through **sublimation.** When toxins evaporate, they move through the atmosphere through **advection.** Then, through **condensation**, they mix with rain. These toxins may harm crops and livestock. Even crops that are unaffected by the toxins may release the chemicals into the atmosphere. This occurs through **transpiration.**

Through **infiltration**, some of the toxic chemicals may also enter the water table. From there, they could enter the Freedman **Aquifer**. This would mean that the drinking water for seven counties would contain toxins.

All of these ill effects could occur even if the toxins have a very short **residence time** in the lake. The best solution would be to prevent the toxins from entering the **hydrologic cycle**.

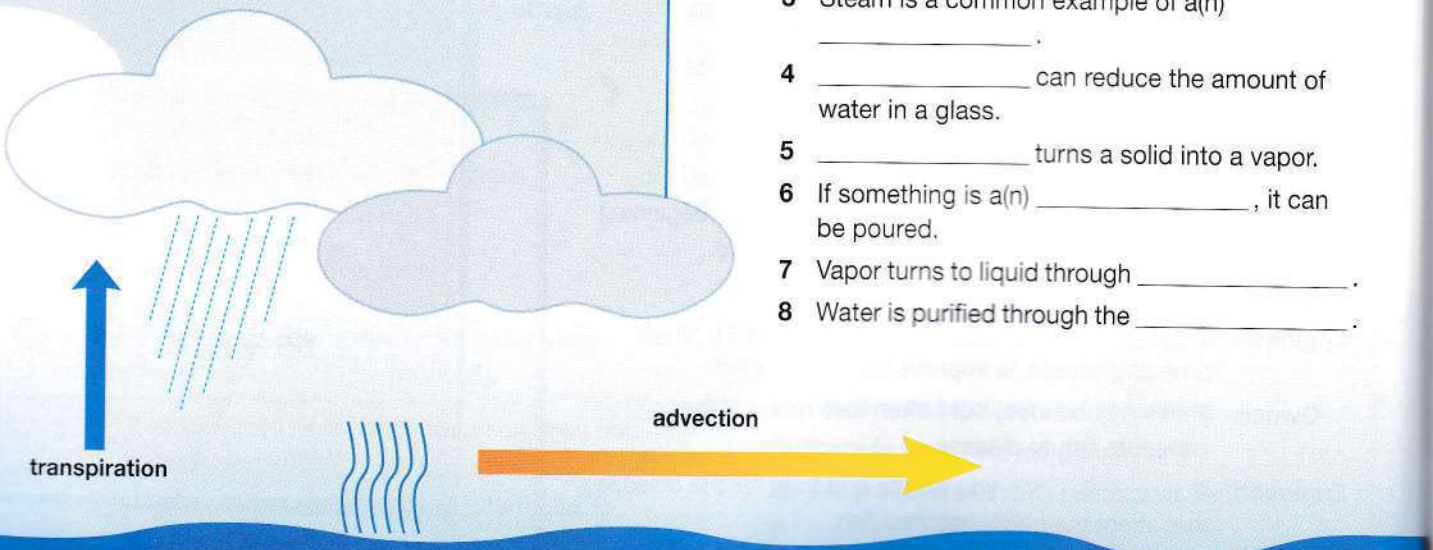
Vocabulary

3 Fill in the blanks with the correct words or phrases from the word bank.

word BANK

water cycle evaporation sublimation
residence time vapor liquid
condensation aquifer

1 The water's _____ in the lake was six days.
2 The _____ is a source of water for the entire region.
3 Steam is a common example of a(n) _____.
4 _____ can reduce the amount of water in a glass.
5 _____ turns a solid into a vapor.
6 If something is a(n) _____, it can be poured.
7 Vapor turns to liquid through _____.
8 Water is purified through the _____.



4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **hydrologic cycle / transpiration**

A The plants released the toxins during the _____ process.

B The _____ redistributes water throughout the Earth.

2 **infiltration / advection**

A The aquifer was filled through _____.

B Water moves through the atmosphere through _____.

5 🎧 **Listen and read the report again. Why is infiltration an important part of the water cycle?**

Listening

6 🎧 **Listen to a conversation between a business owner and an environmental engineer. Choose the correct answers.**

1 What is the conversation mainly about?

A understanding the role of the aquifer in the water cycle

B explaining how sublimation affects solids

C deciding how to stop the spread of toxins

D explaining how toxins travel with and in water

2 Where will infiltration occur?

A below the water table

B at the bottom of the lake

C in the roots of plants

D at the bottom of the aquifer

7 🎧 **Listen again and complete the conversation.**

Owner: I read your hazard report, and I've got some questions. I understand that having these chemicals in the lake is a problem. But I don't **1** _____ _____ they could make it all the way to the aquifer.

Engineer: Infiltration could take these toxins **2** _____ _____ the aquifer.

Owner: What does infiltration **3** _____ _____?

Engineer: It's the process that causes water to **4** _____ _____ the soil.

Owner: But the chemicals are not being **5** _____ _____ the ground. They're in the lake.

Engineer: That's true. But once they settle to the bottom of the lake, they come **6** _____ _____ with the soil. That's when infiltration happens.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I don't understand ...

What does ...?

Can you explain ...?

Student A: You are a business owner. Talk to Student B about:

- a hazard caused by your company
- clarifying his or her terms
- understanding the cause of the hazard

Student B: You are an environmental engineer. Talk to Student A about a hazard at his or her company.

Writing

9 **Use the conversation from Task 8 to answer a client's questions.**

Hello Carla,

After reading your report, there are a few things I need you to clear up for me.

What is advection? And why is transpiration a problem for us?

Thanks for your help,

Walt

Walt,

_____

_____

_____

_____

Carla

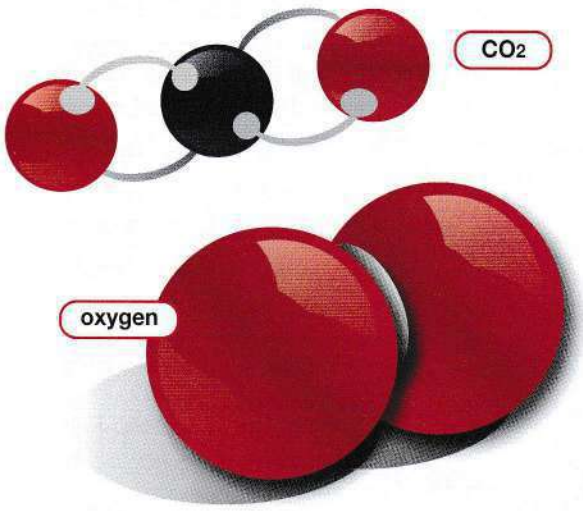
9 Carbon Cycle

Get ready!

1 Before you read the passage, talk about these questions.

1 What is the carbon cycle and what are its parts?

2 Why do environmental engineers need to understand the carbon cycle?



Carbon Emissions Challenge

Natural Processes

The **carbon cycle** is part of what makes life on Earth possible. It allows carbon, part of all living things, to **circulate** throughout the biosphere.

The most common form of carbon is **CO_2** (carbon dioxide). Organisms release CO_2 into the atmosphere. This happens when they perform **aerobic respiration** to **break down** nutrients. Plants then convert this CO_2 into **carbohydrates** for energy. This process is called **photosynthesis.** It takes carbon out of the atmosphere and releases **oxygen**. Thus, carbon is produced by some processes and removed by others.

However, human beings have disrupted the balance of the carbon cycle. We release carbon dioxide into the atmosphere by burning fossil fuels. Further, we cut down the trees that process and remove that carbon dioxide from the air. Some of this excess carbon dioxide **dissolves** into the oceans. But this happens too slowly to maintain appropriate levels. Instead, the excess carbon dioxide **diffuses** into all parts of the cycle.

Reading

2 Read the pamphlet. Then, choose the correct answers.

1 What is the purpose of the pamphlet?

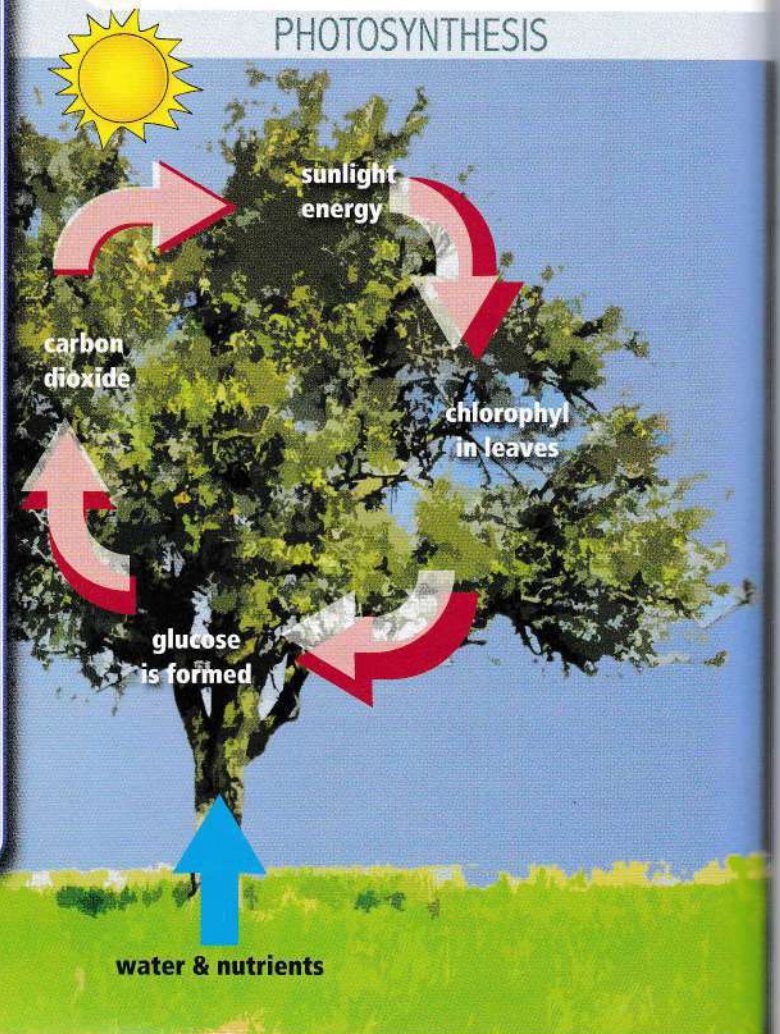
- **A** to explain human effects on the carbon cycle
- **B** to promote responsible use of fossil fuels
- **C** to explain how carbon circulates through the geosphere
- **D** to describe the history of carbon dioxide emissions

2 Which is NOT part of the natural carbon cycle?

- **A** aerobic respiration
- **B** carbohydrate conversion
- **C** nutrient diffusion
- **D** photosynthesis

3 What is one way listed that humans have unbalanced the carbon cycle?

- **A** through excessive aerobic respiration
- **B** by limiting natural carbon dioxide removal methods
- **C** by removing carbon dioxide from the air
- **D** by increasing the rate of photosynthesis



Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ CO_2
2 __ convert
3 __ circulate
4 __ diffuse
5 __ carbohydrate
6 __ aerobic respiration
7 __ photosynthesis
8 __ carbon cycle

A to spread evenly throughout an area
B process transforming sunlight into nutrients
C an energy-providing substance
D to move around or through an area
E the movement of carbon through the biosphere
F a gas released as waste
G to change from one form to another
H process changing organic material into carbon dioxide

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **carbon dioxide / oxygen**

A One of the gases many organisms breath in is _____.

B Plants remove _____ from the air.

2 **break down / dissolve**

A CO_2 is released when organisms _____ carbohydrates.

B Many solids, such as sugar, _____ completely in water.

5 Listen and read the pamphlet again. What is one way that humans affect the carbon cycle?

Listening

6 Listen to a conversation between a student and a professor. Mark the following statements as true (T) or false (F).

1 __ The man asks the woman to clarify part of the carbon cycle.
2 __ The man confuses photosynthesis and aerobic respiration.
3 __ The woman thinks it is appropriate to focus on fossil fuels.

7 Listen again and complete the conversation.

Student: Do you have a moment to **1** _____ _____ this assignment?
Professor: What do you **2** _____ _____ know?
Student: You asked us to define the role of human beings in the carbon cycle, but I'm not **3** _____ _____ what you mean.
Professor: What have you got **4** _____ _____?
Student: Well, it seems like human beings **5** _____ _____ the carbon cycle by adding extra carbon dioxide through fossil fuel emissions.
Professor: Let's try to keep it **6** _____ _____ than that.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

What do you need ...?
It seems like ...
That's not exactly what ...

Student A: You are a professor. Talk to Student B about:

- human contributions to the carbon cycle
- clarifying a question
- keeping answers basic

Student B: You are a student. Talk to Student A about humans' impact on the carbon cycle.

Writing

9 Use the pamphlet and the conversation from Task 8 to complete the assignment.

Introduction to Environmental Engineering — Quiz 4

1 What is the role of human beings in the carbon cycle?

_____

2 How has this role changed over time?

_____

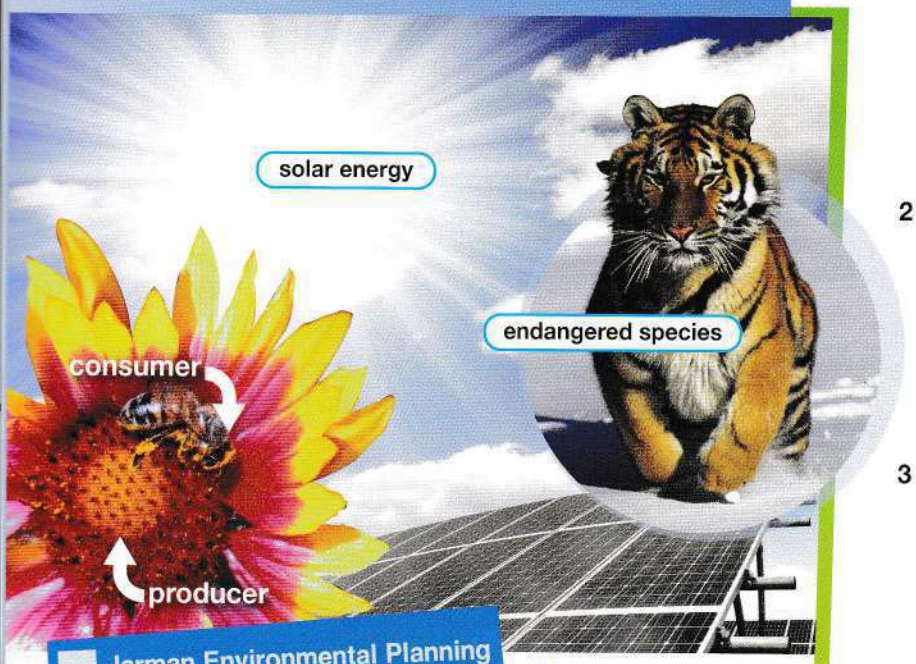
10 Energy Cycle

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some ways that organisms in a food web are interconnected?

2 Why is energy flow important to environmental engineers?



Jarman Environmental Planning

Development Projection

We have researched the possible effects of a highway encircling the city. We do not recommend constructing the highway in the planned location. This highway would bring traffic and associated business development to environments that cannot sustain them. The northern portion of the planned highway would be especially damaging environmentally. It would run through wetlands and disrupt the **energy flow** though their delicate **food web**.

The wetlands already suffer from a low **biomass**. That's because being near the city damaged the **ecological efficiency** of several **food chains**. Highway development would worsen this situation. Particularly because it would destroy key **producers** like fungi and algae. Construction waste damages wetland plants. This makes it difficult for them to process **solar energy.** This would affect several **consumers** at higher **trophic levels. Primary consumers** like crabs would suffer. This, in turn, would lessen the amount of **trophic transfer** to **secondary consumers**. The American alligator, an **endangered species**, is one of these secondary consumers.

Thus, it is our recommendation that highway development be rerouted.

Reading

2 Read the report. Then, choose the correct answers.

1 What is the purpose of the report?

- **A** to explore the financial challenges of building a highway
- **B** to explain how to preserve endangered species like alligators
- **C** to describe the environmental impact of building a highway
- **D** to explain the transfer of energy in a wetlands food web

2 Which is NOT an effect of building the highway?

- **A** damage to producers like fungi and algae
- **B** further depletion of the biomass
- **C** harm to an endangered species of alligator
- **D** increased trophic transfer to consumers like crabs

3 Why do the wetlands have a low biomass?

- **A** they are too close to the city
- **B** highway construction waste
- **C** they lack key producers
- **D** limited solar energy

Vocabulary

3 Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

trophic transfer | trophic levels | secondary consumers | primary consumers | biomass | producers | endangered species

1 Carnivores are _____ because they feed on herbivores.

2 Removing one species from an area can change its overall _____.

3 Plants are _____.

4 Plants and animals occupy different _____.

5 Herbivores, like deer, are _____.

6 _____ is the movement of energy up through a food chain.

7 A(n) _____ faces the likelihood of extinction.

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **food web / ecological efficiency**

A The area's _____ was made up of interlocking food chains.

B The area's _____ contributed to its high biomass.

2 **solar energy / energy flow**

A Trophic transfer is an important part of _____.

B Plants process _____ through photosynthesis.

3 **consumer / food chain**

A A _____ obtains energy from other organisms.

B A _____ can help us understand how organisms relate.

5 🎧 **Listen and read the report again. What is one way to protect endangered species?**

Listening

6 🎧 **Listen to a conversation between an environmental engineer and a developer. Mark the following statements as true (T) or false (F).**

1 __ The woman would prefer not to seek an alternative route.

2 __ Damage to algae will have negative effects on the alligators.

3 __ Rerouting the highway is an inexpensive solution.

7 🎧 **Listen again and complete the conversation.**

Engineer: I know you're not **1** _____ _____ the results of our study, but I'm sure we can find an alternative highway route.

Developer: **2** _____ _____ _____ an alternative route is necessary?

Engineer: Unfortunately, any construction in the northern wetlands will harm the American alligator.

Developer: Can't we **3** _____ _____ _____ to limit the damage?

Engineer: Well, if the algae and fungi **4** _____ _____, several primary consumers, like crabs, fish, and birds, will die.

Developer: But the alligators don't eat algae, do they?

Engineer: No, but they do eat the primary consumers. There's no **5** _____ _____ to know that they'll be able to find alternatives to those energy sources.

Developer: Rerouting is **6** _____ _____ _____ expensive.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Are you sure ...?

Unfortunately ...

I'm sorry ...

Student A: You are an environmental engineer. Talk to Student B about:

- problems with a proposed highway
- how the highway damages endangered species
- solutions to this problem

Student B: You are a developer. Talk to Student A about problems with a proposed highway.

Writing

9 **Use the conversation from Task 8 to fill out the preliminary project form.**

Jarman Environmental Planning

Preliminary Project Proposal

Description of the proposed project:

_____

_____

Reason for project:

_____

_____

Research required:

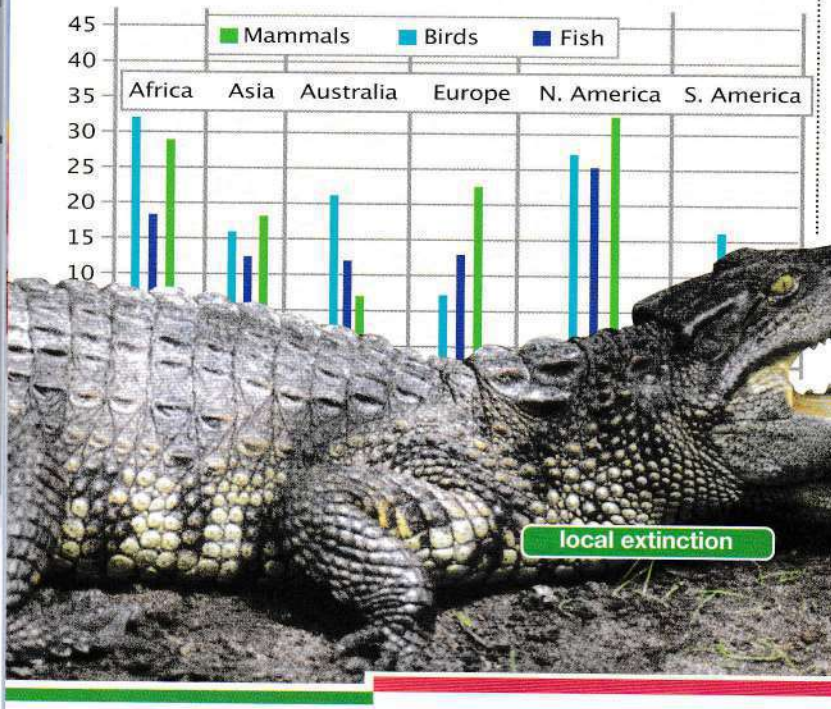
_____

_____

11 Biodiversity and Extinctions

At Jarman Environmental Planning, we are committed to maintaining **biodiversity**. There are many threats to biodiversity. Sometimes species die out for entirely natural reasons, which is called **background extinction**. But human beings cause a significant portion of the damage to biodiversity. In fact, many scientists argue that much of the **Holocene extinction** can be attributed to the spread of humans.

Human action threatens genetic **variation** and **species diversity**. We build highways through fragile habitats. We pollute the air and water. This can cause **local extinction** of important species. From there, the problem spreads. What begins as a small problem may become **ecological extinction** or even **biological extinction**. This, in turn, threatens **ecosystem diversity**. Biodiversity is not just important for the species facing **extinction**. When one species becomes **extinct**, the balance of various ecologies is threatened. This can lead to **mass extinction** of more than just a few exotic species. Eventually, the decrease in biodiversity could threaten human life as we know it.



Get ready!

1 Before you read the passage, talk about these questions.

1 Why is it important to maintain biodiversity?
2 What are some of the negative effects of extinction?

Reading

2 Read the webpage. Then, mark the following statements as true (T) or false (F).

1 __ Background extinction is the direct result of human action.
2 __ Biological extinction leads to local extinction.
3 __ Genetic variation and species diversity are threatened by human activities.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ extinct
2 __ variation
3 __ species diversity
4 __ mass extinction
5 __ local extinction
6 __ ecosystem diversity
7 __ Holocene extinction
8 __ background extinction

A differentiation among individuals
B a dramatic rise in the dying off of species
C no longer existing as a species
D the slow disappearance of a species for natural reasons
E the complete disappearance of a species from one area
F the variety of species in an area
G the disappearance of species during the current geological era
H the variety of ecosystems in an area

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **biological extinction / ecological extinction**

A If a species undergoes _____, an isolated few members remain.

B Species that face _____ disappear entirely from the earth.

2 **biodiversity / extinction**

A _____ is an important part of a successful ecology.

B Volunteers work hard to prevent endangered species' _____.

5 🎧 **Listen and read the webpage again. How do local extinctions affect larger ecosystems?**

Listening

6 🎧 **Listen to a conversation between two environmental engineers. Choose the correct answers.**

1 How did industrial development affect biodiversity?

A It destroyed the leopard frog's habitat.

B It caused the ecological extinction of the leopard frog.

C It disrupted leopard frog mating habits.

D It killed off the leopard frog's predators.

2 What solution does the man offer?

A introducing another frog species

B crossbreeding leopard frogs with a hardier species

C removing the leopard frog's predators

D improving the leopard frog's habitat

7 🎧 **Listen again and complete the conversation.**

Engineer: I just got **1** _____ _____ _____ the wildlife survey from the Clinton Industrial Park.

Coworker: How does it look?

Engineer: Unfortunately, **2** _____ _____ the local species of leopard frog has suffered local extinction.

Coworker: What happened?

Engineer: It's the industrial development. It's affected **3** _____ _____ more than we expected.

Coworker: **4** _____ _____ that affect biodiversity in the area?

Engineer: I'm **5** _____ _____ the leopard frog's disappearance. It may cause predators to deplete the numbers of other frog species.

Coworker: What can we do?

Engineer: I'm considering **6** _____ _____ introduce a hardier species of frog to replace the leopard frog.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I just got the results of ...

How will ...?

I'm concerned that ...

Student A: You are an environmental engineer. Talk to Student B about:

- biodiversity at a development site
- a local extinction
- the effects of that extinction

Student B: You are an environmental engineer. Talk to Student A about an extinction.

Writing

9 **Use the conversation from Task 8 to write a wildlife survey report.**

Jarman Environmental Planning

Wildlife Survey Report

How has biodiversity been affected by development in the region?

_____

_____

_____

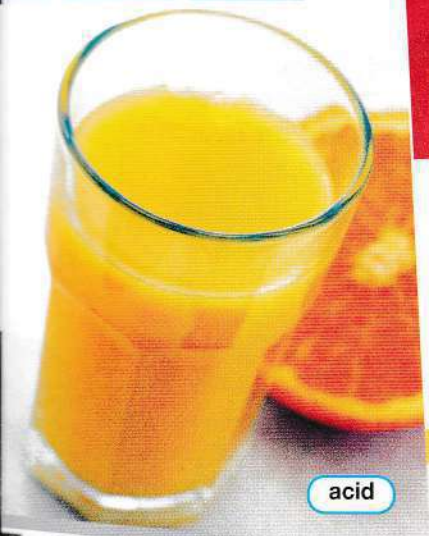
How do you plan to improve biodiversity in the region?

_____

_____

_____

12 Environmental Chemistry



CHEM 102
Course Description

This course introduces students to the basics of **chemistry**. It includes both a lecture and a laboratory section. This course serves as a prerequisite for CHEM 103 (**Organic Chemistry**).

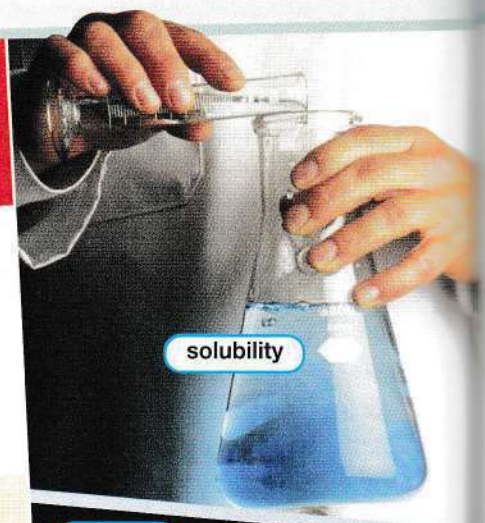
The course will be divided into four units. Each unit will be tested separately. The final exam will cover all four units.

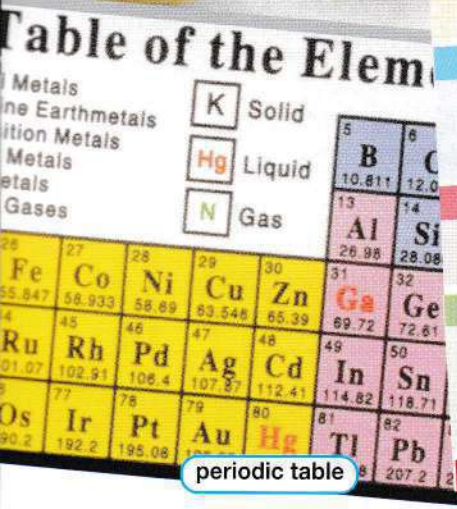
Unit 1—Basic concepts: This unit will introduce students to key chemical concepts. The concepts will be used throughout the course. They include the **periodic table** and the basics of atomic structure.

Unit 2—Reactions: Unit 2 will cover important types of chemical reactions. We will focus on **endothermic** and **exothermic** reactions. We will also learn the **equation** for calculating the **enthalpy** of a system.

Unit 3—**pH scale**: This unit will focus on what makes a substance an **acid** or a **base**. It will also cover the effects of **solubility** on pH **balance**.

Unit 4—**Stoichiometry**: The final unit will introduce students to stoichiometry. This focus on reaction ratios will prepare students for CHEM 103.





equation

$A2+B2=C2$

stoichiometry

$2H_2+O_2 \rightarrow 2H_2O$

Get ready!

1 Before you read the passage, talk about these questions.

1 Why is chemistry an important part of understanding the environment?

2 What are some common types of reactions that chemists study?

Reading

2 Read the course description. Then, mark the following statements as true (T) or false (F).

1 ___ The course is intended for advanced chemistry students.

2 ___ Unit 1 covers types of chemical reactions.

3 ___ The last unit prepares students for Organic Chemistry.

Vocabulary

3 Fill in the blanks with the correct words from the word bank.

WORD BANK

balance endothermic base
equation acid solubility exothermic

1 The substance had high _____ and, thus, dissolved immediately.

2 The _____ reaction failed because it required too much heat.

3 Be careful not to burn your skin when handling a(n) _____.

4 The students had to learn the _____ for converting joules to calories.

5 The _____ reaction was dangerous because it gave off excessive heat.

6 The chemist needed to determine the pH _____ of the compound.

7 Use a(n) _____ to neutralize acidic substances.

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **organic chemistry / stoichiometry**

A _____ analyzes reactions involving carbon compounds.

B _____ analyzes the ratios in chemical reactions.

2 **periodic table / pH scale**

A The _____ organizes all known elements.

B Milk is near the middle of the _____.

3 **enthalpy / chemistry**

A Adding heat increases the _____ of a system.

B _____ studies matter's reactions and interactions.

5 🎧 **Listen and read the course description again. What is one important basic concept in chemistry?**

Listening

6 🎧 **Listen to a conversation between a professor and a student. Choose the correct answers.**

1 What is the man's usual enrollment policy?

A Students must pass a qualifying exam.

B Students must also enroll in Organic Chemistry.

C Late enrollment is not usually allowed.

D All students must enroll in study groups.

2 What concepts does the woman explain?

A exothermic reactions **C** enthalpy

B the periodic table **D** stoichiometry

7 🎧 **Listen again and complete the conversation.**

Student: Professor Adams, did you get my email about enrolling?

Professor: I don't **1** _____ allow enrollment this late in the session. I doubt you could catch up with the other students.

Student: I understand, Professor. But I was enrolled in a similar class at my last school. I think **2** _____ _____.

Professor: We've been moving quickly these first few weeks. I'm **3** _____ _____ you would be able to handle the key concepts. What can you tell me about the periodic table?

Student: It **4** _____ elements by atomic number.

Professor: Good. Are you **5** _____ _____ the pH scale?

Student: Yes, sir. It measures the acid or base **6** _____ _____ a substance.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I doubt ...

I'm not sure ...

What can you tell me about ...?

Student A: You are a professor. Talk to Student B about:

- your enrollment policy
- ideas he or she needs to be familiar with
- exceptions to your policy

Student B: You are a student. Talk to Student A about enrolling in his or her class.

Writing

9 **Use the course description and the conversation from Task 8 to write an answer to an email from a study group.**

Hi Lara,

Before you join our study group, we have a few questions.

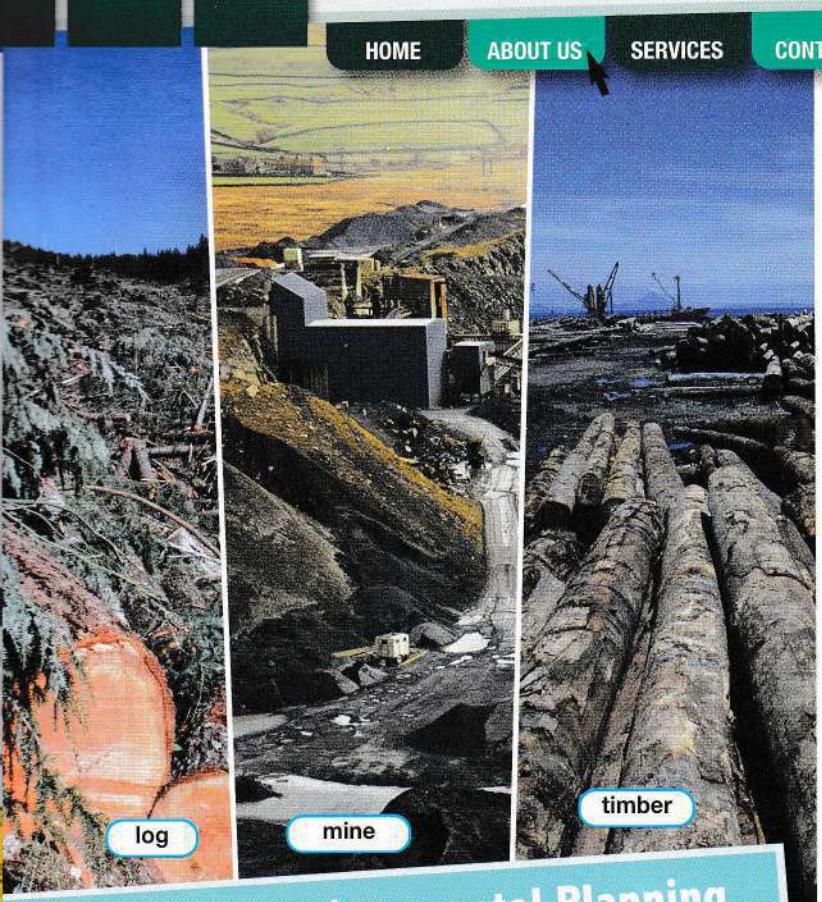
1 How familiar are you with the periodic table?

2 What chemistry concepts do you find particularly easy or challenging?

Thanks,

Monica

13 Resources



Jarman Environmental Planning Resource Management Services

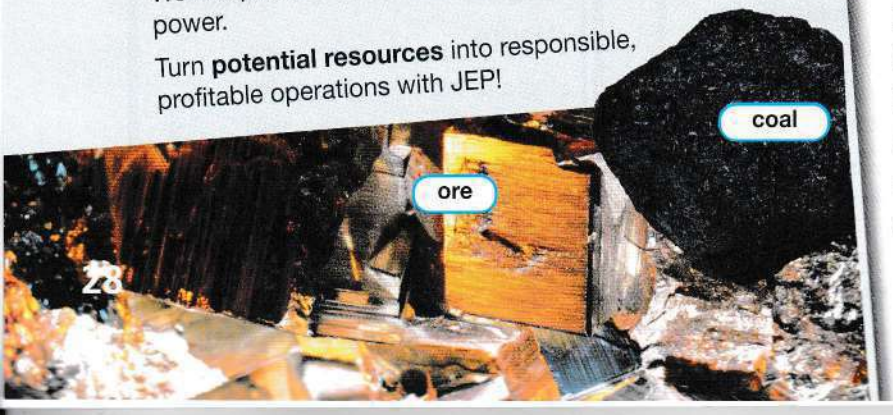
We provide consulting services for companies working with natural resources. We know that it is important to your company to produce a **sustainable yield**. Whether you want to **extract coal** or **log timber**, we can help you do it responsibly.

Our geological survey services will help your company **mine** valuable **ore** without destroying important habitats. Our experience with drilling operations makes us a great fit with **oil**, **petroleum,** and **natural gas** companies. We also provide services to **fisheries**. We can help you improve your facilities. With our help, you can meet and exceed environmental regulations.

JEP also provides our clients with legal services. Our lawyers can help you manage the legal risks of mining substances like **uranium**. They can also work with managers to clarify regulations.

At Jarman Environmental Planning, we are committed to developing the technology to access **stock resources**. We are particularly excited about accessing **hydrogen** power.

Turn **potential resources** into responsible, profitable operations with JEP!



Get ready!

1 Before you read the passage, talk about these questions.

1 What are some common natural resources humans use?

2 Why do environmental engineers need to understand how resources are used?

Reading

2 Read the webpage. Then, choose the correct answers.

1 What is the purpose of the passage?

A to explain why sustainable use is important
B to analyze regulations on resources
C to describe services for resource companies
D to explain how to access stock resources

2 Which of the following does the company NOT do?

A lobby to change resource regulations
B manage legal risks associated with mining
C assure compliance with regulations
D develop technology for stock resources

3 What action do the company's lawyers perform?

A suing companies that break regulations
B managing the legal risks of fisheries
C determining risks to habitats
D teaching managers about regulations

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ hydrogen
2 __ uranium
3 __ fishery
4 __ timber
5 __ extract
6 __ natural gas
7 __ sustainable yield

A a fossil fuel
B a place where fish are bred or caught
C trees cut down for human use
D an element contained in water
E level of use that does not deplete a resource
F to pull or take out something from somewhere
G an element used in nuclear power

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **mine / log**

A The company needed legal permission to _____ uranium.

B If you _____ this hillside, you will destroy owl habitats.

2 **petroleum / coal**

A _____ is used to produce electricity.

B We use billions of barrels of _____, or crude oil, daily.

3 **potential resource / stock resource**

A The nation's oil is a major _____.

B A _____ can't be accessed at present.

4 **ore / oil**

A The US economy depends on _____.

B The land is rich in iron _____.

5 Listen and read the webpage again. Why is sustainable yield an important part of using natural resources?

Listening

6 Listen to a conversation between a representative and an engineer. Mark the following statements as true (T) or false (F).

1 __ The woman works for a logging company.

2 __ The woman's company needs advice about water pollution.

3 __ The man's company has experience with natural gas.

7 Listen again and complete the conversation.

Engineer: JEP, Mike Hanson speaking.

Rep.: I work for Northern Natural Gas, and I'm **1** _____ _____ a few questions about your services.

Engineer: What would you like to know?

Rep.: We're in the planning **2** _____ of opening a new natural gas field. We need to hire a consultant.

Engineer: I think our firm would be a **3** _____ _____. We have extensive experience with natural gas.

Rep.: We're particularly concerned about **4** _____ _____. Do you have experience in that area?

Engineer: Yes. We have one engineer in particular who is **5** _____ _____ with preventing water pollution.

Rep.: Does she understand the legal **6** _____ _____ _____ as well?

Engineer: All of our engineers are up-to-date on current regulations.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

We have extensive experience with ...

We are concerned about ...

... very familiar with ...

Student A: You are a representative of an energy company. Talk to Student B about:

- consulting services your company needs
- the capabilities of his or her consultants
- what is included with fees

Student B: You are an environmental engineer. Talk to Student A about your company's capabilities.

Writing

9 Use the conversation from Task 8 to complete the agreement.

Jarman Environmental Planning

Consultant Agreement Form

The company agrees to provide consulting services for the following project: _____

_____

_____

Areas of consultation include: _____

_____

_____

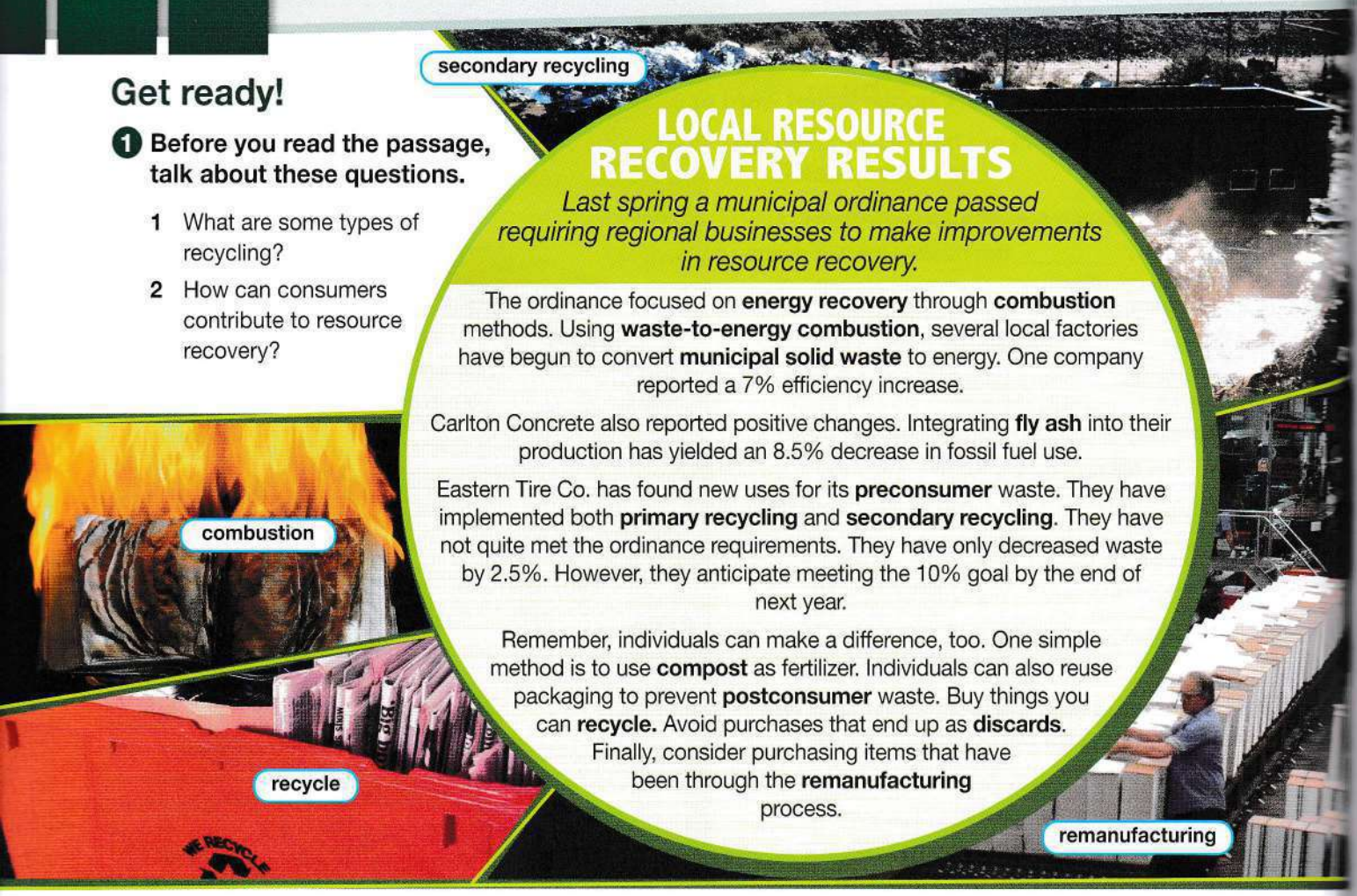
14 Resource Recovery

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some types of recycling?

2 How can consumers contribute to resource recovery?



LOCAL RESOURCE RECOVERY RESULTS

Last spring a municipal ordinance passed requiring regional businesses to make improvements in resource recovery.

The ordinance focused on **energy recovery** through **combustion** methods. Using **waste-to-energy combustion**, several local factories have begun to convert **municipal solid waste** to energy. One company reported a 7% efficiency increase.

Carlton Concrete also reported positive changes. Integrating **fly ash** into their production has yielded an 8.5% decrease in fossil fuel use.

Eastern Tire Co. has found new uses for its **preconsumer** waste. They have implemented both **primary recycling** and **secondary recycling**. They have not quite met the ordinance requirements. They have only decreased waste by 2.5%. However, they anticipate meeting the 10% goal by the end of next year.

Remember, individuals can make a difference, too. One simple method is to use **compost** as fertilizer. Individuals can also reuse packaging to prevent **postconsumer** waste. Buy things you can **recycle.** Avoid purchases that end up as **discards**. Finally, consider purchasing items that have been through the **remanufacturing** process.

Reading

2 Read the newspaper article. Then, choose the correct answers.

1 What is the purpose of the article?

- **A** to report on local efforts to improve resource recovery
- **B** to encourage readers to boycott irresponsible businesses
- **C** to describe how to get resource recovery ordinances passed
- **D** to report businesses' failure to comply with an ordinance

2 Which is NOT a method of resource recovery discussed in the article?

- **A** remanufacturing
- **B** waste-to-energy combustion
- **C** recycling
- **D** discarding

3 What is true of Eastern Tire Co.?

- **A** They are converting municipal solid waste.
- **B** They produce remanufactured goods.
- **C** They have not met their waste reduction goal.
- **D** Their fossil fuel use decreased by 8.5%.

Vocabulary

3 Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

compost discards combustion incinerate postconsumer recycle fly ash preconsumer

1 The restaurant used _____ from the kitchen to fertilize the garden.

2 The concrete company used _____ to improve their product.

3 _____ is a key source of heat energy.

4 _____ waste is produced during the manufacturing process.

5 _____ waste is left over when a consumer uses a product.

6 Things like batteries and medicines are _____ and can't be recycled.

7 Three ways to help the environment are to reduce, reuse, and _____ .

8 After we _____ the waste, we'll need to dispose of the ashes.

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **waste-to-energy combustion / municipal solid waste**

A _____ converts trash into a resource.

B The city produces a lot of _____.

2 **energy recovery / remanufacturing**

A _____ is one way of reusing consumer products.

B _____ can greatly improve a system's efficiency.

3 **primary recycling / secondary recycling**

A Using tire rubber to create other rubber products is _____.

B Converting used paper into new paper is an example of _____.

5 Listen and read the newspaper article again. What is one example of resource recovery on the individual level?

Listening

6 Listen to a conversation between a city manager and an engineer. Mark the following statements as true (T) or false (F).

1 __ Energy recovery rates have improved.

2 __ The city needs to purchase different incinerators.

3 __ The woman's grant application was denied.

7 Listen again and complete the conversation.

City Manager: My secretary mentioned you wanted to talk over energy recovery with me. What's on your mind?

Engineer: Since that ordinance passed, we've seen major **1** _____ _____ recovery efforts.

City Manager: That's great news. Have we met all of the **2** _____ _____ _____?

Engineer: Not quite. We're getting there. But the results are **3** _____.

City Manager: How so?

Engineer: There have been definite improvements in energy recovery and recycling efforts. But our waste-to-energy combustion efforts have **4** _____ _____ setbacks.

City Manager: What do **5** _____ _____?

Engineer: We need more money to purchase the **6** _____ _____ _____ incinerators.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Have we met ...?

... results are ...

We need ...

Student A: You are an environmental engineer. Talk to Student B about:

- results of resource recovery efforts
- things that are going well
- challenges you face

Student B: You are a city manager. Talk to Student A about results of resource recovery efforts.

Writing

9 Use the conversation from Task 8 to write a preliminary grant application.

Federal Public Works Funding

Preliminary Grant Application

Briefly describe the project for which you are requesting funding: _____

_____

_____

Explain why federal funds are necessary to complete this project: _____

_____

_____

15 Atmospheric Change

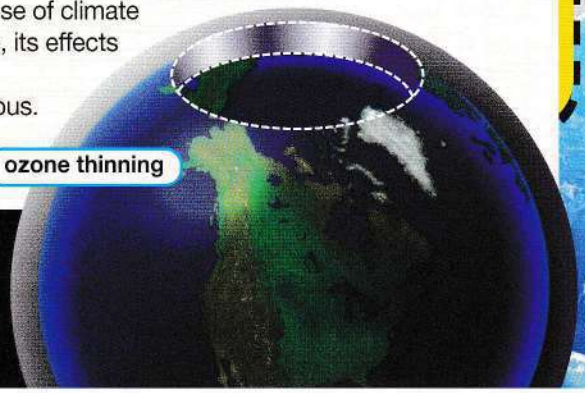
Climate Concerns in the 21st Century

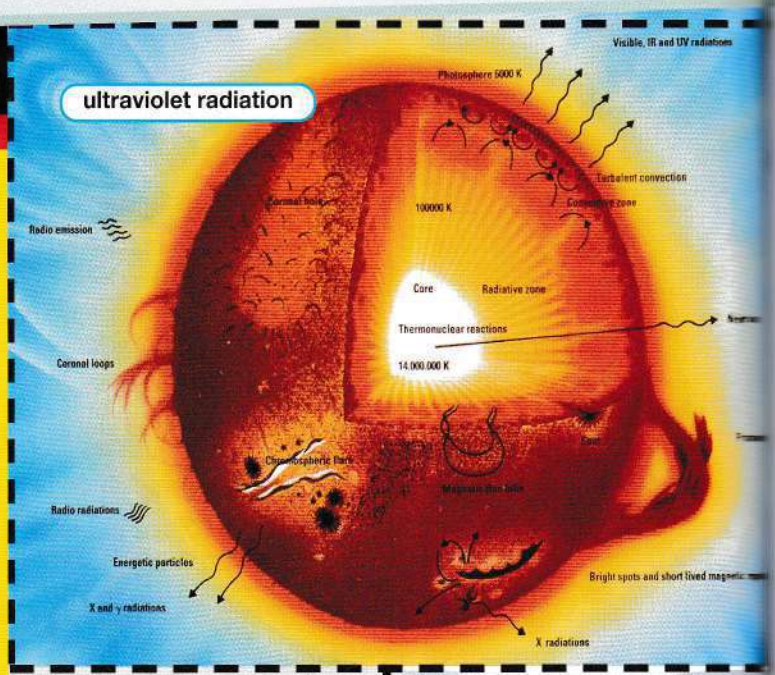
by Martin Kenway

Climate change is widely recognized as one of the most important ecological issues of the 21st century. The 20th century saw several efforts to reverse human damage. The 1992 **Copenhagen Protocol** worked to prevent **ozone thinning**. As a result, **ultraviolet radiation** levels are rising more slowly. The **Kyoto Protocol** targeted production of greenhouse gases like **CFCs** and **carbon dioxide** in 2005. Nations involved in the agreement regulated the use of **Freon** and **methane** gases. This has contributed to minimizing the **greenhouse effect**.

These efforts were admirable and useful. We need new agreements like these that directly attack 21st century problems. Some of our richest ecosystems, like rainforests and wetlands, are nearing their **tipping points**. **Sea levels** are rising due to **glacial** melt. In some places, even the **permafrost** is threatened. If enough of that cold water enters the oceans, **thermohaline circulation** could stop. Such an event could lead to a dangerous drop in global temperatures.

National and international efforts are needed. Whatever the cause of climate change, its effects can be disastrous.





Get ready!

1 Before you read the passage, talk about these questions.

1 What are some factors that may contribute to climate change?

2 What steps have some nations taken to prevent human damage to the atmosphere?

Reading

2 Read the journal article. Then, mark the following statements as true (T) or false (F).

1 __ The Kyoto Protocol came before the Copenhagen Protocol.

2 __ Melting glaciers are leading to a rise in sea levels.

3 __ A loss of thermohaline circulation could cause rising temperatures.

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ permafrost
2 __ glacial
3 __ methane
4 __ sea level
5 __ CFC
6 __ ultraviolet radiation
7 __ carbon dioxide

A lasting layer of frozen soil
B a compound dangerous to the ozone
C very cold or related to ice
D a molecule formed during respiration and combustion
E the height of the ocean relative to land
F solar energy harmful to some organisms
G a greenhouse gas often produced by humans and animals

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **climate change / greenhouse effect**

A The _____ is the trapping of heat by gases such as carbon dioxide and methane.

B _____ is a process that takes place over a long period.

2 **tipping point / ozone thinning**

A When a rainforest reaches its _____, deforestation begins.

B _____ contributes to ultraviolet radiation.

3 **Copenhagen Protocol / Kyoto Protocol**

A The _____ deals with ozone depletion.

B The _____ requires the reduction of greenhouse gases.

4 **thermohaline circulation / Freon**

A _____ is used in some refrigerators as a coolant.

B _____ keeps heat moving through the ocean.

5 Listen and read the journal article again. What is one effect of glacial melt?

Listening

6 Listen to a conversation between two environmental engineers. Choose the correct answers.

1 Which part of the article do the man and woman disagree on?

A its statements about greenhouse gases
B its argument about international agreements
C its statements about thermohaline circulation
D its claim that global warming is a problem

2 What do the two engineers agree about?

A the effects of stopping thermohaline circulation
B the need to combat atmospheric change
C how glacial melt problems are spread
D how to mitigate the effects of global warming

7 Listen again and complete the conversation.

Eng. 1: Did you read Kenway's article on 21st century climate change?

Eng. 2: I did. What **1** _____ _____ _____ of it?

Eng. 1: I'm not sure that stopping thermohaline circulation **2** _____ _____ harmful.

Eng. 2: Really? You think that if thermohaline circulation stopped that would be **3** _____ _____ _____?

Eng. 1: Yeah. It could actually mitigate the **4** _____ _____ global warming.

Eng. 2: I **5** _____. I think it would be devastating.

Eng. 1: **6** _____ _____ _____ _____ you would think that. But I still think there could be some positive effects.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

What did you think ...? / I disagree ...

I can see why ...

Student A: You are an environmental engineer. Talk to Student B about:

- an article on climate change
- your opinion of the article
- a claim you disagree about

Student B: You are an environmental engineer. Talk to Student A about a claim you disagree on.

Writing

9 Use the journal article and the conversation from Task 8 to write an email.

Dear Prof. Kenway,

After reading your article, I have a few questions for you.

1 What do you think is the most important environmental problem of the 21st century?

2 Do you believe that international agreements will continue to be effective?

Thanks for taking the time to answer my questions.

Sincerely,
Kerry Powers

Glossary

ABET [N-UNCOUNT-U2] The **ABET** (American Board for Engineering and Technology) is the governing body that grants accreditation to university engineering degree programs in the United States.

ability [N-UNCOUNT-U1] **Ability** is capability or talent.

accredited [ADJ-U2] Something that is **accredited** has been officially recognized by a governing body as meeting certain basic requirements.

acid [N-COUNT-U12] An **acid** is a corrosive or dissolving substance that neutralizes basic substances.

advection [N-COUNT-U8] **Advection** is the water's movement throughout the atmosphere and around the Earth.

aerobic respiration [N-UNCOUNT-U9] **Aerobic respiration** is a process performed by consumers by which complex organic compounds are converted into CO_2.

analysis [N-COUNT-U4] **Analysis** is the act of closely examining something.

approach [N-COUNT-U4] An **approach** is how you deal with something.

aquifer [N-COUNT-U8] An **aquifer** is an area in the ground that collects water by infiltration.

attack [V-T-U4] To **attack** something is to attempt to solve it.

bachelor's degree [N-COUNT-U2] A **bachelor's degree** is an undergraduate degree that is awarded upon completion of a course of study that typically lasts four years.

background extinction [N-UNCOUNT-U11] **Background extinction** is a low rate of extinction that occurs naturally as environmental conditions change.

balance [N-UNCOUNT-U12] **Balance** is a state of even distribution or equilibrium.

base [N-COUNT-U12] A **base** is a caustic chemical substance that neutralizes acidic substances.

biodiversity [N-UNCOUNT-U11] **Biodiversity** is the presence of a variety of life forms in a particular environment.

biological extinction [N-UNCOUNT-U11] **Biological extinction** is complete extinction of a species, so that no individual from that species exists anywhere.

biomass [N-UNCOUNT-U10] **Biomass** is the dry weight of a group of organisms and is used as a way of measuring the energy in a particular trophic level.

break down [V-I or T-U9] To **break down** is to separate substances into simpler parts.

carbohydrate [N-COUNT-U9] A **carbohydrate** is a substance made up of carbon, oxygen, and hydrogen that provides heat and energy when consumed by an organism.

carbon [N-UNCOUNT-U9] **Carbon** is an element that is found in all living things.

carbon cycle [N-COUNT-U9] The **carbon cycle** is the process by which carbon moves throughout the biosphere.

carbon dioxide [N-UNCOUNT-U15] **Carbon dioxide** (CO_2) is a compound formed from carbon and oxygen that is absorbed by producers during photosynthesis and is released into the atmosphere through respiration.

CFC [N-COUNT-U15] A **CFC** (chlorofluorocarbon) is a compound used to make coolants, propellants, cleaners, and other products.

chemistry [N-UNCOUNT-U12] **Chemistry** is the branch of scientific inquiry that deals with the basic chemical components of matter.

circulate [V-I-U9] To **circulate** is to move continuously throughout a space.

climate change [N-UNCOUNT-U15] **Climate change** is a long-term alteration in weather patterns due to either natural processes or actions by humans.

closed system [N-COUNT-U7] A **closed system** is a system that is not affected or influenced by outside factors or that does not transfer mass in or out.

CO_2 [N-UNCOUNT-U9] **CO_2** (carbon dioxide) is a compound formed from carbon and oxygen that is absorbed by producers during photosynthesis and released into the atmosphere through respiration.

coal [N-UNCOUNT-U13] **Coal** is a type of fossil fuel in the form of a dark, hard substance.

combustion [N-UNCOUNT-U14] **Combustion** is the chemical combination of other substances with oxygen, which releases light and heat.

commitment [N-UNCOUNT-U1] **Commitment** is dedication to something.

compost [N-UNCOUNT-U14] **Compost** is rotted organic matter used as fertilizer.

conclusion [N-COUNT-U3] A **conclusion** is a decision or determination that is made after an experiment.

condensation [N-UNCOUNT-U8] **Condensation** is the process of changing from a vapor into a liquid.

consumer [N-COUNT-U10] A **consumer**, also called a heterotroph, is an organism that gets its nutrients by feeding on other organisms.

consumption [N-UNCOUNT-U7] **Consumption** is the act of using, or consuming, something.

control group [N-COUNT-U3] A **control group** is a part of an experiment that does not receive the substance or treatment that is being tested.

convert [V-T-U6] To **convert** something is to change it into a different form or system of measurement.

Copenhagen Protocol [N-COUNT-U15] The **Copenhagen Protocol** is an international agreement in which nearly 200 countries promised to phase out the use of products that deplete ozone.

critical thinking [N-UNCOUNT-U1] **Critical thinking** is the process of analyzing a problem or situation carefully in order to come to a reasoned decision.

cubed [ADJ-U5] If a number is **cubed**, it is multiplied by itself twice. For instance, 2 cubed (2^3) is 8 because $2\times2\times2=8$.

curious [ADJ-U1] If someone is **curious**, he or she is inquisitive and likes to learn new things.

decimal number [N-COUNT-U6] A **decimal number** is a number that contains a decimal point.

dedicated [ADJ-U1] If someone is **dedicated**, he or she is devoted to a task or role.

denominator [N-COUNT-U6] A **denominator** is the number below the line in a fraction. It is also called a devisor.

diffuse [V-I or T-U9] To **diffuse** something is to spread it out over a large area.

discard [N-COUNT-U14] A **discard** is a thrown-away item that cannot be recycled.

dissolve [V-I or T-U9] To **dissolve** is to turn into a liquid solution, usually by adding a solid in liquid and thus becoming part of that liquid.

doctorate [N-COUNT-U2] A **doctorate** is a postgraduate degree that typically represents the highest possible level of study in a particular field. It is achieved through several years of study beyond the initial undergraduate degree.

EAB [N-UNCOUNT-U2] The **EAB** (Engineering Accreditation Board) is the governing body that grants accreditation to university engineering degree programs in the United Kingdom.

ecological efficiency [N-UNCOUNT-U10] **Ecological efficiency** is a measure of the amount of usable energy that is transferred from one trophic level to the next.

ecological extinction [N-UNCOUNT-U11] **Ecological extinction** is a situation in which a very small number of individuals in a species are still alive, and not enough of them exist for the species to perform its ecological role in the community.

ecosystem diversity [N-UNCOUNT-U11] **Ecosystem diversity** is a measurement of the variety of different ecosystems in a particular area.

endangered species [N-COUNT-U10] An **endangered species** is a species that has become very rare and is at risk of becoming extinct.

endothermic [ADJ-U12] If a reaction is **endothermic**, it absorbs heat.

energy flow [N-UNCOUNT-U10] **Energy flow** is the movement of energy through the food chain.

energy recovery [N-COUNT-U14] **Energy recovery** is the use of methods or techniques to reduce the energy input necessary for a system by exchanging energy between sub-sets of the system.

enthalpy [N-UNCOUNT-U12] **Enthalpy** is the total amount of energy in a given system.

Glossary

equation [N-COUNT-U12] An **equation** is a statement that two mathematical expressions are equal.

evaluate [V-T-U3] To **evaluate** something is to judge something or draw a conclusion about something after thinking carefully about it.

evaporation [N-UNCOUNT-U8] **Evaporation** is the process of changing from a liquid into a gas.

exothermic [ADJ-U12] If a reaction is **exothermic**, it releases heat.

experiment [N-COUNT-U3] An **experiment** is a scientific process that is designed to reveal the effect of something.

experimental group [N-COUNT-U3] An **experimental group** is a part of an experiment that receives the substance or treatment that is being tested.

expertise [N-UNCOUNT-U1] **Expertise** is knowledge or experience in a certain field.

exponent [N-COUNT-U5] An **exponent**, usually represented by a small superscript number, shows how many times a number is multiplied by itself. For instance, in the formula $2^3=8$, the small number 3 is the exponent, indicating that the number 2 should be multiplied by itself 3 times.

extensive quantity [N-COUNT-U7] An **extensive quantity** is a measurement that changes with the amount of a substance. For instance, mass is an extensive quantity because it increases as the amount of a substance is increased.

extinct [ADJ-U11] If a species is **extinct**, all of its members have died and no longer exist.

extinction [N-UNCOUNT-U11] **Extinction** is a situation in which all of the members of a species have died.

extract [V-T-U13] To **extract** something is to remove something from a particular place, often from an enclosed area.

final [ADJ-U7] If something is **final**, it exists or occurs at the end of something.

fishery [N-COUNT-U13] A **fishery** is an area where fish are raised or caught for consumption.

fly ash [N-UNCOUNT-U14] **Fly ash** is a waste product of burning coal that is used to make concrete more flexible.

focus [V-I-U1] To **focus** is to pay close, sustained attention.

food chain [N-COUNT-U10] A **food chain** is a system of organisms in which each organism is the source of food for the next organism in the chain.

food web [N-COUNT-U10] A **food web** is a network of food chains in which a single organism might belong to multiple food chains.

fraction [N-COUNT-U6] A **fraction** is a part of the whole. In mathematics, it is usually represented as two numbers divided by a line or bar.

Freon [N-UNCOUNT-U15] **Freon** is a product that is made with CFCs.

generation [N-UNCOUNT-U7] The **generation** of something is its creation.

glacial [ADJ-U15] If something is **glacial**, it is related to ice or glaciers.

goal-oriented [ADJ-U1] If someone is **goal-oriented**, he or she is focused on accomplishing their objectives.

greenhouse effect [N-UNCOUNT-U15] The **greenhouse effect** is the process by which heat from the sun is trapped near the Earth's surface by greenhouse gases, which can result from human or natural activities.

Holocene extinction [N-UNCOUNT-U11] The **Holocene extinction** is the period of species extinction occurring in the current geological period, from about 10,000 BC to the present.

hundredths [N-PLURAL-U5] **Hundredths** are parts of one divided one hundred times.

hydrogen [N-UNCOUNT-U13] **Hydrogen** is an element that is found in water and can be burned as a fuel.

hydrologic cycle [N-UNCOUNT-U8] The **hydrologic cycle**, also called the water cycle, is the process by which water is purified and redistributed naturally around the Earth.

hypothesis [N-COUNT-U3] A **hypothesis** is an idea or statement that is not proven.

incinerate [V-T-U14] To **incinerate** organic waste is to burn it in order to produce energy.

independent variable [N-COUNT-U3] An **independent variable** is the factor that changes from one group to another.

infiltration [N-UNCOUNT-U8] **Infiltration** is the process of water passing into the soil from the surface of the ground.

initial [ADJ-U7] If something is **initial**, it exists or occurs at the beginning of something.

innovative [ADJ-U1] If someone is **innovative**, he or she is creative and resourceful.

input [N-UNCOUNT-U7] **Input** is something that is entered into a system.

intensive quantity [N-COUNT-U7] An **intensive quantity** is a measurement that does not change with the amount of a substance. For instance, density is an intensive quantity because it does not change if the amount of a substance is increased or decreased.

iteration [N-COUNT-U4] An **iteration** is a single instance of something done repeatedly.

iterative procedure [N-COUNT-U4] **Iterative procedure** is the act of doing something over and over with slight changes until you perfect it.

Kyoto Protocol [N-UNCOUNT-U15] The **Kyoto Protocol** is an international agreement that outlines goals for decreasing 1990 greenhouse emissions levels by 5% by the year 2012.

leading zero [N-COUNT-U5] A **leading zero** is a zero that leads a number string.

liquid [N-COUNT-U8] A **liquid** is a fluid substance, such as water, in a form that is able to flow freely.

local extinction [N-UNCOUNT-U11] **Local extinction** is a situation in which the entire population of a species dies out in a particular area, but the species still exists in other places.

log [V-T-U13] To **log** an area is to cut down trees in the area.

logical [ADJ-U1] If something is **logical**, it is rational and reasonable.

mass extinction [N-UNCOUNT-U11] **Mass extinction** is a sudden rise in extinction rates, usually brought on by a widespread, catastrophic event.

master's degree [N-COUNT-U2] A **master's degree** is a postgraduate degree that is awarded to people who have developed a level of mastery over a particular field. It is achieved through one or more additional years of study beyond the initial undergraduate degree.

methane [N-UNCOUNT-U15] **Methane** is a greenhouse gas that traps heat in the atmosphere and is often produced by human activities. It is also found in natural gas.

mine [V-T-U13] To **mine** something is to dig into the ground in order to extract a particular substance.

mixed number [N-COUNT-U6] A **mixed number** is a number consisting of a whole integer and a fraction.

municipal solid waste [N-UNCOUNT-U14] **Municipal solid waste** is non-liquid and non-gaseous waste created in urban areas or by households and businesses.

natural gas [N-UNCOUNT-U13] **Natural gas** is a fossil fuel in the form of hydrocarbon gas.

numerator [N-COUNT-U6] A **numerator** is the number above the line in a fraction.

observation [N-COUNT-U3] An **observation** is a fact that is discovered by watching something closely.

oil [N-UNCOUNT-U13] **Oil**, also called petroleum, is a type of fossil fuel in the form of a thick, black liquid.

open system [N-COUNT-U7] An **open system** is a system that is influenced or affected by outside factors or that transfers mass in and out.

order of magnitude [N-COUNT-U5] An **order of magnitude** is the class of scale of any amount. It usually contains a value that is of a certain ratio to the class preceding it. For example, 0.1 is one order of magnitude greater than 0.01, and 1 is one order of magnitude greater than 0.1.

ore [N-UNCOUNT-U13] **Ore** is a natural material, such as earth or rocks, from which metal is extracted.

organic chemistry [N-UNCOUNT-U12] **Organic chemistry** is the branch of scientific inquiry that deals with the chemistry of the carbon compounds present in living things.

out of [EXPRESSION-U6] To describe an amount as one number **out of** another is to express a fraction in words. For instance, the fraction $\frac{5}{6}$ can also be expressed as five out of 6.

Glossary

output [N-UNCOUNT-U7] **Output** is something yielded or produced by a system.

outside the box [ADJ PHRASE-U1] If someone's thinking is **outside the box**, it is creative and may go against established procedure or protocol in order to achieve a goal.

oxygen [N-UNCOUNT-U9] **Oxygen** is an element that is found in the air and is necessary to sustain living things.

ozone thinning [N-UNCOUNT-U15] **Ozone thinning** is the process by which ozone in the stratosphere becomes depleted and allows stronger ultraviolet radiation to pass through to the Earth.

percent [N-UNCOUNT-U6] A **percent** is one part out of a hundred.

percentage [N-COUNT-U6] A **percentage** is an amount expressed as parts out of a hundred.

periodic table [N-UNCOUNT-U12] The **periodic table** is an arrangement of elements according to their atomic number.

permafrost [N-UNCOUNT-U15] **Permafrost** is a lasting layer of frozen soil found in the arctic tundra.

petroleum [N-UNCOUNT-U13] **Petroleum**, also called oil or crude oil, is a type of fossil fuel in the form of a thick, black liquid.

pH scale [N-UNCOUNT-U12] The **pH scale** is a measurement of how acidic or alkaline a substance is.

PhD [N-COUNT-U2] The **PhD** (Doctor of Philosophy) is a doctorate that can be achieved in a variety of fields.

photosynthesis [N-UNCOUNT-U9] **Photosynthesis** is the process by which producers, such as plants, convert sunlight into nutrients.

point [N-COUNT-U6] A **point** is a dot or period used to separate decimals from whole numbers.

postconsumer [ADJ-U14] If waste is **postconsumer**, it is waste that is produced as a result of a person using a product.

postgraduate degree [N-COUNT-U2] A **postgraduate degree** is any degree that is awarded upon completion of additional years of study beyond the initial undergraduate degree. Master's degrees and doctorates are examples of postgraduate degrees.

potential resource [N-COUNT-U13] A **potential resource** is a resource that is known about but has not yet been extracted or become available.

ppm [N-COUNT-U6] A **ppm** (part per million) is one part out of a million. Very small amounts are often expressed as ppm because they would be inconvenient to express as decimals or percentages.

preconsumer [ADJ-U14] If waste is **preconsumer**, it is waste that is produced in the process of making something.

prerequisite [N-COUNT-U2] A **prerequisite** is something that is required or necessary prior to something else.

primary consumer [N-COUNT-U10] A **primary consumer** is a consumer, or heterotroph, that feeds on producers, or autotrophs.

primary recycling [N-UNCOUNT-U14] **Primary recycling** is the process of recycling an item and using the recycled materials to produce the same type of item.

problem [N-COUNT-U3] A **problem** is a question or situation that needs to be answered or resolved.

problem identification [N-UNCOUNT-U4] **Problem identification** is the act of stating what issues one must address in a situation.

problem solving [N-UNCOUNT-U4] **Problem solving** is the act of resolving issues and finding solutions.

producer [N-COUNT-U10] A **producer**, also called an autotroph, is an organism that gets its nutrients from nonliving compounds in the environment.

quantity [N-COUNT-U6] A **quantity** is an amount of something. It can be either precise or indefinite.

recycle [V-T-U14] To **recycle** an item is to process an item so it can be used again.

redefine [V-T-U4] To **redefine** something is to state it again in a different manner.

reduce [V-T-U6] To **reduce** a fraction is to simplify it by dividing both the numerator and denominator by their shared factors. For instance, if one reduces the fraction ⅛, it becomes ½ because each number can be divided by 4.

remanufacturing [N-UNCOUNT-U14] **Remanufacturing** is the process of taking apart a nonfunctioning product and replacing broken or worn out parts in order to repair the product and resell it to consumers.

residence time [N-UNCOUNT-U8] **Residence time** is the length of the period that water spends in a particular place, such as the atmosphere, a lake, or an aquifer.

result [N-COUNT-U3] A **result** is something that occurs because of something else.

rounding error [N-COUNT-U5] A **rounding error** is a miscalculation that results from improperly rounding a number to a convenient number of decimals.

scientific method [N-UNCOUNT-U3] The **scientific method** is a systematic procedure for making and testing hypotheses.

scientific notation [N-UNCOUNT-U5] **Scientific notation** is a way of easily expressing very large or very small quantities. It incorporates the use of superscript digits. 3×10^6, for example, is 3,000,000 written in scientific notation.

sea level [N-COUNT-U15] **Sea level** is the height of the surface of the ocean in relation to a fixed point on land.

secondary consumer [N-COUNT-U10] A **secondary consumer** is a consumer, or heterotroph, that feeds on other consumers.

secondary recycling [N-UNCOUNT-U14] **Secondary recycling** is the process of recycling an item and using the recycled materials to produce a different type of item.

significant figure [N-COUNT-U5] A **significant figure** is a digit that helps identify a number's precision. All numbers are significant except for leading and trailing zeros when they serve as placeholders, or digits that are introduced as a result of calculations that are carried out to more decimal places than the original numbers.

solar energy [N-UNCOUNT-U10] **Solar energy** is the energy that is generated by the sun and is used by producers in photosynthesis.

solubility [N-UNCOUNT-U12] **Solubility** is how much of a substance can be dissolved in water or another solvent.

solution [N-COUNT-U4] A **solution** is an answer to a problem.

solve [V-T-U4] To **solve** a problem is to remedy it or find a solution to it.

species diversity [N-UNCOUNT-U11] **Species diversity** is a measurement of the variety of species in a particular area.

squared [ADJ-U5] If a number is **squared**, it is multiplied by itself. For instance, 2 squared (2^2) is 4 because $2\times2=4$.

stock resource [N-COUNT-U13] A **stock resource** is a resource that is available but is not profitable to develop with current technology.

stoichiometry [N-UNCOUNT-U12] **Stoichiometry** is the branch of chemistry that studies the relative amounts of substances involved in chemical reactions.

sublimation [N-UNCOUNT-U8] **Sublimation** is the process of changing from a solid into a vapor.

sustainable yield [N-COUNT-U13] A **sustainable yield** is the highest amount of a resource that can be used without depleting the supply faster than it can be renewed.

synthesis [N-COUNT-U4] A **synthesis** is a combination of ideas into a single idea or plan.

system [N-COUNT-U7] A **system** is a defined set of properties or processes under analysis.

team player [N-COUNT-U1] If someone is a **team player**, he or she puts the success of the group over personal reputation or reward.

tenths [N-PLURAL-U5] **Tenths** are parts of one divided ten times.

testable [ADJ-U3] If something is **testable**, it can be proven or disproven by performing an experiment.

thermohaline circulation [N-UNCOUNT-U15] **Thermohaline circulation** (THC) is the circulation of ocean water around the Earth caused by changes in the density of sea water.

thousandths [N-PLURAL-U5] **Thousandths** are parts of one divided one thousand times.

timber [N-UNCOUNT-U13] **Timber** is trees that are cut down for the use of their wood.

tipping point [N-COUNT-U15] A **tipping point** is the point at which the climate shifts from one state to another.

Glossary

to the nth power [EXPRESSION-U5] If a number is multiplied **to the nth power**, it is multiplied by that exponent. For example, 2 to the fifth power has an exponent of five and, thus, is multiplied by itself five times to equal 64.

trailing zero [N-COUNT-U5] A **trailing zero** is a zero that occurs in the decimal representation of a number. No other digits follow a trailing zero (or a series of trailing zeros), and they are always considered significant.

transpiration [N-UNCOUNT-U8] **Transpiration** is a plant's release of water vapor into the air.

trophic level [N-COUNT-U10] A **trophic level** is an organism's position in the cycle of food consumption, indicating its status as a producer or a consumer.

trophic transfer [N-COUNT-U10] A **trophic transfer** is the process of moving energy from one trophic level to the next through the consumption of a lower organism by a higher organism.

ultraviolet radiation [N-UNCOUNT-U15] **Ultraviolet radiation** is powerful energy that is produced by the sun and can cause illness in organisms that are exposed to high levels of it.

undergraduate degree [N-COUNT-U2] An **undergraduate degree** is a degree that is awarded upon completion of a general course of study that typically last four years.

Universal Accounting Equation [N-UNCOUNT-U7] The **Universal Accounting Equation** (UAE) is a generalized equation for accounting for quantities in a system.

uranium [N-UNCOUNT-U13] **Uranium** is an element that is used to create nuclear power.

vapor [N-COUNT-U8] **Vapor** is a substance, such as water, in the form of a gas, or small particles in the air.

variation [N-COUNT-U11] A **variation** is a change or difference between components of something.

waste-to-energy combustion [N-UNCOUNT-U14] **Waste-to-energy combustion** is the burning of waste to create heat energy.

water cycle [N-COUNT-U8] The **water cycle**, also called the hydrologic cycle, is the process by which water is purified and redistributed naturally around the Earth.

whole number [N-COUNT-U6] A **whole number** is an integer with no fraction or decimal.

CAREER PATHS

ENVIRONMENTAL ENGINEERING

Book 3

Virginia Evans
Jenny Dooley
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Express Publishing

Scope and Sequence

Unit	Topic	Reading context	Vocabulary	Function
1	Risk Assessment	Textbook excerpt	bioconcentration, carcinogen, dose-response assessment, exposure assessment, hazard identification, hazard index, hazard quotient, LOEL, NOAEL, perception, RfD, risk assessment, risk characterization, risk management, uncertainty factor	Describing necessity
2	Population, Environment, and Resources 1	Journal article	birth control, carrying capacity, collapse, consumption, demand, developing country, doubling time, exceed, exponential, family planning, import, overpopulation, population growth, strain, support	Making a prediction
3	Population, Environment, and Resources 2	Pamphlet	clear cutting, deforestation, developing nation, logging, mitigate, nutrient depletion, overfishing, renewable resource, replenish, selective cutting, slash and burn, soil degradation, strip cutting, strip mining, sustainability, tree plantation	Reacting to bad news
4	Urbanization	Newspaper article	light pollution, malnutrition, migrate, noise pollution, open space, overcrowded, poverty, rooftop garden, rural, rural flight, unsanitary, urban agriculture, urban heat island, urban sprawl, urbanization	Bringing up a positive
5	Water Use and Pollution 1	Magazine article	agriculture, drought, fertilizer, groundwater, heavy metals, irrigation, nonpoint source, pathogen, pesticide, point source, runoff, salinity, shortage, VOCs, waste water, water pollution	Talking about priorities
6	Water Use and Pollution 2	Textbook	algae, anaerobic, contaminant, cultural eutrophication, deoxygenation, diffusion, dispersion, dissolved oxygen (DO), eutrophication, flowing, oxygen-demanding waste, plume, standing	Making a recommendation
7	Water Quality Control	Webpage	activated sludge, aeration, bioreactor, BOD, coagulation, disinfection contact, filtration, flocculation, primary treatment, recarbonation, screening, secondary treatment, sedimentation, settle, sludge processing, treatment plant	Making comparisons
8	Air Pollution 1	Webpage	air pollution, air quality standard, ambient air, AQI, carbon monoxide, criteria pollutant, emission offsets, emission standard, ground-level, lead, nitrogen dioxide, ozone, PM, primary pollutant, secondary pollutant, sulfur dioxide	Expressing surprise
9	Air Pollution 2	Report	baghouse, coal-fired power plant, combustion controls, cyclone collector, electrostatic precipitator, emission potential, FBC, flue gas desulfurization, IGGC, particulate control, postcombustion controls, precombustion controls, scrubber	Stating a preference
10	Waste Management 1	Magazine article	carbon storage, cell, composite liner, daily cover, decompose, deep-well disposal, disposal capacity, hazardous, industrial solid waste, lift, methane recovery, open dump, solid waste landfill, surface impoundment, toxic	Correcting a misconception
11	Waste Management 2	Announcement	acquisition, design strategy, green, lifecycle assessment, material intensiveness, material life extension, material selection, packaging, planned obsolescence, product system life extension, raw, source reduction, substitute, virgin material	Providing options
12	Evaluating Impact	Report	assumption, biodiesel, compare, ethanol, fossil fuel, fuel cell, gas emissions, generate, hybrid, methanol, net metering, photovoltaics, rate, ratio, vehicle, wells-to-wheels	Making comparisons
13	Disaster Response	Webpage	absorb, break down, containment, countermeasure, decontamination, derailment, disaster, dispersant, HAZMAT, marine, natural disaster, skimming, oil slick, oil spill, vehicular accident	Offering criticism
14	Land Reclamation and Restoration	Newspaper article	abandoned, brownfield, chlorinated, clean-up, direct push drilling, gasoline, hydraulic fracturing, industrial, injection probe, ISCO, ISCR, reclamation, restoration, soil mixing, solvent	Asking for clarification
15	Water Reclamation and Restoration	Webpage	bioremediation, extraction well, impermeable barrier, injection well, isolation, permeable, phytoremediation, PRB, pump-and-treat, soil solidification, SVE, UV light, vitrification	Listing pros and cons

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1 Risk Assessment

perception

carcinogen

Risk Assessment

When dealing with contaminants, environmental engineers must calculate risk of human exposure. To do so, they use processes called **risk assessment** and **risk management**.

Each individual's subjective **perception** of risk is different. So, environmental engineers rely on risk assessment to determine magnitude of risks objectively. To calculate risks, engineers first engage in **hazard identification**. This process identifies contaminants present and the adverse health effects they produce. For instance, hazard identification might investigate whether or not a contaminant is a **carcinogen**.

Next, **dose-response assessment** determines what concentrations of contaminants produce negative health effects. Through experimentation, engineers can calculate the **LOEL** (lowest-observed-effective level) or **NOAEL** (no-observed-adverse-effect level) of each contaminant. They divide the LOELs by an **uncertainty factor** to calculate the reference doses **(RfDs)**. These numbers are the safe levels of daily exposure for most humans.

During dose-response assessment, engineers employ **exposure assessment**. This process identifies how much of each contaminant people were exposed to, considering factors like **bioconcentration**. Once engineers know exposure levels and RfDs, they calculate **hazard quotients**. This estimates the likelihood of each contaminant affecting people exposed. By adding hazard quotients together, engineers find the **hazard index**.

Once they obtain the hazard index, **risk characterization** estimates the situation's risk. At this point, engineers can come up with a suitable response through risk management.

risk assessment

dose-response assessment

Get ready!

1 Before you read the passage, talk about these questions.

1 What are the various stages of risk assessment?

2 How do environmental engineers calculate the RfD of a chemical?

Reading

2 Read the textbook excerpt. Then, mark the following statements as true (T) or false (F).

1 __ Risk assessment is necessary to calculate the magnitude of a risk.

2 __ Dividing RfD by an uncertainty factor determines LOEL or NOAEL.

3 __ A hazard quotient reflects the odds of multiple chemicals affecting people.

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ RfD
2 __ LOEL
3 __ NOAEL
4 __ bioconcentration
5 __ hazard index
6 __ risk assessment
7 __ uncertainty factor

A a number used on data to estimate results for whole populations

B the amount humans can be exposed to a chemical daily without an effect

C the highest level at which a chemical has no observable effect

D a process that makes chemicals become collected in organisms

E the process used to calculate the risk in a situation

F the lowest level at which a chemical has an observable effect

G the sum of hazard quotients in a situation

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **hazard quotient / hazard identification**

A Through _____, the engineer found that the chemical was dangerous.

B The _____ for the people exposed to the chemical was quite high.

2 **risk characterization / risk management**

A _____ allows engineers to determine the risk in a situation.

B Once they assess the risk in a situation, engineers can begin the process of _____.

3 **perception / carcinogen**

A Based on experiments, engineers determined the chemical was a _____.

B Each engineer has a different subjective _____ of risk.

4 **exposure assessment / dose-response assessment**

A Scientists use _____ to find what amounts of chemicals affect humans.

B Engineers find the contact people had with chemicals using _____.

5 Listen and read the textbook excerpt again. At what stage would an environmental engineer identify a substance as a carcinogen?

Listening

6 Listen to a conversation between an environmental engineer and a factory owner. Choose the correct answers.

1 What are the speakers mainly talking about?

A how to conduct a risk assessment operation

B the results of a risk assessment investigation

C the way to assess exposure to chemicals

2 According to the woman, what caused the factory to close?

A Its current design makes risk assessment difficult.

B It uses many hazardous chemicals.

C It exposes workers to too much of a chemical.

7 Listen again and complete the conversation.

Owner: What's **1** _____ _____?

Engineer: The RfD is the reference dose. It's the maximum **2** _____ _____ _____ for humans.

Owner: I see. But how do we know that number is accurate?

Engineer: Through experimentation. Scientists exposed animals to **3** _____ _____ _____ benzene until they found the LOEL.

Owner: What's **4** _____ _____?

Engineer: The lowest-observed-effect level. It's when negative effects show up. The RfD **5** _____ _____ _____ the LOEL, but you still can't go over it.

Owner: Okay. So what do I need to do?

Engineer: If you want to reopen this factory, **6** _____ _____ _____ redesign it to expose workers to less benzene.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

If you want ... / You'll need to ...

Once ... I can ...

Student A: You are a factory owner. Talk to Student B about:

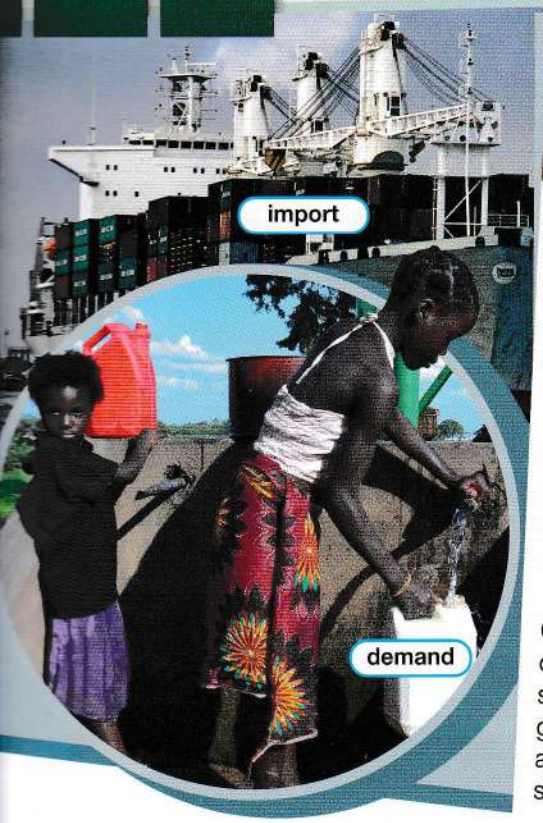
- the results of a risk assessment operation of your factory
- how you can fix the problem with the factory

Student B: You are an engineer. Talk to Student A about the results of a risk assessment.

Writing

9 Use the textbook excerpt and conversation from Task 8 to write an email from an engineer to a factory owner about a risk assessment investigation. Include: the results of the assessment, and what should happen to correct the problem.

2 Population, Environment, and Resources 1



Journal of Population Studies

Population Control for a Better Future

Long ago, **population growth** was a sign of success. Conditions were so difficult that survival was an accomplishment. Today, it's a problem.

The population has reached 7 billion. The current growth rate is about 1.14%. That seems insignificant. But the population's **doubling time** is about 61 years. So by 2073, we'll have 14 billion people. That's dangerously close to **exceeding** the planet's maximum **carrying capacity** of 16 billion.

Overpopulation puts a huge **strain** on our resources. As the population grows, so does **consumption**. Population growth will increase **demand** for food and water. It will also negatively affect services like healthcare and education.

Will the planet be able to **support** this nearly **exponential** growth? It may be difficult. Today, 80% of people live in places where water supplies are threatened. For food, many nations rely on **imports**. To illustrate, just six countries supply 90% of the world's grain. If production **collapses**, people all over the world could suffer.

There is a solution. We must slow population growth. Governments should educate people about **family planning**. They should encourage the use of **birth control**. This is especially true for developing countries where populations are growing more rapidly. Population control is key to maintaining, and even improving, our quality of life.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some effects of population growth?
2 What are some ways to slow population growth?

Reading

2 Read the journal article. Then, choose the correct answers.

1 What is the purpose of the article?
- **A** to highlight the problem of overpopulation
- **B** to describe the causes of population growth
- **C** to compare family planning in different places
- **D** to explain why some resources are scarce

2 Which of the following is NOT a negative effect of overpopulation?
- **A** less access to health care
- **B** increased use of family planning
- **C** increased demand for food
- **D** increased water insecurity

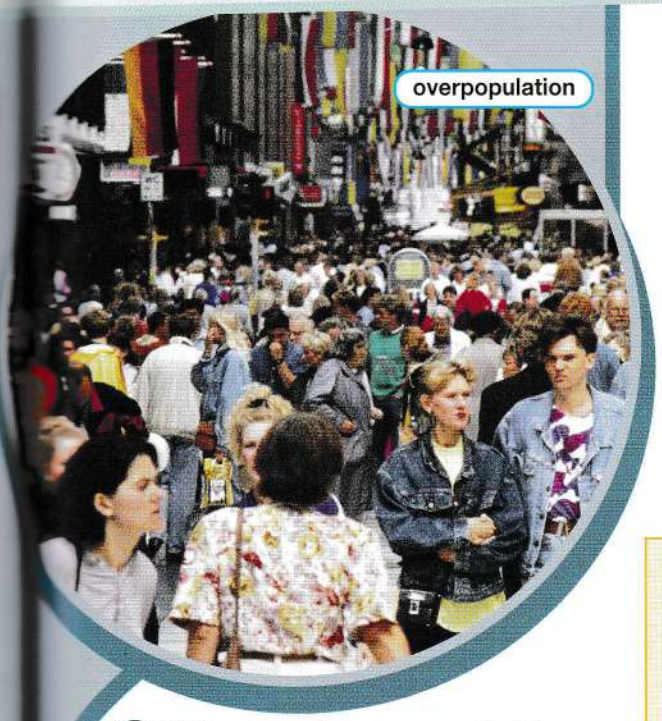
3 According to the article, why do developing countries need family planning?
- **A** Their doubling times are too slow.
- **B** Their growth rate is more than 1.14%.
- **C** Their food supplies are threatened.
- **D** Their populations are growing fast.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ strain
2 __ demand
3 __ support
4 __ import
5 __ develop
6 __ consumption
7 __ birth control
8 __ population growth

- **A** the use of something, such as a natural resource
- **B** to provide resources that people need to survive
- **C** the desire people have to purchase something
- **D** the intentional act of preventing a pregnancy
- **E** to buy something from another country and bring it to your country
- **F** an increase in the number of people in an area
- **G** pressure on a resource because of high demand
- **H** to create or improve something



4 Write a word or phrase that is similar in meaning to the underlined part.

1 Many urban areas are seeing the effects of the <u>presence of too many people</u>.
_ _ _ r _ _ p _ l _ _ _ _ _

2 Some think the planet is already past its <u>maximum number of people it can support</u>.
_ _ _ r y _ _ _ c _ _ _ _ _ t _

3 In the 1960s, the world population experienced <u>rapid</u> growth.
_ _ p _ _ e n _ _ _ _

4 In China, the <u>amount of time it takes for the population to get twice as big</u> is 36 years.
d _ _ _ _ _ n _ _ _ _ e

5 Demand for fossil fuels will eventually <u>pass the limit of</u> supply levels. _ _ _ e _ d

6 <u>The process of determining the size of your family</u> can help slow population growth.
_ a m _ _ _ p _ _ n _ _ _ _

7 A <u>sudden decline</u> of the human population is unlikely.
_ o _ _ _ _ s _

5 Listen and read the journal article again. How does overpopulation strain resources?

Listening

6 Listen to a conversation between a professor and a student. Choose the correct answers.

1 __ The student predicts that the planet will not have any forests.
2 __ The professor thinks population growth will eventually slow down.
3 __ The student does not think widespread family planning will help.

7 Listen again and complete the conversation.

Student: Do you think the planet **1** _____ _____ the population if it keeps growing at this rate?
Professor: I doubt it. The strain on our resources is significant. I mean, **2** _____ _____ _____ are already scarce in some places.
Student: That's true. Our natural resources are suffering, too. Our forests are being destroyed. We **3** _____ _____ have any in the future.
Professor: You're absolutely **4** _____.
Student: What do you think **5** _____ _____ with the population?
Professor: Well, I don't think population growth will **6** _____ _____.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

I can't believe that ... / We may/may not ... in the future.
What do you think will happen with ...?

Student A: You are a student. Talk to Student B about:
- what you thought of an article on population growth
- problems associated with overpopulation
- what you predict will happen in the future

Student B: You are a professor. Talk to Student A about a recent article on population growth.

Writing

9 Use the journal article and the conversation from Task 8 to complete a report about population growth. Include: statistics on population growth, the effects of it, and predictions for the future.

3 Population, Environment, and Resources 2

The Environmental Impact of the Demand for Resources

The demand for resources is having a devastating effect on the planet. If unsustainable methods of obtaining resources continue, the effects could be overwhelming.

Deforestation – Despite the fact that trees are **renewable resources**, **deforestation** can cause many problems. Some **logging** companies practice sustainable methods such as **strip cutting** and **selective cutting**, and developing **tree plantations**. Others use unsustainable methods like **clear cutting**. However, logging causes less deforestation than agriculture. In **developing nations**, farmers make room for crops and livestock using a method known as **slash and burn**. Farmers cut down trees, burn them, and plant crops. After a few years, **nutrient depletion** and **soil degradation** make the land unusable, and the farmers start over.

Mining – To meet demands for mineral resources, many mining companies engage in **strip mining**. This removes the material above minerals deposits, causing soil degradation and leaving behind infertile rock.

Overfishing – Due to unsustainable fishing methods and excessive fishing fleets, **overfishing** is now a major problem. The change in fish populations caused by overfishing can upset marine ecosystems.

What Can People Do? – People can make a difference by practicing **sustainability**. Individuals can make governments pass laws against unsustainable practices. They can also **replenish** natural resources by performing actions like planting trees or by restoring lands after mining. If enough people practice sustainability, they can **mitigate** the damage to the environment.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some of the ways the demand for natural resources has affected the environment?

2 How can people mitigate the negative effects caused by the demand for natural resources?

Reading

2 Read the pamphlet. Then, mark the following statements as true (T) or false (F).

1 __ Strip cutting and clear cutting are two sustainable methods of logging.

2 __ Clearing land using slash and burn methods causes soil degradation.

3 __ Strip mining an area generally results in nutrient depletion of the soil.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ logging
2 __ overfishing
3 __ clear cutting
4 __ sustainability
5 __ slash and burn
6 __ selective cutting
7 __ developing nation
8 __ renewable resource

A the depletion of fish populations caused by excessive fishing

B a nation that is not fully industrialized or wealthy

C the process of cutting down timber and selling it

D the state of supporting environmental balance

E a method of clearing land involving cutting down trees and burning them

F the act of cutting down all the trees in an area at the same time

G a resource that can be replenished over time

H the act of cutting down only a small group of full-grown trees

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **strip cutting / strip mining**

A The company used _____ to gain access to the minerals.

B The loggers practice _____ because it is sustainable.

2 **tree plantation / soil degradation**

A This wood came from a local _____.

B Misuse of the land resulted in _____.

3 **nutrient depletion / deforestation**

A When the farmers over worked the land, the soil suffered from _____.

B Though loggers do contribute to it, most _____ is caused by farmers.

4 **mitigate / replenish**

A The loggers planted new trees to _____ the forest's supply of them.

B New regulation should help _____ damage caused by strip mining.

5 Listen and read the pamphlet again. How does strip mining affect the environment?

Listening

6 Listen to a conversation between two environmental engineers. Choose the correct answers.

1 What is the main topic of the discussion?

A where else people use slash-and-burn

B new methods of sustainable logging

C the results of a law the government passed

D damage caused by the demand for resources

2 According to the man, why is planting trees ineffective?

A farmers that cut down trees again

B the lack of nutrients in the soil

C other plant types grow there first

D trees will not grow in burnt soil

7 Listen again and complete the conversation.

Eng. 2: Well, as I toured the rain forests, I saw acres upon acres of trees **1** _____ _____ _____.

Eng. 1: By loggers? I'm surprised. These days fewer loggers use blatant **2** _____ _____.

Eng. 2: No, it wasn't loggers. It was farmers. They were using **3** _____ _____ _____ techniques to clear land.

Eng. 1: What a shame. It just leads to **4** _____ _____.

Eng. 2: True. But they need the land for agriculture.

Eng. 1: Wow. I'm **5** _____ _____ _____ that. Can't they plant trees to mitigate the effects though?

Eng. 2: Not really. It's hard to replenish the trees because of **6** _____ _____ _____ in the soil.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

They use ... techniques. / What a shame.

It's hard to ... because ...

Student A: You are an environmental engineer. Talk to Student B about:

- harmful actions people are performing to gain natural resources
- how the actions damage the environment
- how further damage can be mitigated

Student B: You are an environmental engineer. Talk to Student A about depletion of natural resources.

Writing

9 Use the pamphlet and conversation from Task 8 to write an email from an environmental engineer to a colleague in a developing nation. Include: how people there gather resources unsustainably, how this action is damaging the environment, and what people can do to prevent further damage.

4 Urbanization

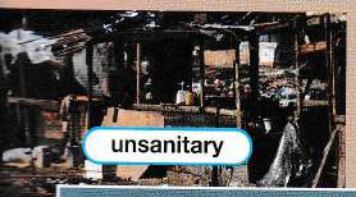
Get ready!

1 Before you read the passage, talk about these questions.

1 What are some causes of urbanization?
2 What are some negative effects of urbanization?


open space


urban heat island


unsanitary


rural

URBANIZATION HITS AFRICA

By Albert Rodriguez

Urbanization is becoming a major problem in Africa. Cities are expanding rapidly because of **rural flight**. However, services cannot keep up, says a study released Monday.

It's no secret that millions of Africans suffer from **poverty** and **malnutrition**. And as people **migrate** from **rural** areas to urban ones, the problems do not just fade away.

"About forty percent of the African population lives in urban areas," says researcher Joan Fitzgerald. "That's 600 million people. And 60% of those people live in slums. Cities can't handle these huge numbers."

Indeed, many African cities are **overcrowded** and **unsanitary**. Millions of people lack clean water and sanitation services, like basic plumbing and sewage.

This is creating many problems. "Whenever cities expand, there is a danger of becoming an **urban heat island**," Fitzgerald said. "Africa could experience this."

Right now, **noise** and **light pollution** are becoming more common. **Urban sprawl** is increasing, too. Previously, North America was the main location of urban sprawl. But the city of Johannesburg is now experiencing it. **Open spaces** near the city are becoming crowded.

Can it be stopped? "City-dwellers in some places plant **rooftop gardens** and engage in **urban agriculture**. This can reduce the effects of urbanization," Fitzgerald said. "But in Africa, bigger issues need to be addressed first."


urban sprawl

Reading

2 Read the newspaper article. Then, choose the correct answers.

1 What is the main idea of the article?
- **A** how urbanization affects African cities
- **B** ways to improve conditions in Africa
- **C** the services available in African cities
- **D** why Africans leave their rural homes

2 What can be inferred about urban heat islands?
- **A** They result from unsanitary conditions.
- **B** African cities don't have this problem yet.
- **C** People in Africa are trying prevent them.
- **D** They lead to more urban sprawl.

3 Which of the following is NOT a problem in African cities?
- **A** pollution from light and noise
- **B** expansion into open spaces
- **C** too much urban agriculture
- **D** little access to clean water

Vocabulary

3 Fill in the blanks with the correct words or phrases from the word bank.

WORD BANK

urban sprawl noise pollution
rural urban agriculture poverty
overcrowded migrate

1 They live in a(n) _____ area far from any cities or towns.
2 People often _____ from one place to another to find better job opportunities.
3 Over one billion people suffer from _____. They lack things like food and water.
4 _____ may eventually lead to hearing loss for some people.
5 _____ results in many spread out neighborhoods in areas around cities.
6 Some parts of the city are _____. There are just too many people.
7 _____ has started in New York. The city has several community gardens.

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **urbanization / open space**

A There is a large _____ just outside the city.

B _____ is causing the expansion of cities around the world.

2 **urban heat island / light pollution**

A Because of _____, the stars are not visible at night.

B The city seems hot because it is a(n) _____.

3 **rural flight / malnutrition**

A Many small towns have been abandoned due to _____.

B Hunger is a huge problem. Millions die because of _____.

4 **unsanitary / rooftop garden**

A If there were more _____, cities might cool down.

B The area is _____.There is trash everywhere.

5 Listen and read the newspaper article again. What problems do some African cities face?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ Rural flight has increased the city's population by 50 million.

2 __ Building affordable housing solved the overcrowding problem.

3 __ The city's rooftop gardens have been successful.

7 Listen again and complete the conversation.

Engineer 1: Definitely. **1** _____ is becoming a big problem here.

Engineer 2: I agree. The city seems to be **2** _____.

Engineer 1: I think so, too. The city government did try to build more affordable **3** _____.

Engineer 2: Yeah, but that was **4** _____ _____. There still aren't enough places for people to live.

Engineer 1: You're absolutely right. It's leading to **5** _____ _____.

Engineer 2: But on the **6** _____ _____, there is more public transportation. It's helping with the pollution from the city's expansion.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

... is leading to ...
On the plus side ...
The good news is ...
There is more/less ...

Student A: You are an environmental engineer. Talk to Student B about:

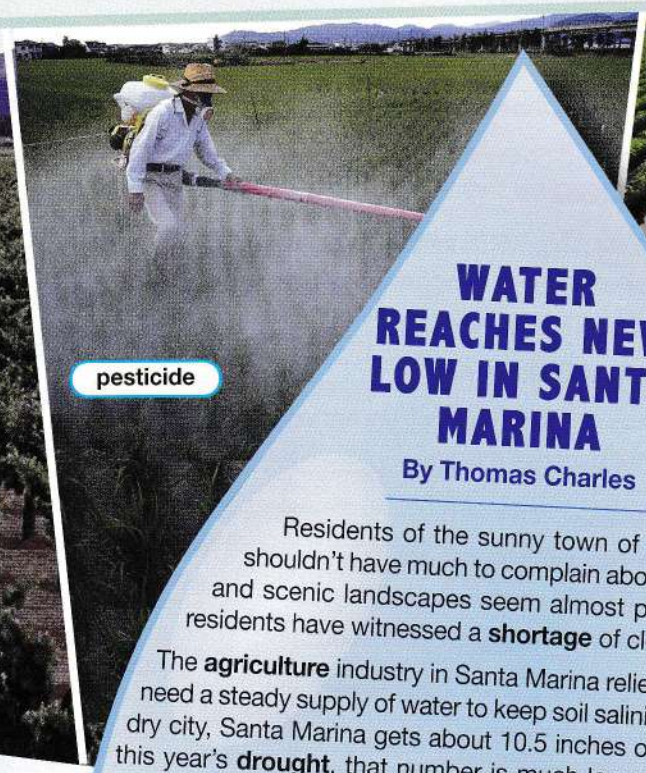
- urbanization in your city
- successful attempts to reduce the impact of urbanization
- unsuccessful attempts to reduce the impact of urbanization

Student B: You are an environmental engineer. Talk to Student A about your city's urbanization solutions.

Writing

9 Use the newspaper article and the conversation from Task 8 to write an article about urbanization. Include: causes of urbanization in a city, the effects, and successful and unsuccessful attempts at solving urbanization problems.

5 Water Use and Pollution 1



WATER REACHES NEW LOW IN SANTA MARINA

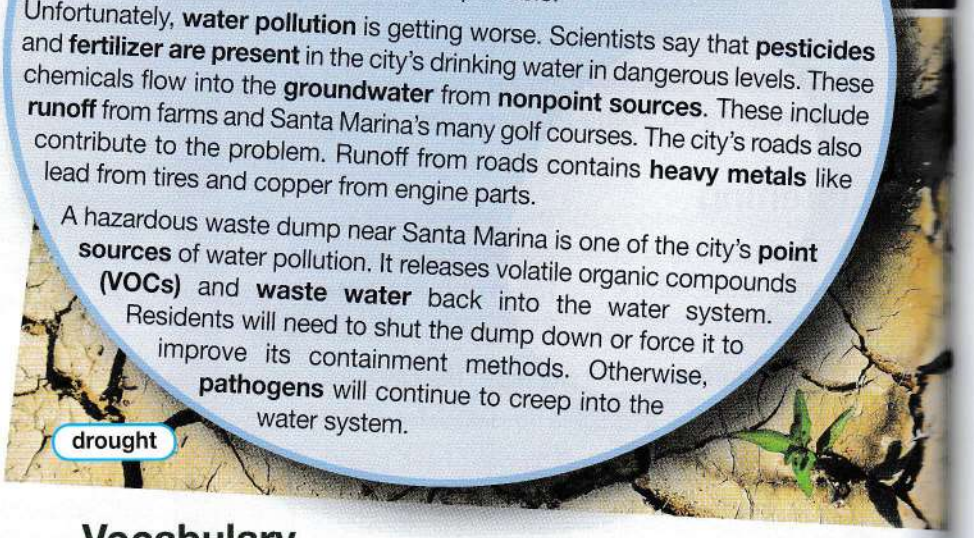
By Thomas Charles

Residents of the sunny town of Santa Marina shouldn't have much to complain about. The blue skies and scenic landscapes seem almost perfect. But recently residents have witnessed a **shortage** of clean water.

The **agriculture** industry in Santa Marina relies on **irrigation**. Farmers need a steady supply of water to keep soil salinity low. A characteristically dry city, Santa Marina gets about 10.5 inches of rainfall per year. But with this year's **drought**, that number is much lower. As such, it's important to keep all the available water as clean as possible.

Unfortunately, **water pollution** is getting worse. Scientists say that **pesticides** and **fertilizer are present** in the city's drinking water in dangerous levels. These chemicals flow into the **groundwater** from **nonpoint sources**. These include **runoff** from farms and Santa Marina's many golf courses. The city's roads also contribute to the problem. Runoff from roads contains **heavy metals** like lead from tires and copper from engine parts.

A hazardous waste dump near Santa Marina is one of the city's **point sources** of water pollution. It releases volatile organic compounds **(VOCs)** and **waste water** back into the water system. Residents will need to shut the dump down or force it to improve its containment methods. Otherwise, **pathogens** will continue to creep into the water system.



Get ready!

1 Before you read the passage, talk about these questions.

1 How can droughts affect human populations?

2 Where does water pollution come from?

Reading

2 Read the magazine article. Then, choose the correct answers.

1 What is the article mainly about?

A how to reclaim groundwater
B a city's problems with water
C how to prevent water pollution
D places that have yearly droughts

2 What is causing the shortage of water?

A increased agriculture
B a lack of groundwater
C irrigation nearby
D drought conditions

3 Which of the following are not flowing into the water through runoff?

A VOCs **C** fertilizer
B pesticides **D** heavy metals

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ VOC
2 __ drought
3 __ salinity
4 __ pathogen
5 __ agriculture
6 __ point source
7 __ heavy metals
8 __ nonpoint source

A an extended period of dryness cause by low rainfall
B dense and poisonous metallic chemical elements
C the amount of salt that something contains
D an agent that causes a disease
E a harmful substance that evaporates at a low temperature
F a source of pollution with multiple origins
G the practice of cultivating land to provide food and products
H a single, specific source of pollution

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **waste water / groundwater**

A The town cleans its _____ in a treatment facility and releases it.

B The engineers dug a well to access the _____.

2 **runoff / shortage**

A During the drought, the town had a water _____.

B Lots of contaminants can get caught up in _____.

3 **water pollution / irrigation**

A The farmers use _____ to get water to their crops.

B _____ is dangerous to many aquatic organisms.

4 **pesticide / fertilizer**

A The farmer uses _____ to help his crops grow.

B The city used to spray _____ around town to kill insects.

5 Listen and read the magazine article again. Where does the city's heavy metal pollution come from?

Listening

6 Listen to a conversation between an engineer and a manager at a water authority. Mark the following statements as true (T) or false (F).

1 __ The woman thinks the main source of contamination is a waste dump.

2 __ A drainage system will help reduce contamination caused by runoff.

3 __ The woman thinks building the drainage system is most important.

7 Listen again and complete the conversation.

Manager: So, what did **1** _____ _____ of the water supply turn up?

Engineer: Bad news. Your water is highly contaminated.

Manager: That's not good. What do you think **2** _____ _____ _____ about it?

Engineer: Well, **3** _____ _____ _____ should be identifying and neutralizing the point source.

Manager: What do you mean?

Engineer: I'm pretty sure that the contamination is coming from a hazardous waste dump upstream.

Manager: And that's **4** _____ _____ _____?

Engineer: Yes. That's where the majority of your contamination **5** _____ _____ _____.

Manager: So we should try to contain the contamination from the dump?

Engineer: Exactly. That ought to clean up your water supply considerably. Then you'll only have to worry about contamination **6** _____ _____.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

What do you think ...? / I'm pretty sure that ...

Is there anything ...?

Student A: You are a manager at a water authority. Talk to Student B about:

- what the pollution his or her investigation revealed
- what the source of the pollution is
- how the pollution can be removed or prevented

Student B: You are an environmental engineer. Talk to Student A about water pollution.

Writing

9 Use the magazine article and conversation from Task 8 to write an email to a manager of a water authority explaining the results of a water supply investigation. Include: the results, the source of any contamination, and what can be done to remove the contamination.

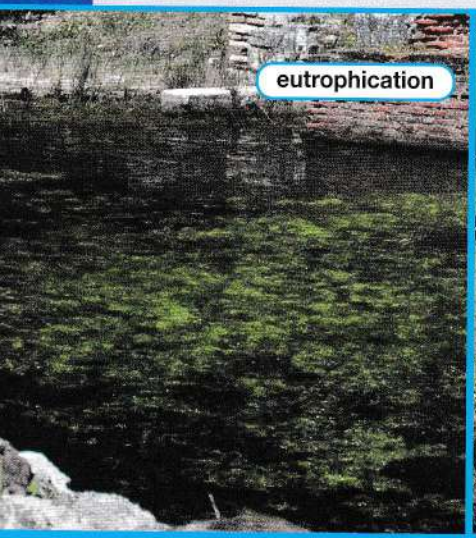
Chapter 6

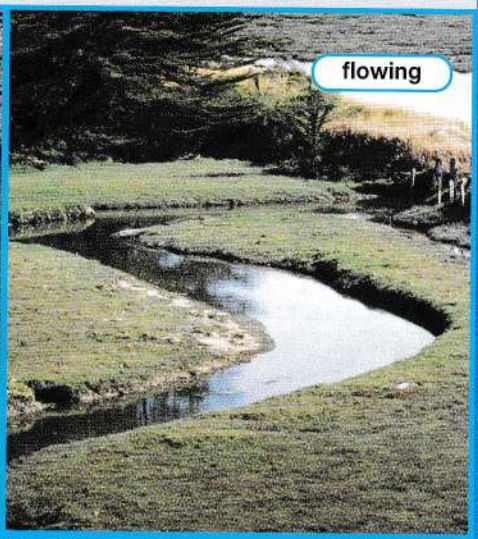
Pollution in Standing Water

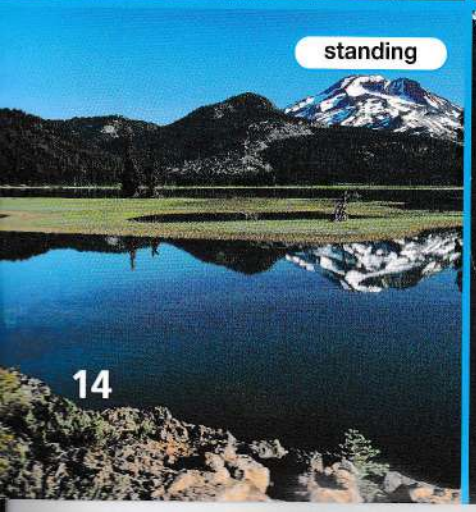
Standing water may become polluted more easily than **flowing** water. Standing water cannot naturally rid itself of unwanted algae and bacteria. Researchers often find pathogens and other contaminants in standing bodies of water. As a result, such standing water is not safe for consumption.

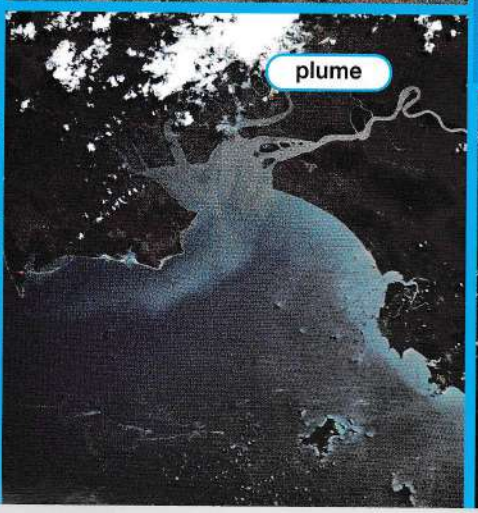
Eutrophication, which is a natural process, can be a serious problem for **standing** water. **Cultural eutrophication**, in particular, presents a threat to stagnant water. How does it happen? Human waste products add nutrients to a body of water. The added nutrients lead to excessive **algae** growth. Once the algae blooms die, they sink and decompose along with other **oxygen-demanding waste**. But decomposition uses oxygen. As the algae decompose, severe **deoxygenation** occurs. This loss of **dissolved oxygen (DO)** has a negative impact on life in a body of water. In the worst cases, marine areas develop completely **anaerobic** regions which are unable to support fish.

But that isn't the only reason standing water is a risk. For example, herbicides or pesticides may create a **contaminant plume**. Through the processes of **dispersion** and **diffusion**, the plume will spread throughout a standing body of water. In **flowing** water, these toxic chemicals would be washed out and diluted. In standing water, the pollution remains in concentrated proportions.









Get ready!

1 Before you read the passage, talk about these questions.

1 How are eutrophication and cultural eutrophication similar? How are they different?

2 What are some causes and risks of deoxygenation in bodies of water?

Reading

2 Read the textbook. Then, mark the following statements as true (T) or false (F).

1 __ Eutrophication occurs most often in flowing water.

2 __ Large amounts of dead algae lead to low DO levels.

3 __ Dispersion naturally removes contaminants from standing water.

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ dispersion
2 __ algae
3 __ contaminant
4 __ anaerobic
5 __ flowing
6 __ standing
7 __ dissolved oxygen

A without oxygen
B the amount of oxygen in water
C not moving
D the process of particles spreading
E a type of plant that grows in motionless water
F a polluting substance
G moving

4 **Place the words or phrases from the word bank under the correct headings.**

WORD BANK

diffusion plume
cultural eutrophication
deoxygenation eutrophication
oxygen-demanding waste

Nutrient increase in water	_____ _____
Particle movement in water	_____ _____
Oxygen levels in water	_____ _____

5 🎧 **Listen and read the textbook again. Why are some bodies of standing water not fit for human consumption?**

Listening

6 🎧 **Listen to a conversation between an environmental engineer and a government official. Choose the correct answers.**

1 Why does the woman call the man?

A to explain the results of water testing
B to discuss the consequences of a contaminant plume
C to encourage the government to make a plan
D talk about the marine life in Summit Lake

2 What is the man most concerned about?

A algae growth
B fish populations
C drinking water
D pollution sources

7 🎧 **Listen again and complete the conversation.**

Engineer: **1** _____ _____ in Summit Lake is a serious concern. The government needs to create a plan to prevent further pollution.
Official: Well, we are **2** _____ _____ these days.
Engineer: The longer we wait, the worse it will get. The algae is growing very quickly.
Official: A little algae never hurt anyone.
Engineer: Actually, algae growth **3** _____ _____ _____ of the water. It's dangerous for the organisms.
Official: So, you're **4** _____ _____ _____ _____.
Engineer: Yes, **5** _____ _____ change the entire aquatic ecosystem.
Official: I just think we're too busy to help out some fish.
Engineer: Well, the toxins also make the water undrinkable.
Official: Undrinkable? Well, that's worth considering. Let's **6** _____ _____ _____ tomorrow.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Cultural eutrophication is ... / It's dangerous for ...
It also makes ...

Student A: You are an environmental engineer. Talk to Student B about:

- the problem in a standing body of water
- the causes of the problem
- the consequences of the problem

Student B: You are a government official. Talk to Student A about pollution in a body of water.

Writing

9 **Use the textbook and conversation from Task 8 to complete a report on a standing body of water. Include: the problems discovered, the cause of the problems, and the likely consequences.**

7 Water Quality Control

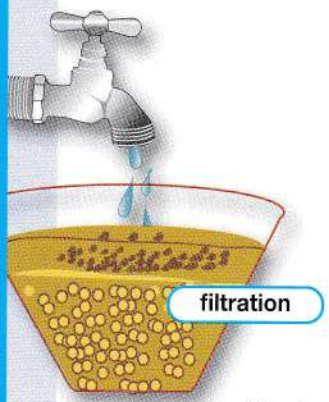
HOME ABOUT

http://AltenSolutions.com/About

Alten Solutions

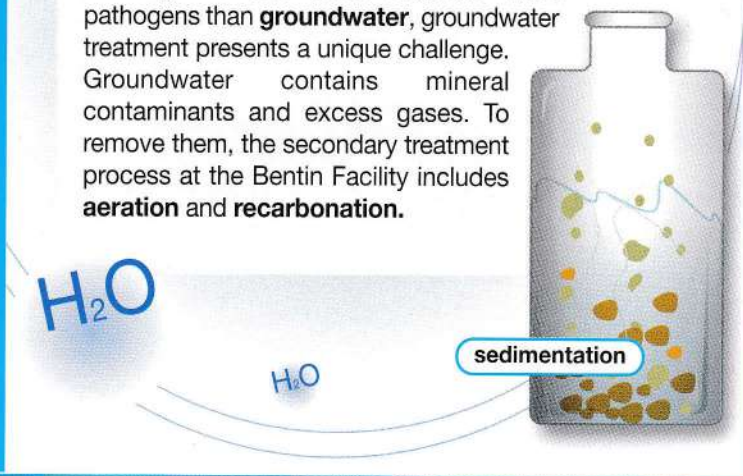
operates three treatment plants, each of which features a different operation. Alten Solutions creates advanced water quality control options based on the location and the type of water.

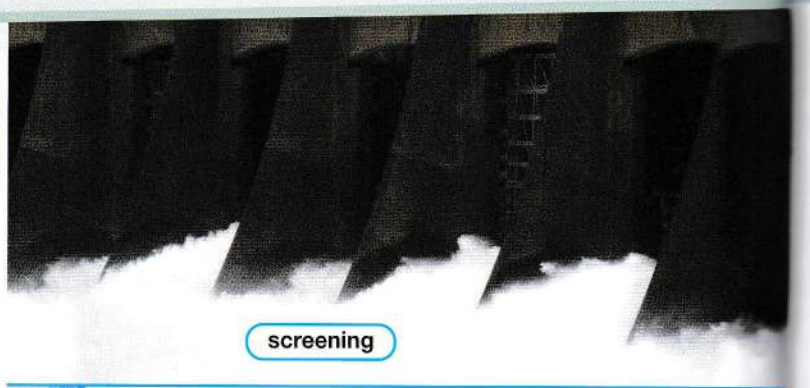
The Crafto Facility, designed for wastewater, is a **primary treatment** plant. At the Crafto Facility, physical processes purify the water. **Screening** removes pollutants that are too large to pass through screening devices. **Sedimentation** allows large particles to settle. In the near future, the Crafto Facility will become a more advanced center. Improvements include using **activated sludge** for optimal wastewater treatment and installing a **bioreactor** to reduce **BOD**.



The Argive Facility is a surface water treatment plant. In addition to the processes at The Crafto Facility, the Argive Facility offers extensive **secondary treatment**. The Argive Facility uses **filtration** and **flocculation** to purify the water. The plant also uses **coagulation** to encourage small particles to settle. **Sludge processing** occurs in the final stages. The session concludes with **disinfection contact** time to ensure the effectiveness of the treatment.

The Bentin Facility is a ground water treatment plant. Although surface water contains more pathogens than **groundwater**, groundwater treatment presents a unique challenge. Groundwater contains mineral contaminants and excess gases. To remove them, the secondary treatment process at the Bentin Facility includes **aeration** and **recarbonation.**





Get ready!

1 Before you read the passage, talk about these questions.

1 What is the difference between a primary and a secondary treatment plant?

2 Why should treatment plants purify wastewater as well as drinking water?

Reading

2 Read the web page. Then, mark the following statements as true (T) or false (F).

1 __ The Crafto Facility uses activated sludge to treat wastewater.

2 __ Groundwater contains fewer pathogens than surface water.

3 __ Alten Solutions has two secondary treatment plants.

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ treatment plant
2 __ recarbonation
3 __ BOD
4 __ sludge processing
5 __ screening
6 __ coagulation
7 __ filtration

A the amount of oxygen needed to oxidize waste
B a facility that purifies water
C a treatment method that separates solid from liquids
D a treatment that balances the pH of water
E a treatment that encourages small particles to join larger ones
F a treatment that removes the smallest particles from water
G a treatment that removes large particles from water

4 **Place the words or phrases from the word bank under the correct headings.**

WORD BANK

sedimentation activated sludge
flocculation primary treatment
bioreactor secondary treatment

Treating wastewater	Settling particles	Water purification facilities

5 **Listen and read the webpage again. How does Alten Solutions plan to change the Crafto Facility?**

Listening

6 **Listen to a conversation between an environmental engineer and a city official. Choose the correct answers.**

1 Why does the man want to speak to the woman?

- **A** to explain the process of treating groundwater
- **B** to discuss the benefits of a wastewater treatment center
- **C** to recommend constructing a new groundwater treatment center
- **D** to evaluate the new treatment center's effectiveness

2 What is the man most concerned about?

- **A** the challenges of building a wastewater treatment center
- **B** the environmental effects of wastewater
- **C** the quality of drinking water in the city
- **D** the function of the groundwater treatment center

7 **Listen again and complete the conversation.**

Engineer: The groundwater treatment involves an **1** _____ process to remove mineral contaminants. The next step in **2** _____ _____, however, would involve a bioreactor.

Official: Wastewater treatment sounds advanced.

Engineer: Well, it is. But, **3** _____ _____. Although we don't drink the treated water directly, it goes back into our **4** _____ _____ _____.

Official: And if it's in our bodies of water, it'll get **5** _____ _____ _____ somehow.

Engineer: Exactly. It's why I'm so worried about the **6** _____ _____ of wastewater.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I think we need ... / A wastewater treatment plant begins ...

If it's in our bodies of water, ...

Student A: You are an environmental engineer. Talk to Student B about:

- the benefits of a new treatment plant
- the differences between a wastewater treatment plant and a groundwater treatment plant
- the consequences of untreated wastewater

Student B: You are a city official. Talk to Student A about the differences between wastewater and groundwater treatment plants.

Writing

9 **Use the web page and conversation from Task 8 to complete a report on the benefits of an advanced wastewater treatment plant. Include: the differences between primary and secondary treatment, and the environmental effects of wastewater.**

8 Air Pollution 1

Frequently Asked Questions

What is an AQI?

An air quality index (AQI) presents local **air pollution** levels. Our **AQI** assigns a number, color and threat level based on the quantity of pollutants in **ambient air**.

How is the AQI calculated?

We place air quality monitors that measure levels of six criteria pollutants in major cities. Then, we compare these levels to government **air quality standards**. We then use this data to update our AQI.

What are pollutants?

Pollutants are waste materials that contaminate air, water or soil. Many pollutants can be detrimental to public health. Pollutants are described as **primary pollutants** or **secondary pollutants**. Primary pollutants are released directly into the air. Secondary pollutants form in the air out of other compounds.

What are the six criteria pollutants?

The six **criteria pollutants** are **ground-level** ozone, **carbon monoxide**, **nitrogen dioxide**, **sulfur dioxide**, **PM** (particulate matter) and **lead**. Governments tend to choose these pollutants because they are the most common pollutants that affect public health.

How do air quality standards differ from emission standards?

The main difference between air quality standards and **emission standards** is what they measure. Air quality standards define acceptable pollution levels in the atmosphere. Emission standards limit the pollution individual sources are allowed to produce. Emission standards also help determine appropriate levels for **emission offsets**.

Get ready!

1 Before you read the passage, talk about these questions.

1 What is an AQI and what does it show?
2 What is the difference between an air quality standard and an emission standard?

Reading

2 Read the webpage. Then, mark the following statements as true (T) or false (F).

1 ___ The webpage's AQI is derived from a government's air quality standards.
2 ___ Secondary pollutants are released directly into the air.
3 ___ Air quality standards limit the pollutants that specific sources can produce.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 ___ PM
2 ___ AQI
3 ___ lead
4 ___ ground-level
5 ___ primary pollutant
6 ___ emission standard
7 ___ secondary pollutant
8 ___ air quality standard

A a waste material that forms within the atmosphere
B small amounts of matter suspended in the air
C an element that can have negative effects on humans
D a system of displaying levels of air pollution
E existing at the same elevation as the ground
F the amount of pollutants that can exist before they affect public health
G a waste material released into the atmosphere
H a regulation limiting pollution produced by a source

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **nitrogen dioxide / ambient air**

A People can get sick if the _____ becomes too polluted.

B The meter measures the amounts of specific gases such as _____.

2 **ozone / carbon monoxide**

A Much of the _____ in the atmosphere is produced by car engines.

B _____ is usually found in the highest layers of the atmosphere.

3 **criteria pollutant / sulfur dioxide**

A The health department decided to classify the gas as a _____.

B The presence of _____ in the air caused damage to the farmer's crops.

4 **air pollution / emission offset**

A The mayor pledged that he would reduce _____ around the city.

B The company had to get an _____ before they could open the factory.

5 Listen and read the webpage again. What pollutants are the pollution levels of the AQI based on?

Listening

6 Listen to a conversation between an environmental engineer and an AQI official. Choose the correct answers.

1 What are the speakers mainly discussing?

A the accuracy of an AQI

B pollution levels in a city

C ways to reduce air pollution

D how the AQI presents data

2 Which pollutants are causing health problems?

A nitrogen dioxide and airborne lead

B sulfur dioxide and ground-level ozone

C carbon monoxide and nitrogen dioxide

D ground-level ozone and carbon monoxide

7 Listen again and complete the conversation.

Engineer: Hi, I'm looking for **1** _____ _____ _____ for Madrid.

AQI Official: Ah, this morning's AQI for Madrid was 116.

Engineer: 116? **2** _____ _____. That's really high. In fact, isn't that dangerously high?

AQI Official: That level of **3** _____ _____ can be unhealthy for sensitive groups.

Engineer: Who exactly would belong to a sensitive group?

AQI Official: You know, children, the elderly, people with disabilities that **4** _____ _____ _____.

Engineer: Hmm. Do you know **5** _____ _____ were present to give the AQI that rating?

AQI Official: Let's see. It looks like there were high levels of **6** _____ _____ and nitrogen dioxide.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

I'm looking for ... / In fact, isn't that ...?

I'm afraid I don't ...

Student A: You are an environmental engineer. Talk to Student B about:

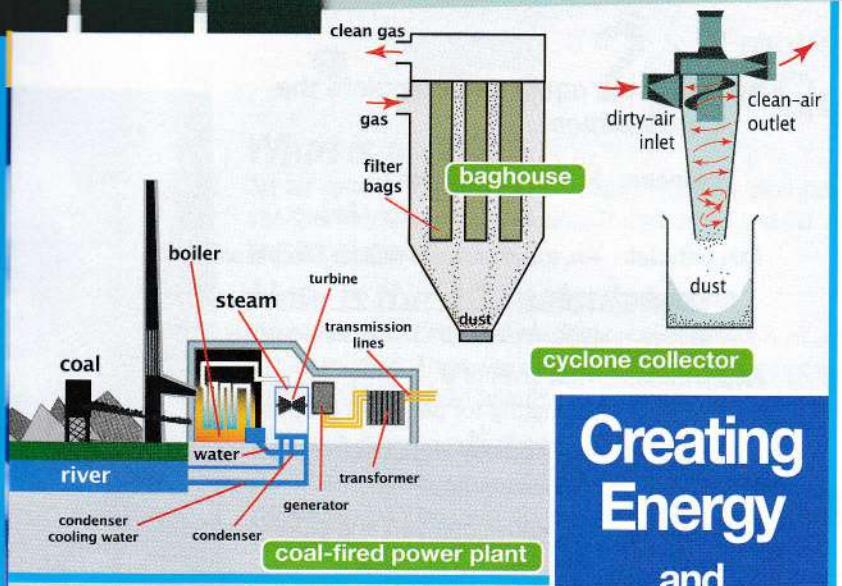
- the AQI for a specific place
- what pollutants were present
- why those pollutants are present

Student B: You are an AQI official. Talk to Student A about pollution levels.

Writing

9 Use the webpage and conversation from Task 8 to write an email from an environmental engineer to a colleague discussing the AQI for a city. Include: the AQI level, the pollutants that caused that AQI level, and an explanation for why those pollutants were present.

9 Air Pollution 2



Creating Energy and Cleaning the Air

REPORT

In this region, over 50% of electricity is generated by **coal-fired power plants**. They also produce 90% of the particulate matter and harmful gases in the atmosphere. This can change. There are many ways to improve practices and clean the air.

The process starts with **precombustion controls**. The goal is to cut coal's **emission potential**. This can be as simple as switching to low-sulfur coal. Plants can also clean coal. Removing sulfur can increase plant efficiency and reduce emissions.

Combustion controls like **FBC** (fluidized-bed combustion) and **IGCCs** (integrated gasification combined cycles) also help. They improve the burning process. FBC can remove over 90% of sulfur. These systems also operate at a relatively low temperature. So they are very efficient. IGCC is also efficient and effective. But IGCC equipment is often prohibitively expensive.

Postcombustion controls are the final step in improving air quality. After combustion, they stop particulate matter from leaving the plant. **Flue-gas desulfurization** using **scrubbers** is one method. However, it's very expensive and not very efficient. A better method is **particulate control**. Devices like **electrostatic precipitators**, **cyclone collectors**, and **baghouses** are extremely effective. Precipitators are low maintenance and remove over 98% of particles. Baghouse efficiency is even closer to 100%. Used in combination with other controls, air quality near plants would greatly improve.

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some negative effects of coal-fired power plants?

2 What are some ways to control or stop the release of particulate matter?

Reading

2 Read the report. Then, choose the correct answers.

1 What is the article mainly about?

A types of particulate control methods
B benefits of making power with coal
C how coal-fired power plants operate
D improving the coal-burning process

2 What do precombustion controls and combustion controls have in common?

A They do not use power very efficiently.
B They increase levels of particulate matter.
C They involve controlling harmful gases.
D They are used in the combustion process.

3 Which of the following is NOT true of particulate control?

A It is a type of postcombustion control.
B It reduces levels of sulfur in the air.
C It is more efficient than using scrubbers.
D It stops the release of most particles.

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ IGCC
2 __ scrubber
3 __ particulate control
4 __ combustion controls
5 __ coal-fired power plant
6 __ flue gas desulfurization
7 __ electrostatic precipitator

A a device used in FBC to remove gas or particles from exhaust
B a facility that burns coal to produce electricity
C a device that uses an electrical charge to remove particles from gas
D a process in which steam is turned into gas and impurities are removed
E methods that make the burning process more efficient
F the process of removing sulfur from exhaust gases
G the process of removing tiny solid particles from gas

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **precombustion controls / postcombustion controls**

A _____ involve the removing of harmful substances from fuel.

B _____ prevent particulate matter from reaching the atmosphere.

2 **baghouse / emission potential**

A Coal, like other fossil fuels, has a very high _____.

B The _____ is composed of thousands of fabric sacks.

3 **cyclone collector / FBC**

A In addition to coal, _____ can burn many types of solid waste.

B The _____ is great for catching large particulate matter.

5 Listen and read the report again. What are some postcombustion controls?

Listening

6 Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).

1 __ The woman wants to use IGCC instead of FBC.

2 __ The plant's biggest problem is releasing too much sulfur.

3 __ The man likes precipitators because they need little maintenance.

7 Listen again and complete the conversation.

Engineer 1: What did you want to discuss today?

Engineer 2: Well, I want to talk about modernizing our plant. Our old systems are producing too much **1** _____ _____.

Engineer 1: I agree. We need to think about more **2** _____ controls.

Engineer 2: **3** _____ _____ to start with combustion controls. Our equipment is really outdated.

Engineer 1: Yeah, you're right. I think **4** _____ is extremely effective.

Engineer 2: Yes, it is. But the technology is too expensive. I'd rather use **5** _____.

Engineer 1: How come?

Engineer 2: Well, it can remove about 90% of **6** _____. And that's our biggest problem.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

I'd prefer to ... / I'd rather ...

If it were up to me ...

I think ... is extremely effective.

Student A: You are an environmental engineer. Talk to Student B about:

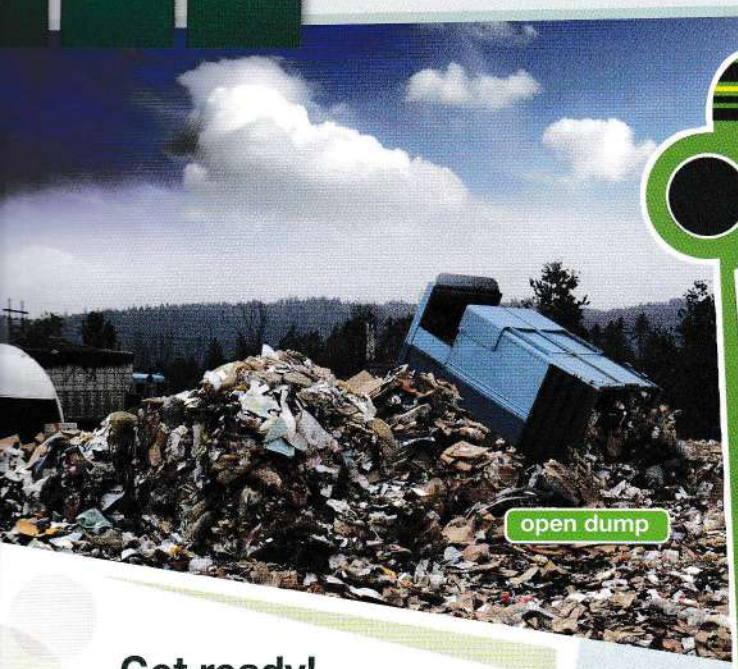
- why your plant needs to be improved
- how you can reduce air pollution from your plant

Student B: You are an environmental engineer. Talk to Student A about ways to improve your coal-fired power plant.

Writing

9 Use the report and the conversation from Task 8 to complete a report about improvements to a power plant. Include: controls that need improvement, your recommendations, and the benefits of these improvements.

10 Waste Management 1



WASTE MANAGEMENT
The Good and the Bad

Waste management is critical for human and environmental health. Without proper waste management, people would just throw garbage in **open dumps**. Fortunately, many places have better ways to handle waste. However, even the best facilities face challenges.

Liquid **hazardous** waste is often stored in **surface impoundments**. However, these can leak and contaminate groundwater. Fumes may also add to air pollution. A better solution is **deep-well disposal**. This method is permanent and environmentally sound if managed properly.

Solid waste landfills are sites that handle municipal and **industrial solid waste**. A **composite liner** is placed under the landfill. The intention is to prevent water pollution. However, environmental agencies suggest that this is only a temporary barrier. On top of the liners is a series of **cells** which have **daily cover** over them. **Lifts** lead to multiple layers of cells.

Solid waste landfills are extremely common. But they are not without problems. Many of them have reached or are close to **disposal capacity**. As the population grows, this will become a bigger problem. In addition, landfills release flammable **toxic** gases as waste **decomposes**. **Methane recovery** can be accomplished with a series of pipes that suck the gas out. Meanwhile, underground **carbon storage** can prevent CO_2 from entering the atmosphere.

WASTE MANAGEMENT

Get ready!

1 Before you read the passage, talk about these questions.

1 Why is waste management important?

2 How do solid waste landfills handle waste?

Reading

2 Read the magazine article. Then, choose the correct answers.

1 What is the purpose of the article?

- **A** to compare types of waste management facilities
- **B** to describe waste management problems and solutions
- **C** to explain how solid waste landfills are created
- **D** to highlight the harmful effects of open dumps

2 What can be inferred about solid waste landfills?

- **A** They can be difficult to operate.
- **B** They often have hazardous liquids.
- **C** They may eventually pollute water.
- **D** They have too many cell layers.

3 Which of the following is NOT a problem with waste facilities?

- **A** They are quickly filling up.
- **B** They emit hazardous gases.
- **C** They are not compacted well.
- **D** They can catch fire.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1	__ toxic	5	__ composite liner
2	__ cell	6	__ methane recovery
3	__ lift	7	__ disposal capacity
4	__ carbon storage	8	__ surface impoundment

- **A** the collection of a gas so that it can be used for another purpose
- **B** an area of compacted waste
- **C** a hole that holds liquid waste
- **D** a synthetic material placed over compacted soil
- **E** poisonous
- **F** the largest amount of waste a facility can hold
- **G** a layer put over cells when they are full
- **H** the capture and storage of CO_2 so that it doesn't pollute the atmosphere

4 **Choose the sentence that uses the underlined part correctly.**

1 Injecting liquid into underground rock is one way to get rid of waste permanently.
_ _ _ p - _ e _ _ _ _ s p _ _ a _

2 The manufacturing process creates a lot of garbage from industrial facilities.
_ _ d u _ _ _ _ a _ s _ _ _ d _ a _ _ _

3 Many poor countries have lots of large, unregulated areas where people throw trash.
_ _ e _ _ u _ _ s

4 Methane is an extremely dangerous greenhouse gas.
_ _ _ a r _ _ _ s

5 Some items in landfills may never break down.
_ _ c _ _ _ o _ _

6 The layer of soil put over cells prevents the wind from blowing waste around.
d _ _ _ _ _ o _ _ r

7 Most of the city's waste goes to a(n) place where waste is dumped and buried.
_ o _ _ _ _ _ s _ _ l _ _ _ _ _ l _

5 **Listen and read the magazine article again. What are some ways to manage hazardous liquid waste?**

Listening

6 **Listen to a conversation between an environmental engineer and a city planner. Mark the following statements as true (T) or false (F).**

1 __ The city's solid waste landfill already has a methane recovery system.

2 __ The landfill's daily covers keep garbage in place and control odors.

3 __ The engineer will make plans for a carbon storage system.

7 **Listen again and complete the conversation.**

Engineer: Okay. I think that a system for **1** _____ _____ would be very beneficial.

City Planner: I was under the **2** _____ that we had a system to do that.

Engineer: No, not **3** _____ _____ _____.

City Planner: I can't believe that. What safety features do we have in place?

Engineer: There's an impermeable **4** _____ _____ to protect the groundwater supply.

City Planner: Okay, but that's pretty standard with solid waste landfills. What else do we have?

Engineer: There's a system of applying **5** _____ _____.

City Planner: I'm not **6** _____ with that.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

I was under the impression that ...
Yes, that's right./No, not at this time.
Let's get going on ...

Student A: You are an environmental engineer. Talk to Student B about:

- what waste disposal methods your city currently uses
- what safety features the facilities have

Student B: You are a city planner. Talk to Student A about your city's waste management methods.

Writing

9 **Use the magazine article and the conversation from Task 8 to complete an informational flyer about your city's waste management programs. Include: the methods the city uses, their benefits, and their safety features.**

11 Waste Management 2

Company Announcement

To all employees,

To better serve the environment, the company is making some policy changes. These **green** initiatives will help us make our world a more sustainable one. We hope to reduce the amount of waste produced by our products. We cannot control what happens to our products after we sell them. Thus, **source reduction** is our only means of controlling how much waste they produce. As such, these changes mostly affect our product **design strategies**.

One way we plan on reducing waste is through **material life extension**. According to a **lifecycle assessment**, the materials in our products can only be used once. Consumers can't recycle them, even if they want to. To change this, we plan to **substitute** current materials with reusable ones. During the **material selection** stage of design, we will use better **raw** materials. We will also use fewer **virgin materials**, in favor of recycled material.

Another way we will reduce waste is through **product system life extension**. We will be redesigning our products so that they last longer. Although **planned obsolescence** may be highly profitable, it is equally unsustainable.

Finally, we will lower the **material intensiveness** of our products, especially during **packaging**. We simply use too much material currently, and it's needlessly toxic. Furthermore, this means we will pay less for the material **acquisition**.

Thank you,
Robert Crowley, Owner
Gadgetry Enterprises, Inc.

Get ready!

1 Before you read the passage, talk about these questions.

1 How can material selection affect the environmental impact of a product?

2 What are some other ways of using source reduction to reduce waste?

Reading

2 Read the announcement. Then, mark the following statements as true (T) or false (F).

1 __ The company's green initiatives will mostly affect their design strategies.

2 __ Using virgin materials instead of recycled ones will extend material life.

3 __ The company will have to pay more to reduce its toxic packing materials.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1 __ substitute
2 __ packaging
3 __ acquisition
4 __ source reduction
5 __ virgin materials
6 __ material selection
7 __ material life extension
8 __ product system life extension

A to replace something with something else
B the practice of designing products to produce less waste
C material that has not been processed or used
D the act of making a product last longer
E the act of putting products in containers
F the act of purchasing something
G the process of choosing material for a product
H the act of making a product's materials last longer

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **planned obsolescence / material intensiveness**

A The firm used _____ to ensure people would buy their products again.

B The designers reduced the product's _____ by using less plastic.

2 **raw / green**

A The company's first _____ initiative was starting a recycling program.

B The firm buys the _____ materials for its products from a local supplier.

3 **lifecycle assessment / design strategy**

A To reduce waste, the company had to change their _____.

B The engineer conducted a _____ to evaluate the products impact.

5 **Listen and read the announcement again. What is the author's opinion of planned obsolescence?**

Listening

6 **Listen to a conversation between an environmental engineer and a company owner. Choose the correct answers.**

1 What are the speakers mainly discussing?

A how to make products function for longer

B how to reduce the waste caused by products

C how to limit the materials used in packaging

D how to extend the material life of products

2 What does the man say about reusable materials?

A He thinks they are too expensive.

B He believes they will be beneficial.

C He doubts his products can use them.

D He wants to know more about them.

7 **Listen again and complete the conversation.**

Owner: Do you have any suggestions on how my company **1** _____ _____ _____?

Engineer: I do. I conducted **2** _____ _____ on your products, and I have a few ideas.

Owner: Great. What do you propose?

Engineer: Well, **3** _____ _____ significantly cut down on the waste your products make.

Owner: Isn't that up to the people **4** _____ _____ _____?

Engineer: Partially. However, through **5** _____ _____, your company can influence it too.

Owner: Huh. I guess I never considered that.

Engineer: Indeed. Anyway, first you should use less material **6** _____ _____ your products.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Do you have any ...?

You could ... by ...

You mean ...

Student A: You are an environmental engineer. Talk to Student B about:

- making the company greener
- what source reduction is
- multiple ways to reduce waste

Student B: You are a company owner. Talk to Student A about making your company greener.

Writing

9 **Use the announcement and conversation from Task 8 to write an email from an environmental engineer to the owner of a company with suggestions for making the company greener. Include: source reduction, material selection, and material intensiveness.**

12 Evaluating Impact

Get ready!

1 Before you read the passage, talk about these questions.

1 What are some types of alternative fuels?

2 Which vehicles produce fewer emissions than conventional cars?

Office of Environmental Improvement

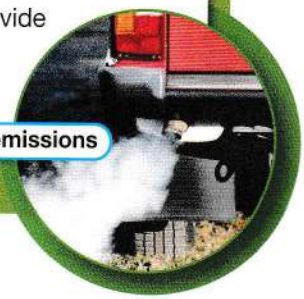
Wells-to-Wheels Analysis

Efforts to improve air quality and reduce dependence on **fossil fuels** are increasing. This **wells-to-wheels** analysis **compares** the **gas emissions** produced by different **vehicles**.

As expected, conventional gasoline-powered vehicles performed the worst. Emissions were estimated based on the **assumption** of 25 miles per gallon of gasoline. At that level of efficiency, they released CO_2 at a **rate** of 450 grams per mile driven. Surprisingly, **fuel cell** vehicles that use natural gas were the second worst producers. They came in at a rate of 200 g/mi.

Hybrids performed better. Hybrid electric vehicles powered with corn **ethanol** produced 180 g/mi. Plug-in hybrid electric vehicles with ethanol performed about the same. The assumption was that the **ratio** of miles driven on gasoline and electricity was half and half.

Based on these estimates, the Office of Environmental Improvement has several recommendations. More gas stations need to offer ethanol. In addition, powering hybrids with **biodiesel** could further reduce emissions. If more efficient engines are created, **methanol** may be another option. There is great potential for improvement with plug-in hybrids. Users could install **photovoltaics** to produce solar power. For one car, this could generate over 10,000 miles worth of electricity. A **net metering** system would provide further incentive to use photovoltaics.



Reading

2 Read the report. Then, choose the correct answers.

1 What is the report mainly about?

- **A** the types of conventional and electric vehicles
- **B** how to increase use of alternative vehicle fuels
- **C** CO_2 emission levels and ways to reduce them
- **D** why hybrid vehicles produce fewer emissions

2 Which of the following is true of emissions from fuel cell vehicles?

- **A** They about the same as conventional vehicles.
- **B** They are higher than those of electric cars.
- **C** They can be reduced with photovoltaics.
- **D** They are lower than those from plug-in hybrids.

3 What can be inferred about methanol?

- **A** It cannot be used with current engines.
- **B** It is more efficient than biodiesel.
- **C** It does not produce any emissions.
- **D** It can be used with photovoltaics.

Vocabulary

3 Match the words or phrases (1-8) with the definitions (A-H).

1	___ ethanol	5	___ fuel cell
2	___ methanol	6	___ wells-to-wheels
3	___ vehicle	7	___ photovoltaics
4	___ ratio	8	___ net metering

- **A** analyzed from the start of a life cycle to the end
- **B** any type of land transportation
- **C** a system in which people can sell excess electricity that they produce
- **D** a wood alcohol often used in race cars
- **E** a way to generate electricity from natural light
- **F** a device that changes chemical energy into electrical energy
- **G** a grain alcohol often mixed with gasoline
- **H** the relationship between the amounts of two things

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **rate / assumption**

A The _____ is that the car can drive 50 miles per gallon of gas.

B The vehicle produces CO_2 at a(n) _____ of 230 grams per mile.

2 **generate / compare**

A The report _____ different types of electric-powered vehicles.

B He _____ power for the car with solar panels on the roof.

3 **biodiesel / gas emissions**

A In addition to powering cars, _____ can create heat for homes.

B _____ are a major cause of the decrease in air quality.

4 **hybrid / fossil fuel**

A Our supply of _____ like coal and natural gas is decreasing.

B She plugs in her _____ every night when she gets home.

5 Listen and read the report again. How were emissions measured for hybrids and what were the results?

Listening

6 Listen to a conversation between an auto-manufacturing executive and an environmental engineer. Mark the following statements as true (T) or false (F).

1 __ Hybrids are more efficient than conventional engines that use ethanol.

2 __ Fuel cell vehicles could potentially be more efficient than hybrids.

3 __ Plug-in hybrids are less practical than fuel cell vehicles.

7 Listen again and complete the conversation.

Executive: So we'd like to create a more **1** _____ _____ vehicle.

Engineer: What did you **2** _____ _____ _____?

Executive: Well, I'm not sure. Perhaps we could convert our conventional engines to run on **3** _____ or biodiesel.

Engineer: You could ... but those aren't as efficient as **4** _____, for instance.

Executive: I see. Can you **5** _____ _____ more about those?

Engineer: They're generally **6** _____ _____ in terms of gas emissions, particularly plug-in hybrids.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

... isn't as efficient/clean/practical as ...

... are more/less ... than ...

How does ... compare with ...?

Student A: You are an auto-manufacturing executive. Talk to Student A about:

- what type of vehicle you want to create
- the pros and cons of different vehicles
- his or her recommendations

Student B: You are an environmental engineer. Talk to Student B about different types of environmentally friendly vehicles.

Writing

9 Use the report and the conversation from Task 8 to complete a report about a company's new vehicle. Include: its benefits, its emission levels, and how it compares to other types of vehicles.

Wells-to-Wheels Analysis

13 Disaster Response

ABOUT www.championdisasterresponse.com

At Champion Disaster Response, we can quickly and safely respond to any **disaster**. We have experience responding to both manmade accidents and **natural disasters**.

Resources – Champion Disaster Response has branches on every continent except Antarctica. Our branches are equipped with everything we could need to respond to a disaster. We can quickly provide assistance and **countermeasures** against further disasters almost anywhere on the planet.

Services – Champion Disaster Response can respond to any disaster, large or small. We will work alongside local authorities to respond to anything from a simple **vehicular accident** to a train **derailment**. Our services range from finding missing persons to full hazardous material (**HAZMAT**) **containment** and **decontamination**.

In many cases, we are able to respond to a disaster entirely on our own. Last year, an oil tanker crashed and caused an **oil spill**. When other emergency services arrived, we had already used **dispersant** to **break down** the **oil slick**. We then assisted local officials in **skimming** away and using materials to **absorb** the remaining oil.

Staff – Champion Disaster Response employs a variety of trained professionals. Many of our employees have previously worked for military and aid organizations. A lot of them have worked in both **marine** and terrestrial environments. Furthermore, our environmental engineers often invent new and effective disaster solutions.

Get ready!

1 Before you read the passage, talk about these questions.

1 What can environmental engineers do to minimize the effects of an oil spill?

2 Besides oil spills, what other disasters can environmental engineers minimize the effects of?

Reading

2 Read the webpage. Then, choose the correct answers.

1 What is the webpage mainly about?

A the capabilities of an engineering company
B the expansion of an engineering company
C the duties of an engineering company's staff
D the engineering company's new disaster solutions

2 Which of the following actions does the company NOT perform?

A supplying disaster countermeasures
B providing HAZMAT containment
C skimming dispersant from water
D absorbing the oil from oil slicks

3 What sort of disaster did the company respond to last year?

A a natural disaster
B a vehicular accident
C a train derailment
D an oil spill

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 __ absorb
2 __ marine
3 __ HAZMAT
4 __ oil slick
5 __ containment
6 __ decontamination
7 __ vehicular accident

A a dangerous substance
B to take in a substance
C a collision involving a means of transportation
D happening or found in the sea
E a floating layer of oil
F the process of removing something harmful
G the process of keeping something from spreading

4 **Read the sentence pairs. Choose which word or phrase best fits each blank.**

1 **dispersant / skimming**

A _____ the material off the surface was an easy way of removing it.

B The engineers used _____ to break apart the oil slick.

2 **disaster / countermeasure**

A I keep numbers for emergency services around in case there is a _____.

B We have reinforced the building as a _____ against earthquakes.

3 **natural disaster / break down**

A I am terrified that a _____ like a tornado will destroy my house.

B We used dispersant to _____ the oil into manageable portions.

4 **oil spill / derailment**

A Luckily, none of the train's passengers were hurt during the _____.

B The tanker was torn open by the reef, causing a massive _____.

5 🎧 **Listen and read the webpage again. How did the company respond to an oil spill?**

Listening

6 🎧 **Listen to a conversation between two environmental engineers. Mark the following statements as true (T) or false (F).**

1 __ The speakers are discussing a marine oil spill that happened this morning.

2 __ People who live near the disaster area were evacuated.

3 __ The engineers would have separated the responders into two different teams.

7 🎧 **Listen again and complete the conversation.**

Engineer 2: Yeah. Apparently a massive **1** _____ _____ _____ before anybody noticed.

Engineer 1: You mean they didn't check that immediately?

Engineer 2: No. And now they've got a **2** _____ _____ _____.

Engineer 1: Wow. **3** _____ of the area is going to take forever.

Engineer 2: If **4** _____ _____ _____ _____ of responding to that disaster, I'd split into two teams.

Engineer 1: Me too. One team to rescue people and another to check for **5** _____ _____.

Engineer 2: Right. I'd **6** _____ _____ of the oil immediately.

Engineer 1: By then, we would be absorbing the spill.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

Have you seen ...? / If I were ...

I'd have begun ...

Student A: You are an environmental engineer. Talk to Student B about:

- a recent disaster
- what responders are doing wrong
- what you would do differently

Student B: You are an environmental engineer. Talk to Student A about the response to a disaster.

Writing

9 **Use the webpage and conversation from Task 8 to write an email to a coworker about a response to a disaster. Include: what the responders did right, what they should have done better, and how the environmental engineer would have handled the situation.**

14 Land Reclamation and Restoration

Land Reclamation:

A Vital Task

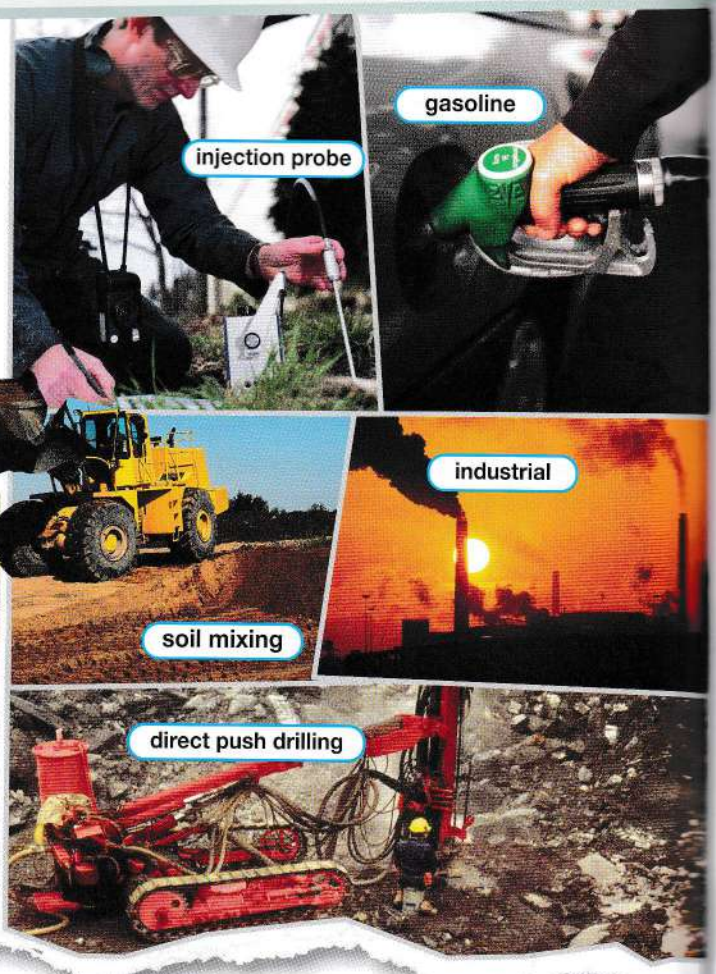
Land **restoration** and **reclamation** may be very important to the future of civilization. As society grows, it is forced to spread into unspoiled territory. Additionally, lands that have been used and contaminated can be dangerous if left alone. By reclaiming areas, environmental engineers can solve both problems together.

For instance, many cities have **industrial** sites that have been **abandoned**. Presently, they have no purpose and pollute the land they occupy. However, a good **clean up** can return these **brownfields** to usable condition.

Environmental engineers have various methods of reclamation. One method is called **ISCO**, or in situ chemical oxidation. This method involves introducing chemical oxidants. These destroy contaminants by changing the amount of electrons they have.

To get oxidants into contaminated land, environmental engineers use a range of techniques. Methods like **soil mixing** and **direct push drilling** are effective in highly permeable soils. For impermeable soil, methods like **hydraulic fracturing** and using **injection probes** are necessary.

The ISCO method is effective for destroying contaminants such as **chlorinated solvents** and **gasoline**-related compounds. However, environmental engineers have recently invented another method known as **ISCR**. In situ chemical reduction uses iron particles the same way ISCO uses chemical oxidants. Although it has not been tested extensively, ISCR may prove more effective than ISCO.



Get ready!

1 Before you read the passage, talk about these questions.

1 Why is land restoration and reclamation important?
2 What kind of techniques environmental engineers use for reclamation?

Reading

2 Read the newspaper article. Then, mark the following statements as true (T) or false (F).

1 __ ISCO uses chemical oxidants to destroy contaminants within the soil.
2 __ Direct push drilling is most effective in impermeable soils.
3 __ ISCR is similar to ISCO, but uses chlorinated solvents to oxidize contaminants.

Vocabulary

3 Match the words or phrases (1-9) with the definitions (A-I).

1 __ ISCO
2 __ ISCR
3 __ solvent
4 __ clean up
5 __ restoration
6 __ chlorinated
7 __ injection probe
8 __ direct push drilling
9 __ hydraulic fracturing

A the process of injecting high pressured liquid into the ground to create cracks
B the act of returning something to the way it used to be
C a liquid capable of dissolving other substances
D a remediation technique that uses chemical oxidants
E the process of hammering a rod into the ground to deliver oxidants
F a perforated rod used to inject oxidants into soil
G having chlorine added
H a remediation technique that uses iron particles
I the process of removing pollution and waste from a location

4 **Fill in the blanks with the correct words or phrases from the word bank.**

WORD BANK

gasoline industrial abandoned
soil mixing reclamation brownfield

1 Since the contaminants were mostly on the surface, we used _____ to deliver the oxidants.
2 Once the contaminants are removed, the _____ will become residential property.
3 ISCO and ISCR are both used for the _____ of contaminated land.
4 The contaminants around the fuel production plant were used to make _____.
5 When the company went bankrupt, the building was left _____.
6 Most of this land was used for _____ purposes around the turn of the century.

5 **Listen and read the newspaper article again. What are the two problems that reclamation and restoration can solve?**

Listening

6 **Listen to a conversation between a property owner and an environmental engineer. Choose the correct answers.**

1 What is the main topic of the discussion?
- **A** what reclamation methods to use on a brownfield
- **B** why ISCO is effective against chlorinated solvents
- **C** how oxidants destroy contaminants in the soil
- **D** why a clean up of the contaminated area is necessary

2 Why does the woman decide to use soil mixing?
- **A** The soil is not permeable enough for direct push drilling.
- **B** It is the most cost effective means of delivery.
- **C** The man wants to avoid experimental methods.
- **D** Hydraulic fracturing is not an available option.

7 **Listen again and complete the conversation.**

Owner: So, what sort of treatment are you going to use on this land?
Eng.: Initially I was going **1** _____ _____ _____, but now I'm leaning towards ISCO.
Owner: ISCR and ISCO? **2** _____ _____ _____ _____?
Eng.: They're different treatment methods. ISCO uses **3** _____ _____, while ISCR uses iron particles.
Owner: Why do you think ISCO will be better?
Eng.: Well, the main contaminant in **4** _____ _____ is trichloroethylene. It's a machine degreaser.
Owner: Is ISCR unable to treat that chemical?
Eng.: ISCR might treat it, but **5** _____ _____ _____. ISCR is still somewhat experimental.
Owner: But ISCO will definitely get the chemical you mentioned?
Eng.: Yes. ISCO effectively destroys **6** _____ _____ like trichloroethylene.

Speaking

8 **With a partner, act out the roles below based on Task 7. Then, switch roles.**

USE LANGUAGE SUCH AS:

What's the difference?
Why do you think ...? / That sounds like ...

Student A: You are a property owner. Talk to Student B about:
- what treatment he or she thinks your brownfield needs
- why the chosen treatment will be effective
- how it will be distributed into the ground

Student B: You are an environmental engineer. Talk to Student A about a brownfield restoration.

Writing

9 **Use the newspaper article and conversation from Task 8 to summarize the treatment plan for a brownfield. Include the type of treatment that will be used, why it was chosen, and how it will be delivered.**

15 Water Reclamation and Restoration

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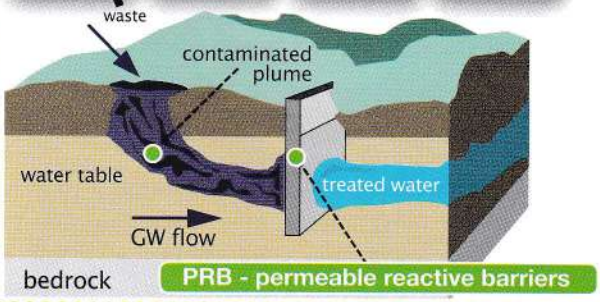
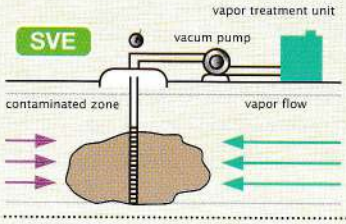
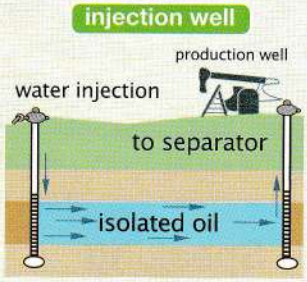
Enviro-Restore
Groundwater Remediation

Enviro-Restore Groundwater Remediation provides long term solutions for groundwater treatment. We offer a range of methods to treat or isolate groundwater contamination.







Treatment Options – Enviro-Restore GR (ERGR) specializes in **pump-and-treat** groundwater treatment systems. Pump-and-treat systems use the strategic placement of **injection wells** and **extraction wells**. These wells push and pull contaminated groundwater from the aquifer and into treatment facilities. Our state-of-the-art treatment facilities treat contaminated groundwater using **UV light** and chemicals. Once groundwater is treated, it can be used or released back into the aquifer.

Pump-and-treat systems are not always the correct solution to groundwater contamination problems. This is why ERGR offers alternative methods of groundwater treatment. We also provide **SVE** (soil vapor extraction) technology for situations where soil is highly permeated with contaminants. If the contaminants are localized, we can treat them with a **PRB** (a **permeable** reactive barrier). Finally, we offer **phytoremediation**, which is a type of **bioremediation** that removes contaminants using plants.

Isolation Options – If you just need groundwater contaminants isolated, we can also assist you. We offer two methods of creating **impermeable barriers** around contaminants. Our preferred method, **soil solidification**, turns soil around the contaminants into an impermeable concrete-like substance. Alternatively, we offer an experimental **vitrification** method, which melts and cools the surrounding soil into glass.

Enviro-Restore Groundwater Remediation

Get ready!

1 Before you read the passage, talk about these questions.

1 How can environmental engineers isolate contaminated groundwater?

2 What are some ways to treat contaminated groundwater?

Reading

2 Read the webpage. Then, mark the following statements as true (T) or false (F).

1 ___ UV Light is used to treat groundwater extracted using pump-and-treat systems.

2 ___ The company offers multiple treatment methods that involve bioremediation.

3 ___ Vitrification is the company's favored method of isolating contaminants.

Vocabulary

3 Match the words or phrases (1-7) with the definitions (A-G).

1 ___ isolation
2 ___ UV light
3 ___ permeable
4 ___ injection well
5 ___ extraction well
6 ___ phytoremediation
7 ___ impermeable barrier

A a type of bioremediation that uses plants
B the act of separating something from its surroundings
C an obstruction that prevents the flow of groundwater
D a well that adds water to an aquifer
E allowing the transmission of water and gas
F light used to treat organic contaminants
G a well that removes water from an aquifer

4 Read the sentence pairs. Choose which word or phrase best fits each blank.

1 **pump-and-treat / bioremediation**

A _____ uses living organisms as a means of treating groundwater.

B The _____ method uses injection and extraction wells to move groundwater.

2 **vitrification / soil solidification**

A Our _____ method turns the ground into an impermeable, cement-like substance.

B The engineers used a method of _____ to transform the soil into glass.

3 **SVE / PRB**

A The _____ system removes contaminants from groundwater using air.

B We can treat the contaminated groundwater by forcing it through a _____.

5 Listen and read the webpage again. What groundwater treatment method does the company provide for situations where contaminants have highly permeated the soil?

Listening

6 Listen to a conversation between two environmental engineers. Choose the correct answers.

1 What are the speakers mainly discussing?

A where a groundwater contaminant came from

B the various prices of treatment methods

C a failure in a contaminant isolation system

D how to treat groundwater in a certain area

2 What does the woman suggest?

A using phytoremediation

B installing an injection well

C trying an SVE system

D extracting the groundwater

7 Listen again and complete the conversation.

Engineer 2: We could use the old **1** _____ - _____ - _____ _____ . It's reliable and easy.

Engineer 1: **2** _____, _____ it takes forever. What about an SVE system?

Engineer 2: Is the soil **3** _____ _____ ? SVE is only efficient in highly permeable soils.

Engineer 1: I guess you're right. What about **4** _____ ?

Engineer 2: I don't know. It could work, but neither of us has experience with it.

Engineer 1: If we could ensure the groundwater would flow through it, we could **5** _____ _____ _____ .

Engineer 2: That might work. Especially if we created **6** _____ _____ leading to the PRB.

Engineer 1: Good idea. It would force the contaminants through the PRB.

Speaking

8 With a partner, act out the roles below based on Task 7. Then, switch roles.

USE LANGUAGE SUCH AS:

Do you have any ...? / It could ... but ...

What if we ...?

Student A: You are an environmental engineer. Talk to Student B about:

- the pros and cons of various treatments
- how one of the systems can be improved
- whether or not the improvement will work

Student B: You are an environmental engineer. Talk to Student A about groundwater remediation methods.

Writing

9 Use the webpage and conversation from Task 8 to write a summary of the environmental engineers' plan to treat the ground water in the region. Include the details of the plan, other systems they considered, and why they chose not to use the other systems.

Glossary

abandoned [ADJ-U14] If something is **abandoned**, it is no longer used and is left alone.

absorb [V-T-U13] To **absorb** something is to take it into and store it inside whatever is absorbing it.

acquisition [N-UNCOUNT-U11] **Acquisition** is the act of buying or obtaining something.

activated sludge [N-UNCOUNT-U7] **Activated sludge** is a method of water treatment that uses air and biological matter to treat sewage and wastewater.

aeration [N-UNCOUNT-U7] **Aeration** refers to the process of removing undesirable and excess gases with the help of air.

agriculture [N-UNCOUNT-U5] **Agriculture** is the practice of cultivating land, plants, and animals to provide food and other products for humans to use.

air pollution [N-UNCOUNT-U8] **Air pollution** is harmful material that is present in the atmosphere.

air quality standard [N-COUNT-U8] An **air quality standard** is an amount of a pollutant that can exist in an area at a time before it negatively affects the heath of people in the area.

algae [N-COUNT-U6] **Algae** are nonflowering plants, including seaweed and other single-celled forms.

ambient air [N-UNCOUNT-U8] **Ambient air** is the air that surrounds someone or something.

anaerobic [ADJ-U6] If something is **anaerobic**, it lacks oxygen.

AQI [N-COUNT-U8] An **AQI** (air quality index) is a scale that assigns values to the quality of air in an area based on the amount of pollutants in the air.

assumption [N-COUNT-U12] An **assumption** is something that is considered true without verifying it.

baghouse [N-COUNT-U9] A **baghouse** is a device that contains many fabric bags in which small particles from gases accumulate and are later removed.

bioconcentration [N-UNCOUNT-U1] **Bioconcentration** is the process by which an organism absorbs larger amounts of a chemical than its surrounding environment. Often, bioconcentration move up food chains, with concentrations growing through each step.

biodiesel [N-UNCOUNT-U12] **Biodiesel** is a biodegradable, renewable fuel source that is made using vegetable oils, animal fat, or grease from restaurants.

bioreactor [N-COUNT-U7] A **bioreactor** is an apparatus that causes biological changes.

bioremediation [N-UNCOUNT-U15] **Bioremediation** is the use of living organisms to treat contaminated groundwater.

birth control [N-UNCOUNT-U2] **Birth control** is the deliberate act of preventing pregnancy.

BOD [N-UNCOUNT-U7] The **BOD** (biochemical oxygen demand) in a body of water is the amount of oxygen needed by aerobic microorganisms to oxidize organic wastes.

break down [V-T-U13] To **break down** a substance is to separate it into smaller parts.

brownfield [N-COUNT-U14] A **brownfield** is a contaminated area where industry once existed, and where restoration is necessary before it can be used for another purpose.

carbon monoxide [N-UNCOUNT-U8] **Carbon monoxide** is a gas and air pollutant that is invisible, odorless and poisonous that is produced by motor vehicles.

carbon storage [N-UNCOUNT-U10] **Carbon storage** is the capture and storage of CO_2 so that it is not released into the atmosphere.

carcinogen [N-COUNT-U1] A **carcinogen** is a substance that causes cancer.

carrying capacity [N-COUNT-U2] A **carrying capacity** is the highest number of people an area can support with its existing resources.

cell [N-COUNT-U10] A **cell** is an area where waste has been compacted.

chlorinated [ADJ-U14] If something is **chlorinated**, it has had chlorine added to it.

clean up [N-COUNT-U14] A **clean up** is a process of cleaning a place carefully by removing pollution and waste.

clear cutting [N-UNCOUNT-U3] **Clear cutting** is the act of cutting down all the trees in an area at once.

coagulation [N-UNCOUNT-U7] **Coagulation** is the process of making small particles join into larger particles through the use of movement and chemicals.

coal-fired power plant [N-COUNT-U9] A **coal-fired power plant** is a facility that produces electricity by burning coal.

collapse [N-UNCOUNT-U2] A **collapse** is a sudden decrease of something.

combustion controls [N-COUNT-U9] **Combustion controls** are methods to make the process of burning fuel more efficient, such as installing better equipment.

compare [V-T-U12] To **compare** is to evaluate two or more things in order to find out how they are the same and how they are different.

composite liner [N-COUNT-U10] A **composite liner** is a piece of synthetic material that is placed over soil that has been pressed down.

consumption [N-UNCOUNT-U2] **Consumption** is using something, such as a natural resource.

containment [N-UNCOUNT-U13] **Containment** is the action of keeping something harmful from spreading.

contaminant [N-COUNT-U6] A **contaminant**, or pollutant, is an unwanted element.

countermeasure [N-COUNT-U13] A **countermeasure** is an action taken to prevent a negative effect from happening.

criteria pollutant [N-COUNT-U8] A **criteria pollutant** is a harmful chemical that governments limit the emissions of with laws and regulations.

cultural eutrophication [N-UNCOUNT-U6] **Cultural eutrophication** is a process in which human activity contributes to nutrient pollution in a body of water.

cyclone collector [N-COUNT-U9] A **cyclone collector** is a cylindrical device in which gas spins, forcing large particles to hit the wall of the device. They fall down into a collection device and are removed.

daily cover [N-COUNT-U10] A **daily cover** is a layer of soil that is put over a day's accumulation of waste.

decompose [V-I or T-U10] To **decompose** is to break down slowly.

decontamination [N-UNCOUNT-U13] **Decontamination** is the process of removing contaminants from something.

deep-well disposal [N-UNCOUNT-U10] **Deep-well disposal** is a method of disposing of liquid waste by injecting it into deep underground rock.

deforestation [N-UNCOUNT-U3] **Deforestation** is the act of cutting large amounts of trees without planting more to replace them.

demand [N-UNCOUNT-U2] **Demand** is level of willingness people have to purchase a particular good or service.

deoxygenation [N-UNCOUNT-U6] **Deoxygenation** is the process of removing oxygen atoms from a molecule or substance.

derailment [N-COUNT-U13] A **derailment** is an accident that forces a train off its tracks.

design strategy [N-COUNT-U11] A **design strategy** is a plan that helps firms decide what to do while designing products.

develop [V-T-U2] To **develop** is to improve or create something.

developing nation [N-COUNT-U3] A **developing nation** is a nation that is not fully industrialized and whose citizens do not have a lot of material wealth.

diffusion [N-UNCOUNT-U6] **Diffusion** is the process in which particles spread from an area of high concentration to an area of low concentration.

direct push drilling [N-UNCOUNT-U14] **Direct push drilling** is a method of drilling that involves pushing or hammering an object into the ground instead of turning it.

disaster [N-COUNT-U13] A **disaster** is an accident or natural occurrence that causes a large amount of damage or death.

disinfection contact [N-UNCOUNT-U6] **Disinfection contact** is the amount of time required to inactivate remaining pathogens.

dispersant [N-COUNT-U13] A **dispersant** is a liquid or gas used to break up another chemical, such as oil.

Glossary

dispersion [N-UNCOUNT-U6] **Dispersion** is the process of spreading or distributing particles over a wide area.

disposal capacity [N-UNCOUNT-U10] **Disposal capacity** is the largest amount of waste that an area can hold.

dissolved oxygen (DO) [N-UNCOUNT-U6] **Dissolved oxygen (DO)**, also called oxygen saturation, is a measurement of the amount of oxygen in a particular medium.

dose-response assessment [N-UNCOUNT-U1] **Dose-response assessment** is the process of determining how much of something is required to produce a health effect.

doubling time [N-COUNT-U2] A **doubling time** is the amount of time it takes for something to get twice as big.

drought [N-COUNT-U5] A **drought** is a period of time during which a region goes without water due to low rainfall.

electrostatic precipitator [N-COUNT-U9] An **electrostatic precipitator** is a device that uses an electrical charge to remove small particles from gas.

emission offset [N-COUNT-U8] An **emission offset** is a reduction in an existing source of pollution meant to make up for the addition of a new source of pollution.

emission potential [N-UNCOUNT-U9] **Emission potential** is the ability of a fuel source to produce contaminants.

emission standard [N-COUNT-U8] An **emission standard** is a regulation that limits the amount of pollution that can be produced by a source.

ethanol [N-UNCOUNT-U12] **Ethanol** is a grain alcohol that is often mixed with gasoline for fuel. It can help diminish carbon dioxide emissions.

eutrophication [N-UNCOUNT-U6] **Eutrophication** is the build up of an excessive richness of nutrients in a body of water; it is dangerous to aquatic life.

exceed [V-T-U2] To **exceed** is to pass the limit of something.

exponential [ADJ-U2] If something is **exponential**, it is growing or increasing very quickly.

exposure assessment [N-UNCOUNT-U1] **Exposure assessment** is the process of determining how many people were exposed to something toxic and how long they were exposed for.

extraction well [N-COUNT-U15] An **extraction well** is a well that lowers the water table and pulls contaminated groundwater from the ground.

family planning [N-UNCOUNT-U2] **Family planning** is the act or process of determining the number of children one wants and when to have them.

FBC [N-UNCOUNT-U9] **FBC** (Fluidized-bed combustion) is a process where a mixture of crushed coal and limestone are blown upwards. They react and form solid calcium sulfate, which is safely removed, instead of being released as emissions.

fertilizer [N-COUNT-U5] **Fertilizer** is a substance farmers add to soil to aid plant growth.

filtration [N-UNCOUNT-U6] **Filtration** is the process of separating the small, unsettled particles from water.

flocculation [N-UNCOUNT-U6] **Flocculation** is the mixing of water to help create larger particles that will settle more easily.

flowing [ADJ-U6] If water is **flowing**, it is constantly moving.

flue gas desulfurization [N-UNCOUNT-U9] **Flue gas desulfurization** is the process of removing sulfur from gases that come out of power station chimneys.

fossil fuel [N-COUNT-U12] A **fossil fuel** is a fuel, such as natural gas, coal, or oil, that is created through natural processes over millions of years.

fuel cell [N-COUNT-U12] A **fuel cell** is a device that uses oxygen to convert energy from chemical fuels into electrical energy.

gas emissions [N-UNCOUNT-U12] **Gas emissions** are gases that have been released into the atmosphere from either a natural or artificial source.

gasoline [N-UNCOUNT-U14] **Gasoline** is a type of refined petroleum mainly used as a fuel for motor vehicles.

generate [V-T-U12] To **generate** is to create energy.

green [ADJ-U11] If something is **green**, it does not harm the environment.

ground-level [ADJ-U8] If something is **ground-level**, it exists at the same elevation as the ground.

groundwater [N-COUNT-U5] **Groundwater** is water located underground in spaces between soil and rocks.

hazard identification [N-UNCOUNT-U1] **Hazard identification** is the process of determining whether certain chemicals have negative effects on health.

hazard index [N-UNCOUNT-U1] The **hazard index** for a situation is the sum of the hazard quotients involved.

hazard quotient [N-UNCOUNT-U1] The **hazard quotient** is the likelihood of a contaminant causing health effects. It is calculated as a ratio of the average daily exposure to a chemical during a period of time to the RfD.

hazardous [ADJ-U10] If something is **hazardous** it is dangerous.

HAZMAT [N-UNCOUNT-U13] **HAZMAT** (hazardous materials) are materials that could be dangerous to people or the environment if released.

heavy metals [N-COUNT-U5] A **heavy metal** is a metallic chemical element that is very dense and can be poisonous even at low concentrations.

hybrid [N-COUNT-U12] A **hybrid** is a vehicle with a power system that uses electricity and a fuel-burning engine.

hydraulic fracturing [N-UNCOUNT-U14] **Hydraulic fracturing** is the process of fracturing rocks by introducing highly pressured liquid into them.

IGCC [N-UNCOUNT-U9] **IGCC** (Integrated gasification combined cycle) is a process where steam turns coal into gas. Impurities are removed before combustion and any excess heat created is used to create steam.

impermeable barrier [N-COUNT-U15] An **impermeable barrier** is a barrier that groundwater cannot flow through.

import [V-T-U2] To **import** is to buy something from one country and bring it into the country where you are from.

industrial [ADJ-U14] If something is **industrial**, it is or was used for the production of goods.

industrial solid waste [N-UNCOUNT-U10] **Industrial solid waste** is non-hazardous waste produced by industrial facilities, such as factories.

injection probe [N-COUNT-U14] An **injection probe** is a thin probe with small perforations along the sides that it is used to inject oxidants to areas.

injection well [N-COUNT-U15] An **injection well** is a well that raises the water table and pushes contaminated groundwater away.

irrigation [N-UNCOUNT-U5] **Irrigation** is the supply of water to land by manmade ditches, streams, or pipes. Irrigation is used mainly for agricultural purposes, such as the watering of crops.

ISCO [N-UNCOUNT-U14] **ISCO** (in situ chemical oxidation) is an environmental remediation technique that uses chemical oxidants to destroy contaminants.

ISCR [N-UNCOUNT-U14] **ISCR** (in situ chemical reduction) is an environmental remediation technique that uses particles of iron to destroy contaminants.

isolation [N-UNCOUNT-U15] **Isolation** is the act of separating something from everything else.

lead [N-UNCOUNT-U8] **Lead** is a toxic metallic element. It can have negative effects on the nervous system, the heart and lungs, the immune system and the kidneys.

lifecycle assessment [N-COUNT-U11] A **lifecycle assessment** is a way of evaluating the total impact a product or service has on the environment.

lift [N-COUNT-U10] A **lift** is a layer that is put over an area when cells are completely full.

light pollution [N-UNCOUNT-U4] **Light pollution** is excessive artificial light that changes the levels of natural light outside.

LOEL [N-UNCOUNT-U1] The **LOEL** (lowest-observed-effect level) is the lowest dose that produces an observable effect in an experiment.

logging [N-UNCOUNT-U3] **Logging** is the process of cutting down trees and selling the timber.

Glossary

malnutrition [N-UNCOUNT-U4] **Malnutrition** is a condition in which the body lacks the nutrients it needs.

marine [ADJ-U13] If something is **marine**, it happens or is found in the ocean.

material intensiveness [N-UNCOUNT-U11] The **material intensiveness** of a product is the amount of a material required to make the product and the toxicity of the product.

material life extension [N-UNCOUNT-U11] **Material life extension** is the act of ensuring that a product's materials will still be useful after the product is worn out. This allows the products materials to be used again, instead of becoming waste.

material selection [N-UNCOUNT-U11] **Material selection** is the stage of product development where a firm decides what materials to make a product out of.

methane recovery [N-UNCOUNT-U10] **Methane recovery** is the collection of the gas methane in order to use it for other purposes, such as generating electricity.

methanol [N-UNCOUNT-U12] **Methanol** is a wood alcohol that is used to make fuel, often for race cars. It burns at a low temperature and as a result, reduces emissions.

migrate [V-I-U4] To **migrate** is to relocate by moving from one country to another.

mitigate [V-T-U3] To **mitigate** something is to make it less severe.

natural disaster [N-COUNT-U13] A **natural disaster** is a disaster caused by a natural event, such as a hurricane or earthquake.

net metering [N-UNCOUNT-U12] **Net metering** is a policy in which the owner of facilities or equipment that produce electricity can sell the excess to others or get credit for it on a utility bill.

nitrogen dioxide [N-UNCOUNT-U8] **Nitrogen dioxide** is a reddish-brown gas and pollutant that is produced by motor vehicles.

NOAEL [N-UNCOUNT-U1] The **NOAEL** (no-observed-adverse-effect level) is the highest dose that does not produce an observable effect in an experiment.

noise pollution [N-UNCOUNT-U4] **Noise pollution** is excessive noise that causes hearing difficulties, stress, lack of concentration, or other adverse effects.

nonpoint source [N-COUNT-U5] A **nonpoint source** is a source of pollution that comes from more than one origin.

nutrient depletion [N-UNCOUNT-U3] **Nutrient depletion** is the removal of nutrients from soil to the point where the nutrients become unavailable.

oil slick [N-COUNT-U13] An **oil slick** is a layer of oil floating on a body of water. Oil slicks are usually caused by oil spills.

oil spill [N-COUNT-U13] An **oil spill** is a disaster that causes oil to spill into the environment.

open dump [N-COUNT-U10] An **open dump** is an open area where people leave trash.

open space [N-COUNT-U4] **Open space** is an area that has not been developed, but instead remains in its natural state.

overcrowded [ADJ-U4] If an area is **overcrowded**, it has too many people for its size.

overfishing [N-UNCOUNT-U3] **Overfishing** is the depletion of fish populations due to too much fishing.

overpopulation [N-UNCOUNT-U2] **Overpopulation** is the presence of too many people in an area.

oxygen-demanding waste [N-COUNT-U6] In a body of water, **oxygen-demanding waste** is matter that requires oxygen.

ozone [N-UNCOUNT-U8] **Ozone** is a molecule, consisting of three oxygen atoms. It is found in the stratosphere and acts as a screen for ultraviolet radiation.

packaging [N-UNCOUNT-U11] **Packaging** is the act of putting products in containers to be sold.

particulate control [N-UNCOUNT-U9] **Particulate control** is the process of removing particulates, or tiny solid particles, from a gas.

pathogen [N-COUNT-U5] A **pathogen** is an agent that causes disease, such as bacteria or a fungus.

perception [N-COUNT-U1] A **perception** is a person's subjective assessment of the scale of a risk.

permeable [ADJ-U15] If something is **permeable**, liquids and gases can pass through it.

pesticide [N-COUNT-U5] A **pesticide** is a substance used to kill pests.

photovoltaics [N-UNCOUNT-U12] **Photovoltaics** is a way to create electricity from light using solar panels constructed with a special material.

phytoremediation [N-UNCOUNT-U15] **Phytoremediation** is a method of bioremediation that specifically uses plants to remove contaminants.

planned obsolescence [N-UNCOUNT-U11] **Planned obsolescence** is the process of producing products that require frequent replacement, which allows the producers to sell more products.

plume [N-COUNT-U6] A **plume** is a cloud of vapor, smoke, or water.

PM [N-UNCOUNT-U8] **PM** (particulate matter) is made up of tiny pieces of matter that become suspended in air or water. PM is produced by motor vehicles and can impair breathing in humans.

point source [N-COUNT-U5] A **point source** is a single specific source of pollution.

population growth [N-UNCOUNT-U2] **Population growth** is an increase of the number of people in an area.

postcombustion controls [N-COUNT-U9] **Postcombustion controls** are methods of capturing and containing emissions before they can pollute the air.

poverty [N-UNCOUNT-U4] **Poverty** is the state of having so little money that you cannot purchase food, clothing, or housing.

PRB [N-COUNT-U15] A **PRB** (permeable reactive barrier) is a permeable barrier that is placed in the ground and treats contaminated groundwater as it passes through it.

precombustion controls [N-COUNT-U9] **Precombustion controls** are methods of decreasing a fuel's ability to produce emissions by removing certain elements or switching to other fuels.

primary pollutant [N-COUNT-U8] A **primary pollutant** is a harmful chemical that is released directly into the air, either by a human action or a natural process.

primary treatment [N-UNCOUNT-U7] **Primary treatment** is the use of physical processes to purify water, such as screening and skimming.

product system life extension [N-UNCOUNT-U11] **Product system life extension** is the act of making a product last longer, so it does not have to be replaced.

pump-and-treat [N-UNCOUNT-U15] **Pump-and-treat** is a system of treating contaminated groundwater that involves pumping contaminated groundwater out of the aquifer with extraction wells, cleaning it above ground, and returning it to the aquifer.

rate [N-COUNT-U12] A **rate** is the amount of something used in relation to one unit of another thing.

ratio [N-COUNT-U12] A **ratio** is the relationship between the amounts of two different things.

raw [ADJ-U11] If a material is **raw**, it has not been processed or used yet.

recarbonation [N-UNCOUNT-U7] **Recarbonation** is the process of adjusting the alkalinity and the pH balance of water.

reclamation [N-UNCOUNT-U14] **Reclamation** is the process of making contaminated lands usable again.

renewable resource [N-COUNT-U3] A **renewable resource** is a resource that can be replenished over time.

replenish [V-T-U3] To **replenish** something is to restore it to the levels that it used to have.

restoration [N-UNCOUNT-U14] **Restoration** is the process of making something return to a state that it previously held.

RfD [N-UNCOUNT-U1] The **RfD** (reference dose) is the largest amount of a chemical humans can be exposed to on a daily basis without developing health effects.

risk assessment [N-UNCOUNT-U1] **Risk assessment** is the process of calculating of how much risk is involved in a situation.

risk characterization [N-UNCOUNT-U1] **Risk characterization** is the process of determining the scale of a public health problem using hazard identification, dose-response assessment and exposure assessment.

Glossary

risk management [N-UNCOUNT-U1] **Risk management** is the process of how to respond to potential risks.

rooftop garden [N-COUNT-U4] A **rooftop garden** is a garden on the top of a building.

runoff [N-UNCOUNT-U5] **Runoff** is the flow of water, and items within it, from a surface.

rural [ADJ-U4] If an area is **rural**, it is located outside of a city, in the countryside.

rural flight [N-UNCOUNT-U4] **Rural flight** is the movement of people from a rural area to an urban area.

salinity [N-UNCOUNT-U5] **Salinity** refers to the amount of salt contained in a substance.

screening [V-I-U7] **Screening** water involves removing sand, grit, and other debris.

scrubber [N-COUNT-U9] A **scrubber** is a device that removes gas and/or particulates from a power station's exhaust.

secondary pollutant [N-COUNT-U8] A **secondary pollutant** is a harmful chemical that is formed when two or more non-harmful chemicals react with each other.

secondary treatment [N-UNCOUNT-U7] **Secondary treatment** is the use microbial oxidation of wastes to purify water, in addition to physical processes.

sedimentation [N-UNCOUNT-U7] **Sedimentation** is matter that settles to the bottom.

selective cutting [N-UNCOUNT-U3] **Selective cutting** is the act of cutting down one tree or a small group of trees that are fully grown.

settle [V-I-U7] To **settle** in water is to move downwards and come to rest at the bottom.

shortage [N-COUNT-U5] A **shortage** is a lack of something needed.

skimming [N-UNCOUNT-U13] **Skimming** is the act of removing a material from the surface of a liquid.

slash and burn [N-UNCOUNT-U3] **Slash and burn** is a method of clearing land for agriculture. It involves cutting down vegetation and burning it, and then planting crops in the burnt fields.

sludge processing [N-UNCOUNT-U7] **Sludge processing** is the process of dewatering solid wastes removed in a water treatment facility and disposing of the liquids and solids.

soil degradation [N-UNCOUNT-U3] **Soil degradation** is a deterioration of soil quality because it has not been used properly.

soil mixing [N-UNCOUNT-U14] **Soil mixing** is a method of adding chemicals to soil while stirring them together.

soil solidification [N-UNCOUNT-U15] **Soil solidification** is a method of isolating groundwater contaminants that involves using chemicals to solidify soil into an impermeable concrete-like material.

solid waste landfill [N-COUNT-U10] A **solid waste landfill** is a place where municipal solid waste is disposed of and later buried under layers of ground.

solvent [N-COUNT-U14] A **solvent** is a liquid capable of dissolving other substances.

source reduction [N-UNCOUNT-U11] **Source reduction** is the practice of reducing the amount of waste products produced as part of their design.

standing [ADJ-U6] If a body of water is **standing**, it is not moving or flowing.

strain [N-UNCOUNT-U2] A **strain** is stress put on a resource because of high demand.

strip cutting [N-UNCOUNT-U3] **Strip cutting** is a logging method that involves clear cutting a narrow strip of trees, usually along a slope that is parallel to a river. After this strip has been allowed to grow back for several years, another strip of trees is cut.

strip mining [N-UNCOUNT-U3] **Strip mining** is a method of mining that involves removing the soil, rocks and vegetation above mineral deposits to get access to the mineral.

substitute [V-T-U11] To **substitute** something is to replace it with something else.

sulfur dioxide [N-UNCOUNT-U8] **Sulfur dioxide** is a compound that is made up of sulfur and oxygen, and can be an air pollutant. Possible negative effects are breathing problems and crop damage.

support [V-T-U2] To **support** is to provide the resources that a population needs to survive.

surface impoundment [N-COUNT-U10] A **surface impoundment** is a low area, such as a hole, that holds liquid waste.

sustainability [N-UNCOUNT-U3] **Sustainability** is the state of not being harmful or damaging to the environment, and supporting environmental balance in the long-term future.

SVE [N-UNCOUNT-U15] **SVE** (soil vapor extraction) is a system of treating contaminated groundwater that injects air into contaminated ground, which catches contaminants in a vapor. The vapor is then extracted from the ground, treated, and released.

toxic [ADJ-U10] If something is **toxic**, it is poisonous.

treatment plant [N-COUNT-U7] A **treatment plant** is a facility that purifies water.

tree plantation [N-COUNT-U3] A **tree plantation** is a place where fast-growing tree species are planted and then cut down when they are mature. The process then repeats.

uncertainty factor [N-COUNT-U1] An **uncertainty factor** is a number used to divide LOEL or NOAEL levels to estimate values for the entire human population.

unsanitary [ADJ-U4] If a place is **unsanitary**, it is extremely dirty and likely to cause disease.

urban agriculture [N-COUNT-U4] **Urban agriculture** is the process of growing, collecting, and distributing food in a city.

urban heat island [N-COUNT-U4] An **urban heat island** is a metropolitan area that is much warmer than the rural areas that surround it.

urban sprawl [N-UNCOUNT-U4] **Urban sprawl** is the spread of a city beyond urban and suburban areas into rural areas.

urbanization [N-UNCOUNT-U4] **Urbanization** is the process of a town or city expanding in size because its population is increasing.

UV light [N-UNCOUNT-U15] **UV** (ultraviolet light) **light** is light with a lower wavelength than visible light that can be used to break down organic compounds and treat contaminated groundwater.

vehicle [N-COUNT-U12] A **vehicle** is a mode of transportation used on land.

vehicular accident [N-COUNT-U13] A **vehicular accident** is an accident that causes two vehicles to crash into each other.

virgin material [N-COUNT-U11] A **virgin material** is a material that has not been processed or used yet.

vitrification [N-UNCOUNT-U15] **Vitrification** is a method of isolating groundwater contaminants by melting and cooling the surrounding soil into glass.

VOCs [N-COUNT-U5] **VOCs** (volatile organic compounds) are substances that can evaporate at very low temperatures and are potentially harmful to the environment and human health.

waste water [N-COUNT-U5] **Waste water** is water that contains waste after being used by humans.

water pollution [N-UNCOUNT-U5] **Water pollution** occurs when unwanted materials are present in a body of water and adversely affect it.

wells-to-wheels [ADJ-U12] If something is **wells-to-wheels**, its environmental impact has been analyzed from the beginning of its life cycle (the fuel extraction process) to the end (when it is transported to a gas station).

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