CAREER PATHS

ENVIRONMENTAL ENGINEERING

Book 2

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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, problem identification, problem solving, procedure, 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, incinerate, 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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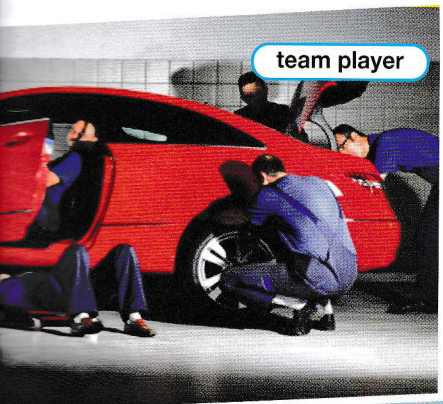
1 Traits of an Environmental Engineer

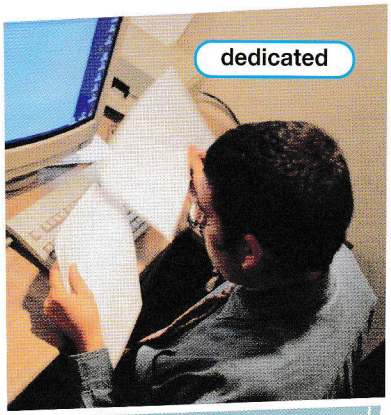
Get ready!

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?





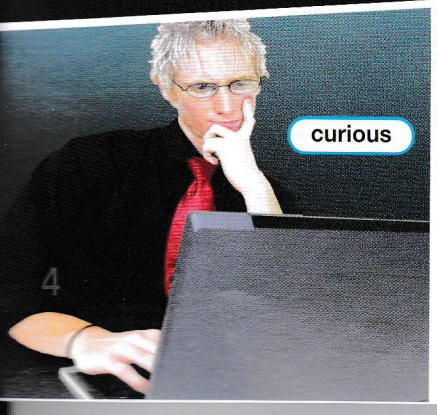
Job Listing:

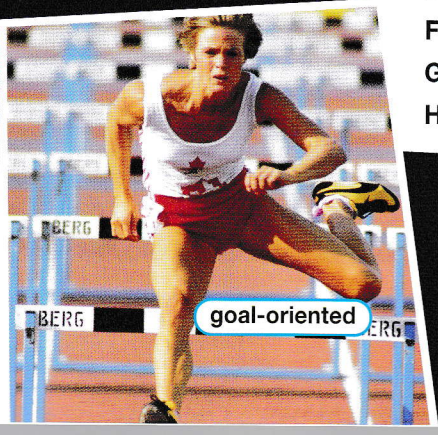
Environmental Engineering

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

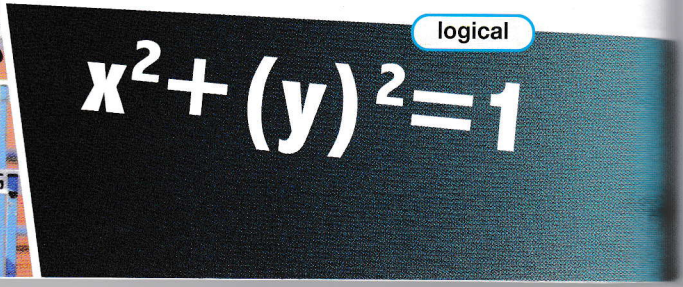
D one who puts the group first

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?

_____

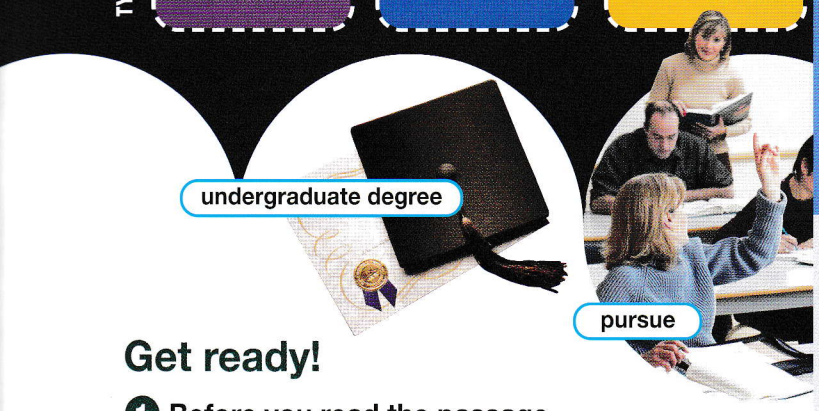
_____

2 Education

HOME | ABOUT US | SERVICES | CONTACT

TYPES OF DEGREES

bachelor's degree — master's degree — PhD



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.

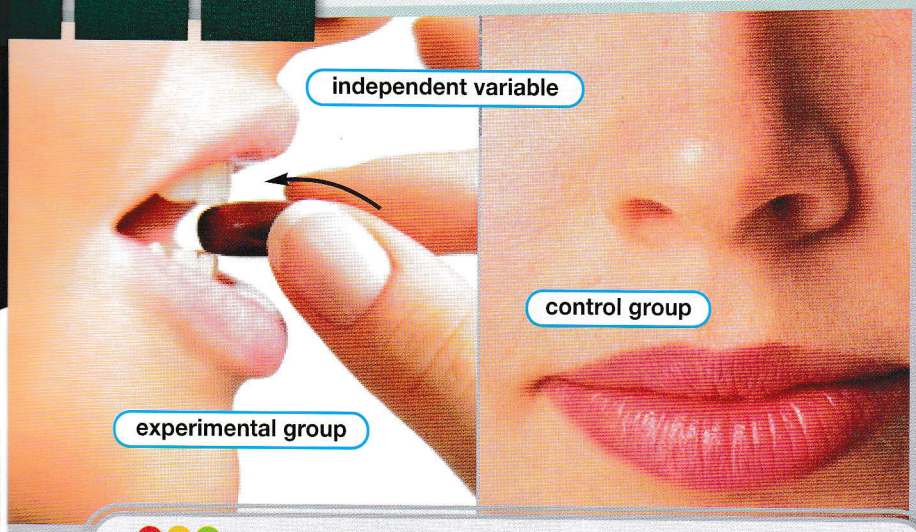
1 Do I need a bachelor's degree in engineering to apply for the PhD program?

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

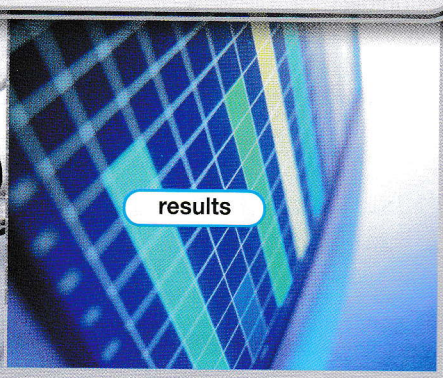
3 The Scientific Method



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?

_____

_____

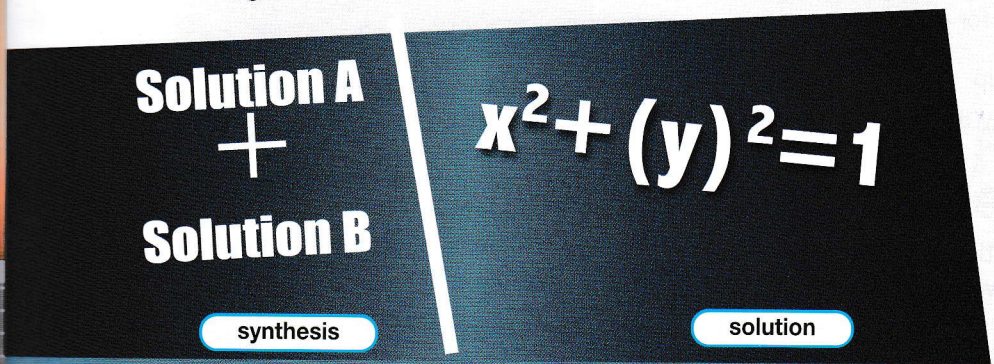
4 Problem Solving

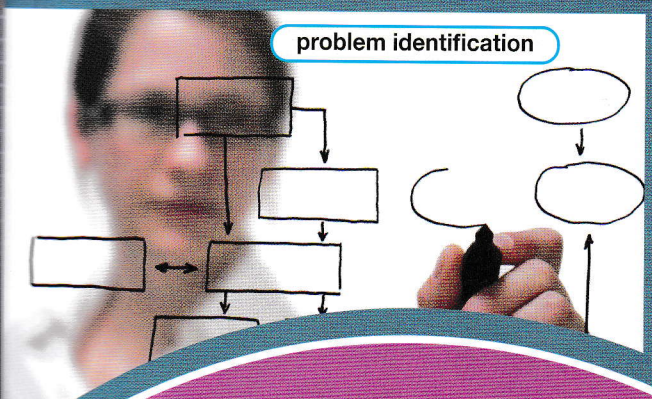
Get ready!

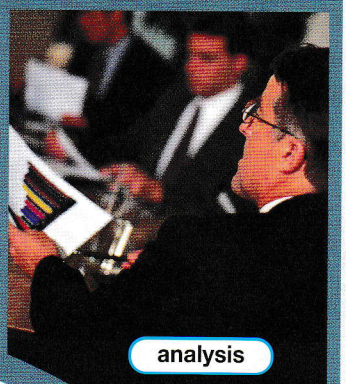
1 Before you read the passage, talk about these questions.

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.

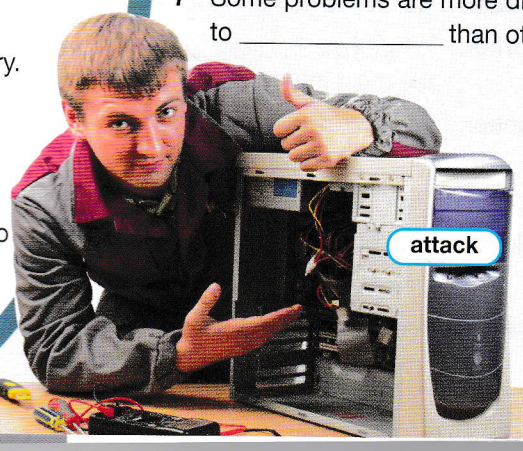
3 The first _____ of the plan failed, but it worked the second time.

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?

_____

_____

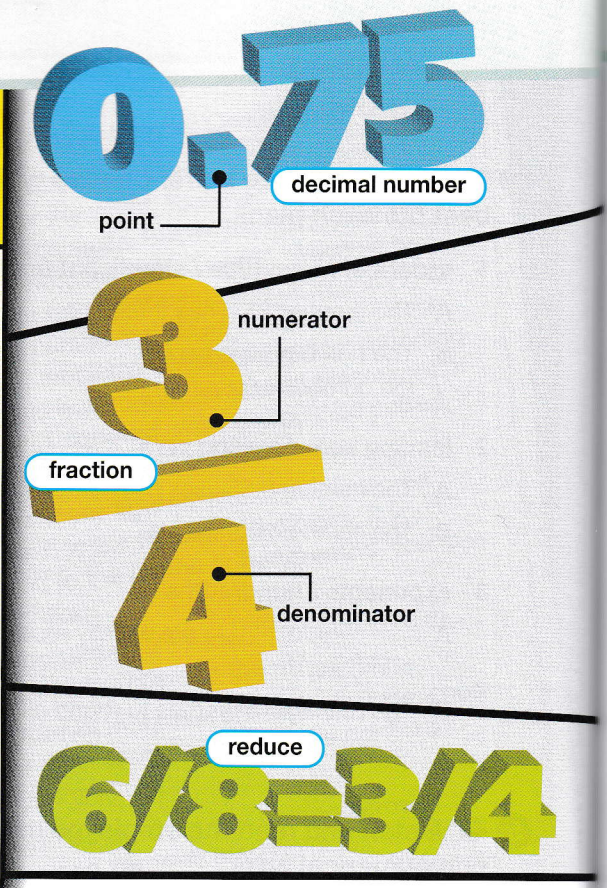
What steps will you take to prevent the error from occurring again?

_____

_____

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!

1 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

2 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

3 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?

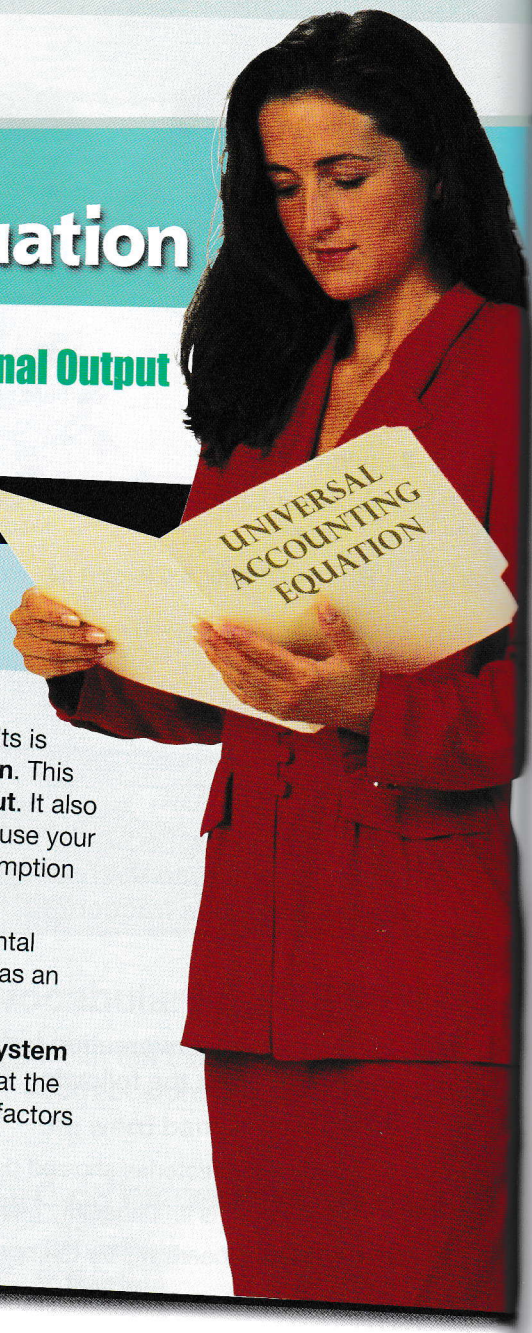
_____

_____

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: _____

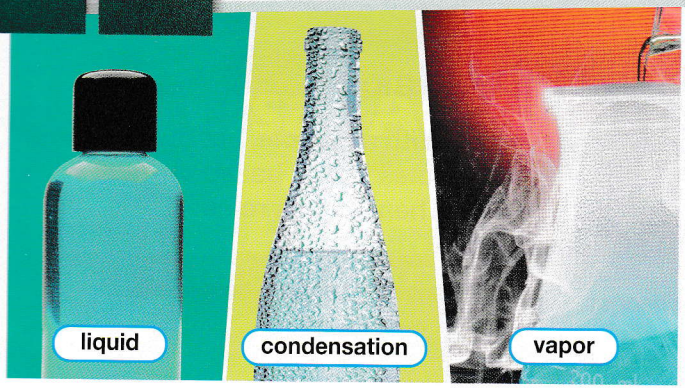
_____

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.

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 _____.

Carbon *Environmental Planning*

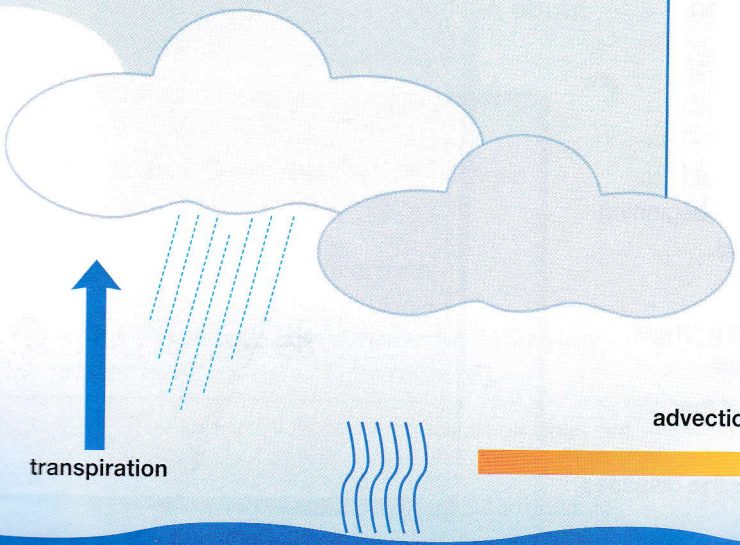
Results of Elm Lake Testing

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**.



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

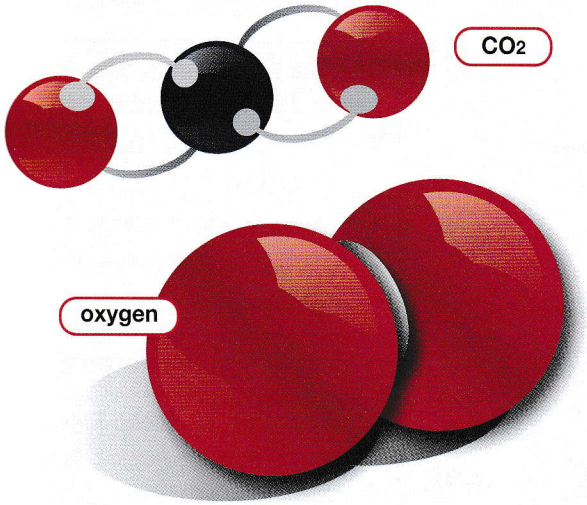
9 Carbon Cycle

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?

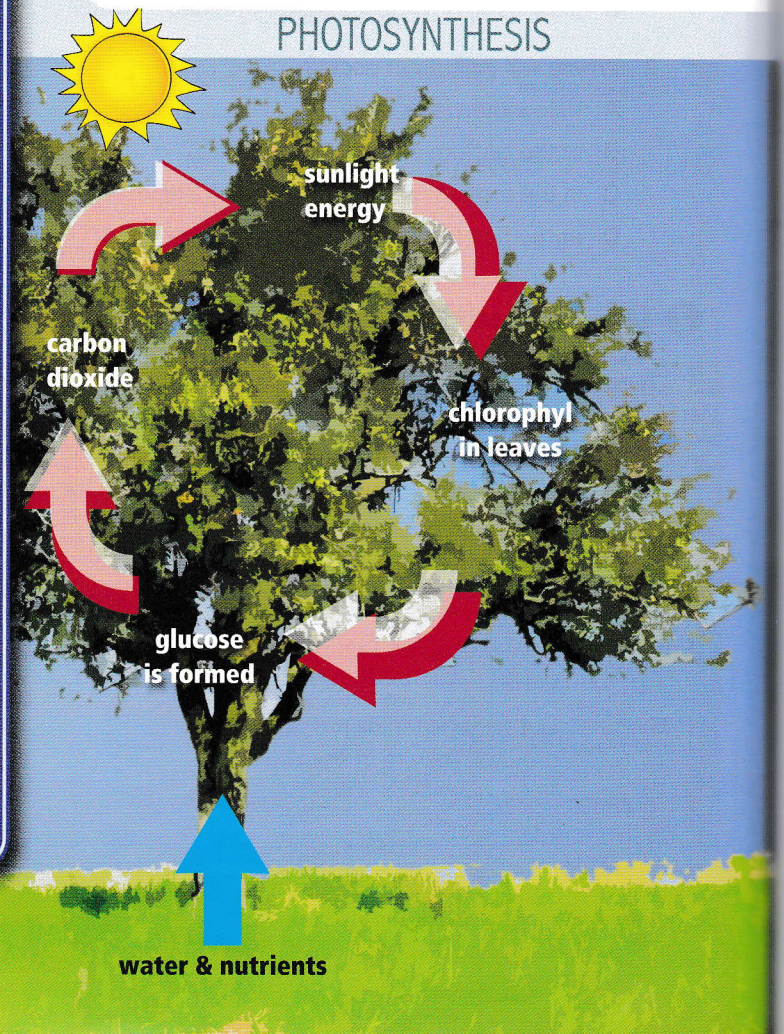
- **A** to explain human effects on the carbon cycle
- **B** to promote responsible use of fossil fuels
- **C** to explain how carbon circulates through the geosphere
- **D** to describe the history of carbon dioxide emissions

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?

_____

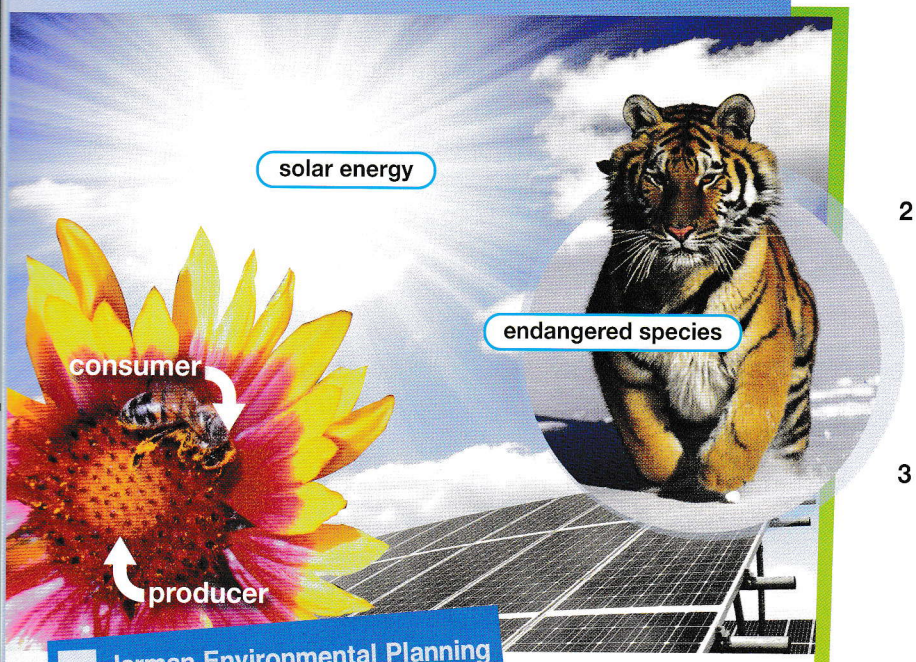
10 Energy Cycle

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:

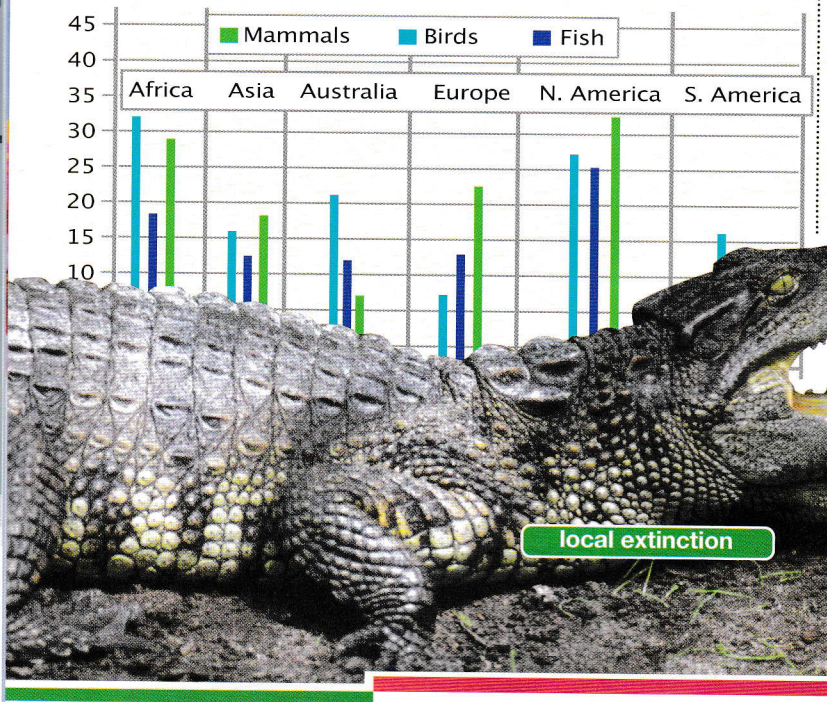
_____

_____

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**).

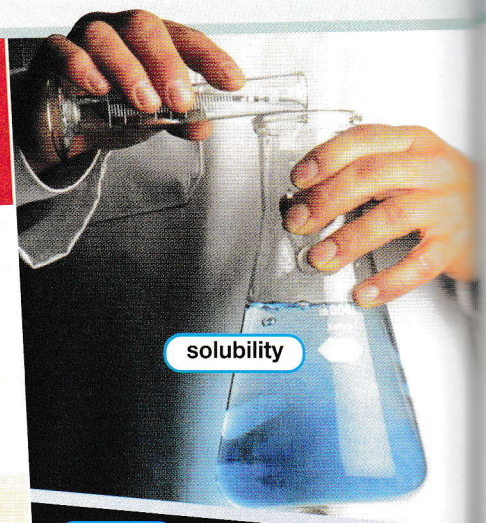
The course will be divided into four units. Each unit will be tested separately. The final exam will cover all four units.

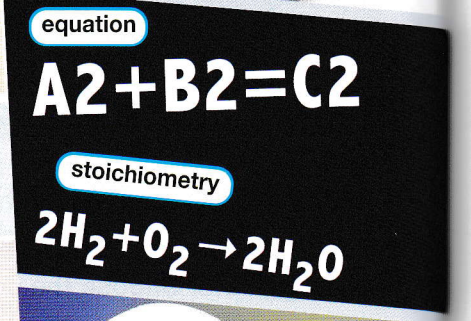
Unit 1—Basic concepts: This unit will introduce students to key chemical concepts. The concepts will be used throughout the course. They include the **periodic table** and the basics of atomic structure.

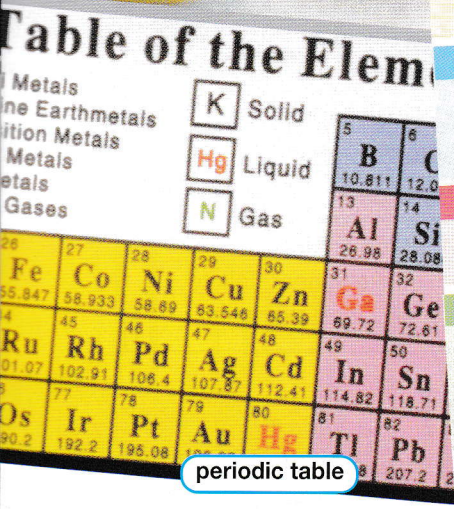
Unit 2—Reactions: Unit 2 will cover important types of chemical reactions. We will focus on **endothermic** and **exothermic** reactions. We will also learn the **equation** for calculating the **enthalpy** of a system.

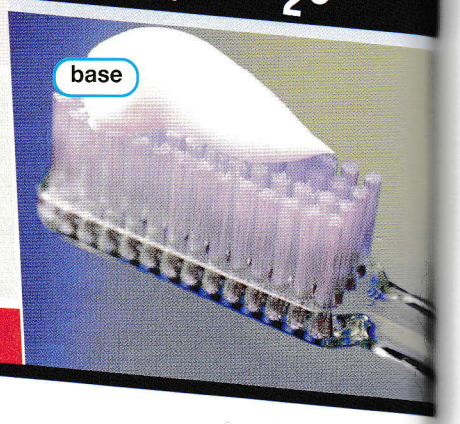
Unit 3—**pH scale**: This unit will focus on what makes a substance an **acid** or a **base**. It will also cover the effects of **solubility** on pH **balance**.

Unit 4—**Stoichiometry**: The final unit will introduce students to stoichiometry. This focus on reaction ratios will prepare students for CHEM 103.









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.

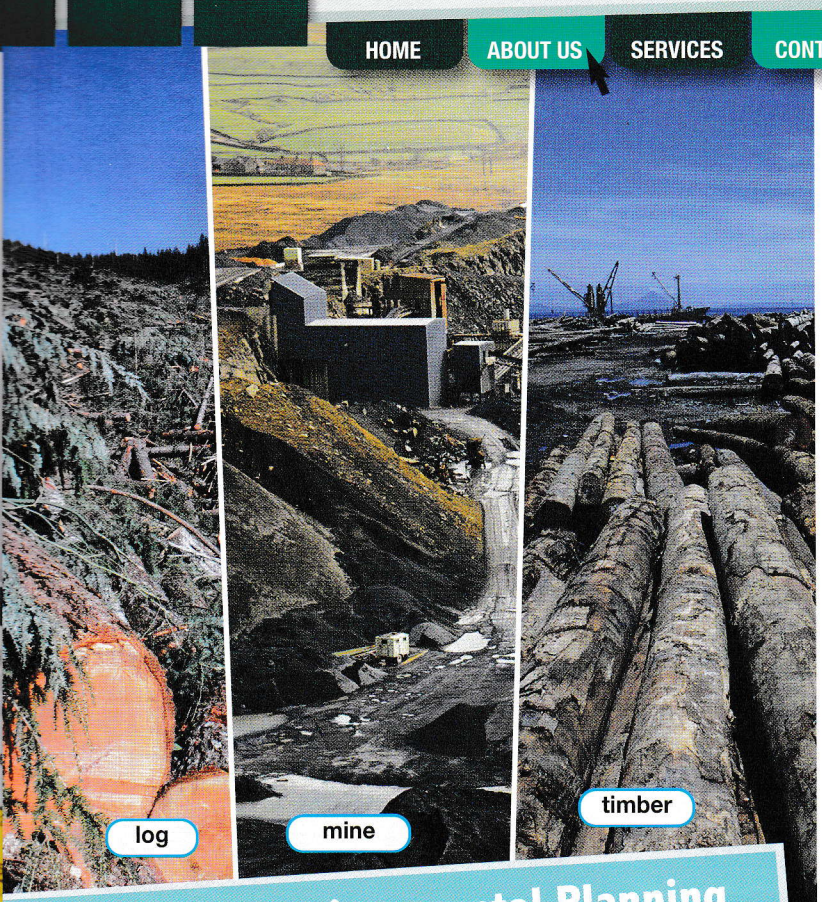
1 How familiar are you with the periodic table?

2 What chemistry concepts do you find particularly easy or challenging?

Thanks,

Monica

13 Resources



Jarman Environmental Planning Resource Management Services

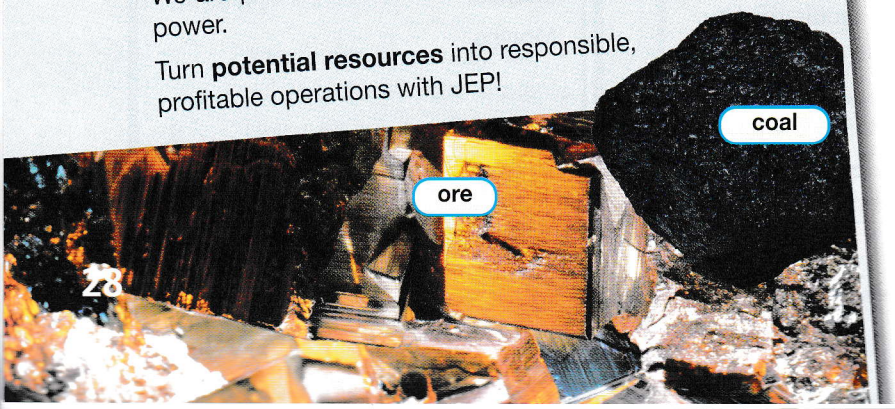
We provide consulting services for companies working with natural resources. We know that it is important to your company to produce a **sustainable yield**. Whether you want to **extract coal** or **log timber**, we can help you do it responsibly.

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: _____

_____

_____

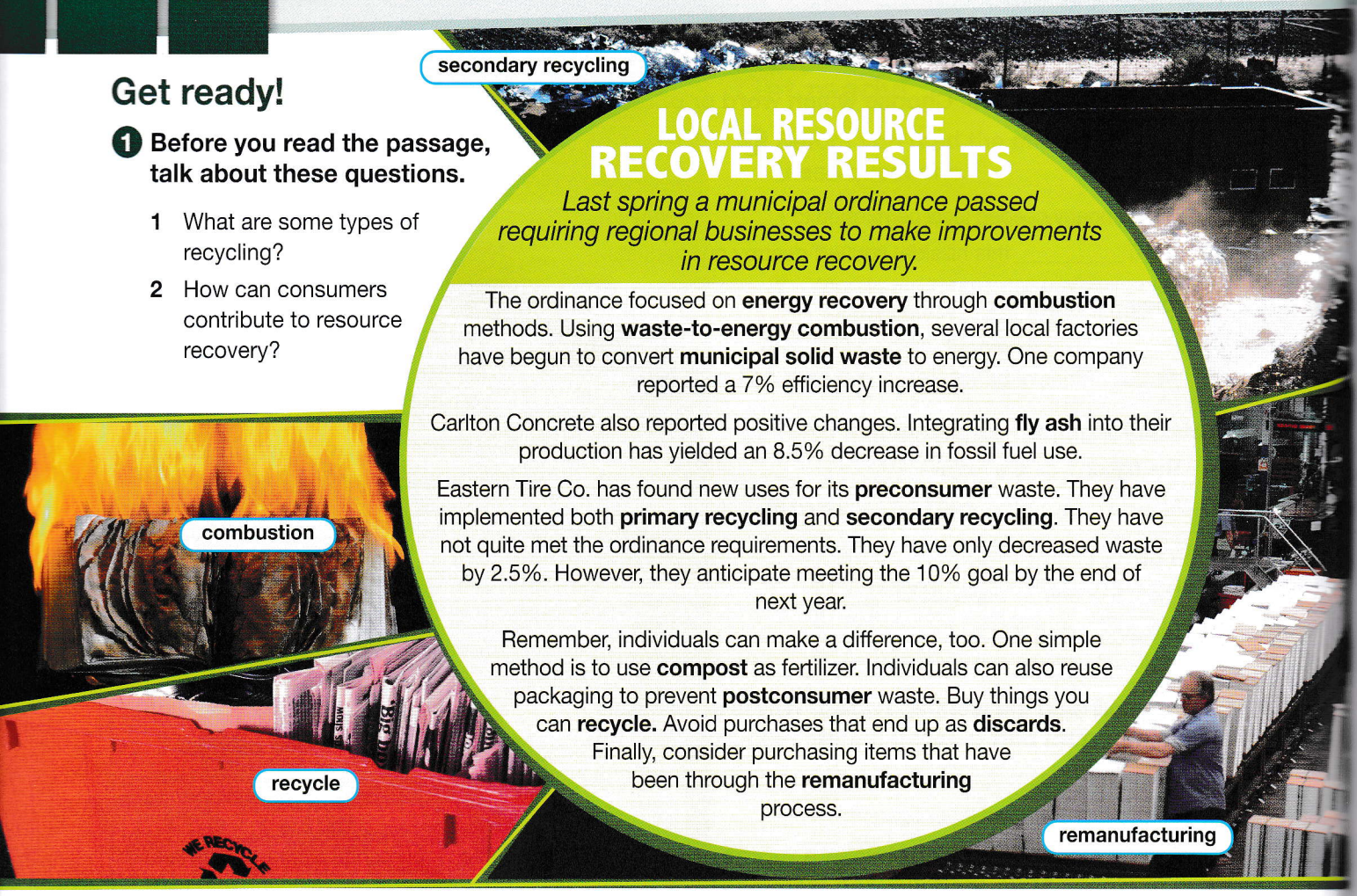
14 Resource Recovery

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

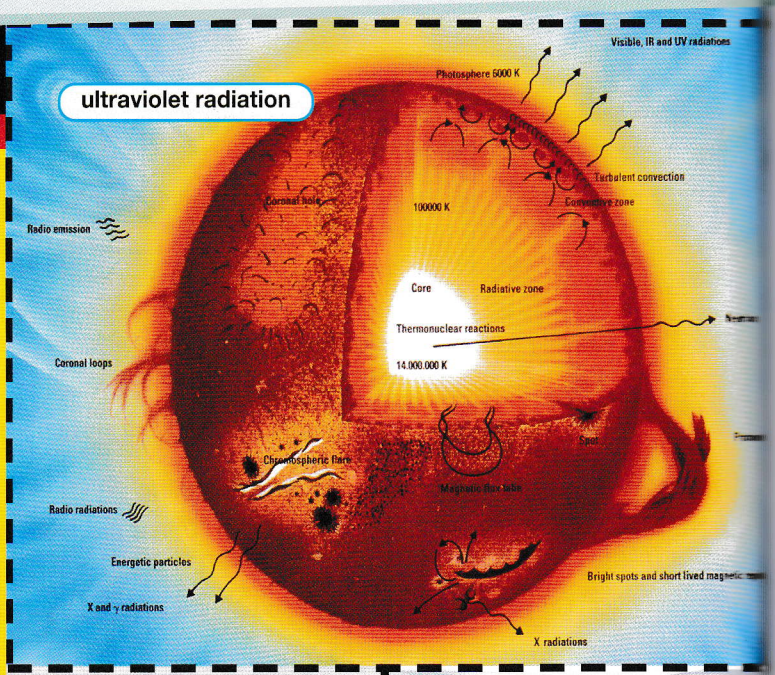
Climate Concerns in the 21st Century

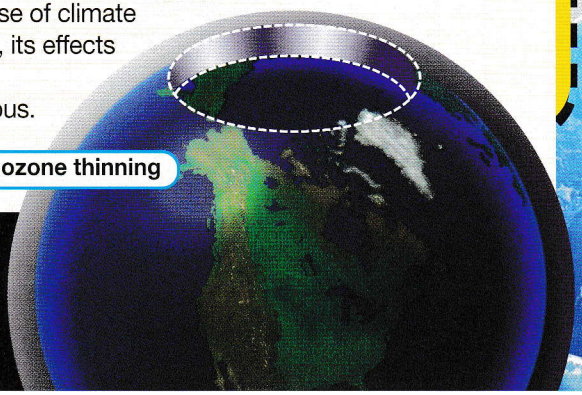
by Martin Kenway

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 ⅘, 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.