

Basic Process Skills

During a science course, you often carry out some short lab activities as well as more detailed experiments. Here are some skills that you will use as you work.

Observing

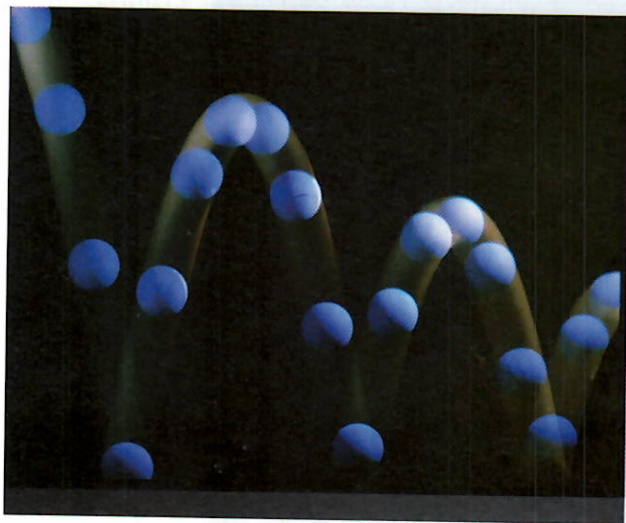
In every science activity, you make a variety of observations. **Observing** is using one or more of the five senses to gather information. Many observations involve the senses of sight, hearing, touch, and smell.

Sometimes you will use tools that increase the power of your senses or make observations more precise. For example, hand lenses enable you to see things in greater detail. Tools may help you eliminate personal opinions or preferences.

In science it is customary to record your observations at the time they are made, usually by writing or drawing in a notebook. You may occasionally make records by using computers, cameras, videotapes, and other tools. As a rule, scientists keep complete accounts of their observations, often using tables to help organize their observations in a regular way.

Inferring

In science as in everyday life, observations are usually followed by inferences. **Inferring** is interpreting an observation or statement based on prior knowledge. For example, you can make several observations using the strobe photograph below. You can observe that the



ball is moving. Based on the motion of the ball, you might infer that the ball was thrown downward at an angle by an experimenter. In making that inference, you would use your knowledge about the motion of projectiles. Someone who knew more about projectile motion might infer that the ball loses energy with each bounce. That is why the height decreases with each bounce.

Notice that an inference is an act of reasoning, not a fact. That means an inference may be logical but not true. It is often necessary to gather further information before you can be confident that an inference is correct. For scientists, that information may come from further observations or from research into the work done by others.

Comparing Observations and Inferences

Sample Observation	Sample Inference
The ball moves less and less vertical distance in the time between each flash of the strobe light.	Gravity is slowing down the ball's upward motion.
The ball moves the same distance to the right in the time between each flash of the strobe light.	Air resistance is so small that it does not slow down the ball's horizontal motion.

Predicting

People often make predictions, but their statements about the future could be either guesses or inferences. In science, a **prediction** is an inference about a future event based on evidence, experience, or knowledge. For example, you can say, *On the first day next month, it will be sunny all day.* If your statement is based on evidence of weather patterns in the area, then the prediction is scientific. If the statement was made without considering any evidence, it's just a guess.

Predictions play a major role in science because they offer scientists a way to test ideas. If scientists understand an event or the properties of a particular object, they should be able to make accurate predictions about that event or object. Some predictions can be tested simply by making observations. For others, carefully designed experiments are needed.

Measuring

Measurements are important in science because they provide specific information and help observers avoid bias. **Measuring** is comparing an object or process to a standard. Scientists use a common set of standards, called the International System of Units, abbreviated as SI (for its French name, *Système International d'Unités*).

What distance does the ball travel in each time interval in the strobe photograph? You can make measurements on the photograph to make more precise statements about the ball's motion.

Calculating

Once scientists have made measurements, calculations are a very important part of analyzing data. How fast is a ball moving? You could directly measure the speed of a ball using probeware such as a motion sensor. But you can also calculate the speed using distance and time measurements. **Calculating** is a process in which a person uses mathematical operations to manipulate numbers and symbols.

Classifying

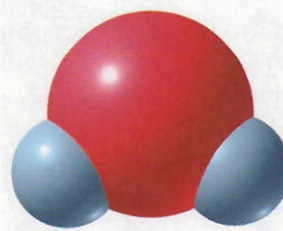
Classifying is grouping items according to some organizing idea or system. Classifying occurs in every branch of science but it's especially important in chemistry because there are so many different ways that elements can combine to form compounds.

Sometimes you place objects into groups using an established system. Other times you create a system by observing a variety of objects and identifying their properties. For example, you could group household cleaners into those that are abrasive and those that are not. Or you could categorize cleaners as toxic or non-toxic. Ammonia is toxic, whereas vinegar is not.

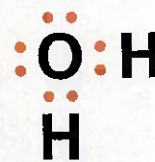


Using Tables and Graphs

Scientists represent and organize data in tables and graphs as part of experiments and other activities. Organizing data in tables and graphs makes it easier to see patterns in data. Scientists analyze and interpret data tables and graphs to determine the relationship of one variable to another and to make predictions based on the data.



Space-filling
model



Electron dot
model

Using Models

Some cities refuse to approve new tall buildings if they would cast shadows on existing parks. As architects plan buildings in such locations, they use models to show where a proposed building's shadow will fall at any time of day at any season of the year. A **model** is a mental or physical representation of an object, process, or event. In science, models are usually made to help people understand natural objects and the processes that affect these objects.

Models can be varied. Mental models, such as mathematical equations, can represent some kinds of ideas or processes. For example, the equation for the surface area of a sphere can model the surface of Earth, enabling scientists to determine its size. Models can be two-dimensional (flat) or three-dimensional (having depth). In chemistry, for example, there are several ways to model the arrangement of atoms in a molecule. Two models for a water molecule are shown above. The electron dot model is two-dimensional. It has the advantage of clearly showing how electrons are shared among atoms in the molecule. The space-filling model cannot show the number of electrons inside the atoms or between atoms, but it does show the arrangement of atoms in space.

Experimental Methods

A science experiment is a procedure designed so that there is only one logical explanation for the results. Some types of experiments are fairly simple to design. Others may require ingenious problem solving.



Posing Questions

As a gardener harvested corn in her vegetable garden, she noticed that on one side of the garden the plants produced very few ears of corn. The gardener wondered, *Why didn't the plants on one side of the garden produce as much corn?*

An experiment may begin when someone like the gardener asks a specific question or wants to solve a particular problem. Sometimes the original question leads directly to an experiment, but often researchers need to restate the problem before they can design an appropriate experiment. The gardener's question about the corn, for example, is too broad to be tested by an experiment, since there are so many possible different answers. To narrow the topic, the gardener might think about several related questions: *Were the seeds the same on both sides of the garden? Was the sunlight the same? Is there something different about the soil?*

Formulating Hypotheses

In science, a question about an event is answered by developing a possible explanation called a **hypothesis**. The hypothesis may be developed after long thought and research or come to a scientist "in a flash." To be useful, a hypothesis must lead to predictions that can be tested.

In this case, the gardener decided to focus on the quality of the soil on each side of her garden. She did some tests and discovered that the soil had a lower pH on the side where the plants did not produce well. That led her to propose this hypothesis: *If the pH of the soil is too low, the plants will produce less corn.* The next step is to make a prediction based on the hypothesis, for example, *If the pH of the soil is increased using lime, the plants will yield more corn.* Notice that the prediction suggests the basic idea for an experiment.

Designing Experiments

A carefully designed experiment can test a prediction in a reliable way, ruling out other possible explanations. As scientists plan their experimental procedures, they pay particular attention to the variables that must be controlled and the procedures that must be defined.

The gardener decided to study three groups of plants:

- Group 1—20 plants on the side of the garden with a low pH;
- Group 2—20 plants on the side of the garden with a low pH, but with lime added; and
- Group 3—20 plants on the side of the garden with a high pH.

Controlling Variables

As researchers design an experiment, they identify the **variables**, factors that can change. Some common variables include mass, volume, time, temperature, light, and the presence or absence of specific materials. An experiment involves three categories of variables. The factor that scientists purposely change is called the **manipulated variable**. The factor that may change because of the manipulated variable and that scientists want to observe is called the **responding variable**. And the factors that scientists purposely keep the same are called the **controlled variables**. Controlling variables helps make researchers confident that the observed changes in the responding variable are due to changes in the manipulated variable.

For the gardener, the manipulated variable is the pH of the soil. The responding variable is the number of ears of corn produced by the plants. Among the variables that must be controlled are the amount of sunlight received each day, the time of year when seeds are planted, and the amount of water the plants receive.

What Is a “Control Group”?

When you read about certain experiments, you may come across references to a control group (or “a control”) and the experimental groups. All of the groups in an experiment are treated exactly the same except for the manipulated variable. In an experimental group, the manipulated variable is being changed. The control group is used as a standard of comparison. It may consist of objects that are not changed in any way or objects that are being treated in the usual way. For example, in the gardener’s experiment, Group 1 is the control group, because for these plants nothing is done to change the low pH of the soil.

Forming Operational Definitions

In an experiment, it is often necessary to define one or more variables explicitly so that any researcher could measure or control the variable in exactly the same way. An **operational definition** describes how a particular variable is to be measured or how a term is to be defined. In this context, the term *operational* means “describing what to do.”

The gardener, for example, has to decide exactly how much lime to add to the soil. Can lime be added after the seeds are planted or only before planting? At what pH should no more lime be added to the soil? In this case, the gardener decided to add lime only before planting, and to add enough lime to make the pH equal in Groups 2 and 3.

Analyzing Data

The observations and measurements that are made in an experiment are called **data**. Scientists customarily record data in an orderly way. When an experiment is done, the researcher analyzes the data for trends or patterns, often by doing calculations or making graphs, to determine whether the results support the hypothesis.

For example, the gardener regularly measured and recorded data such as the soil moisture, daily sunlight, and pH of the soil. She found that the soil pH in Groups 2 and 3 started the same, but after two months the soil pH for Group 3 was a little higher than the soil pH for Group 2.

After harvesting the corn, the gardener recorded the numbers of ears of corn produced by each plant. She totaled the number of ears for each group. Her results were the following.

Group 1: 67 ears of corn

Group 2: 102 ears of corn

Group 3: 126 ears of corn

The overall trend was clear: The gardener’s prediction was correct.

Drawing Conclusions

Based on whether the results confirm or refute the hypothesis, researchers make a final statement that summarizes the experiment. That final statement is called the **conclusion**. For example, the gardener’s conclusion was, *Adding lime to soil with a low pH will improve the production of corn plants.*

Communicating Results

When an experiment has been completed, one or more events may follow. Researchers may repeat the experiment to verify the results. They may publish the experiment so that others can evaluate and replicate their procedures. They may compare their conclusion with the discoveries made by other scientists. And they may raise new questions that lead to new experiments. For example, *Why does the pH level decrease over time when soil is treated with lime?*

Evaluating and Revising

Scientists must be flexible about the conclusions drawn from an experiment. Further research may help confirm the results of the experiment or make it necessary to revise the initial conclusions. For example, a new experiment may show that lime can be effective only when certain microbes are present in the soil. Scientists continuously evaluate and revise experiments based on the findings in new research.



Science Safety

Laboratory work can be exciting, but it can be dangerous if you don't follow safety rules. Ask your teacher to explain any rules you don't understand. Always pay attention to safety symbols and **CAUTION** statements.

General Safety Rules and First Aid

1. Read all directions for an experiment several times. Follow the directions exactly as they are written. If you are in doubt, ask your teacher for assistance.
2. Never perform unauthorized or unsupervised labs, or handle equipment without specific permission.
3. When you design an experiment, do not start until your teacher has approved your plan.
4. If a lab includes physical activity, use caution to avoid injuring yourself or others. Tell your teacher if there is a reason that you should not participate.
5. Never eat, drink, or bring food into the laboratory.
6. Report all accidents to your teacher immediately.
7. Learn the correct ways to deal with a burn, a cut, and acid splashed in your eyes or on your skin.
8. Be aware of the location of the first-aid kit. Your teacher should administer any required first aid.
9. Report any fire to your teacher immediately. Find out the location of the fire extinguisher, the fire alarm, and the phone where emergency numbers are listed.

Dress Code

10. Always wear safety goggles to protect your eyes when working in the lab. Avoid wearing contact lenses. If you must wear contact lenses, ask your teacher what precautions you should take.
11. Wear a laboratory apron to protect your skin and clothing from harmful chemicals or hot materials.
12. Wear disposable plastic gloves to protect yourself from contact with chemicals that can be harmful. Keep your hands away from your face. Dispose of gloves according to your teacher's instructions.
13. Tie back long hair and loose clothing. Remove any jewelry that could contact chemicals or flames.

Heating and Fire Safety

14. Hot plates, hot water, and hot glassware can cause burns. Never touch hot objects with your bare hands. Use an oven mitt or other hand protection.

15. Use a clamp or tongs to hold hot objects. Test an object by first holding the back of your hand near it. If you feel heat on the back of your hand, the object may be too hot to handle.
16. Tie back long hair and loose clothing, and put on safety goggles before using a burner. Follow instructions from your teacher for lighting and extinguishing burners. If the flame leaps out of a burner as you are lighting it, turn the gas off. Never leave a flame unattended or reach across a flame. Make sure your work area is not cluttered with materials.
17. If flammable materials are present, make sure there are no flames, sparks, or exposed sources of heat.
18. Never heat a chemical without your teacher's permission. Chemicals that are harmless when cool can be dangerous when heated. When heating a test tube, point the opening away from you and others in case the contents splash or boil out of the test tube.
19. Never heat a closed container. Expanding hot gases may cause the container to explode.

Using Electricity Safely

20. To avoid an electric shock, never use electrical equipment near water, or when the equipment or your hands are wet. Use ground fault circuit interrupter (GFCI) outlets if you or your equipment may come into contact with moisture.
21. Use only sockets that accept a three-prong plug. Never use two-prong extension cords or adapters. When removing an electrical plug from a socket or extension cord, grasp the plug, not the cord.
22. Disconnect equipment that is not in use. Be sure cords are untangled and cannot trip anyone.
23. Do not use damaged electrical equipment. Look for dangerous conditions such as bare wires or frayed cords. Report damaged equipment immediately.

Using Glassware Safely

24. Handle fragile glassware, such as thermometers, test tubes, and beakers, with care. Do not touch broken glass. Notify your teacher if glassware breaks. Never use chipped or cracked glassware.
25. Never force glass tubing into a stopper. Your teacher will demonstrate the proper methods.
26. Never heat glassware that is not thoroughly dry. Use a wire screen to protect glassware from flames.
27. Hot glassware may not appear hot. Never pick up glassware without first checking to see if it is hot.
28. Never eat or drink from laboratory glassware.

Using Chemicals Safely

29. Do not let any corrosive or poisonous chemicals get on your skin or clothing, or in your eyes. When working with poisonous or irritating vapors, work in a well-ventilated area and wash your hands thoroughly after completing the activity.
30. Never test for an odor unless instructed by your teacher. Avoid inhaling a vapor directly. Use a wafting motion to direct vapor toward your nose.
31. Never mix chemicals “for the fun of it.” You might produce a dangerous, possibly explosive substance.
32. Never touch, taste, or smell a chemical that you do not know for certain to be harmless.
33. Use only those chemicals listed in an investigation. Keep the lids on the containers when chemicals are not being used. To avoid contamination, never return chemicals to their original containers.
34. Take extreme care not to spill any chemicals. If a spill occurs, immediately ask your teacher about the proper cleanup procedure. Dispose of all chemicals as instructed by your teacher.
35. Be careful when working with acids or bases. Pour these chemicals over the sink, not over your workbench. If an acid or base gets on your skin or clothing, rinse it off with plenty of cold water. Immediately notify your teacher about an acid or base spill.
36. When diluting an acid, pour the acid into water. Never pour water into the acid.

Using Sharp Instruments

37. Use sharp instruments only as directed. Scissors, scalpels, pins, and knives are sharp and can cut or puncture your skin. Always direct sharp edges and points away from yourself and others.
38. Notify your teacher immediately if you cut yourself when in the laboratory.

End-of-Experiment Rules

39. All chemicals and any other materials used in the laboratory must be disposed of safely. Follow your teacher’s instructions.
40. Clean up your work area and return all equipment to its proper place. Thoroughly clean glassware before putting it away.
41. Wash your hands thoroughly with soap, or detergent, and warm water. Lather both sides of your hands and between your fingers. Rinse well.
42. Check that all burners are off and the gas supply for the burners is turned off.

Safety Symbols

-  **General Safety Awareness**
Follow all safety instructions.
-  **Physical Safety**
Use caution in physical activities.
-  **Safety Goggles**
Always wear goggles in the laboratory.
-  **Lab Apron**
Always wear a lab apron in the laboratory.
-  **Plastic Gloves**
Protect your hands from unsafe chemicals.
-  **Heating**
Be careful using sources of heat.
-  **Heat-Resistant Gloves**
Do not touch hot objects with bare hands.
-  **Flames**
Work carefully around open flames.
-  **No Flames**
Flammable materials may be present.
-  **Electric Shock**
Take precautions to avoid electric shock.
-  **Fragile Glassware**
Handle glassware carefully.
-  **Corrosive Chemical**
Work carefully with corrosive chemicals.
-  **Poison**
Avoid contact with poisonous chemicals.
-  **Fumes**
Avoid inhaling dangerous vapors.
-  **Sharp Object**
Use caution with sharp or pointed tools.
-  **Disposal**
Follow instructions for disposal.
-  **Hand Washing**
Wash your hands before leaving the lab.

Reading and Study Skills

At the beginning of each section, you will find a reading strategy to help you study. Each strategy uses a graphic organizer to help you stay organized. The following strategies and graphic organizers are used throughout the text.

Reading Strategies

Using Prior Knowledge

This strategy helps you think about your own experience before you read a section. Research has shown that you learn new material better if you can relate it to something you already know.

Previewing

Previewing a lesson can give you a sense of how the textbook is organized and what lies ahead. One technique is to look at the section topics (in green and blue type). You also can preview by reading captions. Sometimes previewing helps you simply because you find out a topic isn't as hard as you thought it might be.

Predicting

You can preview a section and then make a prediction. For example, you might predict the meaning of an important concept. Then, as you read, check to see if your prediction was correct. Often you find out that you knew more about a topic than you realized.

Building Vocabulary

Start building new vocabulary by previewing a section and listing boldface terms you don't recognize. Then look for each term as you read. Writing a sentence with a term, and defining a term in your own words are two techniques that will help you remember definitions.

Identifying the Main Idea

The key symbols next to boldface sentences identify the main ideas in a section. You can use topic sentences to find the main idea in a paragraph. Often, a topic sentence is the first or second sentence in a paragraph.

Identifying Cause and Effect

Cause-and-effect relationships are very important in science. A flowchart will help you identify cause-and-effect relationships as you read about a process.

Comparing and Contrasting

Comparing and contrasting can help you understand how concepts are related. Comparing is identifying both similarities and differences, while contrasting focuses on the differences. Compare-and-contrast tables and Venn diagrams work best with this strategy.

Sequencing

When you sequence events, it helps you to visualize the steps in a process and to remember the order in which they occur. Sequences often involve cause-and-effect relationships. Use flowcharts for linear sequences and cycle diagrams for repeating sequences.

Relating Text and Figures

You can use diagrams and photographs to focus on the essential concepts in a section. Then find text that extends the information in the figures. You can also reinforce concepts by comparing different figures.

Summarizing

Summarizing requires you to identify key ideas and state them briefly in your own words. You will remember the content of an entire section better even if you summarize only a portion of the section.

Outlining

You can quickly organize an outline by writing down the green and blue headings in a section. Then add phrases or sentences from the boldface sentences to expand the outline with the most important concepts.

Monitoring Your Understanding

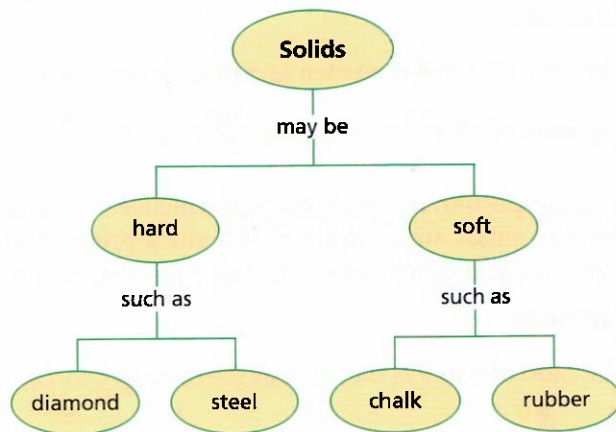
You can evaluate your progress with graphic organizers such as a Know-Write-Learn (KWL) table. To make a KWL table, construct a table with three columns, labeled K, W, and L. Before you read, write what you already know in the first column (K). In the middle column, write what you want to learn (W). After you read, write what you learned (L).

Graphic Organizers

Concept Maps and Web Diagrams

A **concept map** is a diagram that contains concept words in ovals and connects the ovals with linking words. Often the most general concept is placed at the top of the map. The content of the other ovals becomes more specific as you move away from the main concept. Linking words are written on a line between two ovals.

A **web diagram** is a type of concept map that shows how several ideas relate to one central idea. Each subtopic may also link to subtopics, creating the visual effect of a spider web. Linking words are usually not included.



Compare-and-Contrast Tables

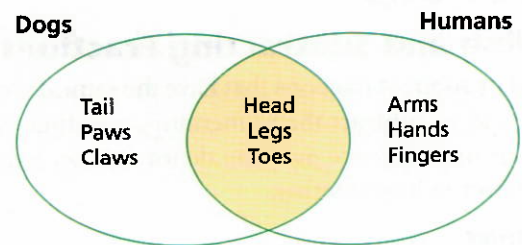
A **compare-and-contrast table** is a way of showing the similarities and differences between two or more objects or processes. The table provides an organized framework for making comparisons based on specific characteristics.

The items to be compared are usually column headings across the top of the table. Characteristics for comparison are listed in the first column. You complete the table by filling in information for each item.

Compare-and-Contrast Table		
Contents	Book	CD-ROM
Paper pages	Yes	No
Photographs	Yes	Yes
Videos	No	Yes

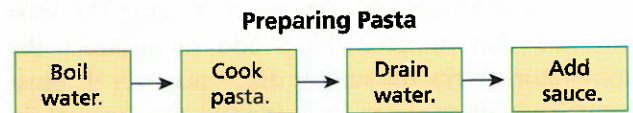
Venn Diagrams

A **Venn diagram** consists of two or more ovals that overlap. Each oval represents a particular object or idea. Unique characteristics are shown in the part of each oval that does not overlap. Shared characteristics are shown in the area of overlap.



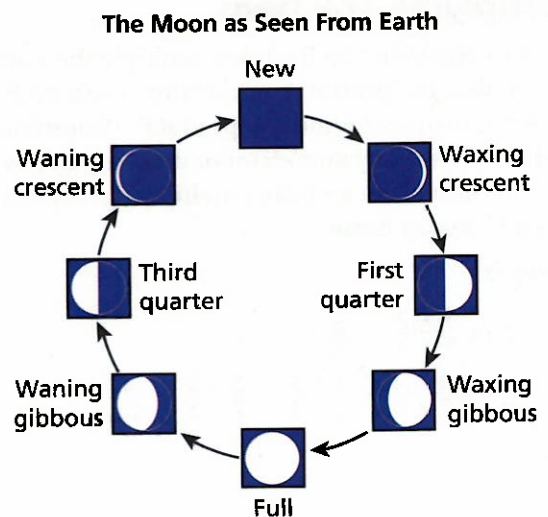
Flowcharts

A **flowchart** is used to represent the order in which a set of events occurs. Each step in the sequence is described in a box. Each box is linked to the next box with an arrow. The flowchart shows a sequence from beginning to end.



Cycle Diagrams

A **cycle diagram** shows boxes representing a cyclical sequence of events. As in a flowchart, boxes are linked with arrows, but the sequence does not have a beginning or end. The boxes are usually arranged in a clockwise circle.



Throughout your study of science, you will often need to solve math problems. This appendix is designed to help you quickly review the basic math skills you will use most often.

Fractions

Adding and Subtracting Fractions

To add or subtract fractions that have the same denominator, add or subtract the numerators, and then write the sum or difference over the denominator. Express the answer in lowest terms.

Examples

$$\frac{3}{10} + \frac{1}{10} = \frac{3+1}{10} = \frac{4}{10} = \frac{2}{5}$$

$$\frac{5}{7} - \frac{2}{7} = \frac{5-2}{7} = \frac{3}{7}$$

To add or subtract fractions with different denominators, find the least common denominator. Write an equivalent fraction for each fraction using the least common denominator. Then add or subtract the numerators. Write the sum or difference over the least common denominator and express the answer in lowest terms.

Examples

$$\frac{1}{3} + \frac{3}{5} = \frac{5}{15} + \frac{9}{15} = \frac{5+9}{15} = \frac{14}{15}$$

$$\frac{7}{8} - \frac{1}{4} = \frac{7}{8} - \frac{2}{8} = \frac{7-2}{8} = \frac{5}{8}$$

Multiplying Fractions

When multiplying two fractions, multiply the numerators to find the product's numerator. Then multiply the denominators to find the product's denominator. It helps to divide any numerator or denominator by the greatest common factor before multiplying. Express the answer in lowest terms.

Examples

$$\frac{3}{5} \times \frac{2}{7} = \frac{3 \times 2}{5 \times 7} = \frac{6}{35}$$

$$\frac{4}{14} \times \frac{6}{9} = \frac{2 \times 2}{7 \times 2} \times \frac{2 \times 3}{3 \times 3} = \frac{2 \times 2}{7 \times 3} = \frac{4}{21}$$

Dividing Fractions

To divide one fraction by another, invert and multiply. Express the answer in lowest terms.

Examples

$$\frac{2}{5} \div \frac{3}{4} = \frac{2}{5} \times \frac{4}{3} = \frac{2 \times 4}{5 \times 3} = \frac{8}{15}$$

$$\frac{9}{16} \div \frac{5}{8} = \frac{9}{16} \times \frac{8}{5} = \frac{9 \times 1}{2 \times 5} = \frac{9}{10}$$

Ratios and Proportions

A ratio compares two numbers or quantities. A ratio is often written as a fraction expressed in lowest terms. A ratio also may be written with a colon.

Examples

The ratio of 3 to 4 is written as 3 to 4, $\frac{3}{4}$, or 3 : 4.

The ratio of 10 to 5 is written as $\frac{10}{5} = \frac{2}{1}$, or 2 : 1.

A proportion is a mathematical sentence that states that two ratios are equivalent. To write a proportion, place an equal sign between the two equivalent ratios.

Examples

The ratio of 6 to 9 is the same as the ratio of 8 to 12.

$$\frac{6}{9} = \frac{8}{12}$$

The ratio of 2 to 4 is the same as the ratio of 7 to 14.

$$\frac{2}{4} = \frac{7}{14}$$

You can set up a proportion to determine an unknown quantity. Use x to represent the unknown. To find the value of x , cross multiply and then divide both sides of the equation by the number that comes before x .

Example

Two out of five students have blue notebooks. If this same ratio exists in a class of twenty students, how many students in the class have blue notebooks?

$$\begin{aligned} \frac{2}{5} &= \frac{x}{20} && \leftarrow \text{Cross multiply.} \\ 2 \times 20 &= 5x && \leftarrow \text{Divide.} \\ 8 &= x \end{aligned}$$

Percents and Decimals

To convert a percent to a decimal value, write the number without the percent sign and move the decimal point two places to the left. Add a zero before the decimal point.

Examples

$$38\% = 0.38$$

$$13.92\% = 0.1392$$

You can convert a decimal value to a percent value by moving the decimal point two places to the right and adding the percent sign.

Examples

$$0.46 = 46\%$$

$$0.8215 = 82.15\%$$

Exponents

A base is a number that is used as a factor. An exponent is a number that tells how many times the base is to be used as a factor.

Example

$$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$$

A power is any number that can be expressed as a product in which all of the factors are the same. Any number raised to the zero power is 1. Any number raised to the first power is that number. The only exception is the number 0, which is zero regardless of the power it is raised to.

Exponents	
Powers of 2	Powers of 10
$2^2 = 4$	$10^2 = 100$
$2^1 = 2$	$10^1 = 10$
$2^0 = 1$	$10^0 = 1$
$2^{-1} = \frac{1}{2}$	$10^{-1} = \frac{1}{10}$
$2^{-2} = \frac{1}{4}$	$10^{-2} = \frac{1}{100}$

Multiplying Exponents

To multiply exponential expressions with the same base, add the exponents. The general expression for exponents with the same base is $x^a \times x^b = x^{a+b}$.

Example

$$3^2 \times 3^4 = (3 \times 3) \times (3 \times 3 \times 3 \times 3) = 3^6 = 729$$

To raise a power to a power, keep the base and multiply the exponents. The general expression is $(x^a)^b = x^{ab}$.

Example

$$(3^2)^3 = (3^2) \times (3^2) \times (3^2) = 3^6 = 729$$

To raise a product to a power, raise each factor to the power. The general expression is $(xy)^n = x^n y^n$.

Example

$$(3 \times 9)^2 = 3^2 \times 9^2 = 9 \times 81 = 729$$

Dividing Exponents

To divide exponential expressions with the same base, keep the base and subtract the exponents. The general expression is:

$$\frac{x^a}{x^b} = x^{a-b}$$

Example

$$\frac{5^6}{5^4} = 5^{6-4} = 5^2 = 25$$

When the exponent of the denominator is greater than the exponent of the numerator, the exponent of the result is negative. A negative exponent follows the general expression:

$$x^{-n} = \frac{1}{x^n}$$

Example

$$2^3 \div 2^5 = 2^{3-5} = 2^{-2} = \frac{1}{2^2} = \frac{1}{4}$$

Scientific Notation

Scientific notation is used to express very large numbers or very small numbers. To convert a large number to scientific notation, move the decimal point to the left until it is located to the right of the first nonzero number. The number of places that you move the decimal point becomes the positive exponent of 10.

Example

$$18,930,000 = 1.893 \times 10^7$$

To write a number less than 1 in scientific notation, move the decimal point to the right of the first nonzero number. Use the number of places you moved the decimal point as the negative exponent of 10.

Example

$$0.0027 = \frac{2.7}{10 \times 10 \times 10} = 2.7 \times 10^{-3}$$

Adding and Subtracting

To add or subtract numbers in scientific notation, the exponents must be the same. If they are different, rewrite one of the numbers to make the exponents the same. Then write the answer so that only one number is to the left of the decimal point.

Example

$$\begin{aligned} 3.20 \times 10^3 + 5.1 \times 10^2 \\ &= 32.0 \times 10^2 + 5.1 \times 10^2 \\ &= 37.1 \times 10^2 \\ &= 3.71 \times 10^3 \end{aligned}$$

Multiplying and Dividing

To multiply or divide numbers in scientific notation, the exponents are added or subtracted.

Examples

$$\begin{aligned} (1.2 \times 10^3) \times (3.4 \times 10^4) &= (4.1 \times 10^{3+4}) \\ &= 4.1 \times 10^7 \\ (5.0 \times 10^9) \div (2.5 \times 10^6) &= (2.0 \times 10^{9-6}) \\ &= 2.0 \times 10^3 \end{aligned}$$

Significant Figures

When measurements are combined in calculations, the uncertainty of each measurement must be correctly reflected in the final result. The digits that are accurate in the answer are called significant figures. When the result of a calculation has more significant figures than needed, the result must be rounded off. If the first digit after the last significant digit is less than 5, round down. If the first digit after the last significant digit is 5 or more, round up.

Examples

1577 rounded to three significant figures is 1580.
1574 rounded to three significant figures is 1570.
2.458462 rounded to three significant figures is 2.46.
2.458462 rounded to four significant figures is 2.458.

Adding and Subtracting

In addition and subtraction, the number of significant figures in the answer depends on the number with the largest uncertainty.

Example

$$\begin{array}{r} 25.34 \text{ g} \\ 152 \text{ g} \\ + 4.009 \text{ g} \\ \hline 181 \text{ g} \end{array}$$

The measurement with the largest uncertainty is 152 g and it is measured to the nearest gram. Therefore, the answer is given to the nearest gram.

Multiplying and Dividing

In multiplication and division, the measurement with the smallest number of significant figures determines the number of significant figures in the answer.

Example

$$\begin{aligned} \text{Density} &= \frac{\text{Mass}}{\text{Volume}} \\ &= \frac{20.79 \text{ g}}{5.5 \text{ mL}} \\ &= 3.8 \text{ g/mL} \end{aligned}$$

Because 5.5 mL has only two significant figures, the answer must be rounded to two significant figures.

Formulas and Equations

An equation is a mathematical sentence that contains one or more variables and one or more mathematical operators (such as $+$, $-$, \div , \times , and $=$). An equation expresses a relationship between two or more quantities.

A formula is a special kind of equation. A formula such as $V = l \times w \times h$ states the relationship between unknown quantities represented by the variables V , l , w , and h . The formula means that volume (of a rectangular solid) equals length times width times height. Some formulas have numbers that do not vary, such as the formula for the perimeter of a square: $P = 4s$. In this formula, the number 4 is a constant.

To solve for a quantity in an equation or formula, substitute known values for the variables. Be sure to include units.

Example

An airplane travels in a straight line at a speed of 600 km/h. How far does it fly in 3.5 hours?

Write the formula that relates speed, distance, and time.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$v = \frac{d}{t}$$

To solve for distance, multiply both sides of the equation by t .

$$v = \frac{d}{t}$$

$$v \times t = \frac{d}{t} \times t$$

$$v \times t = d$$

Substitute in the known values.

$$600 \text{ km/h} \times 3.5 \text{ h} = d$$

$$d = 2100 \text{ km}$$

Conversion Factors

Many problems involve converting measurements from one unit to another. You can convert units by using an equation that shows how units are related. For example, $1 \text{ in.} = 2.54 \text{ cm}$ relates inches and centimeters.

To write a conversion factor, divide both sides of the equation by 1 in.

$$\frac{1 \text{ in.}}{1 \text{ in.}} = \frac{2.54 \text{ cm}}{1 \text{ in.}}$$

$$1 = 2.54 \text{ cm/in.}$$

Because the conversion factor is equal to 1, you can multiply one side of an equation by it and preserve equality. You can make a second conversion factor by dividing both sides of the equation by 2.54 cm.

$$\frac{1 \text{ in.}}{2.54 \text{ cm}} = \frac{2.54 \text{ cm}}{2.54 \text{ cm}} = 1$$

One conversion factor converts inches to centimeters and the other converts centimeters to inches. Choose the conversion factor that cancels out the unit that you have a measurement for.

Example

Convert 25 inches to centimeters. Use d to represent the unknown number of centimeters.

$$d = 25 \text{ in.} \times \frac{2.54 \text{ cm}}{1 \text{ in.}}$$

$$= 64 \text{ cm}$$

Some conversions are more complicated and require multiple steps.

Example

Convert 23°F to a Celsius temperature.

The conversion formula is

$$^\circ\text{F} = \left(\frac{9}{5} \times ^\circ\text{C}\right) + 32^\circ\text{F}$$

Substitute in 23°F :

$$23^\circ\text{F} = \left(\frac{9}{5} \times ^\circ\text{C}\right) + 32^\circ\text{F}$$

$$23^\circ\text{F} - 32^\circ\text{F} = \frac{9}{5} \times ^\circ\text{C}$$

$$-9^\circ\text{F} = \frac{9}{5} \times ^\circ\text{C}$$

$$-9^\circ\text{F} \times \frac{5}{9} = -5^\circ\text{C}$$

Data Tables

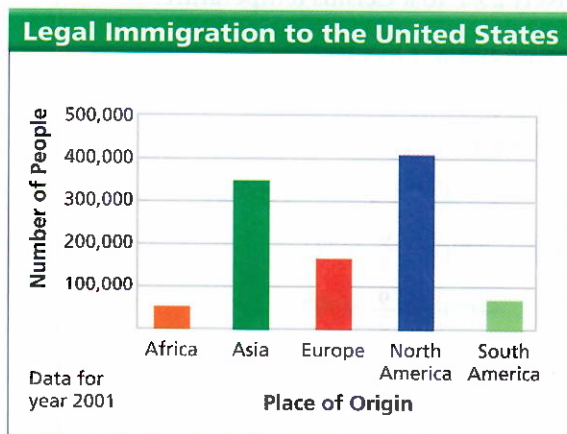
Data tables help to organize data and make it easier to see patterns in data. If you plan data tables before doing an experiment, they will help you record observations in an orderly fashion.

The data table below shows United States immigration data for the year 2001. Always include units of measurement so people can understand the data.

Immigration to the United States, 2001	
Place of Origin	Number of Legal Immigrants
Africa	53,948
Asia	349,776
Europe	175,371
North America	407,888
South America	68,888

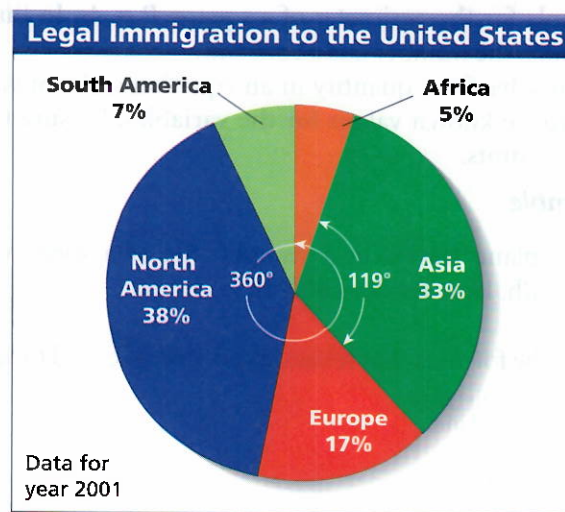
Bar Graphs

To make a bar graph, begin by placing category labels along the bottom axis. Add an overall label for the axis *Place of Origin*. Decide on a scale for the vertical axis. An appropriate scale for the data in the table is 0 to 500,000. Label the vertical axis *Number of People*. For each continent, draw a bar whose height corresponds to the number of immigrants. You will need to round off the values. For example, the bar for Africa should correspond to 54,000 people. Add a graph title to make it clear what the graph shows.



Circle Graphs

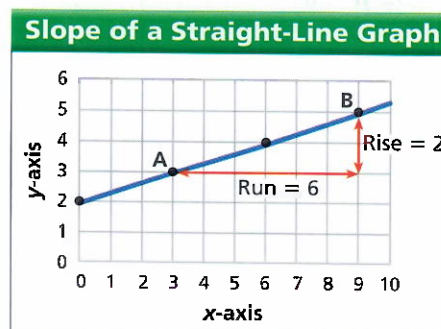
Use the total number to calculate percentages. For example, the percentage of immigrants from Africa in 2001 was $53,948 \div 1,061,984 = 0.051 \approx 5\%$. Multiply each percent by 360° to find the central angle of each wedge. For Africa, the central angle is 18° . Use a protractor to draw each central angle. Color and label the wedges and finish your graph with a title.



Line Graphs

The slope of a straight-line graph equals the “rise over the run.” The rise is the change in the y values and the run is the change in the x values. Using points A and B on the graph below gives

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}} = \frac{5 - 3}{9 - 3} = \frac{2}{6} = 0.33$$



SI (*Système International d'Unités*) is a revised version of the metric system, which was originally developed in France in 1791. SI units of measurement are used by scientists throughout the world. The system is based on multiples of ten. Each unit is ten times larger or ten times smaller than the next unit. The most commonly used SI units are given below.

You can use conversion factors to convert between SI and non-SI units. Try the following conversions. How tall are you in meters? What is your weight in newtons? What is your normal body temperature in degrees Celsius?

Commonly Used Metric Units

Length The distance from one point to another
 meter (m) A meter is slightly longer than a yard.
 1 meter = 1000 millimeters (mm)
 1 meter = 100 centimeters (cm)
 1000 meters = 1 kilometer (km)

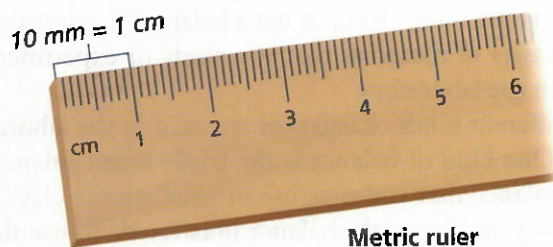
Volume The amount of space an object takes up
 liter (L) A liter is slightly more than a quart.
 1 liter = 1000 milliliters (mL)

Mass The amount of matter in an object
 gram (g) A gram has a mass equal to about one
 paper clip.
 1000 grams = 1 kilogram (kg)

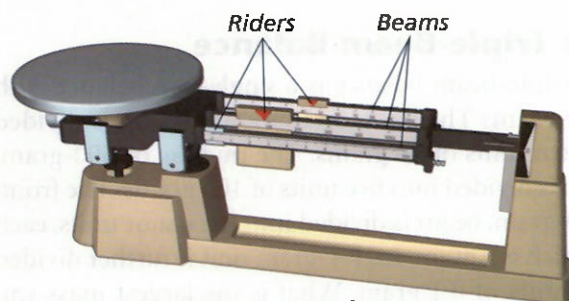
Temperature The measure of hotness or coldness
 degrees 0°C = freezing point of water at sea level
 Celsius (°C) 100°C = boiling point of water at sea level

Metric-Customary Equivalents

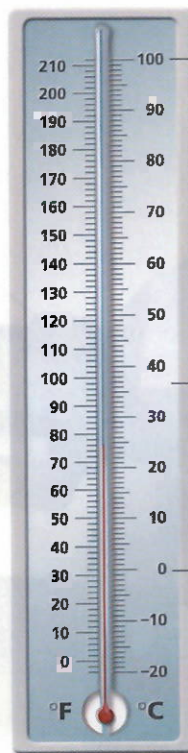
2.54 centimeters (cm) = 1 inch (in.)
 1 meter (m) = 39.37 inches (in.)
 1 kilometer (km) = 0.62 miles (mi)
 1 liter (L) = 1.06 quarts (qt)
 250 milliliters (mL) = 1 cup (c)
 9.8 newtons (N) = 2.2 pounds (lb)
 $^{\circ}\text{C} = 5/9 \times (^{\circ}\text{F} - 32)$



Metric ruler



Triple-Beam Balance



Thermometer

Boiling
point of
water at
sea level

Human body
temperature

Freezing
point of
water



Graduated cylinder

The laboratory balance is an important tool in scientific investigations. You can use a balance to determine the masses of materials that you study or experiment with in the laboratory.

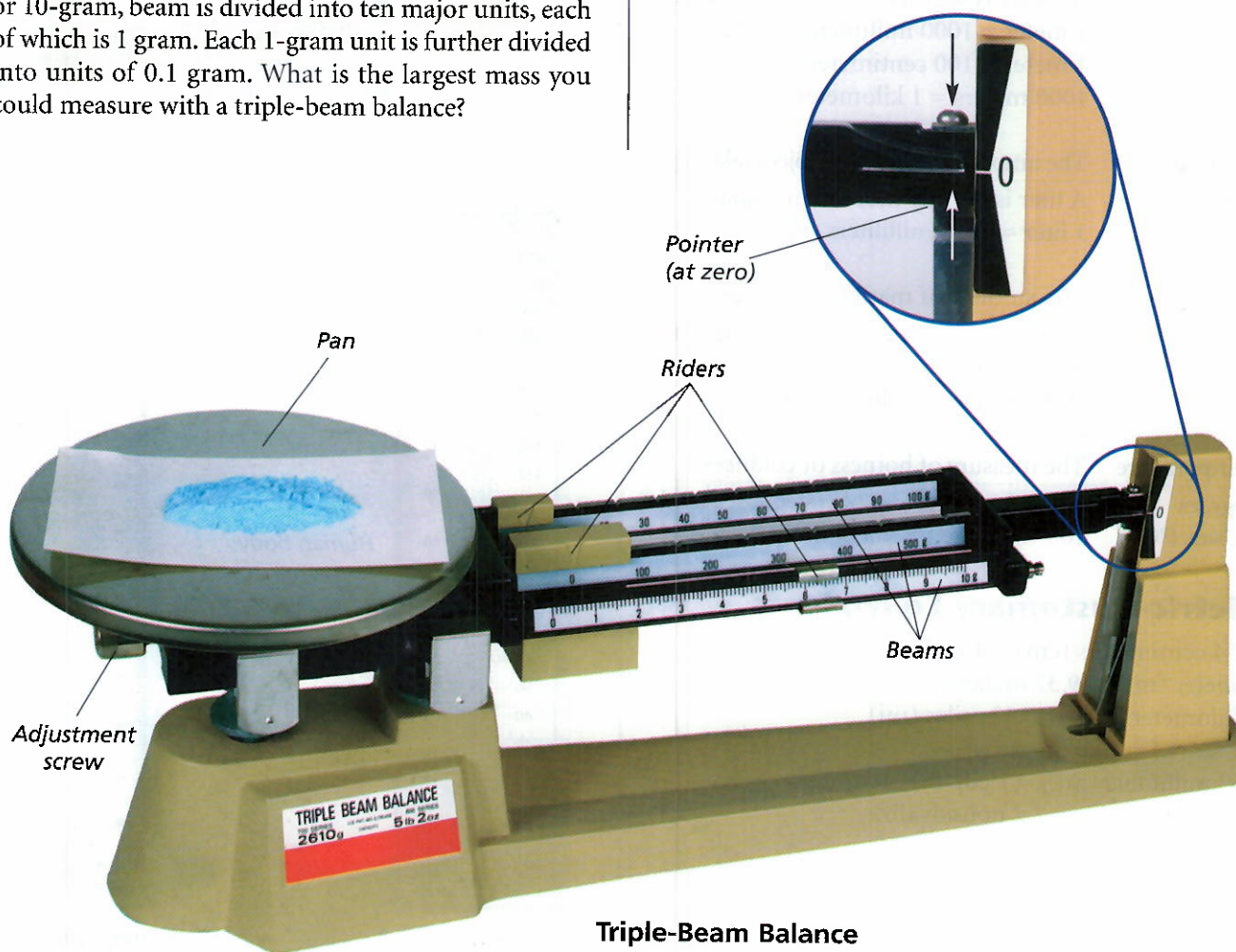
Different kinds of balances are used in the laboratory. One kind of balance is the triple-beam balance. The balance that you may use in your science class is probably similar to the balance illustrated. To use the balance properly, you should learn the name, location, and function of each part of the balance you are using.

The Triple-Beam Balance

The triple-beam balance is a single-pan balance with three beams. The back, or 100-gram, beam is divided into ten units of 10 grams. The middle, or 500-gram, beam is divided into five units of 100 grams. The front, or 10-gram, beam is divided into ten major units, each of which is 1 gram. Each 1-gram unit is further divided into units of 0.1 gram. What is the largest mass you could measure with a triple-beam balance?

The following procedure can be used to find the mass of an object with a triple-beam balance.

1. When no object is on the pan, and the riders are at zero, make sure the pointer is at zero. If it is not, use the adjustment screw to zero the balance.
2. Place the object on the pan.
3. Move the rider on the middle beam notch by notch until the horizontal pointer drops below zero. Move the rider back one notch.
4. Move the rider on the back beam notch by notch until the pointer again drops below zero. Move the rider back one notch.
5. Slowly slide the rider along the front beam until the pointer stops at zero. The mass of the object is the sum of the readings on the three beams.



Triple-Beam Balance

Element	Symbol	Atomic Number	Atomic Mass [†]	Element	Symbol	Atomic Number	Atomic Mass [†]
Actinium	Ac	89	(277)	Neodymium	Nd	60	144.24
Aluminum	Al	13	26.982	Neon	Ne	10	20.179
Americium	Am	95	(243)	Neptunium	Np	93	(237)
Antimony	Sb	51	121.75	Nickel	Ni	28	58.71
Argon	Ar	18	39.948	Niobium	Nb	41	92.906
Arsenic	As	33	74.922	Nitrogen	N	7	14.007
Astatine	At	85	(210)	Nobelium	No	102	(259)
Barium	Ba	56	137.33	Osmium	Os	76	190.2
Berkelium	Bk	97	(247)	Oxygen	O	8	15.999
Beryllium	Be	4	9.0122	Palladium	Pd	46	106.4
Bismuth	Bi	83	208.98	Phosphorus	P	15	30.974
Bohrium	Bh	107	(264)	Platinum	Pt	78	195.09
Boron	B	5	10.81	Plutonium	Pu	94	(244)
Bromine	Br	35	79.904	Polonium	Po	84	(209)
Cadmium	Cd	48	112.41	Potassium	K	19	39.098
Calcium	Ca	20	40.08	Praseodymium	Pr	59	140.91
Californium	Cf	98	(251)	Promethium	Pm	61	(145)
Carbon	C	6	12.011	Protactinium	Pa	91	231.04
Cerium	Ce	58	140.12	Radium	Ra	88	(226)
Cesium	Cs	55	132.91	Radon	Rn	86	(222)
Chlorine	Cl	17	35.453	Rhenium	Re	75	186.21
Chromium	Cr	24	51.996	Rhodium	Rh	45	102.91
Cobalt	Co	27	58.933	Rubidium	Rb	37	85.468
Copper	Cu	29	63.546	Ruthenium	Ru	44	101.07
Curium	Cm	96	(247)	Rutherfordium	Rf	104	(261)
Dubnium	Db	105	(262)	Samarium	Sm	62	150.4
Dysprosium	Dy	66	162.50	Scandium	Sc	21	44.956
Einsteinium	Es	99	(252)	Seaborgium	Sg	106	(263)
Erbium	Er	68	167.26	Selenium	Se	34	78.96
Europium	Eu	63	151.96	Silicon	Si	14	28.086
Fermium	Fm	100	(257)	Silver	Ag	47	107.87
Fluorine	F	9	18.998	Sodium	Na	11	22.990
Francium	Fr	87	(223)	Strontium	Sr	38	87.62
Gadolinium	Gd	64	157.25	Sulfur	S	16	32.06
Gallium	Ga	31	69.72	Tantalum	Ta	73	180.95
Germanium	Ge	32	72.59	Technetium	Tc	43	(98)
Gold	Au	79	196.97	Tellurium	Te	52	127.60
Hafnium	Hf	72	178.49	Terbium	Tb	65	158.93
Hassium	Hs	108	(265)	Thallium	Tl	81	204.37
Helium	He	2	4.0026	Thorium	Th	90	232.04
Holmium	Ho	67	164.93	Thulium	Tm	69	168.93
Hydrogen	H	1	1.0079	Tin	Sn	50	118.69
Indium	In	49	114.82	Titanium	Ti	22	47.90
Iodine	I	53	126.90	Tungsten	W	74	183.85
Iridium	Ir	77	192.22	Ununbium	Uub*	112	(277)
Iron	Fe	26	55.847	Ununnilium	Uun*	110	(269)
Krypton	Kr	36	83.80	Ununquadium	Uuq*	114	—
Lanthanum	La	57	138.91	Ununonium	Uuu*	111	(272)
Lawrencium	Lr	103	(262)	Uranium	U	92	238.03
Lead	Pb	82	207.2	Vanadium	V	23	50.941
Lithium	Li	3	6.941	Xenon	Xe	54	131.30
Lutetium	Lu	71	174.97	Ytterbium	Yb	70	173.04
Magnesium	Mg	12	24.305	Yttrium	Y	39	88.906
Manganese	Mn	25	54.938	Zinc	Zn	30	65.38
Meitnerium	Mt	109	(268)	Zirconium	Zr	40	91.22
Mendelevium	Md	101	(258)				
Mercury	Hg	80	200.59				
Molybdenum	Mo	42	95.94				

[†] Number in parentheses gives the mass number of the most stable isotope.

* Name not officially assigned

Appendix D

United States Physical Map

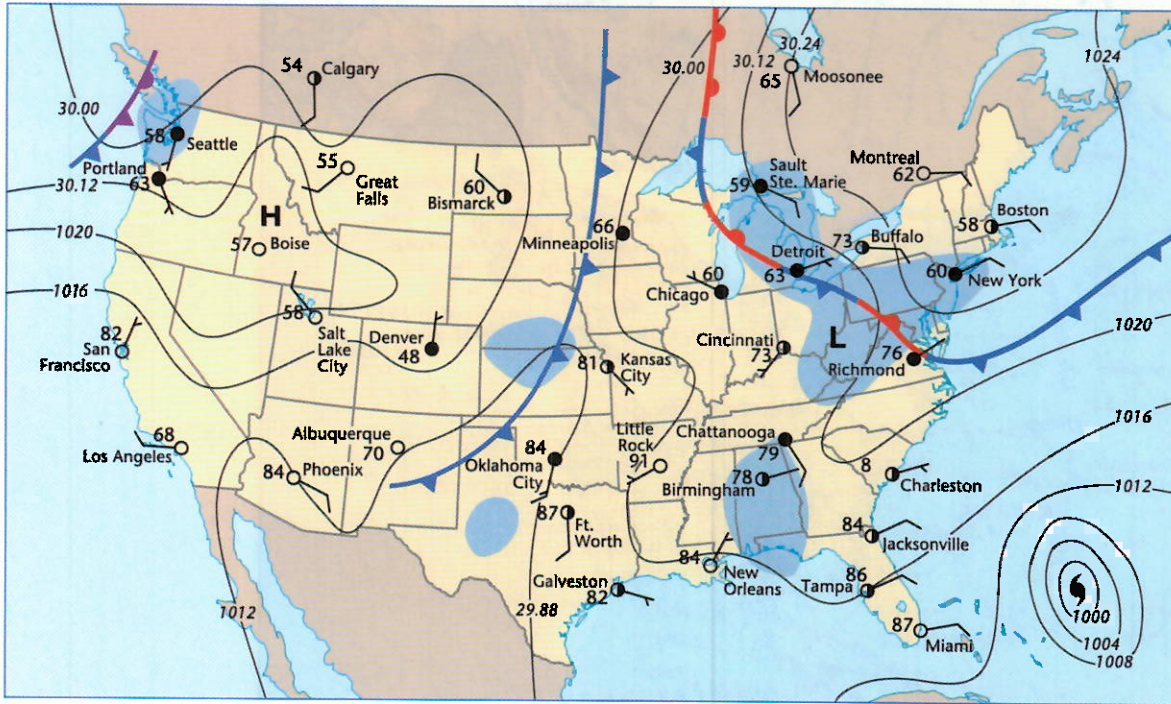
Appendices





This weather map shows data collected from many weather stations. Below the map is an explanation of what the symbols mean.

Weather Map



Explanation of Fronts

Cold Front

Boundary between a cold air mass and a warm air mass. Brings brief storms and cooler weather.

Warm Front

Boundary between a warm air mass and a cold air mass. Usually accompanied by precipitation.

Stationary Front

Boundary between warm and cold air masses when no movement occurs. Long periods of precipitation.

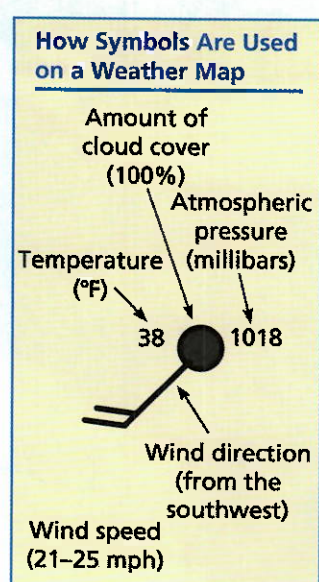
Occluded Front

Boundary on which a warm front has been overtaken by a cold front. Brings precipitation.

Weather	Symbol
Drizzle	☂
Fog	☁
Hail	⚡
Haze	☁
Rain	●
Shower	▽
Sleet	⚡
Smoke	☁
Snow	*
Thunderstorm	⚡
Hurricane	☪

Wind Speed (mph)	Symbol
1-2	—
3-8	—
9-14	—
15-20	—
21-25	—
26-31	—
32-37	—
38-43	—
44-49	—
50-54	—
55-60	—
61-66	—
67-71	—
72-77	—

Cloud Cover (%)	Symbol
0	○
10	○
20-30	○
40	○
50	○
60	○
70-80	○
90	○
100	●

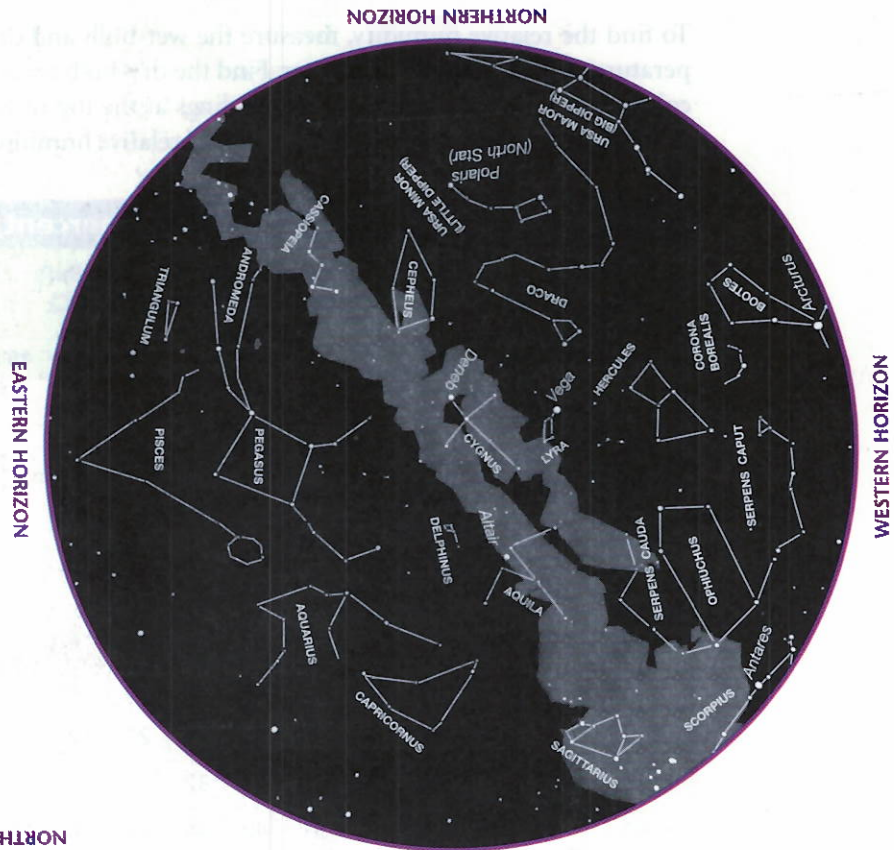


To find the relative humidity, measure the wet-bulb and dry-bulb temperatures with a sling psychrometer. Find the dry-bulb reading in the left column and the difference between readings at the top of the table. The number where these readings intersect is the relative humidity in percent.

Relative Humidity (percent)														
Dry-Bulb Reading (°C)	Difference Between Wet-Bulb and Dry-Bulb Readings (°C)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
5	86	72	58	45	33	20	7							
6	86	73	60	48	35	24	11							
7	87	74	62	50	38	26	15							
8	87	75	63	51	40	29	19	8						
9	88	76	64	53	42	32	22	12						
10	88	77	66	55	44	34	24	15	6					
11	89	78	67	56	46	36	27	18	9					
12	89	78	68	58	48	39	29	21	12					
13	89	79	69	59	50	41	32	23	15	7				
14	90	79	70	60	51	42	34	26	18	10				
15	90	80	71	61	53	44	36	27	20	13	6			
16	90	81	71	63	54	46	38	30	23	15	8			
17	90	81	72	64	55	47	40	32	25	18	11			
18	91	82	73	65	57	49	41	34	27	20	14	7		
19	91	82	74	65	58	50	43	36	29	22	16	10		
20	91	83	74	66	59	51	44	37	31	24	18	12	6	
21	91	83	75	67	60	53	46	39	32	26	20	14	9	
22	92	83	76	68	61	54	47	40	34	28	22	17	11	6
23	92	84	76	69	62	55	48	42	36	30	24	19	13	8
24	92	84	77	69	62	56	49	43	37	31	26	20	15	10
25	92	84	77	70	63	57	50	44	39	33	28	22	17	12
26	92	85	78	71	64	58	51	46	40	34	29	24	19	14
27	92	85	78	71	65	58	52	47	41	36	31	26	21	16
28	93	85	78	72	65	59	53	48	42	37	32	27	22	18
29	93	86	79	72	66	60	54	49	43	38	33	28	24	19
30	93	86	79	73	67	61	55	50	44	39	35	30	25	21

Autumn Sky

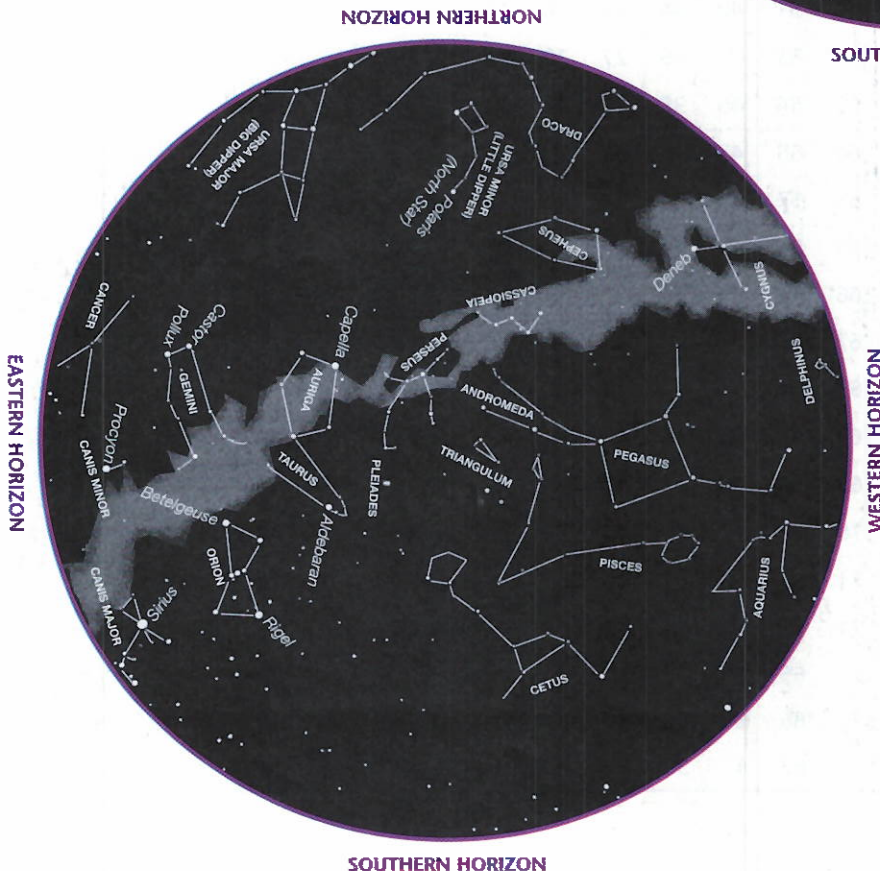
To use this chart, hold it up in front of you and turn it so the direction you are facing is at the bottom of the chart. The chart works best at 35° N latitude, but it can be used at other latitudes. It works best at the following dates and times: September 1 at 10:00 P.M., October 1 at 8 P.M., and November 1 at 6 P.M.



NORTHERN HORIZON
SOUTHERN HORIZON

Winter Sky

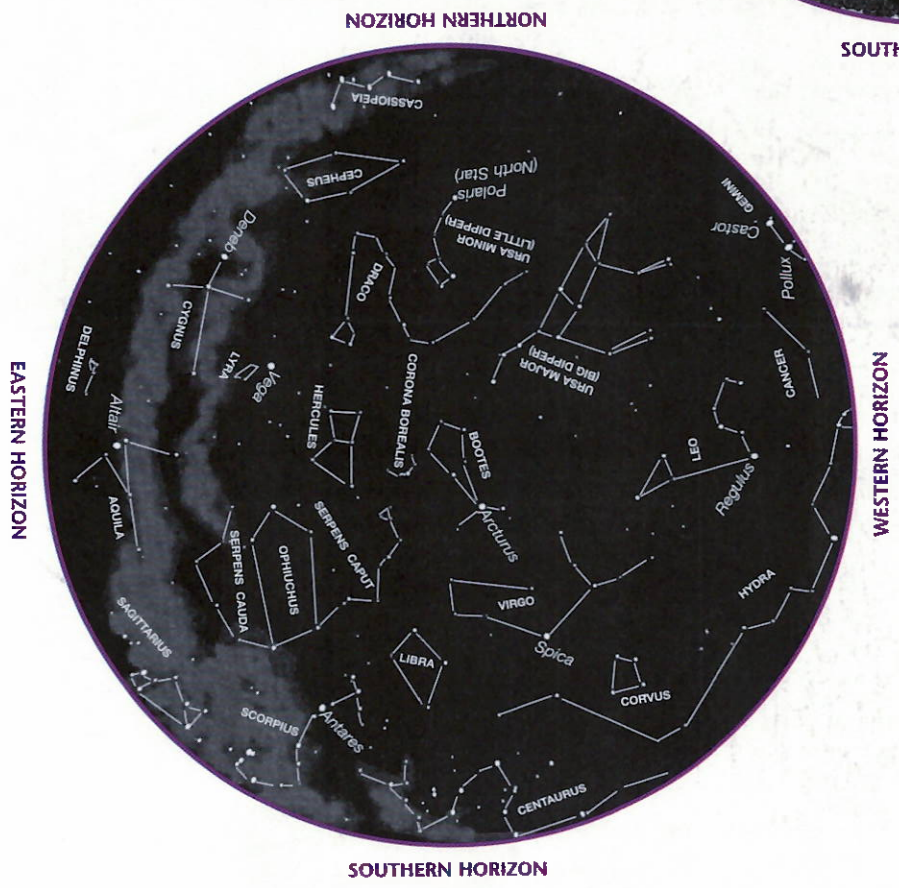
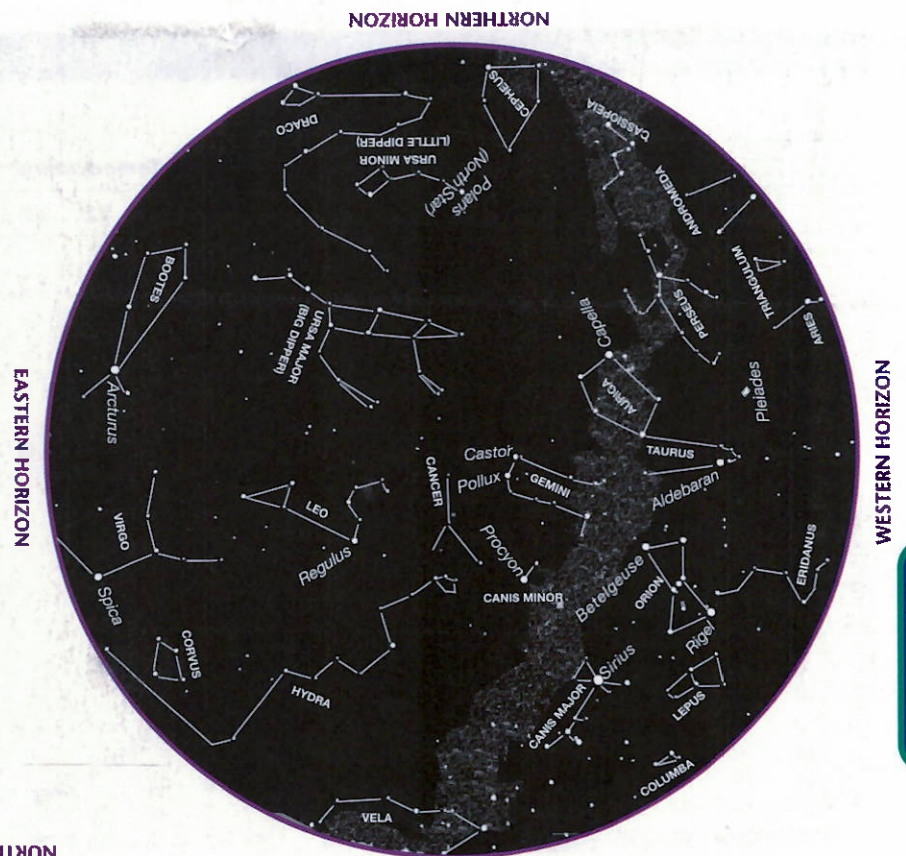
To use this chart, hold it up in front of you and turn it so the direction you are facing is at the bottom of the chart. The chart works best at 35° N latitude, but it can be used at other latitudes. It works best at the following dates and times: December 1 at 10:00 P.M., January 1 at 8 P.M., and February 1 at 6 P.M.



SOUTHERN HORIZON

Spring Sky

To use this chart, hold it up in front of you and turn it so the direction you are facing is at the bottom of the chart. The chart works best at 35° N latitude, but it can be used at other latitudes. It works best at the following dates and times: March 1 at 10:00 P.M. and April 1 at 8 P.M.



Summer Sky

To use this chart, hold it up in front of you and turn it so the direction you are facing is at the bottom of the chart. The chart works best at 35° N latitude, but it can be used at other latitudes. It works best at the following dates and times: May 15 at 11:00 P.M. and June 15 at 9 P.M.

Appendix H

Dew Point

Dew-point temperature (°C)

Dry bulb (°C)	(Dry-Bulb Temperature Minus Wet-Bulb Temperature = Depression of the Wet Bulb)																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
-20	-33																					
-18	-28																					
-16	-24																					
-14	-21	-36																				
-12	-18	-28																				
-10	-14	-22																				
-8	-12	-18	-29																			
-6	-10	-14	-22																			
-4	-7	-12	-17	-29																		
-2	-5	-8	-13	-20																		
0	-3	-6	-9	-15	-24																	
2	-1	-3	-6	-11	-17																	
4	1	-1	-4	-7	-11	-19																
6	4	1	-1	-4	-7	-13	-21															
8	6	3	1	2	-5	-9	-14															
10	8	6	4	1	-2	-5	-9	-14	-18													
12	10	8	6	4	1	-2	-5	-9	-16													
14	12	11	9	6	4	1	-2	-5	-10	-17												
16	14	13	11	9	7	4	1	-1	-6	-10	-17											
18	16	15	13	11	9	7	4	2	-2	5	10	-19										
20	19	17	15	14	12	10	7	4	2	-2	-5	-10	-19									
22	21	19	17	16	14	12	10	8	5	3	-1	-5	-10	-19								
24	23	21	20	18	16	14	12	10	8	6	2	-1	-5	-10	-18							
26	25	23	22	20	18	17	15	13	11	9	6	3	0	-4	-9	-18						
28	27	25	24	22	20	19	17	16	14	11	9	7	4	1	-3	-9	16					
30	29	27	26	24	23	21	19	18	16	14	12	10	8	5	1	-2	-8	-15				
32	31	29	28	27	25	24	22	21	19	17	15	13	11	8	5	2	-2	-7	-14			
34	33	31	30	29	27	26	24	23	21	20	18	16	14	12	9	6	3	-1	-5	-12	-29	
36	35	33	32	31	29	28	27	25	24	22	20	19	17	15	13	10	7	4	0	-4	-10	
38	37	35	34	33	32	30	29	28	26	25	23	21	19	17	15	13	11	8	5	1	-3	9
40	39	37	36	35	34	32	31	30	28	27	25	24	22	20	18	16	14	12	9	6	2	-2

Appendices

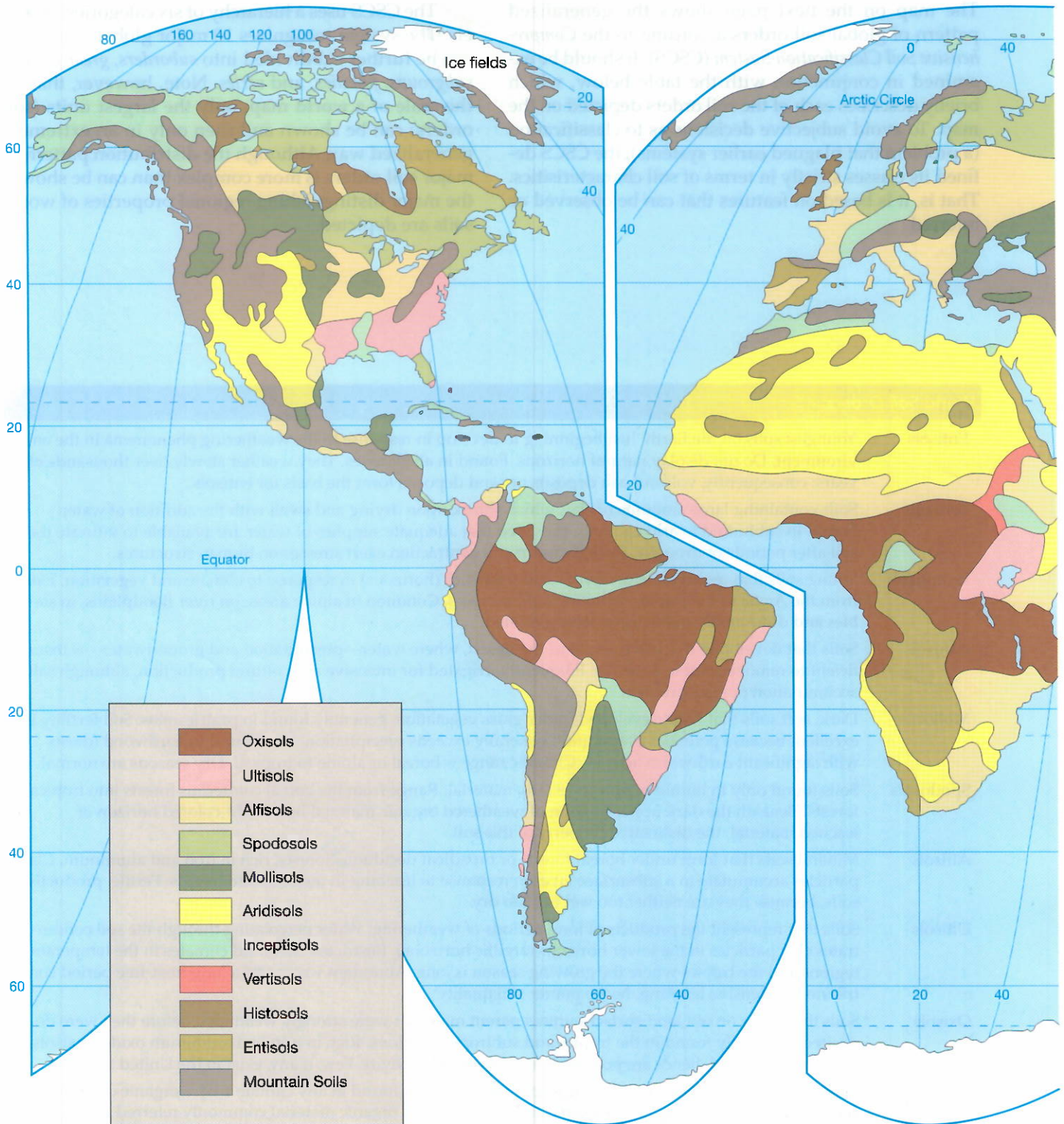
The map on the next page shows the generalized pattern of global soil orders according to the *Comprehensive Soil Classification System* (CSCS). It should be examined in conjunction with the table below, which briefly describes each of the soil orders depicted on the map. To avoid subjective decisions as to classification (a problem that plagued earlier systems), the CSCS defined its classes strictly in terms of soil characteristics. That is, it is based on features that can be observed or inferred.

The CSCS uses a hierarchy of six categories, or levels. The system recognizes 10 major global orders that can be further subdivided into *suborders*, *great groups*, *subgroups*, *families*, and *series*. Note, however, that on the scale of a world map, only the largest units (soil orders) can be shown and then only in an extremely generalized way. Although the distribution pattern of major soil orders is more complex than can be shown, the major distinguishing regional properties of world soils are depicted.

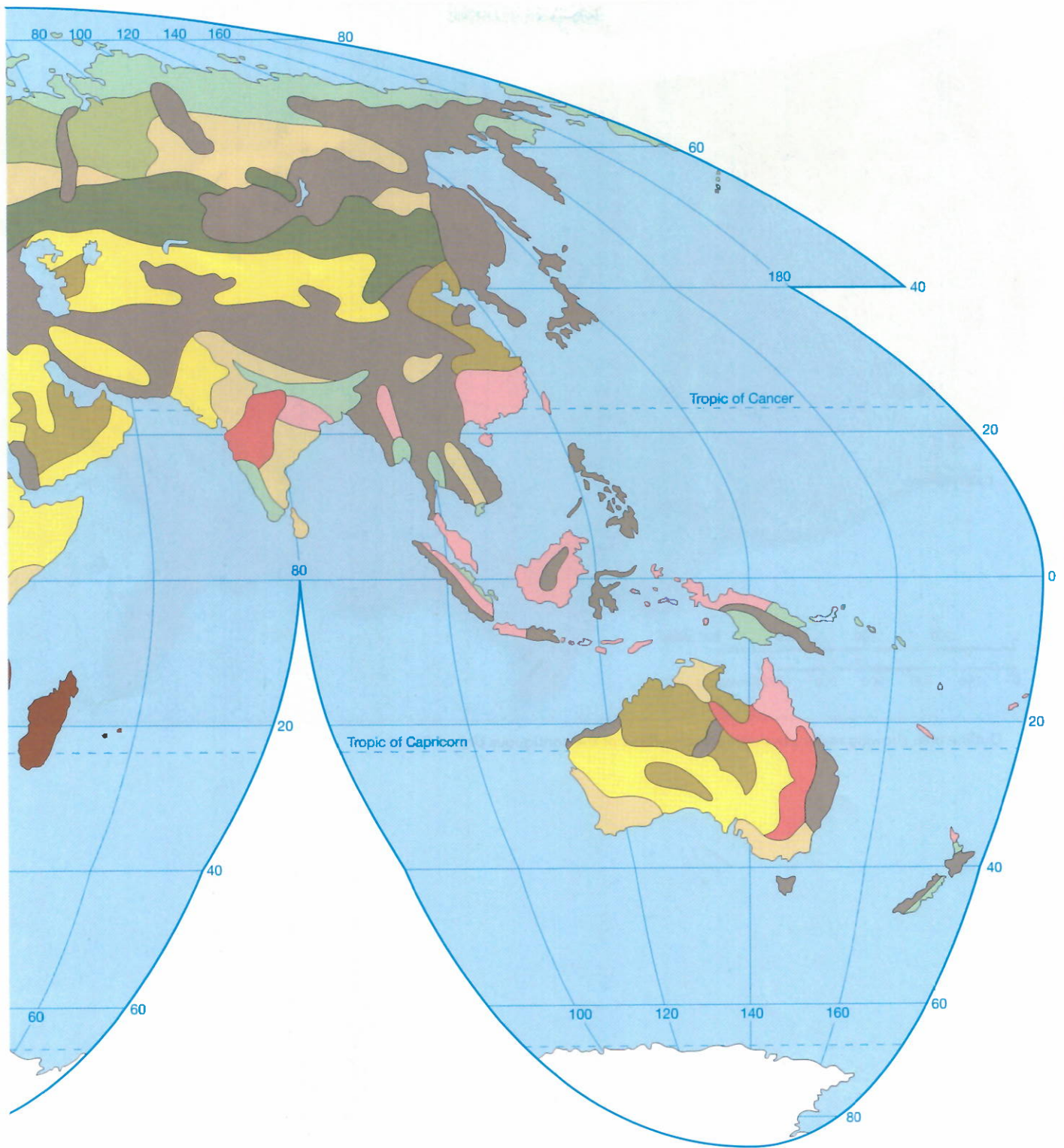
World Soil Orders.

Entisols	Youngest soils on the Earth. Just beginning to develop in response to the weathering phenomena in the environment. Do not display natural horizons. Found in all climates. They weather slowly over thousands of years; consequently, volcanic ash deposits or sand deposits form the basis for entisols.
Vertisols	Soils containing large amounts of clay, which shrink upon drying and swell with the addition of water. Found in subhumid to arid climates, provided that adequate supplies of water are available to saturate the soil after periods of drought. Soil expansion and contraction exert stresses on human structures.
Inceptisols	Young soils that reveal developmental characteristics (horizons) in response to climate and vegetation. Exist from the Arctic to the tropics on young land surfaces. Common in alpine areas, on river floodplains, in stables and dune areas, and in areas once glaciated.
Aridisols	Soils that develop in dry places, such as the desert, where water—precipitation and groundwater—is insufficient to remove soluble minerals. Frequently irrigated for intensive agricultural production, although salt accumulation poses a problem.
Mollisols	Dark, soft soils that have developed under grass vegetation, generally found in prairie areas. Soil fertility is excellent because potential evaporation generally exceeds precipitation. Also found in hardwood forests with significant earthworm activity. Climatic range is boreal or alpine to tropical. Dry seasons are normal.
Spodosols	Soils found only in humid regions on sandy material. Range from the boreal coniferous forests into tropical forests. Beneath the dark upper horizon of weathered organic material lies a light-colored horizon of leached material, the distinctive property of this soil.
Alfisols	Mineral soils that form under boreal forests or broadleaf deciduous forests, rich in iron and aluminum. Clay particles accumulate in a subsurface layer in response to leaching in moist environments. Fertile, productive soils, because they are neither too wet nor too dry.
Ultisols	Soils that represent the products of long periods of weathering. Water percolating through the soil concentrates clay particles in the lower horizons (argillic horizons). Restricted to humid climates in the temperate regions and the tropics where the growing season is long. Abundant water and a long frost-free period contribute to extensive leaching, hence poorer soil quality.
Oxisols	Soils that occur on old land surfaces unless parent materials were strongly weathered before they were deposited. Generally found in the tropics and subtropical regions. Rich in iron and aluminum oxides, oxisols are heavily leached; hence are poor soils for agricultural activity. Few, if any, exist in the United States.
Histosols	Organic soils with little or no climatic implications. Can be found in any climate where organic debris can accumulate to form a bog soil. Dark, partially decomposed organic material commonly referred to as <i>peat</i> .

Source: Robert E. Norris et al., *Geography: An Introductory Perspective*, Columbus, Ohio: Merrill, 1982.



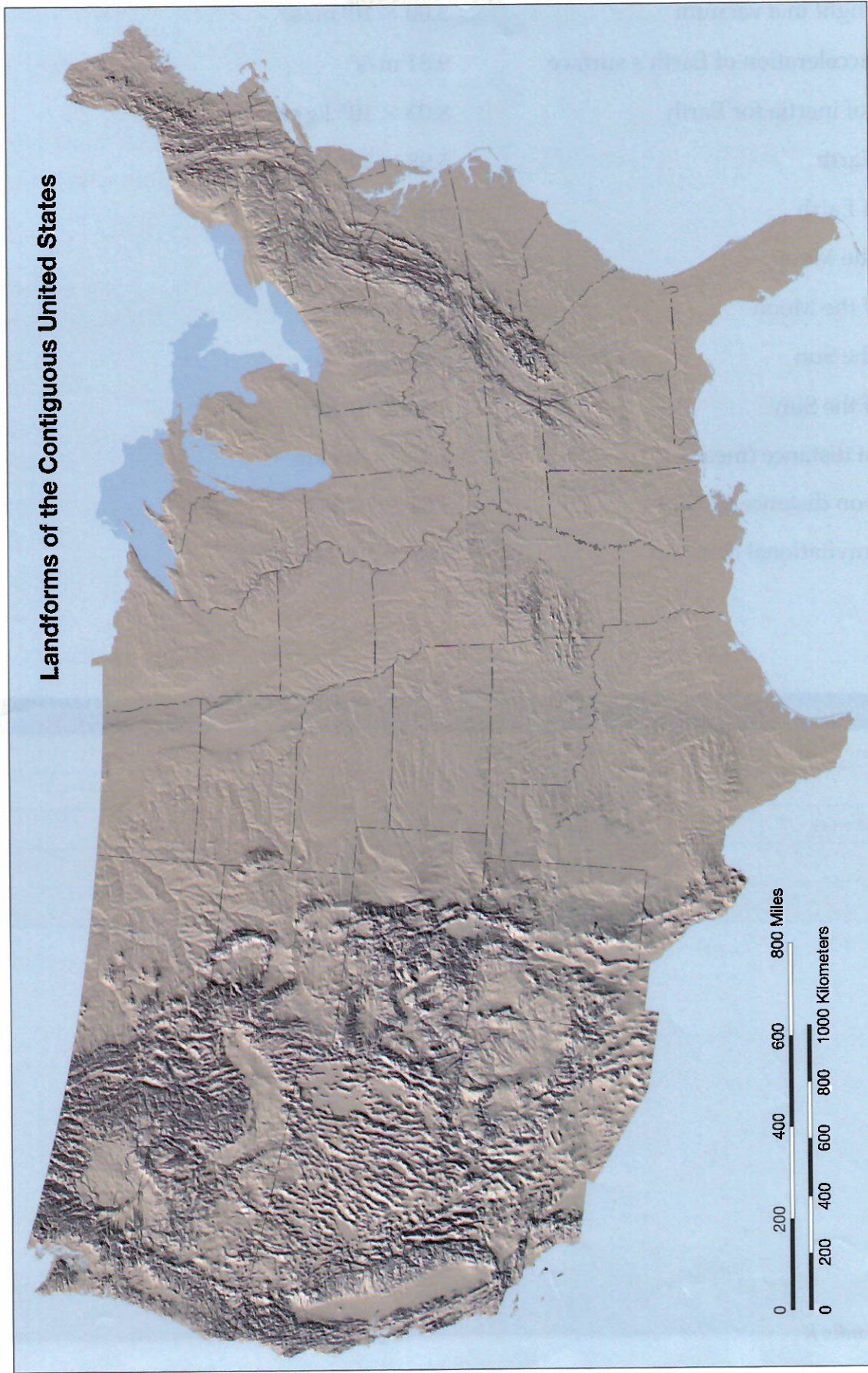
Soil distribution. The pattern of global soil orders is remarkably similar to the pattern of major climates. Soil classification is from the *Comprehensive Soil Classification System*.





Outline map showing major physiographic provinces of the contiguous United States.

Landforms of the Contiguous United States



Digital shaded relief landform map of the United States. (Data provided by the U.S. Geological Survey)

Appendix K

Speed of light in a vacuum	$3.00 \times 10^8 \text{ m/s}$
Free fall acceleration of Earth's surface	9.81 m/s^2
Moment of inertia for Earth	$8.03 \times 10^{31} \text{ kg}\cdot\text{m}^2$
Mass of Earth	$5.98 \times 10^{24} \text{ kg}$
Radius of Earth	$6.37 \times 10^6 \text{ m}$
Mass of the Moon	$7.35 \times 10^{22} \text{ kg}$
Radius of the Moon	$1.74 \times 10^6 \text{ m}$
Mass of the Sun	$1.99 \times 10^{30} \text{ kg}$
Radius of the Sun	$6.96 \times 10^5 \text{ km}$
Earth-Sun distance (mean)	$1.496 \times 10^8 \text{ km}$
Earth-Moon distance (mean)	$3.84 \times 10^5 \text{ km}$
Earth's gravitational constant	$6.67 \times 10^{-11} \text{ N}\cdot\text{m}^2/\text{kg}^2$

Some SI Derived Units

Quantity	Unit name	Abbreviation
Force	newton	N
Energy and work	joule	J
Power	watt	W
Pressure	pascal	Pa

A

absolute magnitude the apparent brightness of a star if it were viewed from a distance of 32.6 light-years; used to compare the true brightness of stars (p. 703)

absolute magnitude/magnitud absoluta luminosidad aparente de una estrella si se observara a una distancia de 32.6 años luz; usada para comparar la luminosidad real de las estrellas (pág. 703)

absorption spectrum a continuous spectrum produced when white light is passed through a cool gas under low pressure; The gas absorbs selected wavelengths of light, and the spectrum looks like it has dark lines superimposed. (p. 676)

absorption spectrum/espectro de absorción espectro continuo producido cuando pasa luz blanca a través de un gas frío a presión baja; el gas absorbe determinadas longitudes de onda de luz y el espectro pareciera tener líneas oscuras superpuestas (pág. 676)

abyssal plain very level area of the deep-ocean floor, usually lying at the foot of the continental rise (p. 404)

abyssal plain/planicie abisal área muy nivelada del fondo oceánico profundo, que se encuentra por lo general en la base del pie continental (pág. 404)

abyssal zone a subdivision of the benthic zone characterized by extremely high pressures, low temperatures, low oxygen, few nutrients, and no sunlight (p. 431)

abyssal zone/zona abisal subdivisión de la zona bentónica caracterizada por tener presiones extremadamente altas, bajas temperaturas, poco oxígeno, pocas sustancias nutrientes y ausencia de luz solar (pág. 431)

accretion process that occurs when crustal fragments collide with and stay connected to a continental plate (p. 321)

accretion/acreción proceso que ocurre cuando los fragmentos corticales chocan con una placa continental y permanecen conectados a ella (pág. 321)

accretionary wedge a large wedge-shaped mass of sediment that accumulates in subduction zones; Here sediment is scraped from the subducting oceanic plate and accreted to the overriding crustal block. (p. 319)

accretionary wedge/prisma acrecionario masa grande de sedimento en forma de prisma que se acumula en las zonas de subducción; el sedimento es raspado de la placa oceánica de subducción y acrecentado al bloque cortical preponderante (pág. 319)

aftershock a small earthquake that follows the main earthquake (p. 221)

aftershock/replica terremoto pequeño que sigue al terremoto mayor (pág. 221)

air mass a large body of air that is characterized by similar temperatures and amounts of moisture at any given altitude (p. 559)

air mass/masa de aire cuerpo grande de aire que se caracteriza por tener temperatura y humedad similares a cualquier altitud dada (pág. 559)

air pressure the force exerted by the weight of a column of air above a given point (p. 532)

air pressure/ presión de aire fuerza ejercida por el peso de una columna de aire sobre un punto dado (pág. 532)

albedo the fraction of total radiation that is reflected back by a surface (p. 492)

albedo/albedo fracción de la radiación total que es reflejada por una superficie (pág. 492)

alluvial fan a fan-shaped deposit of sediment formed when a stream's slope is abruptly reduced (p. 201)

alluvial fan/abanico alluvial depósito de sedimentos en forma de abanico, formado cuando la vertiente de una corriente de agua se reduce abruptamente (pág. 201)

andesitic composition the composition of igneous rocks lying between felsic and mafic (p. 73)

andesitic composition/composición andesítica composición de rocas ígneas que se encuentra entre las rocas félsicas y máficas (pág. 73)

anemometer an instrument used to determine wind speed (p. 545)

anemometer/anemómetro instrumento usado para determinar la velocidad del viento (pág. 545)

Glossary

- angiosperm** flowering plant that produces seeds within a fruit (p. 383)
- angiosperm/angiosperma** planta que da flores y produce semillas dentro de una fruta (pág. 383)
- anticline** a fold in sedimentary strata resembling an arch (p. 310)
- anticline/anticlinal** pliegue en el estrato sedimentario que parece un arco (pág. 310)
- anticyclone** a high-pressure center characterized by a clockwise flow of air in the Northern Hemisphere (p. 538)
- anticyclon/anticiclón** centro de alta presión en el hemisferio norte que se caracteriza por una masa de aire que se mueve en dirección de las agujas del reloj (pág. 538)
- aphelion** the place in the orbit of a planet where the planet is farthest from the sun (p. 624)
- aphelion/afelio** punto en la órbita de un planeta en el que éste se encuentra más alejado del Sol (pág. 624)
- apogee** the point where the moon is farthest from Earth (p. 626)
- apogee/apogeo** punto donde la Luna se encuentra más alejada de la Tierra (pág. 626)
- apparent magnitude** the brightness of a star when viewed from Earth (p. 703)
- apparent magnitude/magnitud aparente** luminosidad de una estrella vista desde la Tierra (pág. 703)
- aquifer** rock or soil through which groundwater moves easily (p. 171)
- aquifer/acuífero** roca o tierra a través de la cual el agua subterránea se mueve fácilmente (pág. 171)
- artesian well** a well in which the water naturally rises above the level of the water table (p. 173)
- artesian well/pozo artesiano** pozo en el cual el agua sube naturalmente por encima del nivel freático (pág. 173)
- asteroid** a small, rocky body, which can range in size from a few hundred kilometers to less than a kilometer; The asteroids' orbits lie mainly between those of Mars and Jupiter. (p. 661)
- asteroid/asteroide** cuerpo rocoso y pequeño, cuyo tamaño puede variar entre cientos de kilómetros a menos de un kilómetro; las órbitas de los asteroides se encuentran principalmente entre las órbitas de Marte y Júpiter (pág. 661)
- asthenosphere** a weak plastic layer of the mantle situated below the lithosphere; The rock within this zone is easily deformed. (p. 235)
- asthenosphere/astenosfera** capa plástica y débil del manto situada debajo de la litosfera; la roca en esta zona se deforma fácilmente (pág. 235)
- astronomical unit (AU)** average distance from Earth to the sun; 1.5×10^8 , or 150 million kilometers (p. 618)
- astronomical unit (AU)/unidad astronómica (UA)** distancia promedio de la Tierra al Sol; 1.5×10^8 , ó 150 millones de kilómetros (pág. 618)
- astronomy** the scientific study of the universe; It includes the observation and interpretation of celestial bodies and phenomena. (p. 3)
- astronomy/astronomía** estudio científico del universo; incluye la observación y la interpretación de cuerpos y fenómenos celestes (pág. 3)
- atmosphere** the gaseous portion of a planet; the planet's envelope of air; one of the traditional subdivisions of Earth's physical environment (p. 7)
- atmosphere/atmósfera** porción gaseosa de un planeta; envoltura de aire del planeta; una de las subdivisiones tradicionales del medio ambiente físico de la Tierra (pág. 7)
- atomic number** the number of protons in the nucleus of an atom (p. 35)
- atomic number/número atómico** número de protones en el núcleo de un átomo (pág. 35)
- aurora** a bright display of ever-changing light caused by solar radiation interacting with the upper atmosphere in the region of the poles (p. 688)
- aurora/aurora** polar luz brillante en constante movimiento causada por la radiación solar que interactúa con la parte superior de la atmósfera en la región de los polos (pág. 688)
- autumnal equinox** the equinox that occurs on September 22 or 23 in the Northern Hemisphere and on March 21 or 22 in the Southern Hemisphere (p. 482)
- autumnal equinox/equinoccio de otoño** equinoccio que ocurre el 22 ó 23 de septiembre en el hemisferio norte y el 21 ó 22 de marzo en el hemisferio sur (pág. 482)

B

- barometer** an instrument that measures atmospheric pressure (p. 533)
- barometer/barómetro** instrumento que mide la presión atmosférica (pág. 533)
- barrier island** a low, elongated ridge of sand that parallels the coast (p. 466)
- barrier island/isla barrera** lomo de arena bajo y alargado que se encuentra paralelo a la costa (pág. 466)
- basaltic composition** a compositional group of igneous rocks indicating that the rock contains substantial dark silicate minerals and calcium-rich plagioclase feldspar (p. 73)
- basaltic composition/composición basáltica** grupo composicional de rocas ígneas que indica que la roca contiene cantidades sustanciales de minerales de silicato oscuros y feldespato de plagioclasa rico en calcio (pág. 73)
- batholith** a large mass of igneous rock that formed when magma intruded at depth, became crystallized, and subsequently was exposed by erosion; Batholiths have a surface exposure greater than 100 square kilometers. (p. 290)
- batholith/batolito** masa grande de roca ígnea que se forma cuando el magma penetra en la profundidad, se cristaliza y luego queda expuesta debido a la erosión; los batolitos tienen una superficie expuesta mayor a los 100 kilómetros cuadrados (pág. 290)
- bathymetry** the measurement of ocean depths and the charting of the shape or topography of the ocean floor (p. 396)
- bathymetry/batimetría** medición de las profundidades marinas y trazado de la forma o topografía del fondo marino (pág. 396)
- beach** the accumulation of sediment found along the shore of a lake or an ocean (p. 461)
- beach/playa** acumulación de sedimento que se encuentra a lo largo de la costa de un lago u océano (pág. 461)
- bed load** sediment that is carried by a stream along the bottom of its channel (p. 165)
- bed load/carga del lecho** sedimento arrastrado por una corriente de agua a lo largo del fondo de su canal (pág. 165)
- benthic zone** the marine-life zone that includes any sea-bottom surface regardless of its distance from shore (p. 431)
- benthic zone/zona béntica** zona de vida marina que incluye cualquier superficie del fondo del mar sin importar su distancia de la costa (pág. 431)
- benthos** the forms of marine life that live on or in the ocean bottom; includes marine algae, sea stars, and crabs (p. 429)
- benthos/bentos** organismos marinos que viven en el fondo marino; incluyen algas marinas, estrellas de mar y cangrejos (pág. 429)
- Bergeron process** a theory that relates the formation of precipitation to supercooled clouds, freezing nuclei, and the different saturation levels of ice and liquid water (p. 521)
- Bergeron process/proceso de Bergeron** teoría que relaciona la formación de precipitación con nubes sobreenfriadas, núcleos congelados y los diferentes niveles de saturación del agua helada y el agua líquida (pág. 521)
- big bang theory** the theory that proposes that the universe originated as a single mass, which subsequently exploded (p. 720)
- big bang theory/teoría del Big Bang** teoría que propone que el universo se originó como una masa única, la cual estalló posteriormente (pág. 720)
- binary star** one of two stars revolving around a common center of mass under their mutual gravitational attraction (p. 701)
- binary star/estrella binaria** una de dos estrellas que giran alrededor de un centro de masa común atraídas por su fuerza gravitacional mutua (pág. 701)
- biogenous sediment** seafloor sediment of biological origin, such as shells and skeletons of marine life (p. 408)
- biogenous sediment/sedimento biogénico** sedimento del fondo marino de origen biológico, como conchas y esqueletos de organismos marinos (pág. 408)
- biosphere** all life on Earth; the parts of the solid Earth, hydrosphere, and atmosphere in which living organisms can be found (p. 7)

Glossary

biosphere/biosfera toda la vida en la Tierra; partes de la Tierra sólida, la hidrosfera y la atmósfera en las que se encuentran los organismos vivos (pág. 7)

black hole a massive star that has collapsed to such a small volume that its gravity prevents the escape of everything, including light (p. 714)

black hole/agujero negro estrella masiva que se ha reducido a un volumen tan pequeño que su fuerza de gravedad no permite que nada se escape, incluyendo la luz (pág. 714)

C

calcareous ooze thick, common biogenous sediment produced by dissolving calcium carbonate shells (p. 408)

calcareous ooze/fango calcáreo sedimento biógeno común y grueso, producido por la disolución de conchas de carbonato de calcio (pág. 408)

caldera a large depression typically caused by collapse or ejection of the summit area of a volcano (p. 287)

caldera/caldera depresión grande causada típicamente por el colapso o la expulsión de la cima de un volcán (pág. 287)

capacity the total amount of sediment a stream is able to transport (p. 165)

capacity/capacidad cantidad total de sedimento que puede transportar una corriente de agua (pág. 165)

cavern a naturally formed underground chamber or series of chambers most commonly produced by solution activity in limestone (p. 176)

cavern/caverna cámara subterráneas o serie de cámaras subterráneas formadas naturalmente y producidas comúnmente por actividad de solución sobre piedra caliza (pág. 176)

cementation solidification of sediments by the deposition of dissolved minerals in the tiny spaces between the sedimentary particles (p. 76)

cementation/cementación solidificación de sedimentos por el depósito de minerales disueltos en los espacios diminutos entre las partículas sedimentarias (pág. 76)

Cepheid variable a star whose brightness varies periodically because it expands and contracts; a type of pulsating star (p. 705)

Cepheid variable/variable Cefeida estrella cuya luminosidad varía periódicamente porque se expande y se contrae; tipo de estrella púlsar (pág. 705)

chemical bond a force that holds together atoms that form a compound (p. 38)

chemical bond/enlace químico fuerza que une los átomos que forman un compuesto (pág. 38)

chemical sedimentary rock sedimentary rock consisting of material that was precipitated from water by either inorganic or organic means (p. 77)

chemical sedimentary rock/roca sedimentaria química roca sedimentaria formada de material precipitado del agua por medios inorgánicos u orgánicos (pág. 77)

chemical weathering the processes by which the internal structure of a mineral is altered by the removal and/or addition of elements (p. 129)

chemical weathering/meteorización química proceso mediante el cual la estructura interna de un mineral es alterada por la extracción y/o la suma de elementos (pág. 129)

chemosynthesis the process by which certain microorganisms use chemical energy to produce food (p. 433)

chemosynthesis/quimiosíntesis proceso por el cual ciertos microorganismos usan energía química para producir alimento (pág. 433)

chromatic aberration the property of a lens whereby light of different colors is focused at different places (p. 679)

chromatic aberration/aberración cromática propiedad de una lente en la cual se enfoca luz de diferentes colores en distintos lugares (pág. 679)

chromosphere the first layer of the solar atmosphere found directly above the photosphere (p. 686)

chromosphere/cromosfera primera capa de la atmósfera solar que se encuentra directamente por encima de la fotosfera (pág. 686)

cinder cone a small volcano built primarily of pyroclastic material ejected from a single vent (p. 284)

cinder cone/cono de escoria volcán pequeño formado principalmente de material piroclástico expulsado por una sola abertura (pág. 284)

- cirque** an amphitheater-shaped basin at the head of a glaciated valley produced by frost wedging and plucking (p. 193)
- cirque/circo** cuenca en forma de anfiteatro en la cabecera de un valle glaciar producida por la erosión de hielo (pág. 193)
- cirrus** one of three basic cloud forms; also one of the three high cloud types; They are thin, delicate ice-crystal clouds often appearing as veil-like patches or thin, wispy fibers. (p. 517)
- cirrus/cirro** una de las tres formaciones básicas de las nubes; también uno de los tres tipos de nubes altas; son nubes cristalinas delicadas que parecen retazos de velo o fibras tenues y finas (pág. 517)
- clastic sedimentary rock** a sedimentary rock made of broken fragments of preexisting rock (p. 77)
- clastic sedimentary rock/roca sedimentaria clástica** roca sedimentaria hecha de fragmentos rotos de roca preexistente (pág. 77)
- cleavage** the tendency of a mineral to break along planes of weak bonding (p. 52)
- cleavage/clivaje** tendencia de un mineral a fracturarse a lo largo de planos de enlace débiles (pág. 52)
- cold front** a front along which a cold air mass thrusts beneath a warmer air mass (p. 566)
- cold front/frente frío** frente en el que una masa de aire frío avanza bajo una masa de aire caliente (pág. 566)
- collision-coalescence process** a theory of raindrop formation in warm clouds (above 0°C) in which large cloud droplets collide and join together with smaller droplets to form a raindrop; Opposite electrical charges may bind the cloud droplets together. (p. 521)
- collision-coalescence process/proceso de coalescencia y colisión** teoría sobre la formación de gotas de agua en nubes cálidas (por encima de los 0 °C), en la cual las gotas grandes de agua en una nube chocan y se unen con gotitas más pequeñas para formar una gota de mayor tamaño; las corrientes eléctricas opuestas pueden unir las gotitas (pág. 521)
- coma** the fuzzy, gaseous component of a comet's head (p. 662)
- coma/coma** componente gaseoso y difuso que rodea el núcleo de un cometa (pág. 662)
- comet** a small body made of rocky and metallic pieces held together by frozen gases; Comets generally revolve about the sun in an elongated orbit. (p. 661)
- comet/cometa** cuerpo pequeño formado por materiales rocosos y metálicos unidos por medio de gases congelados; los cometas generalmente giran alrededor del Sol en una órbita alargada (pág. 661)
- compaction** process by which sediments are squeezed together by the weight of overlying materials driving out water (p. 76)
- compaction/compactación** proceso por el cual los sedimentos se unen y expulsan agua debido al peso de los materiales que los cubren (pág. 76)
- composite cone** a volcano composed of both lava flows and pyroclastic material (p. 285)
- composite cone/estratovolcán** volcán compuesto de flujos de lava y material piroclástico (pág. 285)
- compost** partly decomposed organic material that is used as fertilizer (p. 115)
- compost/compost** material orgánico parcialmente descompuesto que se usa como fertilizante (pág. 115)
- compound** a substance formed by the chemical combination of two or more elements in definite proportions and usually having properties different from those of its constituent elements (p. 37)
- compound/compuesto** sustancia formada por la combinación química de dos o más elementos en proporciones definidas y que tiene usualmente propiedades diferentes a las de los elementos que la componen (pág. 37)
- condensation** the change of state from a gas to a liquid (p. 506)
- condensation/condensación** cambio de estado de un gas a un líquido (pág. 506)
- condensation nuclei** tiny bits of particulate matter that serve as surfaces on which water vapor condenses (p. 516)
- condensation nuclei/núcleos de condensación** partículas muy pequeñas de materia que sirven como superficies para que se condense el vapor (pág. 516)

Glossary

conduction the transfer of heat through matter by molecular activity; Energy is transferred through collisions from one molecule to another. (p. 483)

conduction/conducción transferencia de calor a través de la materia por actividad molecular; la energía se transfiere a través de choques de una molécula contra otra (pág. 483)

conservation the careful use of resources (p. 113)

conservation/conservación uso cuidadoso de los recursos (pág. 113)

constellation an apparent group of stars originally named for mythical characters; The sky is presently divided into 88 constellations. (p. 700)

constellation/constelación grupo aparente de estrellas nombrado originalmente a partir de personajes míticos; el cielo se encuentra en la actualidad dividido en 88 constelaciones (pág. 700)

contact metamorphism changes in rock caused by the heat from a nearby magma body (p. 81)

contact metamorphism/metamorfismo de contacto cambios en una roca causados por el calor de una masa de magma cercano (pág. 81)

continental drift a hypothesis that originally proposed that the continents had once been joined to form a single supercontinent; The supercontinent broke into pieces, which drifted into their present-day positions. (p. 248)

continental drift/deriva continental hipótesis que propuso originalmente que los continentes estuvieron unidos formando un solo supercontinente; el supercontinente se quebró en pedazos, los cuales se desplazaron hasta sus posiciones actuales (pág. 248)

continental glacier a very large, thick mass of glacial ice that covers a large region and flows outward in all directions from one or more accumulation centers; also called a continental ice sheet (p. 189)

continental glacier/glaciar continental masa muy grande y gruesa de hielo glacial que cubre una región grande y fluye hacia afuera en todas direcciones desde uno o más centros de acumulación; también se le llama capa de hielo continental (pág. 189)

continental margin that portion of the seafloor

adjacent to the continents; It may include the continental shelf, continental slope, and continental rise. (p. 402)

continental margin/margen continental porción del suelo marino adyacente a los continentes; puede incluir la plataforma continental, el talud continental y el pie continental (pág. 402)

continental rise the gently sloping surface at the base of the continental slope (p. 403)

continental rise/pie continental superficie que se encuentra levemente en declive en la base del talud continental (pág. 403)

continental shelf the gently sloping submerged portion of the continental margin, extending from the shoreline to the continental slope (p. 402)

continental shelf/plataforma continental porción sumergida y levemente en declive del margen continental, que se extiende desde la costa hasta el talud continental (pág. 402)

continental slope the steep gradient that leads to the deep-ocean floor and marks the seaward edge of the continental shelf (p. 403)

continental slope/talud continental pendiente empinada que conduce al suelo marino profundo y marca el límite de la plataforma continental que da al mar (pág. 403)

continental volcanic arc mountains formed in part by volcanic activity caused by the subduction of oceanic lithosphere beneath a continent (p. 261)

continental volcanic arc/arco volcánico continental montañas formadas en parte por actividad volcánica causada por la subducción de la litosfera volcánica debajo de un continente (pág. 261)

continuous spectrum an uninterrupted band of light emitted by an incandescent solid, liquid, or gas under pressure (p. 676)

continuous spectrum/espectro continuo banda de luz continua emitida por un sólido, un líquido o un gas incandescente bajo presión (pág. 676)

contour interval on a topographic map, tells the distance in elevation between adjacent contour lines (p. 14)

contour interval/intervalo entre curvas de nivel en un mapa topográfico, indica la diferencia de altitud entre dos curvas de nivel adyacentes (pág. 14)

contour line line on a topographic map that indicates an elevation; Every point along a contour line has the same elevation. (p. 14)

contour line/curva de nivel línea en un mapa topográfico que indica una altitud; todos los puntos a lo largo de una curva de nivel tienen la misma altitud (pág. 14)

convection the transfer of heat by the movement of a mass or substance; It can take place only in fluids. (p. 484)

convection/convección transferencia de calor por el movimiento de una masa o sustancia; puede ocurrir sólo en líquidos (pág. 484)

convective flow the motion of matter resulting from changes in temperature; The convective flow of material in the mantle is due to Earth's unequal heating and causes the tectonic plates to move. (p. 269)

convective flow/flujo convectivo movimiento de materia resultante de cambios en la temperatura; el flujo convectivo de material en el manto se debe al calentamiento desigual de la tierra y hace que las placas tectónicas se muevan (pág. 269)

convergent boundary a boundary in which two plates move together (p. 255)

convergent boundary/límite convergente límite en el cual dos placas se muevan juntas (pág. 255)

core the innermost layer of Earth, located beneath the mantle; The core is divided into an outer core and an inner core. (p. 8)

core/núcleo capa más interna de la tierra, ubicada debajo del manto; el núcleo está dividido en un núcleo exterior y un núcleo interior (pág. 8)

Coriolis effect the apparent deflective force of Earth's rotation on all free-moving objects, including the atmosphere and oceans; Deflection is to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. (p. 449)

Coriolis effect/efecto de Coriolis aparente fuerza desviadora que la rotación de la Tierra ejerce sobre todos los objetos que están en movimiento libre, incluyendo la atmósfera y los océanos; el

desvío es hacia la derecha en el hemisferio norte y hacia la izquierda en el hemisferio sur (pág. 449)

corona the outer weak layer of the solar atmosphere (p. 686)

corona/corona solar débil capa exterior de la atmósfera solar (pág. 686)

correlation establishing the equivalence of rocks of similar age in different areas (p. 342)

correlation/correlación establecimiento de la equivalencia de rocas de edades similares en diferentes áreas (pág. 342)

covalent bond a bond that forms when atoms share electrons (p. 39)

covalent bond/enlace covalente enlace que se forma cuando los átomos comparten electrones (pág. 39)

crater the depression at the summit of a volcano or that which is produced by a meteorite impact (p. 283)

crater/cráter depresión en la cumbre de un volcán o la que se produce por el impacto de un meteorito (pág. 283)

creep the slow downhill movement of soil and regolith (p. 147)

creep/reptación movimiento lento cuesta abajo de tierra y regolitos (pág. 147)

crevasse a deep crack in the brittle surface of a glacier (p. 190)

crevasse/hendidura grieta profunda en la superficie frágil de un glaciar (pág. 190)

cross-cutting relationships, principle of a principle of relative dating; A rock or fault is younger than any rock or fault through which it cuts. (p. 341)

cross-cutting relationships, principle of/relaciones de corte transversal, principio de principio de datación relativa; una roca o falla es más joven que cualquier roca o falla que atraviesa (pág. 341)

crust the thin, rocky outer layer of Earth (p. 8)

crust/corteza capa exterior fina y rocosa de la tierra (pág. 8)

crystal form the external appearance of a mineral as determined by its internal arrangement of atoms (p. 49)

Glossary

crystal form/forma cristalina apariencia externa de un mineral determinada según la distribución interna de los átomos (pág. 49)

cumulus one of three basic cloud forms; also the name given to one of the clouds of vertical development; They are billowy individual cloud masses that often have flat bases. (p. 517)

cumulus/cúmulo una de las tres formas básicas de las nubes; nombre dado también a una de las nubes de desarrollo vertical; son masas de nubes individuales ondulantes que tienen a menudo bases planas (pág. 517)

cyclone a low-pressure center characterized by a counterclockwise flow of air in the Northern Hemisphere (p. 538)

cyclone/ciclón centro de baja presión en el hemisferio norte caracterizado por una corriente de aire que corre en sentido contrario a las manecillas del reloj (pág. 538)

D

decompression melting melting due to a drop in confining pressure that occurs as rock rises (p. 292)

decompression melting/fusión por descompresión fusión debida a una disminución de la presión restrictiva que ocurre a medida que una roca va subiendo (pág. 292)

deflation the lifting and removal of loose material by wind (p. 203)

deflation/deflación levantamiento y remoción de material suelto por el viento (pág. 203)

deformation general term for the processes of folding, faulting, shearing, compression, or extension of rocks as the result of various natural forces (p. 308)

deformation/deformación término general para los procesos de plegamiento, formación de fallas, partición, compresión o extensión en rocas, como resultado de diferentes fuerzas naturales (pág. 308)

delta an accumulation of sediment formed where a stream enters a lake or an ocean (p. 166)

delta/delta acumulación de sedimento que se forma donde una corriente de agua entra a un lago u océano (pág. 166)

density mass per unit volume of a substance, usually expressed as grams per cubic centimeter (p. 53)

density/densidad masa por unidad de volumen de una sustancia, expresada por lo general en gramos por centímetro cúbico (pág. 53)

density current current of ocean water that results from density differences among water masses (p. 451)

density current/corriente de densidad corriente de agua oceánica que resulta de las diferencias de densidad entre las masas de agua (pág. 451)

deposition the process by which an agent of erosion loses energy and drops the sediment it is carrying; also the process by which water vapor is changed directly to a solid without passing through the liquid state (p. 76, p. 506)

deposition/deposición proceso por el cual un agente de erosión pierde energía y deja caer el sedimento que arrastra; también es el proceso por el cual el vapor de agua pasa al estado sólido sin pasar por el estado líquido (pág. 76, pág. 506)

desert pavement a layer of coarse pebbles and gravel created when wind removed the finer material (p. 204)

desert pavement/pavimento desértico capa de guijarros gruesos y grava que se forma cuando el viento remueve el material más fino (pág. 204)

dew point the temperature to which air has to be cooled in order to reach saturation (p. 508)

dew point/punto de condensación temperatura a la cual se tiene que enfriar el aire para que alcance la saturación (pág. 508)

dike a tabular-shaped intrusive igneous feature that occurs when magma is injected into fractures in the surrounding rock, cutting across preexisting rock layers (p. 290)

dike/dique masa intrusiva de magma solidificado de forma tabular que se forma cuando el magma es inyectado en las fracturas de la roca circundante, penetrando transversalmente las capas de rocas preexistentes (pág. 290)

dinosaur land-dwelling reptile of the Mesozoic era (p. 377)

dinosaur/dinosaurio reptil de tierra de la era Mesozoica (pág. 377)

discharge the quantity of water in a stream that passes a given point in a period of time (p. 161)

discharge/caudal cantidad de agua en una corriente que pasa por un punto determinado en un período (pág. 161)

divergent boundary a region where the rigid plates are moving apart, typified by the oceanic ridges (p. 255)

divergent boundary/límite divergente zona donde las placas tectónicas se separan, tipificada por las dorsales oceánicas (pág. 255)

divide an imaginary line that separates the drainage of two streams; often found along a ridge (p. 169)

divide/divisoria de aguas línea imaginaria que separa el drenaje de dos corrientes de agua; frecuentemente se encuentra a lo largo de una elevación (pág. 169)

Doppler effect the apparent change in frequency of electromagnetic or sound waves caused by the relative motions of the source and the observer (p. 677)

Doppler effect/efecto Doppler variación aparente en la frecuencia de una onda sonora o electromagnética debido al movimiento relativo entre la fuente de la onda y el observador (pág. 677)

drainage basin the land area that contributes water to a stream (p. 169)

drainage basin/cuenca de avenamiento área de tierra que aporta agua a un arroyo (pág. 169)

drumlin a streamlined asymmetrical hill composed of glacial till; The steep side of the hill faces the direction from which the ice advanced. (p. 196)

drumlin/drumlin colina asimétrica compuesta de tilita glacial; el lado empinado de la colina mira hacia la dirección desde la cual avanzó el hielo (pág. 196)

dry adiabatic rate the rate of adiabatic cooling or warming in unsaturated air; The rate of temperature change is 1°C per 100 meters. (p. 511)

dry adiabatic rate/tasa adiabática seca tasa de enfriamiento o calentamiento adiabático en el aire no saturado; la tasa de cambio en la

temperatura es de 1 °C por cada 100 metros (pág. 511)

dry-summer subtropical climate a climate located on the west sides of continents between 30° and 45° latitude; It is the only humid climate with a strong winter precipitation maximum. (p. 596)

dry-summer subtropical climate/clima

subtropical de veranos secos clima que se encuentra en el occidente de los continentes entre los 30° y 45° de latitud; es el único clima húmedo que tiene una precipitación máxima elevada en invierno (pág. 596)

dune a hill or ridge of wind-deposited sand (p. 204)

dune/duna colina o elevación formada por arena depositada por el viento (pág. 204)

E

earthflow slow-moving downslope movement of water-saturated, clay-rich sediment, most characteristic of humid regions (p. 146)

earthflow/deslizamiento de tierra movimiento lento y descendente de sedimento saturado con agua, rico en arcilla, muy característico de las regiones húmedas (pág. 146)

earthquake the vibration of Earth produced by the rapid release of energy (p. 218)

earthquake/terremoto vibración de la Tierra producida por una liberación rápida de energía (pág. 218)

Earth science the name for all the sciences that collectively seek to understand Earth; It includes geology, oceanography, meteorology, and astronomy. (p. 2)

Earth science/ciencias de la Tierra nombre dado a todas las ciencias que colectivamente estudian la Tierra; incluye la geología, la oceanografía, la meteorología y la astronomía (pág. 2)

elastic rebound hypothesis the explanation stating that when rocks are deformed, they break, releasing the stored energy that results in the vibrations of an earthquake (p. 220)

elastic rebound hypothesis/teoría del rebote elástico explicación que dice que al deformarse las rocas, éstas se rompen, liberando energía que causa las vibraciones de un terremoto (pág. 220)

Glossary

electromagnetic spectrum the arrangement of electromagnetic radiation according to wavelength (p. 674)

electromagnetic spectrum/espectro

electromagnético orden de la radiación electromagnética según la longitud de onda (pág. 674)

element a substance that cannot be broken down into simpler substances by ordinary chemical or physical means (p. 34)

element/elemento sustancia que no puede ser descompuesta en sustancias más sencillas a través de métodos químicos o físicos comunes (pág. 34)

ellipse an oval (p. 618)

ellipse/elipse óvalo (pág. 618)

El Niño the name given to the periodic warming of the ocean that occurs in the central and eastern Pacific; A major El Niño episode can cause extreme weather in many parts of the world. (p. 546)

El Niño/El Niño nombre dado al calentamiento periódico que ocurre en las regiones central y oriental del océano Pacífico; un episodio intenso de El Niño puede causar fenómenos climáticos extremos en muchas partes del mundo (pág. 546)

emission spectrum a series of bright lines of particular wavelengths produced by a hot gas under low pressure (p. 676)

emission spectrum/espectro de emisión serie de luces brillantes con longitudes de onda específicas, producidas por un gas caliente sometido a bajas presiones (pág. 676)

energy level one of several distinct regions around the nucleus of an atom where electrons are located (p. 35)

energy level/nivel de energía una de varias regiones específicas que rodea el núcleo de un átomo y en donde se ubican los electrones (pág. 35)

eon the largest time unit on the geologic time scale, next in order of magnitude above era (p. 353)

eon/eón unidad de mayor intervalo en la escala geocronológica, mayor que una era (pág. 353)

epicenter the location on Earth's surface directly above the focus, or origin, of an earthquake (p. 219)

epicenter/epicentro punto en la superficie de la Tierra que está justo sobre el foco, u origen, de un terremoto (pág. 219)

epoch a unit of the geologic time scale that is a subdivision of a period (p. 353)

epoch/época unidad de la escala geocronológica, que es una subdivisión de un período (pág. 353)

era a major division on the geologic time scale; Eras are divided into shorter units called periods. (p. 353)

era/era una de las grandes divisiones de la escala geocronológica; las eras se dividen en unidades más pequeñas llamadas períodos (pág. 353)

erosion the incorporation and transportation of material by a mobile agent, such as water, wind, or ice (p. 76)

erosion/erosión incorporación y transporte de un material por un agente móvil, como el agua, el viento o el hielo (pág. 76)

esker sinuous ridge composed largely of sand and gravel deposited by a stream flowing in a tunnel beneath a glacier near its terminus (p. 197)

esker/esker elevación alargada y sinuosa, compuesta por arena y grava que han sido depositadas por un arroyo que fluye por el túnel de un glaciar, cerca de su punta. (pág. 197)

evaporation the process of converting a liquid to a gas (p. 505)

evaporation/evaporación proceso mediante el cual un líquido se convierte en gas (pág. 505)

exfoliation type of weathering caused by reducing pressure on a rock surface, allowing slabs of outer rock to break off in layers (p. 128)

exfoliation/exfoliación tipo de meteorización causada por la disminución de la presión en una superficie rocosa, lo que permite que los estratos externos de la roca se desprendan en láminas (pág. 128)

extrusive igneous rock igneous rock that has formed on Earth's surface (p. 71)

extrusive igneous rock/roca ígnea extrusiva roca ígnea que ha sido formada en la superficie de la Tierra (pág. 71)

eye a zone of scattered clouds and calm averaging about 20 kilometers in diameter at the center of a hurricane (p. 576)

eye/ojo zona de calma, con pocas nubes, que en promedio mide 20 kilómetros de diámetro y que se encuentra en el centro de un huracán (pág. 576)

eye wall the doughnut-shaped area of intense cumulonimbus development and very strong winds that surrounds the eye of a hurricane (p. 576)

eye wall/pared del ojo zona en forma de rosquilla con gran intensidad de cumulonimbos y fuertes vientos, que rodea el ojo de un huracán (pág. 576)

F

fault a fracture in Earth along which movement has occurred (p. 219)

fault/falla fractura en la Tierra en la cual ha habido movimiento (pág. 219)

fault-block mountain a mountain formed when large blocks of crust are tilted, uplifted, or dropped between large normal faults (p. 315)

fault block mountain/montaña de bloque de falla montaña formada cuando los bloques grandes de corteza terrestre se inclinan, se elevan o caen entre fallas grandes (pág. 315)

fetch the distance that the wind has traveled across open water (p. 456)

fetch/alcance del viento distancia que ha recorrido el viento sobre aguas abiertas (pág. 456)

firn coarse grains of ice resulting from recrystallization of compressed snow (p. 189)

firn/neviza granos gruesos de hielo formados cuando la nieve comprimida se vuelve a cristalizar (pág. 189)

flood occurs when the discharge of a stream becomes so great that it exceeds the carrying capacity of its channel and overflows its banks (p. 168)

flood/inundación ocurre cuando el caudal de una corriente de agua es tan grande que sobrepasa la capacidad de su canal y se desborda por sus riberas (pág. 168)

floodplain the flat, low-lying portion of a stream valley subject to periodic flooding (p. 167)

floodplain/planicie aluvial parte plana y baja del valle de un arroyo que está expuesta a inundaciones periódicas (pág. 167)

focus the point within Earth where an earthquake originates (p. 218)

focus/foco punto dentro de la Tierra en el cual se origina un terremoto (pág. 218)

folded mountain a mountain created primarily by compressional stresses, which create folds in the rock layers (p. 314)

folded mountain/montaña de pliegues montaña que ha sido creada principalmente por esfuerzos de compresión, los cuales causan pliegues en los estratos de roca (pág. 314)

foliated metamorphic rock a metamorphic rock with a texture that gives the rock a layered appearance (p. 83)

foliated metamorphic rock/roca metamórfica esquistosa roca metamórfica que tiene una textura que le da una apariencia de capas (pág. 83)

food chain a succession of organisms through which food energy is transferred, starting with primary producers (p. 437)

food chain/cadena alimentaria serie de organismos a través de los cuales se transfiere la energía de los alimentos y que empieza por los productores primarios (pág. 437)

food web a group of interrelated food chains (p. 437)

food web/red alimentaria grupo de cadenas alimentarias interrelacionadas (pág. 437)

foreshock a small earthquake that often precedes a major earthquake (p. 221)

foreshock/sismo premonitor pequeño terremoto que generalmente precede a un terremoto mayor (pág. 221)

fossil the remains or traces of an organism preserved from the geologic past (p. 343)

fossil/fósil remanentes o vestigios de un organismo que ha sido preservado del pasado geológico (pág. 343)

fossil fuel general term for any hydrocarbon that may be used as a fuel, including coal, oil, and natural gas (p. 95)

Glossary

fossil fuel/combustible fósil término general usado para describir los hidrocarburos que se utilizan como combustible, entre los cuales están el carbón mineral, el petróleo y el gas natural (pág. 95)

fracture any break or rupture in rock along which no appreciable movement has taken place (p. 53)

fracture/fractura discontinuidad en una roca en la cual no se manifiesta que haya ocurrido movimiento alguno (pág. 53)

front the boundary between two adjoining air masses having contrasting characteristics (p. 512)

front/frente límite entre dos masas de aire adyacentes que tienen características que contrastan (pág. 512)

frost wedging the mechanical breakup of rock caused by the expansion of freezing water in cracks and crevices (p. 127)

frost wedging/gelifracción fragmentación mecánica de una roca, causada por la expansión tras la congelación del agua en sus grietas y poros (pág. 127)

Glossary

G

galaxy a group of stars, dust, and gases held together by gravity (p. 715)

galaxy/galaxia grupo de estrellas, polvo y gas unidos por la gravedad (pág. 715)

galaxy cluster a system of galaxies containing from several to thousands of member galaxies (p. 718)

galaxy cluster/cúmulo de galaxias sistema que puede contener hasta miles de galaxias (pág. 718)

gas hydrate a gas, such as methane, trapped in a lattice-like structure of water molecules (p. 411)

gas hydrate/hidrato de gas un gas, por ejemplo el metano, que queda atrapado en una red de moléculas de agua (pág. 411)

geocentric describes the concept of an Earth-centered universe (p. 615)

geocentric/geocéntrico describe un universo cuyo centro es la Tierra (pág. 615)

geologic time scale the division of Earth history into blocks of time—eons, eras, periods, and

epochs; The time scale was created using relative dating principles. (p. 353)

geologic time scale/escala geocronológica división de la historia de la Tierra en bloques de tiempo: eones, eras, períodos y épocas; la escala cronológica fue creada usando los principios de datación relativa (pág. 353)

geology the science that examines Earth, its form and composition, and the changes it has undergone and is undergoing (p. 2)

geology/geología ciencia que estudia la Tierra, su forma, su composición y los cambios que ha tenido y que continúa teniendo (pág. 2)

geosphere layer of Earth under both the atmosphere and the oceans; It is composed of the core, the mantle, and the crust. (p. 7)

geosphere/geosfera estrato de la Tierra que se encuentra bajo la atmósfera y los océanos; está compuesta por el núcleo, el manto y la corteza (pág. 7)

geothermal energy energy that can be extracted from Earth's internal heat, for example, natural steam used for power generation (p. 105)

geothermal energy/energía geotérmica energía que puede extraerse del calor interno de la Tierra; por ejemplo, el vapor natural que se usa para generar electricidad (pág. 105)

geothermal gradient the gradual increase in temperature with depth in the crust; The average is 30°C per kilometer in the upper crust. (p. 291)

geothermal gradient/gradiente geotérmico aumento gradual de la temperatura a medida que se penetra en la corteza; la media es 30 °C por kilómetro en la corteza superior (pág. 291)

geyser a hot spring or fountain that ejects water at various intervals (p. 172)

geyser/géiser manantial o fuente de agua caliente que expelle agua a intervalos (pág. 172)

glacial erratic an ice-transported boulder that was not derived from bedrock near its present site (p. 194)

glacial erratic/bloque errático roca transportada por el hielo y que no se originó del lecho rocoso donde se encuentra (pág. 194)

glacier a thick mass of ice originating on land

from the compaction and recrystallization of snow that shows evidence of past or present flow (p. 188)

glacier/glaciar masa gruesa de hielo que se origina en la superficie terrestre por compactación y recristalización de la nieve, mostrando evidencias de flujo en el pasado o en la actualidad (pág. 188)

global warming the increase in average temperatures of Earth and the atmosphere due in part to increased carbon dioxide levels (p. 110)

global warming/calentamiento global aumento de la temperatura media de la Tierra y de la atmósfera causado en parte por el aumento en los niveles de dióxido de carbono (pág. 110)

Gondwana late Paleozoic continent that formed the southern portion of Pangaea, consisting of all or parts of present-day South America, Africa, Australia, India, and Antarctica (p. 370)

Gondwana/Gondwana continente de finales del paleozoico, que formaba la porción austral de Pangea y que abarcaba lo que hoy en día son América del Sur, África, Australia, India y la Antártida (pág. 370)

graben a valley formed by the downward displacement of a fault-bounded block (p. 315)

graben/fosa tectónica valle formado por el desplazamiento descendente de un bloque rodeado de fallas (pág. 315)

gradient the slope of a stream over a certain distance (p. 161)

gradient/gradiente pendiente de un arroyo a lo largo de una distancia determinada (pág. 161)

granitic composition a compositional group of igneous rocks that indicate a rock is composed almost entirely of light-colored silicates, mainly quartz and feldspar (p. 73)

granitic composition/composición de granito grupo estructural de rocas ígneas que indica que una roca está compuesta casi enteramente de silicatos de color claro, principalmente cuarzo y feldespato (pág. 73)

greenhouse effect the heating of Earth's surface and atmosphere from solar radiation being absorbed and emitted by the atmosphere, mainly

by water vapor and carbon dioxide (p. 487)

greenhouse effect/efecto invernadero calentamiento de la superficie y la atmósfera de la Tierra debido a la absorción y emisión de radiación solar por la atmósfera, principalmente por el vapor de agua y el dióxido de carbono (pág. 487)

groundwater water underground in the zone of saturation (p. 171)

groundwater/agua subterránea agua que se encuentra bajo la tierra, en las zonas de saturación (pág. 171)

gymnosperm seed-bearing plant that bears its seeds on the surfaces of cones (p. 379)

gymnosperm/gimnosperma planta cuyas semillas se encuentran en las superficies de los conos (pág. 379)

gyre the large circular surface current pattern found in each ocean (p. 449)

gyre/giro patrón de corriente circular grande que se encuentra en todos los océanos (pág. 449)

H

half-life the time required for one half of the atoms of a radioactive substance to decay (p. 348)

half-life/vida media tiempo requerido para que se desintegre la mitad de los átomos de una sustancia radiactiva (pág. 348)

hardness the resistance a mineral offers to scratching (p. 52)

hardness/dureza resistencia que ofrece un mineral a ser rayado (pág. 52)

heliocentric describes the view that the sun is at the center of the solar system (p. 616)

heliocentric/heliocéntrico describe la idea de que el Sol es el centro del sistema solar (pág. 616)

heat thermal energy transferred from one object to another (p. 483)

heat/calor energía térmica que se transfiere de un objeto a otro (pág. 483)

Hertzprung-Russell diagram See H-R diagram

Hertzprung-Russell diagram/diagrama Hertzprung-Russell ver diagrama HR

horst an elongated, uplifted block of crust bounded by faults (p. 315)

Glossary

- horst/pilar tectónico** bloque de corteza alargado que ha sido empujado hacia arriba y se encuentra rodeado de fallas (pág. 315)
- hot spot** a concentration of heat in the mantle capable of producing magma, which rises to Earth's surface; The Pacific plate moves over a hot spot, producing the Hawaiian Islands. (p. 268)
- hot spot/punto caliente** concentración de calor en el manto capaz de producir magma, la cual sube a la superficie terrestre; la placa tectónica del Pacífico se mueve sobre un punto caliente que formó las islas hawaianas (pág. 268)
- H-R diagram** a plot of stars according to their absolute magnitudes and temperatures (p. 704)
- H-R diagram/diagrama HR** diagrama de estrellas basado en las temperaturas y magnitudes absolutas de las mismas (pág. 704)
- Hubble's law** a law that states that the galaxies are retreating from the Milky Way at a speed that is proportional to their distance (p. 719)
- Hubble's law/ley de Hubble** ley que establece que las galaxias se alejan de la vía láctea a una velocidad proporcional a sus distancias (pág. 719)
- humidity** a general term referring to water vapor in the air but not to liquid droplets of fog, cloud, or rain (p. 506)
- humidity/humedad** término general que se refiere al vapor de agua en el aire, excluyendo las gotas líquidas de niebla, nubes o lluvia (pág. 506)
- humid subtropical climate** a climate generally located on the eastern side of a continent and characterized by hot, sultry summers and cool winters (p. 596)
- humid subtropical climate/clima subtropical húmedo** clima que generalmente se encuentra en la parte oriental de un continente y que se caracteriza por tener veranos calientes y sofocantes, e inviernos templados (pág. 596)
- hurricane** a tropical cyclonic storm having winds in excess of 119 kilometers per hour (p. 575)
- hurricane/huracán** tormenta tropical ciclónica con vientos cuyas velocidades exceden los 119 kilómetros por hora (pág. 575)
- hydroelectric power** the power generated by falling water (p. 105)
- hydroelectric power/energía hidroeléctrica** energía generada por el agua en movimiento (pág. 105)
- hydrogenous sediment** seafloor sediment consisting of minerals that crystallize from seawater; An important example is manganese nodules. (p. 409)
- hydrogenous sediment/sedimento hidrogenado** sedimento del fondo oceánico, formado por minerales que se han cristalizado a partir del agua marina; un ejemplo importante son los nódulos de manganeso (pág. 409)
- hydrosphere** the water portion of Earth; one of the traditional subdivisions of Earth's physical environment (p. 7)
- hydrosphere/hidrosfera** parte acuática de la Tierra; una de las divisiones tradicionales del medio ambiente físico de la Tierra (pág. 7)
- hydrothermal solution** the hot, watery solution that escapes from a mass of magma during the later stages of crystallization; Such solutions may alter the surrounding rock. (p. 83)
- hydrothermal solution/solución hidrotérmica** solución acuosa y caliente que sale del magma durante las últimas fases de la cristalización; estas soluciones pueden alterar las rocas que las rodean (pág. 83)
- hygrometer** an instrument designed to measure relative humidity (p. 508)
- hygrometer/higrómetro** instrumento diseñado para medir la humedad relativa (pág. 508)
- hypothesis** a tentative explanation that is tested to determine if it is valid (p. 23)
- hypothesis/hipótesis** explicación tentativa cuya validez es sometida a prueba (pág. 23)
- ice age** a period of time when much of Earth's land is covered by glaciers (p. 88)
- ice age/era glacial** período en el que gran parte de la Tierra estaba cubierta por glaciares (pág. 88)
- igneous rock** a rock formed by the crystallization of molten magma (p. 66)
- igneous rock/roca ígnea** roca formada por la cristalización de magma líquido (pág. 66)

index fossil a fossil that is associated with a particular span of geologic time (p. 346)

index fossil/fósil índice fósil asociado a un período específico en la escala geocronológica (pág. 346)

infiltration the movement of surface water into rock or soil through cracks and pore spaces (p. 159)

infiltration/infiltración movimiento del agua desde la superficie hacia las rocas o la tierra a través de grietas y aperturas porosas (pág. 159)

inner core the solid innermost layer of Earth, about 1220 kilometers in radius (p. 235)

inner core/núcleo interno estrato sólido más profundo de la Tierra; tiene un radio de 1220 kilómetros (pág. 235)

intertidal zone the area where land and sea meet and overlap; the zone between high and low tides (p. 431)

intertidal zone/zona intermareal área donde se encuentran y se solapan la tierra y el mar; zona entre la marea alta y la marea baja (pág. 431)

intraplate volcanism igneous activity that occurs within a tectonic plate away from plate boundaries (p. 295)

intraplate volcanism/vulcanismo de placa actividad ígnea que ocurre en una placa tectónica lejos de sus límites (pág. 295)

intrusive igneous rock igneous rock that formed below Earth's surface (p. 71)

intrusive igneous rock/roca ígnea intrusiva roca ígnea formada bajo la superficie de la Tierra (pág. 71)

ion an atom or a molecule that possesses an electrical charge (p. 37)

ion/ion átomo o molécula que tiene una carga eléctrica (pág. 37)

ionic bond a bond that forms between negative and positive ions (p. 38)

ionic bond/enlace iónico enlace que se forma entre iones negativos e iones positivos (pág. 38)

isostasy the concept that Earth's crust is floating in gravitational balance upon the material of the mantle (p. 323)

isostasy/isostasia concepto que explica que la corteza terrestre está flotando sobre el material

del manto gracias a un equilibrio gravitacional (pág. 323)

isostatic adjustment process of establishing a new level of gravitational equilibrium (p. 323)

isostatic adjustment/ajuste isostático proceso en el cual se establece un nuevo nivel de equilibrio gravitacional (pág. 323)

isotherm a line connecting points of equal temperature (p. 492)

isotherm/isoterma línea que conecta puntos que tienen temperaturas idénticas (pág. 492)

isotope an atom with the same number of protons but different numbers of neutrons for a given element; An isotope's mass number is different from that of the given element. (p. 36)

isotope/isótopo para cualquier elemento, es un átomo con igual número de protones pero distinto número de neutrones; el número de masa de un isótopo es distinto al de ese elemento (pág. 36)

jet stream swift (120–240 kilometers per hour), high-altitude winds (p. 536)

jet stream/corriente de chorro vientos de alta velocidad (120–240 kilómetros por hora) que se encuentran a grandes altitudes (pág. 536)

Jovian planet the Jupiter-like planets: Jupiter, Saturn, Uranus, and Neptune; These planets have relatively low densities and are huge gas giants. (p. 645)

Jovian planet/planeta joviano cualquier planeta de la familia de Júpiter: Júpiter, Saturno, Urano y Neptuno; estos planetas tienen densidades relativamente bajas y están compuestos principalmente de gas (pág. 645)

K

karst topography an area that has a land surface or topography with numerous depressions called sinkholes (p. 178)

karst topography/relieve kárstico zona cuya superficie o topografía presenta numerosas depresiones llamadas dolinas (pág. 178)

kettle depression created when a block of ice

Glossary

became lodged in glacial deposits and subsequently melted (p. 196)

kettle/marmita depresión creada cuando se derrite un bloque de hielo que se había alojado en un depósito glacial (pág. 196)

Köppen climate classification system a system for classifying climates that is based on mean monthly and annual values of temperature and precipitation (p. 592)

Köppen climate classification system/sistema de clasificación de climas de Köppen sistema para clasificar los climas en base a los valores promedio de las temperaturas y de las precipitaciones mensuales y anuales (pág. 592)

L

laccolith a massive igneous body intruded between preexisting strata (p. 290)

laccolith/lacolito cuerpo ígneo gigantesco que ha penetrado entre dos estratos preexistentes (pág. 290)

latent heat the energy absorbed or released during a change in state (p. 505)

latent heat/calor latente energía absorbida o desprendida durante un cambio de estado físico (pág. 505)

laterite a red, highly leached soil type found in the tropics that is rich in oxides of iron and aluminum (p. 139)

laterite/laterita suelo rojizo y altamente lixiviado de las regiones tropicales, rico en óxidos de hierro y aluminio (pág. 139)

latitude the distance north or south of the equator, measured in degrees (p. 11)

latitude/latitud distancia al norte o al sur del ecuador, que se mide en grados (pág. 11)

Laurasia the continental mass that formed the northern portion of Pangaea, consisting of present-day North America and Eurasia (p. 372)

Laurasia/Laurasia masa continental que se formó en la parte norte de Pangea, y que abarcaba lo que hoy en día son América del Norte y Eurasia (pág. 372)

lava magma that reaches Earth's surface (p. 67)

lava/lava magma que ha llegado a la superficie de

la Tierra (pág. 67)

light-year the distance light travels in a year, about 9.5 trillion kilometers (p. 702)

light-year/año luz distancia recorrida por la luz en un año o aproximadamente 9.5 billones de kilómetros (pág. 702)

liquefaction a phenomenon, sometimes associated with earthquakes, in which soils and other unconsolidated materials saturated with water are turned into a liquid that is not able to support buildings (p. 230)

liquefaction/licuefacción fenómeno, a veces asociado con los terremotos, en el cual la tierra, junto con otros materiales no consolidados saturados con agua, se convierten en un líquido que no es capaz de sostener los edificios (pág. 230)

lithosphere the rigid outer layer of Earth, including the crust and upper mantle (p. 234)

lithosphere/litosfera capa externa y rígida de la Tierra, que incluye la corteza y el manto superior (pág. 234)

loess deposits of windblown silt, lacking visible layers, generally light yellow, and capable of maintaining a nearly vertical cliff (p. 204)

loess/loes depósitos de limo transportado por el viento, generalmente amarillos y sin estratos visibles, y que son capaces de crear precipicios casi verticales (pág. 204)

longitude the distance east or west of the prime meridian, measure in degrees (p. 11)

longitude/longitud distancia hacia el este o el oeste del Primer meridiano; se mide en grados (pág. 11)

longshore current a near-shore current that flows parallel to the shore (p. 463)

longshore current/corriente litoral corriente que está cerca de la costa y que fluye paralela a la misma (pág. 463)

lunar eclipse an eclipse of the moon; A lunar eclipse occurs when the moon passes through Earth's shadow. (p. 628)

lunar eclipse/eclipse lunar eclipse de la Luna; ocurre cuando la Luna pasa a través de la sombra de la Tierra (pág. 628)

lunar regolith a thin, gray layer on the surface of

the moon, consisting of loosely compacted, fragmented material believed to have been formed by repeated impacts of meteorites (p. 632)

lunar regolith/regolito lunar capa gris y delgada sobre la superficie lunar compuesta de material fragmentado y ligeramente compactado, el cual se cree que fue formado por los impactos repetidos de meteoritos (pág. 632)

luster the appearance or quality of light reflected from the surface of a mineral (p. 49)

luster/brillo apariencia o calidad de la luz que es reflejada por la superficie de un mineral (pág. 49)

M

magma a body of molten rock found at depth, including any dissolved gases and crystals (p. 67)

magma/magma roca fundida que se encuentra en las profundidades de la Tierra; puede contener gas y cristales disueltos (pág. 67)

main-sequence star a star that falls into the main sequence category on the H-R diagram; This category contains the majority of stars and runs diagonally from the upper left to the lower right on the H-R diagram. (p. 704)

main-sequence star/estrella de secuencia principal estrella que pertenece a la categoría de Secuencia Principal en el diagrama HR; esta categoría contiene la mayoría de las estrellas y pasa diagonalmente de la esquina superior izquierda a la esquina inferior derecha en el diagrama HR (pág. 704)

mammal animal that bears live young and maintains a steady body temperature (p. 383)

mammal/mamífero animal que da a luz y es capaz de regular su temperatura corporal (pág. 383)

manganese nodule rounded lump of hydrogenous sediment scattered on the ocean floor, consisting mainly of manganese and iron and usually containing small amounts of copper, nickel, and cobalt (p. 412)

manganese nodule/nódulo de manganeso masa redonda de sedimento hidrogenado que se encuentra esparcida por el fondo oceánico; está

formado principalmente por manganeso y hierro, y generalmente tiene pequeñas cantidades de cobre, níquel y cobalto (pág. 412)

mantle the 2890-kilometer-thick layer of Earth located below the crust (p. 8)

mantle/manto estrato de la Tierra que se encuentra justo por debajo de la corteza; tiene 2890 kilómetros de profundidad (pág. 8)

mantle plume a mass of hotter-than-normal mantle material that ascends toward the surface, where it may lead to igneous activity (p. 269)

mantle plume/pluma eruptiva masa de material del manto caliente que sube hacia la superficie, donde puede desencadenar una actividad ígnea (pág. 269)

mare (*plural maria*) the Latin name for the smooth areas of the moon formerly thought to be seas (p. 632)

mare/mare (*plural: maria*) nombre en Latín para las zonas lisas de la Luna que antiguamente se pensaba eran mares (pág. 632)

marine west coast climate a climate found on windward coasts from latitudes 40° to 65° and dominated by maritime air masses; Winters are mild, and summers are cool. (p. 596)

marine west coast climate/clima marítimo de la costa oeste clima de las costas expuestas al viento que se encuentran entre las latitudes 40° y 65°; en este clima predominan los aires marinos, los inviernos son templados y los veranos son frescos (pág. 596)

mass movement the downslope movement of rock, regolith, and soil under the direct influence of gravity (p. 143)

mass movement/movimiento de masas movimiento descendente de rocas, regolito y tierra por influencia directa de la gravedad (pág. 143)

mass number the number of neutrons and protons in the nucleus of an atom (p. 36)

mass number/número de masa número de neutrones y protones en el núcleo de un átomo (pág. 36)

meander a looplike bend in the course of a stream (p. 163)

meander/meandro sinuosidad en el recorrido de un arroyo (pág. 163)

- mechanical weathering** the physical disintegration of rock, resulting in smaller fragments (p. 126)
- mechanical weathering/meteorización mecánica** desintegración física de las rocas que produce fragmentos más pequeños (pág. 126)
- mesosphere** the layer of the atmosphere immediately above the stratosphere and characterized by decreasing temperatures with height (p. 480)
- mesosphere/mesosfera** estrato de la atmósfera que se encuentra inmediatamente por encima de la estratosfera y está caracterizada por el descenso de la temperatura con el aumento de la altura (pág. 480)
- metallic bond** a bond that forms when electrons are shared by metal ions (p. 39)
- metallic bond/enlace metálico** enlace que se forma cuando los iones metálicos comparten electrones (pág. 39)
- metamorphic rock** rock formed by the alteration of preexisting rock deep within Earth (but still in the solid state) by heat, pressure, and/or chemically active fluids (p. 66)
- metamorphic rock/roca metamórfica** roca formada por la alteración de una roca preexistente en las profundidades de la Tierra (pero todavía en estado sólido) debido al calor, la presión o líquidos químicamente activos (pág. 66)
- metamorphism** the changes in mineral composition and texture of a rock subjected to high temperature and pressure within Earth (p. 80)
- metamorphism/metamorfismo** cambios en la composición mineral y la textura de una roca sometida a temperaturas y presiones elevadas dentro de la Tierra (pág. 80)
- meteor** the luminous phenomenon observed when a meteoroid enters Earth's atmosphere and burns up, popularly called a shooting star (p. 663)
- meteor/meteoro** fenómeno luminoso que se observa cuando un meteoróide entra a la atmósfera de la Tierra y se desintegra, conocido popularmente como estrella fugaz (pág. 663)
- meteorite** any portion of a meteoroid that reaches Earth's surface (p. 664)
- meteorite/meteorito** cualquier fragmento de un meteoróide que llega a la superficie terrestre (pág. 664)
- meteoroid** a small, solid particle that travels through space (p. 663)
- meteoroid/meteoróide** partícula sólida y pequeña que viaja a través del espacio (pág. 663)
- meteorology** the scientific study of the atmosphere and atmospheric phenomena; the study of weather and climate (p. 3)
- meteorology/meteorología** estudio científico de la atmósfera y los fenómenos que ocurren en ella; estudio del estado del tiempo y el clima (pág. 3)
- mid-ocean ridge** *See* oceanic ridge
- mid-ocean ridge/dorsal mesoocéánica** *ver* dorsal oceánica
- mineral** a naturally occurring, inorganic crystalline material with a unique chemical composition (p. 43)
- mineral/mineral** material cristalino inorgánico que ocurre de manera natural y que tiene una composición química única (pág. 43)
- mixed zone** an area of the ocean surface with uniform temperatures created by the mixing of water by waves, currents, and tides (p. 426)
- mixed zone/zona mixta** área de la superficie del océano que tiene una temperatura uniforme mantenida por la mezcla de aguas por el viento, las corrientes y las mareas (pág. 426)
- Moho** the Mohorovičić discontinuity, which is shortened to Moho; It is the boundary separating the crust from the mantle, discernible by an increase in the velocity of seismic waves. (p. 236)
- Moho/Moho** la discontinuidad de Mohorovičić, abreviada Moho; es el límite que separa la corteza del manto y que se distingue por un aumento en la velocidad de las ondas sísmicas (pág. 236)
- Mohs scale** a series of 10 minerals used as a standard in determining hardness (p. 52)
- Mohs scale/escala de Mohs** serie de 10 minerales usados como guía para determinar la dureza (pág. 52)
- moment magnitude** a more precise measure of earthquake magnitude than the Richter

scale, which is derived from the amount of displacement that occurs along a fault zone and estimates the energy released by an earthquake (p. 227)

moment magnitude/magnitud de momento medida más exacta para la magnitud de un terremoto que la escala de Richter, que se deriva del desplazamiento que ocurre a lo largo de una zona de falla y estima la energía que libera un terremoto (pág. 227)

monocline a large steplike fold in otherwise horizontal sedimentary strata (p. 310)

monocline/pliegue monoclinal pliegue grande en forma de escalón en un estrato horizontal de sedimento (pág. 310)

monsoon seasonal reversal of wind direction associated with large continents, especially Asia; In winter, the wind blows from land to sea. In summer, the wind blows from sea to land. (p. 542)

monsoon/monzón cambio estacional en la dirección del viento asociado con los grandes continentes, particularmente Asia; en invierno, el viento sopla de la tierra al mar y en verano, sopla del mar a la tierra (pág. 542)

moraine a ridge of unsorted sediment left by a glacier (p. 194)

moraine/morrena loma de sedimento mixto depositado por un glaciar (pág. 194)

mudflow quickly moving downhill flow of soil and rock fragments containing a large amount of water (p. 146)

mudflow/corriente de barro movimiento descendente y rápido de tierra y fragmentos de roca que contienen gran cantidad de agua (pág. 146)

N

natural levee an elevated landform that parallels a stream and acts to confine its waters, except during floodstage (p. 167)

natural levee/terraplén natural formación de tierra elevada paralela a un arroyo y que sirve para contener sus aguas, excepto durante una etapa de inundación (pág. 167)

neap tide lowest tidal range, occurring near the times of the first-quarter and third-quarter phases of the moon (p. 459)

neap tide/marea muerta menor rango entre mareas, que ocurre aproximadamente cuando la Luna está en cuarto creciente y en cuarto menguante (pág. 459)

nebula a cloud of gas and/or dust in space (p. 647)

nebula/nébula nube de gas y/o polvo en el espacio (pág. 647)

nekton organisms that can move independently of ocean currents by swimming or other means of propulsion; includes most adult fish and squid, marine mammals, and marine reptiles (p. 429)

nekton/necton grupo de organismos que pueden moverse independientemente de las corrientes del océano, nadando o mediante otros medios de propulsión; incluye la mayoría de los peces y calamares adultos, y los mamíferos y reptiles marinos (pág. 429)

neritic zone the marine-life zone that extends from the low-tide line out to the shelf break (p. 431)

neritic zone/zona nerítica zona con vida marítima que se extiende desde la línea de marea baja hasta el talud continental (pág. 431)

neutron star a star of extremely high density composed entirely of neutrons (p. 713)

neutron star/estrella de neutrones estrella de gran densidad, compuesta enteramente de neutrones (pág. 713)

nonfoliated metamorphic rock metamorphic rock that does not exhibit a banded or layered appearance (p. 83)

nonfoliated metamorphic rock/roca metamórfica no esquistosa roca metamórfica que no tiene una apariencia estratificada (pág. 83)

nonpoint source pollution water pollution that does not have a specific point of origin (p. 109)

nonpoint source pollution/contaminación no localizada contaminación del agua que no tiene un origen determinado (pág. 109)

nonrenewable resource resource that takes millions of years to form (p. 94)

nonrenewable resource/recurso no renovable recurso que toma millones de años en formarse (pág. 94)

Glossary

normal fault a fault in which the rock above the fault plane has moved down relative to the rock below (p. 311)

normal fault/falla normal falla en la que la roca que está por encima del plano de la falla se desplaza hacia abajo, en relación a la roca que está por debajo (pág. 311)

normal polarity a magnetic field that is the same as that which exists at present (p. 266)

normal polarity/polaridad normal campo magnético igual al que existe en el presente (pág. 266)

nova a star that explosively increases in brightness (p. 705)

nova/nova estrella cuyo brillo aumenta repentinamente (pág. 705)

nuclear fusion the way in which the sun produces energy; Nuclear fusion occurs when less massive nuclei combine into more massive nuclei, releasing tremendous amounts of energy. (p. 689)

nuclear fusion/fusión nuclear proceso mediante el cual el Sol genera energía; la fusión nuclear ocurre cuando los núcleos menos masivos se unen para formar núcleos más masivos y desprenden enormes cantidades de energía en el proceso (pág. 689)

O

occluded front a front formed when a cold front overtakes a warm front; It marks the beginning of the end of a middle-latitude cyclone. (p. 567)

occluded front/frente ocluido frente que se forma cuando un frente frío alcanza a un frente cálido; indica el principio del fin de un ciclón de las latitudes medias (pág. 567)

ocean basin floor area of the deep-ocean floor between the continental margin and the oceanic ridge (p. 404)

ocean basin floor/cuenca del fondo oceánico zona del fondo de los océanos profundos, ubicada entre el margen continental y la elevación oceánica (pág. 404)

ocean current mass of ocean water that flows from one place to another (p. 448)

ocean current/corriente oceánica masa de agua

oceánica que fluye de un lugar a otro (pág. 448)

oceanic ridge a continuous elevated zone on the floor of all the major ocean basins and varying in width from 1000 to 4000 kilometers; The rifts at the crests of ridges represent divergent plate boundaries. (p. 258)

oceanic ridge/dorsal oceánica zona de elevación continua en el fondo de todas las cuencas de los océanos, cuya anchura varía entre 1000 y 4000 kilómetros; las grietas en las cimas de las elevaciones representan límites divergentes de las placas tectónicas (pág. 258)

oceanic zone the marine-life zone beyond the continental shelf (p. 431)

oceanic zone/zona oceánica zona con vida marina que se encuentra más allá de la plataforma continental (pág. 431)

oceanography the scientific study of the oceans and oceanic phenomena (p. 3)

oceanography/oceanografía estudio científico de los océanos y sus fenómenos (pág. 3)

ore a material from which a useful mineral or minerals can be mined at a profit (p. 98)

ore/mena material a partir del cual se pueden explotar minerales útiles para obtener un beneficio económico (pág. 98)

original horizontality, principle of a principle of relative dating; Layers of sediments are generally deposited in a horizontal or nearly horizontal position. (p. 340)

original horizontality, principle of/horizontalidad original, principio de la principio de la datación relativa; los estratos de sedimentos generalmente son depositadas en posición horizontal o casi horizontal (pág. 340)

orogenesis the processes that collectively result in the formation of mountains (p. 314)

orogenesis/orogénesis aquellos procesos que en colectivo resultan en la formación de las montañas (pág. 314)

orographic lifting mountains acting as barriers to the flow of air, forcing the air to ascend; The air cools adiabatically, and clouds and precipitation may result. (p. 512)

orographic lifting/elevación orográfica montaña o montañas que forman una barrera para el flujo

- del aire, empujando el aire hacia arriba; el aire se enfría de manera adiabática, lo cual causa la formación de nubes y precipitación (pág. 512)
- outer core** a layer beneath the mantle about 2260 kilometers thick; The outer core contains liquid iron and generates Earth's magnetic field. (p. 235)
- outer core/núcleo exterior** estrato que se encuentra por debajo del manto, con un grosor de aproximadamente 2260 kilómetros; el núcleo exterior contiene hierro líquido y genera el campo magnético de la Tierra (pág. 235)
- outwash plain** a relatively flat, gently sloping plain consisting of materials deposited by meltwater streams in front of the margin of an ice sheet (p. 196)
- outwash plain/llanura aluvial** llanura relativamente plana y con leves inclinaciones formada por materiales depositados por los arroyos de aguanieve al borde de un helero (pág. 196)
- ozone** a molecule of oxygen containing three oxygen atoms (p. 478)
- ozone/ozono** molécula de oxígeno que contiene tres átomos de oxígeno (pág. 478)

P

- P wave** earthquake wave that pushes and pulls rocks in the direction of the wave; also known as a compression wave (p. 223)
- P wave/onda P** onda sísmica que empuja y atrae las rocas; también se llama onda de compresión (pág. 223)
- paleomagnetism** the natural remnant magnetism in rock bodies; the permanent magnetization acquired by rock that can be used to determine the location of the magnetic poles at the time it became magnetized (p. 265)
- paleomagnetism/paleomagnetismo** restos de magnetismo natural en cuerpos rocosos; magnetización permanente que adquieren las rocas, que se puede usar para determinar la localización de los polos magnéticos en el momento en que se magnetizaron (pág. 265)
- Pangaea** the proposed supercontinent that 200 million years ago began to break apart and form the present landmasses (p. 248)
- Pangaea/Pangea** supercontinente que hace 200 millones de años comenzó a fragmentarse y a formar las masas de tierra actuales (pág. 248)
- pedalfer** soil of humid regions characterized by the accumulation of iron oxides and aluminum-rich clays in the B horizon (p. 139)
- pedalfer/pedalfer** suelo de las regiones húmedas que se caracteriza por la acumulación de óxidos de hierro y de arcillas ricas en aluminio en el horizonte B (pág. 139)
- pedocal** soil associated with drier regions and characterized by an accumulation of calcium carbonate in the upper horizons (p. 139)
- pedocal/pedocal** suelo asociado con las regiones más secas y que se caracteriza por una acumulación de carbonato de calcio en los horizontes superiores (pág. 139)
- pelagic zone** open ocean of any depth; Animals in this zone swim or float freely. (p. 431)
- pelagic zone/zona pelágica** océano abierto de cualquier profundidad; los animales de esta zona nadan o flotan libremente (pág. 431)
- perigee** the point at which the moon is closest to Earth (p. 626)
- perigee/perigeo** el punto en el que la Luna está más cerca de la Tierra (pág. 626)
- perihelion** the point in the orbit of a planet where it is closest to the sun (p. 624)
- perihelion/perihelio** el punto en la órbita de un planeta en el que éste está más cerca del Sol (pág. 624)
- period** a basic unit of the geologic time scale that is a subdivision of an era; Periods may be divided into smaller units called epochs. (p. 353)
- period/período** unidad básica de la escala geocronológica que es una subdivisión de una era; los períodos pueden dividirse en unidades más pequeñas llamadas épocas (pág. 353)
- permeability** a measure of a material's ability to transmit fluids (p. 171)
- permeability/permeabilidad** la capacidad de un material para transmitir fluidos (pág. 171)
- phases of the moon** the progression of changes in the moon's appearance during the month (p. 626)

Glossary

phases of the moon/fases de la Luna la progresión de los cambios de la apariencia de la Luna a lo largo del mes (pág. 626)

photic zone the upper part of the ocean into which sunlight penetrates (p. 430)

photic zone/zona fótica parte superior del océano en la que penetra la luz solar (pág. 430)

photon a small packet of light energy (p. 675)

photon/fotón partícula de energía luminosa (pág. 675)

photosphere the region of the sun that radiates energy to space; visible surface of the sun (p. 685)

photosphere/fotosfera región del Sol que irradia energía al espacio; la superficie visible del Sol (pág. 685)

photosynthesis the process by which plants, algae, and certain prokaryotes use light energy to convert water and carbon dioxide into energy-rich glucose molecules (p. 433)

photosynthesis/fotosíntesis proceso mediante el cual plantas, algas y ciertos procariontes usan la energía luminosa para convertir agua y dióxido de carbono en moléculas de glucosa ricas en energía (pág. 433)

phytoplankton algal plankton, which are the most important community of primary producers in the ocean (p. 429)

phytoplankton/fitoplancton plancton algal, que es la comunidad más importante de productores primarios del océano (pág. 429)

planetesimal small, irregularly shaped body formed by colliding matter (p. 648)

planetesimal/planetésimo cuerpo pequeño, de forma irregular, formado por materia en colisión (pág. 648)

plankton passively drifting or weakly swimming organisms that cannot move independently of ocean currents; includes microscopic algae, protozoa, jellyfish, and larval forms of many animals (p. 428)

plankton/plancton organismos que flotan pasivamente o nadan débilmente, que no se pueden mover independientemente de corrientes oceánicas; incluyen algas microscópicas, protozoos, medusas y formas larvales de muchos animales (pág. 428)

plate one of numerous rigid sections of the lithosphere that moves as a unit over the material of the asthenosphere (p. 254)

plate/placa una de las numerosas secciones rígidas de la litosfera que se mueve como unidad sobre la materia de la astenosfera (pág. 254)

plate tectonics the theory that proposes that Earth's outer shell consists of individual plates that interact in various ways and thereby produce earthquakes, volcanoes, mountains, and the crust itself (p. 254)

plate tectonics/tectónica de placas teoría que propone que la capa exterior de la Tierra se compone de placas individuales que interactúan de varias maneras y producen como resultado terremotos, volcanes, montañas y la corteza en sí (pág. 254)

playa lake a flat area on the floor of an undrained desert basin (playa) that fills and becomes a lake after heavy rain (p. 201)

playa lake/salar superficie plana en el suelo de una cuenca desértica sin drenaje que se llena y se convierte en un lago tras lluvias fuertes (pág. 201)

pluton an intrusive igneous structure that results from the cooling and hardening of magma beneath the surface of Earth (p. 289)

pluton/plutón estructura intrusiva ígnea que resulta del enfriamiento y endurecimiento del magma bajo la superficie de la Tierra (pág. 289)

point source pollution water pollution that comes from a known and specific location (p. 108)

point source pollution/contaminación de fuentes localizadas contaminación acuática que procede de una fuente conocida y específica (pág. 108)

polar easterlies in the global pattern of prevailing winds, winds that blow from the polar high toward the subpolar low; These winds, however, should not be thought of as persistent winds, such as the trade winds. (p. 541)

polar easterlies/vientos polares del este en el patrón global de vientos dominantes, los vientos que soplan desde la zona polar de alta presión a la zona subpolar de baja presión; sin embargo, estos vientos no deben considerarse como

- vientos persistentes, como por ejemplo los vientos alisios (pág. 541)
- polar front** the stormy frontal zone separating cold air masses of polar origin from warm air masses of tropical origin (p. 541)
- polar front/frente polar** la zona frontal tormentosa que separa masas de aire frío de origen polar de masas de aire cálido de origen tropical (pág. 541)
- polar zone** the region between 66.5° north and south latitudes and the poles; The sun's rays strike at a very small angle in the polar zone. (p. 589)
- polar zone/zona polar** la región entre los 66.5° de latitud y los polos; los rayos del Sol llegan a la zona polar en un ángulo muy pequeño (pág. 589)
- porosity** the volume of open spaces in rock or soil (p. 171)
- porosity/porosidad** el volumen de espacios abiertos en una roca o suelo (pág. 171)
- porphyritic texture** an igneous texture consisting of large crystals embedded in a matrix of much smaller crystals (p. 72)
- porphyritic texture/textura porfirítica** textura ígnea formada por grandes cristales incrustados en una matriz de cristales mucho más pequeños (pág. 72)
- precession** a slow motion of Earth's axis that traces out a cone over a period of 26,000 years (p. 622)
- precession/precisión** movimiento lento del eje de la Tierra que traza un cono a lo largo de un período de 26,000 años (pág. 622)
- precipitation** any form of water that falls from a cloud (p. 504)
- precipitation/precipitación** cualquier forma de agua que cae de una nube (pág. 504)
- pressure gradient** the amount of pressure change occurring over a given distance (p. 534)
- pressure gradient/gradiente de presión** medida del cambio de presión que ocurre a lo largo de una distancia dada (pág. 534)
- prevailing wind** a wind that consistently blows from one direction more than from another (p. 545)
- prevailing wind/viento dominante** un viento que sopla constantemente de una dirección más que de otra (pág. 545)
- primary productivity** the production of organic matter from inorganic substances through photosynthesis or chemosynthesis (p. 433)
- primary productivity/productividad primaria** la producción de materia orgánica a partir de sustancias inorgánicas a través de la fotosíntesis o quimiosíntesis (pág. 433)
- prominence** a concentration of gases above the solar surface that appears as a bright archlike structure (p. 688)
- prominence/prominencia** concentración de gases sobre la superficie solar que aparece como una estructura brillante en forma de arco (pág. 688)
- protostar** a collapsing cloud of gas and dust destined to become a star; a developing star not yet hot enough to engage in nuclear fusion (p. 708)
- protostar/protoestrella** nube de gas y polvo en colapso destinada a convertirse en una estrella; una estrella en desarrollo que todavía no está lo suficientemente caliente para iniciar la fusión nuclear (pág. 708)
- pulsar** a variable radio source of small size that emits radio pulses in very regular periods (p. 713)
- pulsar/púlsar** fuente de radio variable de tamaño pequeño que emite pulsaciones de radio en períodos muy regulares (pág. 713)
- pycnocline** a layer of water in which there is a rapid change of density with depth (p. 426)
- pycnocline/picnoclina** capa de agua en la que se produce un rápido cambio de densidad con la profundidad (pág. 426)
- pyroclastic material** the volcanic rock ejected during an eruption, including ash, bombs, and blocks (p. 283)
- pyroclastic material/material piroclástico** roca volcánica expulsada durante una erupción, incluyendo cenizas, bombas y bloques (pág. 283)

R

radiation the transfer of energy (heat) through space by electromagnetic waves (p. 485)

Glossary

S

- S wave** a seismic wave that shakes particles perpendicular to the direction the wave is traveling (p. 223)
- S wave/onda S** onda sísmica que sacude partículas perpendiculares a la dirección en que viaja la onda (pág. 223)
- salinity** the proportion of dissolved salts to pure water, usually expressed in parts per thousand (‰) (p. 422)
- salinity/salinidad** la proporción de sales disueltas en agua pura, generalmente expresada en partes por miles (‰) (pág. 422)
- saturated** the state of air that contains the maximum quantity of water vapor that it can hold at any given temperature and pressure (p. 506)
- saturated/saturado** el estado del aire que contiene la máxima cantidad de vapor de agua que puede retener a una temperatura y presión determinadas (pág. 506)
- scattering** the redirecting (in all directions) of light by small particles and gas molecules in the atmosphere; The result is more light rays with weaker intensity. (p. 486)
- scattering/dispersión** la redirección (en todas direcciones) de luz por pequeñas partículas y moléculas de gas en la atmósfera; el resultado es más rayos de luz con menos intensidad (pág. 486)
- seafloor spreading** the process by which plate tectonics produces new oceanic lithosphere at ocean ridges (p. 259)
- seafloor spreading/expansión de los suelos oceánicos** proceso por el cual la tectónica de placas produce una nueva litosfera oceánica en las dorsales oceánicas (pág. 259)
- seamount** an isolated volcanic peak that rises at least 1000 meters above the deep-ocean floor (p. 404)
- seamount/monte marino** pico volcánico aislado que se eleva al menos 1000 metros sobre el suelo oceánico (pág. 404)
- sediment** loose particles created by the weathering and erosion of rock, by chemical precipitation

from solution in water, or from the secretions of organisms and transported by water, wind, or glaciers (p. 68)

sediment/sedimento partículas sueltas formadas por la meteorización y la erosión de una roca, por la precipitación química de una solución en agua o por las secreciones de organismos, y transportadas por el agua, el viento o los glaciares (pág. 68)

sedimentary rock rock formed from the weathered products of preexisting rocks that have been transported, deposited, compacted, and cemented (p. 66)

sedimentary rock/roca sedimentaria roca formada a partir de productos erosionados de rocas anteriores que han sido transportados, depositados, endurecidos y cimentados (pág. 66)

seismic gap an area along a fault where there has not been any earthquake activity for a long period of time (p. 232)

seismic gap/brecha sísmica área a lo largo de una falla donde no ha habido actividad sísmica durante un largo período (pág. 232)

seismogram the record made by a seismograph (p. 222)

seismogram/sismograma registro hecho por un sismógrafo (pág. 222)

seismograph an instrument that records earthquake waves (p. 222)

seismograph/sismógrafo instrumento que registra ondas sísmicas (pág. 222)

shield A large, relatively flat expanse of ancient metamorphic rock within the stable continental interior (p. 365)

shield/escudo extensión grande y relativamente plana de roca metamórfica antigua dentro del interior continental estable (pág. 365)

shield volcano a broad, gently sloping volcano built from fluid basaltic lavas (p. 284)

shield volcano/volcán en escudo volcán ancho, de laderas poco inclinadas, formado por el fluido de lavas basálticas (pág. 284)

silicate any one of numerous minerals that have the oxygen and silicon tetrahedron as their basic structure (p. 45)

silicate/silicato cualquiera de los numerosos

minerales que tienen como su estructura básica el tetraedro de oxígeno y silicio (pág. 45)

siliceous ooze biogenous sediment composed of the silica-based shells of single-celled animals and algae (p. 408)

siliceous ooze/fango silíceo sedimento biógeno compuesto de esqueletos de sílice de animales unicelulares y algas (pág. 408)

silicon-oxygen tetrahedron a structure composed of four oxygen atoms surrounding a silicon atom, which constitutes the basic building block of silicate minerals (p. 45)

silicon-oxygen tetrahedron/tetraedro de oxígeno y silicio estructura compuesta de cuatro átomos de oxígeno que rodean un átomo de silicio, que constituye la pieza clave para formar los silicatos (pág. 45)

sill a tabular igneous body formed when magma is injected along sedimentary bedding surfaces (p. 298)

sill/sill cuerpo tabular ígneo que se forma cuando el magma es inyectado a lo largo de superficies de lechos sedimentarios (pág. 298)

sinkhole a depression produced in a region where soluble rock has been removed by groundwater (p. 178)

sinkhole/dolina depresión que se produce en una región cuando el agua subterránea disuelve la roca soluble (pág. 178)

slab-pull a mechanism that contributes to plate motion in which cool, dense oceanic crust sinks into the mantle and "pulls" the trailing lithosphere along (p. 269)

slab-pull/subducción de placa mecanismo que contribuye al movimiento de placas en el cual la corteza oceánica, densa y fría se hunde en el manto, arrastrando consigo la litosfera (pág. 269)

slump the downward slipping of a mass of rock or unconsolidated material moving as a unit along a curved surface (p. 146)

slump/desprendimiento el movimiento hacia abajo de una masa de rocas o material no consolidado que se mueve como unidad a lo largo de una superficie curva (pág. 146)

snowline lowest elevation in a particular area that

remains covered in snow all year (p. 188)

snowline/línea de nieve elevación más baja en un área concreta que queda cubierta por la nieve todo el año (pág. 188)

soil a combination of mineral and organic matter, water, and air; that portion of the regolith that supports plant growth (p. 133)

soil/suelo combinación de materia mineral y orgánica, agua y aire; parte del regolito que permite el crecimiento de plantas (pág. 138)

soil horizon a layer of soil that has identifiable characteristics produced by chemical weathering and other soil-forming processes (p. 138)

soil horizon/horizonte capa del suelo que tiene unas características identificables producidas por alteraciones químicas y otros procesos de formación del suelo (p. 138)

soil profile a vertical section through a soil showing its succession of horizons and the underlying parent material (p. 138)

soil profile/perfil del suelo sección vertical de un suelo que muestra la sucesión de horizontes y los materiales litológicos subyacentes (pág. 138)

solar eclipse an eclipse of the sun; A solar eclipse occurs when the moon moves in a line directly between Earth and the sun, casting a shadow on Earth. (p. 628)

solar eclipse/eclipse solar eclipse del Sol; un eclipse solar ocurre cuando la Luna se mueve en línea directa entre la Tierra y el Sol, formando una sombra sobre la Tierra (pág. 268)

solar flare a sudden and tremendous eruption in the solar chromosphere (p. 688)

solar flare/destello solar gran erupción de energía repentina en la cromosfera solar (pág. 688)

solar wind streams of protons and electrons ejected at high speed from the solar corona (p. 686)

solar wind/viento solar ráfagas de protones y electrones lanzadas a alta velocidad desde la corona solar (pág. 686)

sonar An electronic depth-sounding mechanism; Sonar is an acronym for sound navigation and ranging. Sonar calculates ocean depth by recording the time it takes for an energy pulse to reach the ocean floor and return. (p. 398)

Glossary

sonar/sonar mecanismo electrónico de sonido de profundidad; *sonar* es un acrónimo en inglés para *Sound Navigation and Ranging* (navegación y rango de sonido); un sonar calcula la profundidad del océano al registrar el tiempo que tarda una pulsación de energía en llegar al suelo oceánico y volver (pág. 398)

spectroscopy the study of the properties of light that depend on wavelength (p. 676)

spectroscopy/espectroscopia estudio de las propiedades de la luz que depende de la longitud de onda (pág. 676)

spring a flow of groundwater that emerges naturally at the ground surface (p. 171)

spring/manantial fuente de agua subterránea que emerge de forma natural en la superficie de la tierra (pág. 171)

spring equinox the equinox that occurs on March 21 or 22 in the Northern Hemisphere (p. 482)

spring equinox/equinoccio de primavera el equinoccio que tiene lugar el 21 ó 22 de marzo en el hemisferio norte (pág. 482)

spring tide highest tidal range that occurs due to the alignment of Earth, the moon, and the sun (p. 459)

spring tide/marea viva rango de marea más alto que ocurre debido a la alineación de la Tierra, la Luna y el Sol (pág. 459)

stalactite an icicle-like structure that hangs from the ceiling of a cavern (p. 177)

stalactite/estalactita estructura en forma de carámbano que cuelga del techo de una caverna (pág. 177)

stalagmite a columnlike form that grows upward from the floor of a cavern (p. 177)

stalagmite/estalagmita estructura en forma de columna que crece hacia arriba desde el suelo de una caverna (pág. 177)

stationary front a situation in which the surface position of a front does not move; The flow on either side of such a boundary is nearly parallel to the position of the front. (p. 566)

stationary front/frente estacionario situación en la que la posición de la superficie de un frente no se mueve; el movimiento a cada lado de ese límite es casi paralelo a la posición del frente

(pág. 566)

storm surge the abnormal rise of the sea along a shore as a result of strong winds (p. 577)

storm surge/marea de tempestad la subida anormal del mar a lo largo de la costa como resultado de fuertes vientos (p. 577)

strain the change in shape or volume of a body of rock as a result of stress (p. 308)

strain/deformación el cambio en la forma o el volumen de un cuerpo rocoso como resultado del esfuerzo (pág. 308)

stratosphere the layer of the atmosphere immediately above the troposphere, characterized by increasing temperatures with height, due to the concentration of ozone (p. 480)

stratosphere/estratosfera la capa de la atmósfera inmediatamente por encima de la troposfera, que se caracteriza por el aumento de la temperatura con la altura, debido a la concentración de ozono (pág. 480)

stratus one of three basic cloud forms; They are sheets or layers that cover much or all of the sky. (p. 518)

stratus/estrato una de las tres formas básicas de las nubes; son como sábanas o capas que cubren todo o casi todo el cielo (pág. 518)

streak the color of a mineral in powdered form (p. 51)

streak/raya el color de un mineral en forma pulverizada (pág. 51)

stream channel the course that the water in a stream follows (p. 161)

stream channel/cauce el curso que sigue el agua de una corriente (pág. 161)

stress the force per unit area acting on a solid (p. 308)

stress/esfuerzo la fuerza por unidad de área que actúa sobre un sólido (pág. 308)

strike-slip fault a fault along which the movement is horizontal and parallel to the trend of the fault (p. 313)

strike-slip fault/falla de desgarre falla a lo largo de la cual el movimiento es horizontal y paralelo a la tendencia de la falla (pág. 313)

stromatolite structure produced by algae trapping

sediment and forming layered mounds of calcium carbonate (p. 368)

stromatolite/estromatolito estructura producida por algas atrapadas en sedimento que forma pilas estratificadas de carbonato de calcio (pág. 368)

subarctic climate A climate found north of the humid continental climate and south of the polar climate; characterized by bitterly cold winters and short cool summers; Places within this climatic realm experience the highest annual temperature ranges on Earth. (p. 597)

subartic climate/clima subártico clima que prevalece al norte del clima húmedo continental y al sur del clima polar; se caracteriza por inviernos fríos rigurosos y veranos frescos y cortos; los lugares que se hallan en este ambiente tienen el rango de temperaturas más elevado de la Tierra (pág. 597)

subduction zone a destructive plate margin where oceanic crust is being pushed down into the mantle beneath a second plate (p. 261)

subduction zone/zona de subducción margen de placa destructivo donde la corteza oceánica es empujada hacia abajo, al manto, bajo una segunda placa (pág. 261)

sublimation the conversion of a solid directly to a gas without passing through the liquid state (p. 506)

sublimation/sublimación conversión de un sólido directamente a gas sin pasar por estado líquido (pág. 506)

submarine canyon a seaward extension of a valley that was cut on the continental shelf during a time when sea level was lower; a canyon carved into the outer continental shelf, slope, and rise by turbidity currents (p. 403)

submarine canyon/cañón submarino extensión de un valle hacia el mar que se cortó en la plataforma continental durante una era en la que el nivel del mar era más bajo; un cañón cavado en la parte exterior de la plataforma continental, el talud continental y el pie continental por corrientes de turbidez (pág. 403)

submersible a small underwater craft used for deep-sea research (p. 400)

submersible/sumergible nave submarina pequeña que se usa en la investigación oceánica (pág. 400)

summer solstice the solstice that occurs on June 21 or 22 in the Northern Hemisphere and on December 21 or 22 in the Southern Hemisphere (p. 482)

summer solstice/solsticio de verano solsticio que tiene lugar el 21 ó 22 de junio en el hemisferio norte y el 21 ó 22 de diciembre en el hemisferio sur (pág. 482)

sunspot a dark spot on the sun, which is cool by contrast to the surrounding photosphere (p. 687)

sunspot/mancha solar área oscura del Sol que está más fría que la fotosfera que la rodea (pág. 687)

supercooled water the condition of water droplets that remain in the liquid state at temperatures well below 0°C (p. 521)

supercooled water/agua subenfriada condición en que las gotas de agua permanecen en estado líquido a temperaturas inferiores a 0 °C (pág. 521)

supergiant a very large, very bright red giant star (p. 704)

supergiant/supergigante estrella roja muy grande y muy brillante (pág. 704)

supernova an exploding star that increases in brightness many thousands of times (p. 711)

supernova/supernova estrella en explosión que aumenta su brillo muchos miles de veces (pág. 711)

superposition, law of a law that states that in any undeformed sequence of sedimentary rocks, each bed is older than the layers above and younger than the layers below. (p. 340)

superposition, law of/ley de superposición ley que enuncia que en cualquier secuencia no deformada de rocas sedimentarias, cada capa es más antigua que los estratos de arriba y más joven que los estratos de abajo (pág. 340)

supersaturated air the condition of air that is more highly concentrated than is normally possible under given temperature and pressure conditions; When describing humidity, it refers to a relative humidity that is greater than 100 percent. (p. 521)

Glossary

supersaturated air/aire sobresaturado condición del aire con un nivel de concentración mucho más alto de lo que es normalmente posible bajo ciertas condiciones de temperatura y presión; al describir la humedad, se refiere a una humedad relativa que es mayor que el 100 por ciento (pág. 521)

surface current movement of water that flows horizontally in the upper part of the ocean's surface (p. 448)

surface current/corriente superficial movimiento de agua que fluye horizontalmente en la parte superior de la superficie oceánica (pág. 448)

surface wave a seismic wave that travels along the surface of Earth (p. 223)

surface wave/onda superficial onda sísmica que viaja a lo largo de la superficie de la Tierra (pág. 223)

syncline a linear downfold in sedimentary strata; the opposite of anticline (p. 310)

syncline/sinclinal pliegue lineal en el estrato sedimentario; lo opuesto de anticlinal (pág. 310)

system any size group of interacting parts that form a complex whole (p. 18)

system/sistema grupo de cualquier tamaño de partes relacionadas que forman un conjunto complejo (pág. 18)

T

talus an accumulation of rock debris at the base of a cliff (p. 127)

talus/talud acumulación de restos de roca al pie de un acantilado (pág. 127)

temperate zone region located between 23.5° and 66.5° north and south of the equator; The sun's rays strike Earth at a smaller angle in the temperate zone than near the equator. (p. 589)

temperate zone/zona templada región situada entre 23.5° y 66.5° norte y sur del ecuador; los rayos de Sol llegan a la Tierra formando un ángulo más pequeño en la zona templada que en el ecuador. (pág. 589)

temperature a measure of the average kinetic energy of individual atoms or molecules in a substance (p. 483)

temperature/temperatura medición de la energía

cinética promedio de los átomos o moléculas individuales en una sustancia (pág. 483)

temperature inversion a layer of limited depth in the atmosphere of limited depth where the temperature increases rather than decreases with height (p. 514)

temperature inversion/inversión de temperatura capa de poca densidad en la atmósfera de poca densidad donde la temperatura aumenta con la altura en vez de descender (pág. 514)

terrane a crustal block bounded by faults, whose geologic history is distinct from the histories of adjoining crustal blocks (p. 322)

terrane/terreno formación de rocas de la corteza rodeada de fallas, cuya historia geológica es distinta a la historias de las formaciones de rocas lindantes (pág. 322)

terrestrial planet any of the Earth-like planets, including Mercury, Venus, Mars, and Earth (p. 645)

terrestrial planet/planeta terrestre cualquiera de los planetas similares a la Tierra, como Mercurio, Venus, Marte y Tierra (pág. 645)

terrigenous sediment seafloor sediment derived from eroded rocks on land (p. 408)

terrigenous sediment/sedimento terrígeno sedimento en el fondo oceánico que se deriva de la erosión de rocas en la tierra (pág. 408)

theory a well-tested and widely accepted view that explains certain observable facts (p. 24)

theory/teoría perspectiva comprobada y generalmente aceptada que explica ciertos hechos observables (pág. 24)

thermocline a layer of water in which there is a rapid change in temperature with depth (p. 424)

thermocline/termoclina capa de agua en la cual se observa un rápido cambio de temperatura con la profundidad (pág. 424)

thermosphere the region of the atmosphere immediately above the mesosphere and characterized by increasing temperatures due to absorption of very short-wave solar energy by oxygen (p. 480)

thermosphere/termosfera capa de la atmósfera inmediatamente superior a la mesosfera y que se caracteriza por un aumento de temperatura

- causado por la absorción de energía solar de ondas muy cortas por el oxígeno (pág. 480)
- thrust fault** a reverse fault with a dip less than 45°, normally about 10–15° (p. 312)
- thrust fault/falla de empuje** falla inversa con una depresión de menos de 45°, normalmente entre 10° y 15° (pág. 312)
- thunderstorm** a storm produced by a cumulonimbus cloud and always accompanied by lightning and thunder; It is of relatively short duration and usually accompanied by strong wind gusts, heavy rain, and sometimes hail. (p. 571)
- thunderstorm/tormenta eléctrica** tormenta causada por una nube cumulonimbo y siempre acompañada de relámpagos y truenos; es de duración relativamente corta y va generalmente acompañada de fuertes ráfagas de viento, precipitaciones y a veces granizo (pág. 571)
- tidal range** the difference in height between successive high and low tides (p. 459)
- tidal range/rango de marea** diferencia en altura entre sucesivas mareas altas y bajas (pág. 459)
- tide** daily change in the elevation of the ocean surface (p. 458)
- tide/marea** cambios diarios en el ascenso de la superficie oceánica (pág. 458)
- till** sediment of different sizes deposited directly by a glacier (p. 194)
- till/tillita** sedimentos de diferentes tamaños depositados directamente por un glaciar (pág. 194)
- topographic map** a map that represents Earth's surface in three dimensions; It shows elevation, distance, directions, and slope angles. (p. 14)
- topographic map/mapa topográfico** mapa que representa la superficie de la Tierra en tres dimensiones; muestra elevación, distancia, direcciones y ángulos de inclinación (pág. 14)
- tornado** a small, very intense cyclonic storm with exceedingly high winds, most often produced along cold fronts in conjunction with severe thunderstorms (p. 573)
- tornado/tornado** pequeña tormenta ciclónica pero sumamente intensa, con vientos de gran velocidad, que a menudo ocurre a lo largo de frentes fríos acompañados de poderosas tormentas eléctricas (pág. 573)
- trade winds** two belts of winds that blow almost constantly from easterly directions and are located on the north and south sides of the subtropical highs (p. 541)
- trade winds/vientos alisios** dos cinturones de viento que soplan casi constantemente desde la dirección del este y que se encuentran al norte y al sur de los centros de las altas presiones subtropicales (pág. 541)
- transform fault boundary** a boundary in which two plates slide past each other without creating or destroying lithosphere (p. 255)
- transform fault boundary/límite de falla de transformación** límite en el que dos placas se deslizan a lo largo de la falla sin generar o destruir litosfera (pág. 255)
- travertine** a form of limestone that is deposited by hot springs or as a cave deposit (p. 177)
- travertine/travertino** tipo de piedra caliza que es depositada por fuentes termales o que forma parte del depósito de cuevas (pág. 177)
- trench** a surface feature in the seafloor produced by the descending plate during subduction (p. 261)
- trench/fosa** depresión en el fondo oceánico causada por la placa descendiente durante la subducción (pág. 261)
- tributary** a stream that empties itself into another stream (p. 162)
- tributary/afluente** corriente de agua que desemboca en otra corriente (pág. 162)
- trophic level** a nourishment level in a food chain; Plant and algae producers constitute the lowest level, followed by herbivores and a series of carnivores at progressively higher levels. (p. 436)
- trophic level/nivel trófico** nivel de alimentación en la cadena alimenticia; los productores como las plantas y las algas forman parte del nivel más bajo, seguidos de herbívoros y una serie de carnívoros en los niveles superiores progresivos (pág. 436)
- tropical wet and dry climate** a climate that is transitional between the wet tropics and the subtropical steppes (p. 593)

tropical wet and dry climate/clima tropical seco y húmedo clima de transición entre los húmedos trópicos y las estepas subtropicales (pág. 593)

tropical zone region between 23.5° north (the tropic of Cancer) and 23.5° south (the tropic of Capricorn) of the equator; The sun's rays are most intense and the temperatures are always warm. (p. 589)

tropical zone/zona tropical región entre 23.5° norte (trópico de Cáncer) y 23.5° sur (trópico de Capricornio) del ecuador; los rayos solares son de mayor intensidad y la temperatura es siempre cálida (pág. 589)

troposphere the lowermost layer of the atmosphere; It is generally characterized by a decrease in temperature with height. (p. 480)

troposphere/troposfera capa más inferior de la atmósfera; generalmente se caracteriza por un decrecimiento de la temperatura con la altura (pág. 480)

tsunami the Japanese word for a seismic sea wave (p. 230)

tsunami/tsunami palabra japonesa con la que se denomina a una ola sísmica marina (pág. 230)

turbidity current a downslope movement of dense, sediment-laden water created when sand and mud on the continental shelf and slope are dislodged and thrown into suspension (p. 403)

turbidity current/corriente de turbidez movimiento descendente de una densa masa de agua cargada de sedimentos que ocurre cuando la arena y el barro de la plataforma y el talud continental se desplazan y quedan en suspensión (pág. 403)

U

ultramafic igneous rock composed mainly of iron and magnesium-rich minerals (p. 73)

ultramafic/ultramáfica roca ígnea compuesta principalmente de hierro y minerales ricos en magnesio (pág. 73)

unconformity a surface that represents a break in the rock record, caused by erosion or lack of deposition (p. 341)

unconformity/discordancia superficie que representa una interrupción en la evolución de la

roca, causada por erosión o por falta de deposición (pág. 341)

uniformitarianism the concept that processes that have shaped Earth in the past are essentially the same as those operating today (p. 337)

uniformitarianism/uniformismo principio que dice que los procesos que dieron forma a la Tierra en el pasado geológico son esencialmente los mismos que ocurren en la actualidad (pág. 337)

uplifted mountain a circular or an elongated structure formed by uplifting of the underlying basement rock (p. 316)

uplifted mountain/montaña formada por elevación estructura circular o elongada formada por el levantamiento de rocas subyacentes del basamento (pág. 316)

upwelling the rising of cold water from deeper layers to replace warmer surface water that has been moved away (p. 450)

upwelling/afloramiento movimiento ascendente de aguas frías desde las profundidades del mar para reemplazar las aguas más calidas de la superficie que han sido desplazadas (pág. 450)

V

valley glacier a glacier confined to a mountain valley, which in most instances had previously been a stream valley; also known as an alpine glacier (p. 189)

valley glacier/glaciar de valle glaciar localizado en un valle de montaña, que en varias etapas anteriores había sido un valle fluvial; también conocido como glaciar alpino (pág. 189)

vent an opening in the surface of Earth through which molten rock and gases are released (p. 281)

vent/chimenea abertura en la superficie de la Tierra a través de la cual salen roca derretida y gases (pág. 281)

ventifact a cobble or pebble polished and shaped by the sandblasting effect of wind (p. 204)

ventifact/ventifacto canto o guijarro pulido y esculpido por el efecto abrasivo del viento (pág. 204)

viscosity a measure of a fluid's resistance to flow (p. 281)

viscosity/viscosidad una medida que indica la resistencia de un líquido al fluir (pág. 281)

volcanic island arc a chain of volcanic islands generally located a few hundred kilometers from a trench where subduction of one oceanic slab beneath another is occurring (p. 262)

volcanic island arc/arco de islas volcánicas una cadena de islas volcánicas generalmente ubicada a unos cientos de kilómetros de una fosa donde está ocurriendo la subducción de una placa oceánica debajo de otra (pág. 262)

volcano a mountain formed of lava and/or pyroclastic material (p. 283)

volcano/volcán montaña formada de lava y/o material piroclástico (pág. 283)

W

warm front a front along which a warm air mass overrides a retreating mass of cooler air (p. 565)

warm front/frente cálido zona frontal de una masa de aire cálido que avanza para reemplazar una masa de aire frío que retrocede (pág. 656)

water cycle the constant movement of water among the oceans, the atmosphere, geosphere, and the biosphere (p. 158)

water cycle/ciclo del agua movimiento constante del agua en los océanos, la atmósfera, la geosfera y la biosfera (pág. 283)

water table the upper level of the saturated zone of groundwater (p. 171)

water table/nivel freático nivel superior de la zona de saturación de las aguas subterráneas (pág. 171)

wave height the vertical distance between the trough and crest of a wave (p. 456)

wave height/altura de la ola distancia vertical entre el valle y la cresta de una ola (pág. 456)

wavelength the horizontal distance separating successive crests or troughs (p. 456)

wavelength/longitud de la ola distancia horizontal que separa crestas o valles sucesivos (pág. 456)

wave period the time interval between the passage of successive crests at a stationary point (p. 456)

wave period/período de la ola el intervalo entre el paso de crestas sucesivas por un mismo punto (pág. 462)

wave refraction the process by which the portion of a wave in shallow water slows, causing the wave to bend and tend to align itself with the underwater contours (p. 462)

wave refraction/refracción de la ola proceso en que la porción de una ola en aguas poco profundas disminuye su velocidad, lo cual causa que la ola se rompa y tienda a alinearse con las curvas de la superficie submarina (pág. 462)

weathering the disintegration and decomposition of rock at or near Earth's surface (p. 68)

weathering/meteorización la desintegración y descomposición de una roca en o cerca de la superficie de la Tierra (pág. 68)

well an opening bored into the zone of saturation (p. 173)

well/pozo abertura excavada dentro de la zona de saturación (pág. 173)

westerlies the dominant west-to-east motion of the atmosphere that characterizes the regions on the poleward side of the subtropical highs (p. 541)

westerlies/vientos del oeste el movimiento dominante de oeste a este de la atmósfera que caracteriza las regiones en el lado polar de las zonas de alta presión subtropicales (pág. 541)

wet adiabatic rate the rate of adiabatic temperature change in saturated air; The rate of temperature change is variable, but it is always less than the dry adiabatic rate. (p. 511)

wet adiabatic rate/tasa adiabática húmeda la tasa del cambio de temperatura adiabática en el aire saturado; la tasa de cambio de temperatura es variable, pero siempre es menor que la tasa adiabática seca (pág. 511)

wet tropical climate a climate with high temperatures and high annual precipitation (p. 593)

wet tropical climate/clima tropical húmedo clima de altas temperaturas y alta precipitación anual (pág. 593)

white dwarf a star that has exhausted most or all of its nuclear fuel and has collapsed to a very small size, believed to be near its final stage of evolution (p. 712)

white dwarf/enana blanca estrella que ha agotado todo o casi todo su combustible nuclear y que se desvanece hasta alcanzar un tamaño pequeño,

Glossary

que se considera el estado final de su evolución (pág. 712)

winter solstice the solstice that occurs on December 21 or 22 in the Northern Hemisphere and on June 21 or 22 in the Southern Hemisphere (p. 482)

winter solstice/solsticio de invierno el solsticio que tiene lugar el 21 ó 22 de diciembre en el hemisferio norte, y el 21 ó 22 de junio en el hemisferio sur (pág. 482)

Z

zone of saturation zone where all open spaces in sediment and rock are completely filled with water (p. 171)

zone of saturation/zona de saturación zona donde todos los espacios abiertos en el sedimento y la roca están completamente llenos de agua (pág. 171)

zooplankton animal plankton (p. 429)

zooplankton/zooplancton plancton animal (pág. 429)

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