Glencoe Science

Chapter Resources

The Nature of Science

Includes:

Reproducible Student Pages

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Reproducible Student Pages

Reproducible Student Pages

■ Hands-On Activities

■ Meeting Individual Needs

Extension and Intervention

■ Assessment

■ Transparency Activities

Hands-On Activities

TRY AT HOME Mini LAB

Classifying Parts of a System

Procedure

Think about how your school's cafeteria is run. Consider the physical structure of the cafeteria. How many people run it? Where does the food come from? How is it prepared? Where does it go? What other parts of the cafeteria system are necessary?

Data and Observations

Use the space below to sketch the physical structure of your cafeteria or to organize your ideas.

Analysis

Classify the parts of your school cafeteria's system as structures, cycles, or processes.

TRY AT HOME Mini LAB

Forming a Hypothesis

Procedure

1. Fill a large **pot** with **water.** Place an **unopened can of diet soda** and an **unopened can of regular soda** into the pot of water and observe what each can does.
2. In the table in the Data and Observations section, make a list of the possible explanations for your observation. Select the best explanation and write a hypothesis.
3. Read the nutritional facts on the back of each can and compare their ingredients.
4. Revise your hypothesis based on this new information.

Data and Observations

Hypothesis on Why Cans Behave Differently in Water	
Observations	
Possible explanations	
Best explanation	
Hypothesis	
Comparison of ingredients	
Revised hypothesis	

Analysis

1. What did you observe when you placed the cans in the water?

2. How did the nutritional information on the cans change your hypothesis?

3. Infer why the two cans behaved differently in the water.

Mini LAB Thinking Like a Scientist

Procedure

1. Pour 15 mL of **water** into a **test tube.**
2. Slowly pour 5 mL of **vegetable oil** into the test tube.
3. Add two drops of **food coloring** and observe the liquid for 5 min.

Data and Observations

	Observation of Water in a Test Tube
After the addition of oil	
After the addition of food coloring	
After 5 min	

Analysis

1. Record your observations of the test tube's contents before and after the oil and the food coloring were added to it.

2. Infer a scientific explanation for your observations.

LAB What is the right answer?

Lab Preview

Directions: *Answer these questions before you begin the Lab.*

1. Why does this lab require a sharp objects safety symbol?

____

2. What must you do before you construct your model?

____

____

____

____

Scientists sometimes develop more than one explanation for observations. Can more than one explanation be correct? Do scientific explanations depend on judgment?

Real-World Question

Can more than one explanation apply to the same observation?

Materials

cardboard mailing tubes
**empty shoe boxes*
length of rope
scissors
**Alternate materials*

Goals

- **Make a hypothesis** to explain an observation.
- **Construct** a model to support your hypothesis.
- **Refine** your model based on testing.

Safety Precautions

WARNING: *Be careful when punching holes with sharp tools.*

Procedure

1. You will be shown a cardboard tube with four ropes coming out of it, one longer than the others. Your teacher will show you that when any of the three short ropes—A, C, or D—are pulled, the longer rope, B, gets shorter. Pulling on rope B returns the other ropes to their original lengths.
2. Make a hypothesis as to how the teacher's model works.
3. In the Data and Observations section, **sketch** a model of a tube with ropes based on your hypothesis. Check your sketch to be sure that your model will do what you expect. Revise your sketch if necessary. Using a cardboard tube and two lengths of rope, build a model according to your design. Test your model by pulling each of the ropes. If it does not perform as planned, modify your hypothesis and your model to make it work like your teacher's model.

LAB (continued)

Data and Observations

Conclude and Apply

1. **Compare** your model with those made by others in your class.

2. Can more than one design give the same result? Can more than one explanation apply to the same observation? Explain.

3. Without opening the tube, can you tell which model is exactly like your teacher's?

Communicating Your Data

Make a display of your working model. Include sketches of your designs. **For more help, refer to the Science Skill Handbook.**

LAB

Identifying Parts of an Investigation

Lab Preview

Directions: *Answer these questions before you begin the Lab.*

1. What is the experiment you are examining in this lab?

____

2. What will you be graphing in this lab?

____

____

Science investigations contain many parts. How can you identify the various parts of an investigation? In addition to variables and constants, many experiments contain a control. A control is one test, or trial, where everything is held constant. A scientist compares the control trial to the other trials.

Real-World Question

What are the various parts of an experiment to test which fertilizer helps a plant grow best?

Materials

description of fertilizer experiment

Goals

- **Identify** parts of an experiment.
- **Identify** constants, variables, and controls in the experiment.
- **Graph** the results of the experiment and draw appropriate conclusions.

Procedure

1. **Read** the description of the fertilizer experiment.
2. **List** factors that remained constant in the experiment.
3. **Identify** any variables in the experiment.
4. **Identify** the control in the experiment.
5. **Identify** one possible hypothesis that the gardener could have tested in her investigation.
6. **Describe** how the gardener went about testing her hypothesis using different types of fertilizers.
7. **Graph** the data that the gardener collected in a line graph.

A gardener was interested in helping her plants grow faster. When she went to the nursery, she found three fertilizers available for her plants. One of those fertilizers, fertilizer A, was recommended to her. However, she decided to conduct a test to determine which of the three fertilizers, if any, helped her plants grow fastest. The gardener planted four seeds, each in a separate pot. She used the same type of pot and the same type of soil in each pot. She fertilized one seed with fertilizer A, one with fertilizer B, and one with fertilizer C. She did not fertilize the fourth seed. She placed the four pots near one another in her garden. She made sure to give each plant the same amount of water each day. She measured the height of the plants each week and recorded her data. After eight weeks of careful observation and record-keeping, she had the following table of data.

LAB (continued)

Plant Height (cm)				
Week	Fertilizer A	Fertilizer B	Fertilizer C	No Fertilizer
1	0	0	0	0
2	2	4	1	1
3	5	8	5	4
4	9	13	8	7
5	14	18	12	10
6	20	24	15	13
7	27	31	19	16
8	35	39	22	20

Analyze Your Data

1. **Describe** the results indicated by your graph. What part of an investigation have you just done?

   ____

2. **Infer** Based on the results in the table and your graph, which fertilizer do you think the gardener should use if she wants her plants to grow the fastest? What part of an investigation have you just done?

   ____

3. **Define** Suppose the gardener told a friend who also grows these plants about her results.

   What is this an example of? ______________________________

Conclude and Apply

1. **Interpret Data** Suppose fertilizer B is much more expensive than fertilizers A and C. Would this affect which fertilizer you think the gardener should buy? Why or why not?

   ____

2. **Explain** Does every researcher need the same hypothesis for an experiment? What is a second possible hypothesis for this experiment (different from the one you wrote in step 5 in the Procedure section)?

   ____

3. **Explain** if the gardener conducted an adequate test of her hypothesis.

   ____

Communicating Your Data

Compare your conclusions with those of other students in your class. **For more help, refer to the Science Skill Handbook.**

LAB 1 Laboratory Activity

Solving a Problem with a Scientific Method

A method by which a scientist solves a problem is called a scientific method. This method usually includes observation, hypothesis formation, experimentation, and interpretation. Scientific methods are often compared to the procedures a detective uses in solving a crime or mystery. The following investigation creates a scientific problem for you and asks you to solve it. You will use a scientific method in attempting to solve the problem.

Strategy

You will use a scientific method to solve whether flasks A and B contain similar liquids.
You will make careful observations.
You will record accurate experimental results.
You will use your data as a basis for deciding if the two liquids are similar or different.

Materials

2 Erlenmeyer flasks containing liquids
2 stoppers (to fit flasks)
beaker
clock or watch with second hand

Procedure

Part A—Observation

WARNING: *Do not dispose of these materials in the sink or trash can. Do not taste, eat, or drink any materials used in the lab. Inform your teacher if you come in contact with any chemicals.*

1. Examine the two flasks. **DO NOT** remove the stoppers and **DO NOT** shake the contents.
2. Notice that the flasks have been labeled A and B.
3. Record in Table 1 two or three similarities and differences between the two flasks.
   a. Do you think both flasks contain the same liquid? Explain.

   ____

   b. Is your hypothesis to question **a** based on experimentation or observation? ____________

   c. Would scientists form a hypothesis about answers to questions, or would they experiment first?

   ____

   d. Do both flasks contain exactly the same amount of liquid? ____________

Data and Observations

Table 1

Similarities	Differences

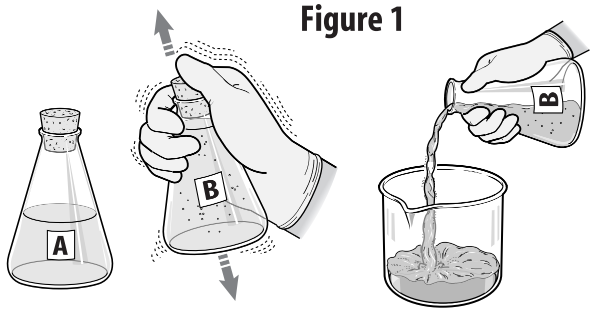
Laboratory Activity 1 (continued)

Part B—Experimentation

Experiment 1: What happens if you shake the liquids?

Procedure

Figure 1



1. Give each flask *one hard shake using an up-and-down motion of your hand.* Make sure your thumb covers the stopper as you shake. Use Figure 1 as your guide.
2. Observe each flask carefully.
3. Record your observations in Table 2. Again, look for similarities and differences.
   a. After shaking the flasks, do you think they contain different liquids? ____________________
   b. What was present in flask A that might have been responsible for the change in the liquid?
   ____

Data and Observations

Table 2

Experiment 1	
Similarities	**Differences**

Experiment 2: What happens if you remove some of the liquid in flask B?

Procedure

1. Remove the stopper from flask B and pour out half of the contents into a beaker or other suitable container. See Figure 1. Make sure the amount of liquid remaining in flask B is equal to the amount of liquid in flask A.
2. Replace the stopper. Give both flasks *one hard shake using an up-and-down motion of your hand.* Hold the stopper in place while shaking.
3. Observe each flask carefully.
4. Record any similarities or differences observed in Table 3.
   a. Do both flasks now appear to contain the same liquid? ____________________
   b. What may have been added to flask B that was not present before? ____________________

Data and Observations

Table 3

Experiment 2	
Similarities	**Differences**

Laboratory Activity 1 (continued)

Experiment 3: What happens if you shake the flasks more than once?

Procedure

1. Give both flasks *one hard shake using an up-and-down motion.*
2. Note the exact time in *seconds* after shaking that it takes for each liquid to return to its original condition. Record the time in Table 4 under 1 shake, Trial 1.
3. Give both flasks *two hard shakes using an up-and-down motion.*
4. Again record in Table 4 the time it takes for the liquids to return to their original conditions. Record these times under 2 shakes, Trial 1.
5. Give both flasks *three hard shakes using an up-and-down hand motion.*
6. Record in Table 4 under 3 shakes, Trial 1, the time it takes for them to return to their original conditions.
   - **a.** After one shake, are the two liquids generally behaving in a similar way? That is, is the time needed for flasks A and B to return to their original conditions about the same? ___________
   - **b.** After two and three shakes, are flasks A and B generally behaving in a way similar to each other? ___________
7. Look at your data in Table 4.
   - **a.** As the number of shakes increases from one to three, does flask A show an increase or decrease in time needed to return to its original condition? ___________
   - **b.** Does flask B show a similar change? ___________
8. Run two more trials for each part of Experiment 3. Be sure to keep track of the amount of time needed for the liquids to return to their original conditions. Record the results of these trials as Trials 2 and 3 in Table 4.
9. Do three trials give better evidence than one trial in helping you to determine
   - **a.** the contents of flasks A and B? ___________
   - **b.** the effects of shaking on flasks A and B? ___________

Data and Observations

Table 4

Experiment 3									
Time to Return to Original Condition (s)									
	1 Shake			2 Shakes			3 Shakes		
Trial	1	2	3	1	2	3	1	2	3
Flask A									
Flask B									

Laboratory Activity 1 (continued)

Questions and Conclusions

Questions 1 through 4 should help you to interpret what you have observed. Interpretations are reasonings based on observations and experiments. They are usually the next step in a scientific method.

1. On the basis of your first observations in Part A, could you decide if both flasks contained the same liquid? ____________________
2. After performing Experiment 1, could you decide if both flasks contained the same liquid?
____
3. Which experiment or experiments may have helped you to decide that the liquids in flasks A and B were similar or different? Explain.
____
4. Besides the liquid itself, what else seems to be needed in order for the liquid to change color?
____

Questions 5 through 7 should help you to form a hypothesis. In a hypothesis, all facts are joined in an attempt to explain what has been observed.

5. Explain why flask B did not change color when shaken in Experiment 1.
____
6. Why must the liquids in the half-filled flasks be shaken in order to produce a color change?
____
7. Did more shaking increase the amount of time needed for the liquids in flasks A and B to change back to their original color? Why or why not?
____
8. Why is experimenting a better method of problem solving than guessing?
____
9. What is meant by the phrase "solving a problem by using scientific methods"?
____

Strategy Check

_______ Can you use a scientific method to solve whether or not flasks A and B contain similar liquids?

_______ Can you make careful observations?

_______ Can you record accurate experimental results?

_______ Can you use your data as a basis for deciding if the two liquids are similar or different?

Name Date Class

LAB 2 Laboratory Activity

Modeling the Weather

Consider weather models as examples of scientific modeling. Scientists constantly gather weather data and use them in different models for different purposes. Sometimes they organize the information historically to show what the weather has been like in the past. This might help farmers predict when the temperature will be right to plant or harvest crops. Scientists use complex computer models to help predict when hurricanes will form, what path they will follow, when they will hit land, and how powerful they will be. Other weather models—for example, weather maps in daily newspapers and weather forecasts on television—present a lot of information in a way that ordinary people can understand.

Strategy

You will observe some different symbols on a weather map.
You will compare weather models for the type of information included.
You will infer the weather in your area and make a weather model of your own.

Materials

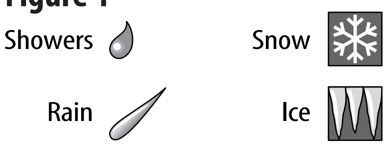
colored pencils
weather pages from newspapers
information on today's local weather

Procedure

Part A—Understanding a Weather Model

1. Look at the weather map in Figure 6. Find the state or province where you live and draw a small star near your city or town. Add the name of your hometown to the map. Now look at the shaded temperature bands and the key that explains what temperatures the shading represents. Determine the temperature range for your city or town, and write the name of your hometown next to the appropriate temperature range in Table 1 in the Data and Observations section.
2. Choose three other cities, one city from each temperature band. Draw a small star near the name of each city you select, and record the names of the cities in the appropriate space in Table 1.
3. Examine the symbols in Figure 1, which are used to show different types of precipitation.

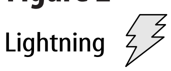
Figure 1



Find each of these symbols on the weather map. Determine if there is any precipitation in your hometown or in the cities you chose, and identify the type of precipitation for each city. Record this information in Table 1.

4. The symbol for lightning occurs in only one place on the weather map. Locate the symbol. If it occurs near any of your cities, add this information to Table 1 under *Precipitation.*

Figure 2



5. Study the symbols that show whether the day was sunny or cloudy in Figure 3.

Figure 3

Laboratory Activity 2 (continued)

Look at the weather map to see which parts of the continent were sunny and which were cloudy. Add the information on your chosen cities to the table.

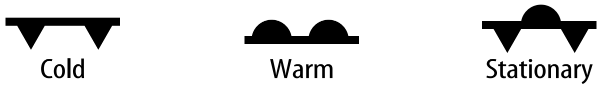
6. Find the areas of low and high pressure. These are shown by the letters *L* and *H* in circles as shown in Figure 4.

Figure 4

Circle any high pressure area in red. Then circle any low pressure area in blue.

7. The boundaries between warm and cold masses of air are called fronts. There are three types of fronts: warm, cold, and stationary. Refer to Figure 5 to identify the symbols used for each type of front.

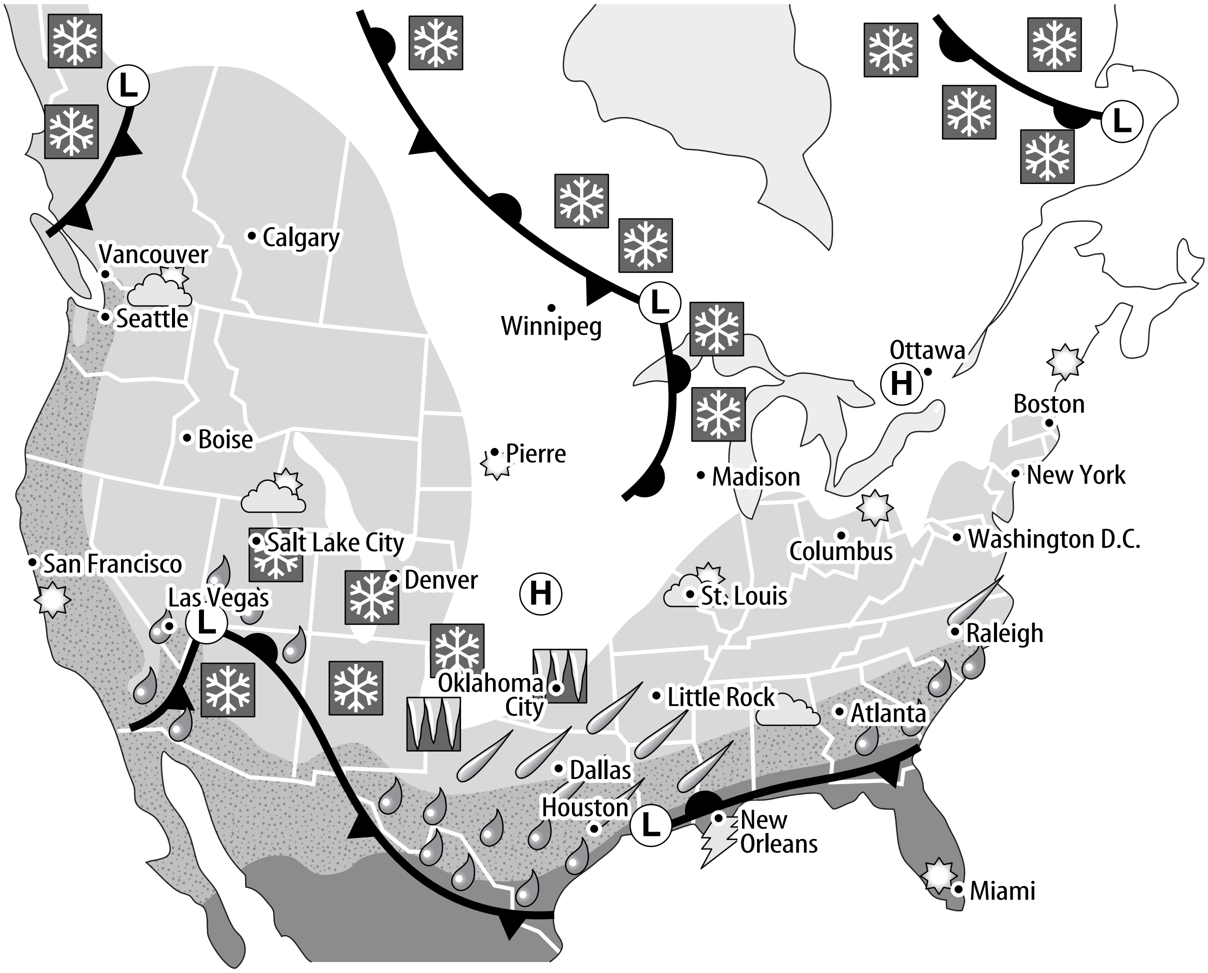
Figure 5



Find a warm front on the weather map, and highlight it in yellow. Highlight a cold front in green.

8. The semicircles and triangles on the symbols for the fronts point in the direction the front is moving. A stationary front does not move, so the symbols appear on both sides of one line. Draw arrows to indicate the direction of the warm and cold fronts on the weather map.

Figure 6



Laboratory Activity 2 (continued)

Part B—Comparing Weather Models

1. Look at the weather pages of several newspapers. In Table 2 in the Data and Observations section, list two types of weather models presented in these pages.
2. Study the different information presented in the different models. Note the types of information presented in each of the two models you selected. Circle any information that was not included in the national weather map you studied above.
3. Determine who might use the information presented in each model you chose. For example, farmers might be interested in information on rainfall and boaters or fishers might want to track water temperatures. Add this information to Table 2.

Part C—Creating a Weather Model

1. On a separate sheet of paper, create a key for temperature ranges to be used on a model for today's local (city and state) weather. Decide how wide a temperature range you would like to show.
2. Use local weather information to create a weather model for today's local weather. Your model does not have to be similar to the one shown in Figure 6. Include all of the information you have. You can get information from local weather reports in the newspaper; on radio, television, or the Internet; and by observing the local conditions. Include all the information you have available in your weather model.
3. Create symbols and a key to interpret any new information. Be sure every symbol you used in your model is identified in your key.

Data and Observations

Table 1

City	Temperature	Precipitation	Cloud Cover
	below 30° F		
	30–49° F		
	50–69° F		
	70° F and above		

Table 2

Type of Model	Type of User

Laboratory Activity 2 (continued)

Questions and Conclusions

1. Refer to the weather map in Figure 6 to answer the following questions. Does the model give you enough information to identify what the highest and lowest temperatures in the United States are on this day and where will they occur? Explain.

2. What season of the year does this weather map represent? What information did you use to help you determine the season?

3. Does the model give you enough information to be certain which month the weather map represents? Is it the model or the weather patterns that limits how specific you can be?

4. Which symbols used on the weather map were easy enough to understand that almost anyone could interpret their meaning? Which symbols do you think some people might not understand?

5. Considering the symbols used and the information included in this model, who do you think might use this model?

6. Refer to the weather models in the newspapers to answer the following questions. Is temperature shown in the same way on all of the models? Explain any differences.

7. Are the weather models predictions or historical records?

Strategy Check

_______ Can you observe the different symbols on a weather map?

_______ Can you compare weather models for the type of information they include?

_______ Can you infer the weather of your own region and make a weather model of your own?

Name Date Class

FOLDABLES Reading & Study Skills

The Nature of Science

Directions: *Use this page to label your Foldable at the beginning of the chapter.*

Science

Know

Want

Learned

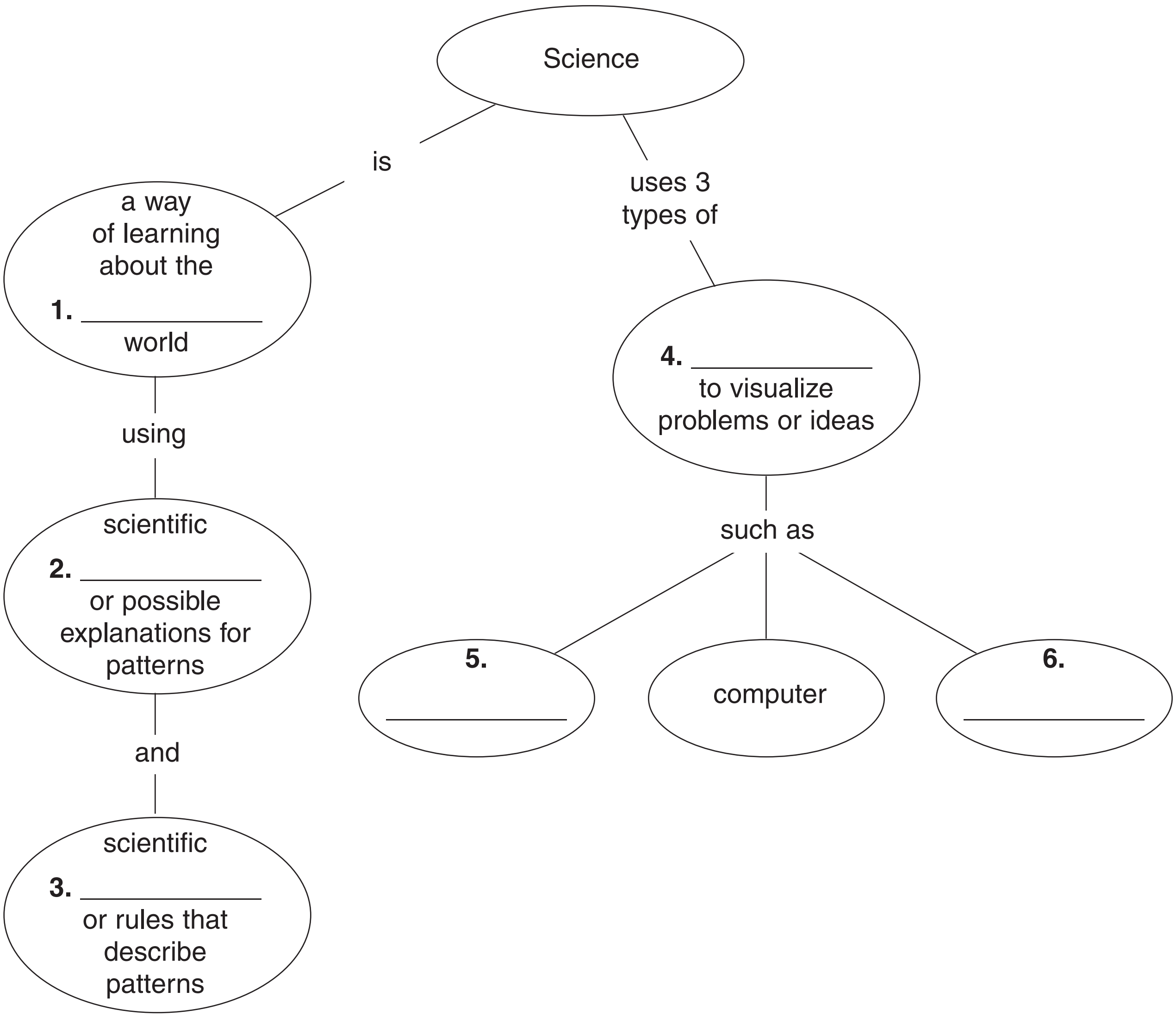
Meeting Individual Needs

Directed Reading for Content Mastery

Overview
The Nature of Science

Directions: *Complete the concept map using the terms listed below.*

models	**theories**	**physical**
laws	**idea**	**natural**

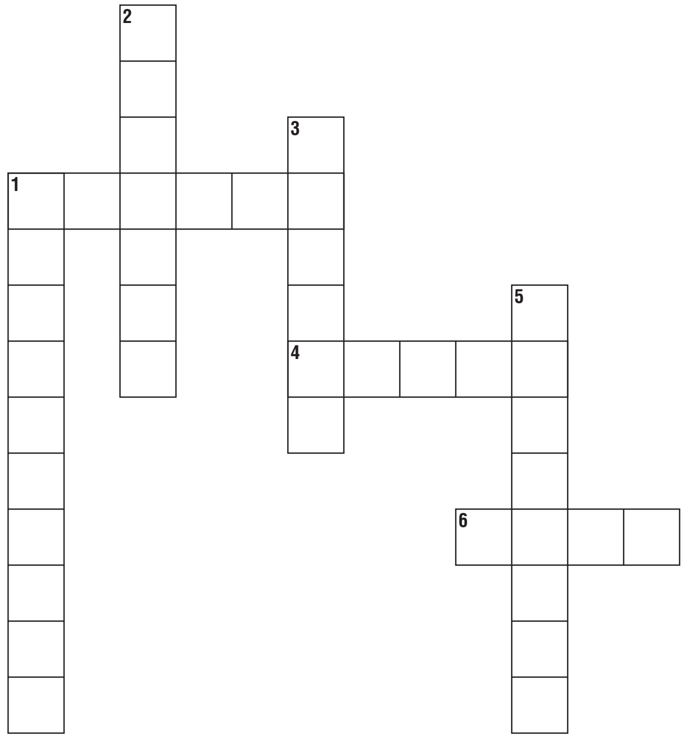


Meeting Individual Needs

Directed Reading for Content Mastery

Section 1 ▪ What is science?

Directions: *Use the clues below to complete the crossword puzzle.*



Across

1. A scientific ______ is a possible explanation for a pattern observed repeatedly in the natural world.

4. The study of Earth systems and the systems in space is called ______ science.

6. The study of living systems and the way they interact is called ______ science.

Down

1. The practical use of science; applied science

2. A way of learning more about the natural world

3. A collection of structures, cycles, and processes that relate to and interact with one another

5. The study of matter and energy is ______ science.

Directed Reading for Content Mastery

Section 2 ▪ Science in Action
Section 3 ▪ Models in Science
Section 4 ▪ Evaluating Scientific Explanation

Directions: *Draw a line to connect the description on the left with the correct term on the right.*

1. a model built using computer software	physical model
2. a model you can see and touch	chart
3. ways scientists solve problems	scientific methods
4. using knowledge and thinking skills to decide if you agree with an explanation	variables
5. a variable that remains the same	constant
6. a prediction that can be tested	controlled experiment
7. an explanation based on observations	inference
8. concepts that describe how someone thinks about something in the natural world	computer model
9. factors that can be changed in an experiment	hypothesis
10. an experiment where one factor is changed, and its effects on another factor are observed	idea model
11. a way to organize scientific data from an experiment	independent laboratory
12. a laboratory not hired by or related in any way to a company that is selling a product	critical thinking
13. wearing an apron and goggles in the laboratory	safety habit

Directed Reading for Content Mastery

Key Terms
The Nature of Science

Directions: *Use the terms in the list below to fill in the blanks below.*

scientific theory	**observing**	**science**
law	**systems**	**life science**
Earth science	**energy**	**technology**

Anyone who tries to learn something about things around them is a scientist. **1.** ____________________ is a way of learning more about the natural world. This learning process often begins by **2.** ____________________, or watching something in nature, then asking questions about it.

A **3.** ____________________ is a possible explanation for those patterns that a scientist might see when observing nature. Theories are usually supported by the results from many investigations. When a pattern in nature is observed time and time again, it becomes a scientific **4.** ____________________, and it stands until someone makes an observation that does not fit the pattern.

Many scientists are interested in studying **5.** ____________________, or collections of structures, cycles, and processes that relate to and interact with one another. The study of living systems is called **6.** ____________________. Scientists who study living systems often ask questions like "How do vaccines help prevent disease?" or "What kind of organisms live in a swamp?" Other scientists study **7.** ____________________, which is the study of Earth and the systems in space. These scientists might study asteroids, clouds, or volcanoes. Still other scientists study the physical sciences, which study matter and **8.** ____________________.

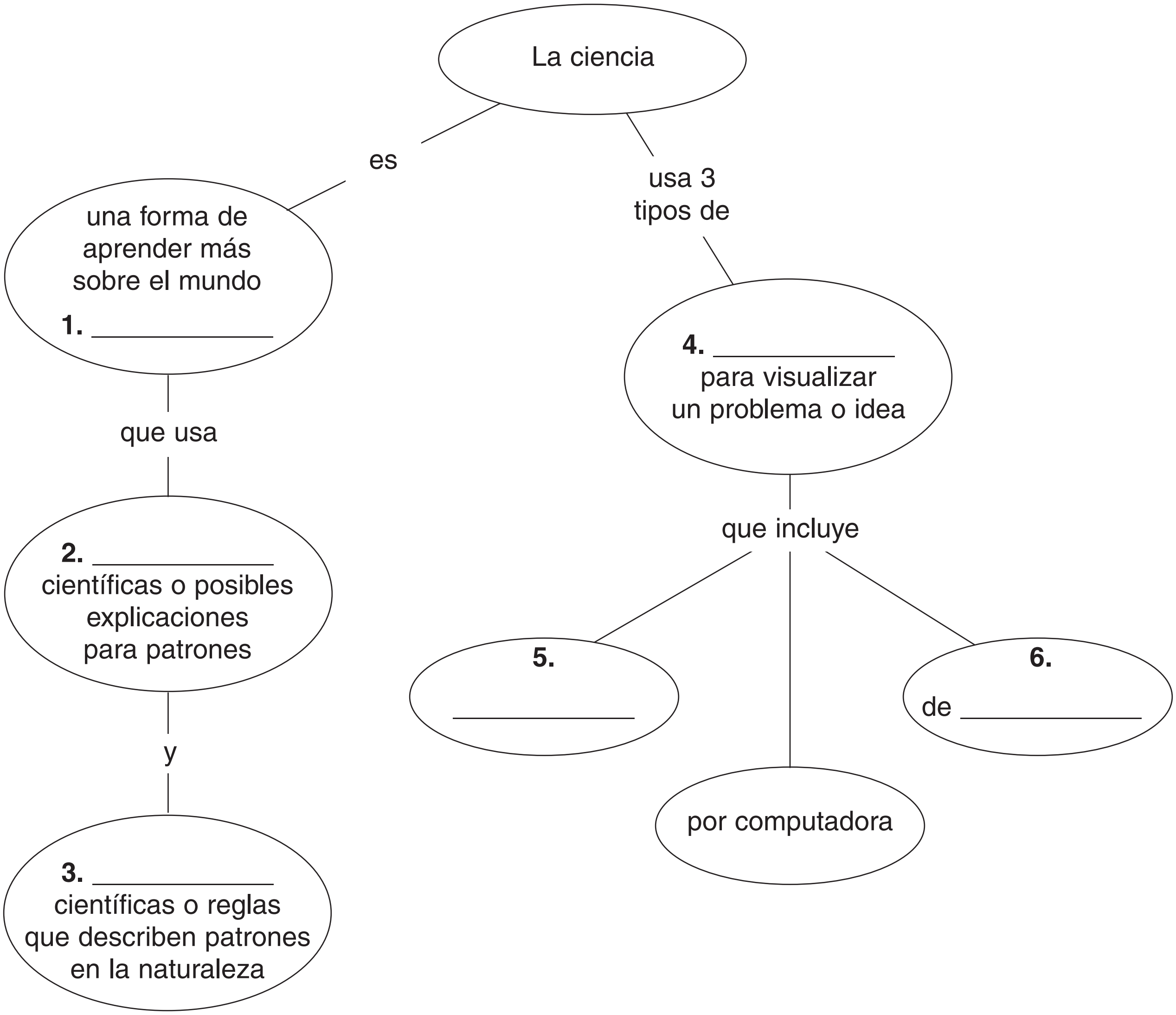
Science has many uses in the daily world. When you use a computer, a toaster, or a radio, you are using **9.** ____________________, or applied science. Many scientists and engineers study the practical applications of science.

Lectura dirigida para Dominio del contenido

Sinopsis
La naturaleza de la ciencia

Instrucciones: *Completa el mapa conceptual con los siguientes términos.*

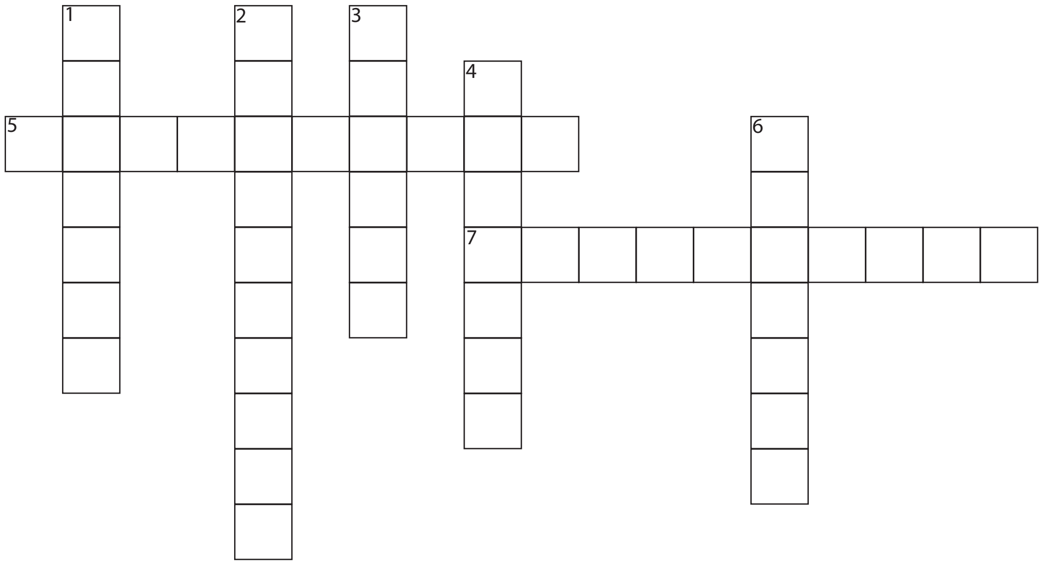
modelos **teorías** **físico** **leyes** **natural**



Lectura dirigida para Dominio del contenido

Sección 1 ▪ ¿Qué es la ciencia?

Instrucciones: *Usa lo que sabes sobre la ciencia para completar el crucigrama.*



Horizontales

5. El uso práctico de la ciencia, ciencia aplicada

7. Las ciencias ______ estudian los sistemas terrestres y los sistemas del espacio.

Verticales

1. Una manera de aprender sobre el mundo natural.

2. Las ciencias ______ estudian la interacción entre los seres vivos

3. Un(a) ______ científica es una explicación posible para un patrón observado repetidamente en el mundo natural

4. Colección de estructuras, ciclos y procesos relacionados que interaccionan unos con otros

7. Las ciencias ______ estudian la materia y la energía.

Lectura dirigida para Dominio del contenido

Sección 2 ▪ La ciencia en acción
Sección 3 ▪ Modelos en la ciencia
Sección 4 ▪ Evalúa las explicaciones científicas

Instrucciones: *Une con una línea la descripción a la izquierda con el término correcto a la derecha.*

1. modelo hecho con programas de computadora
2. modelo que puedes ver y tocar
3. modelo que puedes ver y tocar
4. uso del conocimiento y destrezas de razonamiento para decidir si estás de acuerdo con una explicación
5. variable que no se cambia
6. predicción que puede ponerse a prueba
7. predicción que puede ponerse a prueba
8. conceptos que describen la manera cómo alguien piensa sobre algo en el mundo natural
9. factores que pueden cambiarse en un experimento
10. experimento en donde se cambia un factor y se observan sus efectos sobre otro factor
11. forma de organizar los datos científicos de un experimento
12. laboratorio que no ha sido contratado o no tiene relación con la compañía que vende el producto
13. uso de delantal de gafas de seguridad en el laboratorio

modelo físico

tabla

métodos científicos

variables

constante

experimento controlado

inferencia

modelo por computadora

hipótesis

modelo de ideas

laboratorio independiente

pensamiento crítico

hábitos de seguridad

Lectura dirigida para Dominio del contenido

Términos claves
La naturaleza de la ciencia

Instrucciones: *Usa lo que has aprendido para llenar los espacios en blanco con los siguientes términos.*

teoría científica **observación** **ciencia** **ley** **sistemas**
ciencias biológicas **ciencias terrestres** **energía** **tecnología**

Cualquier persona que trata de aprender sobre lo que le rodea es un científico. El(La) **1.** ____________________ es una manera de aprender más sobre el mundo natural. Este proceso de aprendizaje comienza con la **2.** ___________, o mirando cuidadosamente algo en la naturaleza y luego preguntándose sobre eso.

Un(a) **3.** ___________ es una posible explicación para los patrones que los científicos pueden observar en la naturaleza. Las teorías generalmente tienen el apoyo de los resultados de muchas investigaciones. Cuando un patrón se observa en la naturaleza muchas veces, se convierte en una **4.** ___________ científica y se mantiene hasta que alguien haga una observación que refute el patrón.

Muchos científicos se interesan por estudiar **5.** ___________ o aquellos grupos de estructuras, ciclos y procesos que se relacionan e interaccionan entre sí. El estudio de los sistemas vivos se llama **6.** ___________. Los científicos que estudian los sistemas vivos se preguntan con frecuencia cosas como "¿Cómo evitan las enfermedades las vacunas?" o "¿Qué tipo de organismos viven en un pantano?". Otros científicos estudian **7.** ___________, que es el estudio de la Tierra y los sistemas del espacio. Estos científicos podrían estudiar asteroides, nubes o volcanes. Otros científicos estudian las ciencias físicas, que es el estudio de la materia y la **8.** ___________.

La ciencia tiene muchos usos en la vida diaria. Cuando usas una computadora, una tostadora o una radio, estás usando **9.** ___________ o ciencia aplicada. Muchos científicos e ingenieros estudian las aplicaciones prácticas de la ciencia.

SECTION 1 Reinforcement

What is science?

Directions: *Answer the following questions on the lines provided.*

1. What is the difference between science and technology?

2. Technology often is used to do things that people cannot do. List three types of activities that scientists might use technology for.

a.

b.

c.

3. Give examples of professions in each of the three branches of science discussed in the chapter.

a. life science

b. Earth science

c. physical science

Directions: *Answer the following questions using complete sentences.*

4. What kind of questions can science answer? What kind of questions can't science answer?

5. How does an observation become a scientific law? Give an example.

Name Date Class

SECTION 2 Reinforcement

Science in Action

Directions: *Circle the term in the puzzle that fits each clue. Then write the term on the line. In the puzzle, terms read across or down.*

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

Meeting Individual Needs

1. Using your senses to gather information is called ____________________.
2. A reasonable and educated guess based on what you know and observe is called a(n) ____________________.
3. Making an educated guess on the results of an experiment based on observations and the hypothesis is called making a(n) ____________________.
4. In any good experiment, the scientist needs to ____________________ the hypothesis.
5. You can use a table or a graph to ____________________ your findings.
6. After your investigation, you can use the results of your experiments to draw ____________________.

Directions: *Answer the following question on the lines provided.*

7. What is a controlled experiment? Give an example.

____

____

____

____

____

SECTION 3 Reinforcement

Models in Science

Directions: *Complete the following sentences using the correct terms.*

1. A model built using software that you can see on a computer screen is a ____________________ model.
2. $E = mc^2$ is Einstein's ____________________ model of the theory of relativity.
3. A mobile that shows our solar system is a ____________________ model.
4. Some models are used to communicate ____________________ to other people.
5. Some models are used because testing with a model is ____________________ and less expensive than the real thing.

Directions: *Answer the following questions on the lines provided.*

6. List one example of a model used to test a prediction.

7. List one way a computer model could help a scientist studying plants.

8. What are the limitations of models?

9. Ancient scientists thought that Earth was the center of the universe, and imagined the sky as a blanket that covered the planet. Why did this early model change?

SECTION 4 Reinforcement

Evaluating Scientific Explanation

Directions: *Fill in the blanks with the following terms.*

repeatable	**explanations**	**laboratory**	**changing**
evaluate	**inferences**	**data**	**critical thinking**
conclusions			

Scientists often have to evaluate scientific explanations in two parts. Scientists evaluate the observations that are made, and evaluate the **1.** ____________________ made from those observations. To make a decision, scientists use their **2.** ____________________ skills to evaluate the evidence. Scientists have to be careful whenever they are collecting any type of **3.** ____________________. Measurements must be accurate and instruments must be properly calibrated, as scientists cannot afford to be careless in their data collection.

Valid scientific explanations must be **4.** ____________________ by other scientists. If a scientist's experiment cannot be recreated accurately by other scientists, it might mean that the experiment is invalid. Once the experiments and evidence have been tested and examined, the scientist might draw **5.** ____________________ based on the observations. However, when drawing conclusions, scientists should ask themselves if they considered all of the possible **6.** ____________________. It is important to keep an open mind when drawing conclusions from scientific information. It is also important to remember that scientific information is constantly **7.** ____________________, and that all scientific models are subject to change.

It is important to know that scientific reasoning is used not only in the **8.** ____________________. Scientific reasoning and critical thinking skills are used every day. These skills will help you **9.** ____________________ claims and make good decisions about the world around you.

Directions: *Answer the following questions on the lines provided.*

10. Why is it important for a scientist to write down every observation, including unexpected observations? ____________________

____

11. How is evaluating an advertising claim a use of the scientific process?

____

12. Does an advertiser's claim that its results have been verified by an independent laboratory impress you?

____

Meeting Individual Needs

SECTION 1 Enrichment

All Kinds of Scientists

A scientist is a person who tries to learn about the natural world. A scientist's understanding comes from collecting information through observation and experimentation. A scientist then forms ideas and tests those ideas to prove or disprove them. There are many kinds of scientists. For example, you've already learned that a volcanologist is an Earth scientist who studies volcanoes. Listed below are additional kinds of scientists.

Directions: *Use dictionaries, encyclopedias, and library books to define what the following scientists study. Also, list the branch of science—***life***,* **Earth***, or* **physical***—in which the scientist specializes.*

1. Zoologist ______________________________
2. Astronomer ______________________________
3. Ethnobotanist ______________________________
4. Paleontologist ______________________________
5. Meteorologist ______________________________
6. Ichthyologist ______________________________
7. Ornithologist ______________________________
8. Entomologist ______________________________
9. Chemist ______________________________
10. Anthropologist ______________________________
11. Herpetologist ______________________________

SECTION 2 Enrichment

Would you keep secrets in science?

The scientific method is a formal process used by scientists to help them understand our world. Most scientific investigations follow a general pattern in which scientists observe something, make a hypothesis, test the hypothesis, and come to a conclusion. Without scientific methods, science would have no rhyme or reason. That's how it was centuries ago when it was very common for scientists to keep their findings to themselves or, at best, to publish their findings in books that were both expensive and unavailable to most people.

New Technologies

With the invention of new technologies, like the microscope and the telescope, scientists were making so many new discoveries that it was hard for them to know what to do with the information. Robert Boyle, a seventeenth-century chemist, tried, unsuccessfully, to get other scientists to provide clear descriptions of their findings. He also tried to make them see the importance of being able to repeat an experiment and get the same results. But Boyle wasn't the only one to try to make sense of science. Francis Bacon, a seventeenth-century philosopher, said that ordering large amounts of data would allow scientists to develop theories and ideas about their findings.

Galileo (1564–1642) was also an early pioneer of scientific methods. While studying falling objects, he observed that when heavy objects fall, they pick up speed. He formed a hypothesis that speed is in direct proportion to distance. He deduced that objects falling from unequal distances need the same amount of time. This proved false. So, Galileo formed a new hypothesis: speed is achieved in direct proportion to the time, not the distance traversed. He tested this hypothesis and confirmed it.This was, perhaps, the first use of scientific methods.

Societies Formed

In the mid-1600, it became clear that something had to be done with the vast amounts of information scientists were gathering. So the first scientific societies were formed to allow scientists to get together to discuss others' findings, and develop new ideas. The first society, the Royal Society of London for the Promotion of Natural Knowledge, was formed in 1662, followed by the Académie des Sciences of Paris in 1666. Then the first scientific journal, the Royal Society's *Philosophical Transactions*, was born, followed by the Académie's *Mémoires*. These scientific journals opened up a scientific revolution that led to the development of scientific methods, including sharing methods and reporting failures.

1. Define scientific methods in your own words.

____

2. Why do you think scientists were not willing to listen to Robert Boyle's ideas?

____

3. What influence did the scientific societies of the 1600s have on the scientists of today?

____

____

____

____

SECTION 3 Enrichment

Are computer models more accurate?

Because of advances in technology, scientists now use computer models to help them study everything from solar eclipses to weather patterns to ocean temperatures. Computer models also can help scientists make predictions.

Ocean Modeling

For example, the National Oceanic and Atmospheric Administration (NOAA) has been using computer models to study ocean temperatures and make predictions about global warming. NOAA scientists spent years studying temperature data from the Atlantic, Pacific, and Indian oceans. They discovered that the oceans have become warmer over the past several decades—confirming that Earth is, indeed, heating up.

Using computer models, NOAA scientists quantified temperature changes in the oceans. Perhaps even more surprising, they found that computer models showed more significant warming than historical data alone. That's because the computer models took into account a factor the historical data did not—heat is trapped in the oceans. The computer models showed that oceans absorb heat and transfer it to subsurface depths, thereby separating the heat from the atmosphere. The computer models provided more accurate findings than temperature data taken over a nearly 50-year-period.

Nobody expected the computer models to be more accurate. That's because, until now, scientists, forecasters, and others have had to modify computer model output and take into account model biases, strengths, and weaknesses. Since computer models use software, the models are only as dependable as the information and data that's built into them.

1. Do you think computer models are an accurate way for scientists to make predictions? Explain.

____

____

____

2. What was the one thing that led NOAA scientists to realize that the computer models were more accurate than the historical data?

____

____

3. What could critics of computer models say about the accuracy of the NOAA findings about global warming?

____

____

____

____

4. Name two weather-related events that could be predicted by computer models.

____

____

SECTION 4 Enrichment

Science Notebooks: Now and Then

Although today's generation of scientists is the first to use technology to record data, observations, and field notes, most still do their record-keeping the old-fashioned way—with a paper notebook.

There's much debate over whether electronic or paper science notebooks are better. Some say electronic data are more likely to be altered than paper data. Others say electronic data are safer because the records can be dated, certified, and sealed. Some say paper notebooks should be loose-leaf pages. Others say bound books are the only way to prevent data from being lost.

Most Famous of All

No matter which method of record-keeping they choose, scientists agree that the most well-known scientific notebook belonged to Leonardo daVinci, a sixteenth century Italian painter, scientist, and civil engineer.

Of his 30 notebooks, daVinci's most famous science-only notebook, the *Codex Leicester,* has been called "one of the world's great art treasures" and "a scientific journal of epic proportions." The codex contains specific information about daVinci's ideas and includes data and detailed drawings. Historians who've studied the codex say most of daVinci's scientific theories are correct. For example, daVinci believed that the glow of a crescent moon comes from sunlight reflected from Earth. His theory was proven 100 years later by the German astronomer Johannes Kepler.

He Wrote sdrawkcaB

The codex is a 72-page manuscript that contains 360 fingernail-sized, pen-and-ink sketches. The pages are made of pure linen and daVinci wrote in brown ink and red chalk. What's most interesting is the way in which daVinci wrote—backwards! Using mirror-writing (which is read by holding the text up to a mirror), daVinci also started each notebook by writing on what we would think of as the last page.

Nobody knows why daVinci used mirror-writing. Perhaps he did it to protect his ideas from people who might want to steal them. Maybe he liked the challenge of writing that way. Or, possibly he wrote backwards because he was left-handed and didn't want to smudge the ink on the paper as he wrote.

1. Practice mirror-writing by writing an observation about today's weather. Would you use this technique in your own science notebook? Why or why not?

2. DaVinci's fingernail-sized sketches are called mechanical illustrations. What is a mechanical illustration and how might it improve the information contained in a science notebook?

3. Use library resources to find out which of daVinci's scientific ideas, theories, or explanations proved to be true or were later invented by others. List eight of them here.

Note-taking Worksheet

The Nature of Science

Section 1 What is science?

A. __________________—a way of learning about the natural world

1. Scientists ask ____________________ about the natural world, but questions about art, politics, personal preferences, or morality can't be answered by science.
2. Answers are ____________________ because new knowledge and discoveries are continually being made.
3. **Scientific** _________________—an attempted explanation for repeatedly observed patterns in the natural world
4. A rule that describes a pattern in nature is a **scientific** _____________.

B. Scientists study __________________—collections of structures, cycles, and processes that relate to and interact with each other.

C. Science is divided into _______________ main branches that study different systems.

1. ______________ **science** studies living things and how they interact.
2. Earth and space systems are studied in _______________ **science.**
3. ___________________ **science** studies matter and energy.
4. The practical use of science is called _____________________.

Section 2 Science in Action

A. The _____________________________ includes observing, questioning, and researching; forming a **hypothesis**; predicting an outcome; investigating; analyzing; forming conclusions, communicating findings; and repeating the process.

B. Scientists _______________ conclusions based on observations.

C. A _________________________________ is one type of scientific investigation.

1. Factors that can be changed in an experiment are ____________________.
2. ____________________ are variables that remain unchanged.

D. ________________ is important for both laboratory and field scientists.

Meeting Individual Needs

Section 3 Models in Science

A. _______________—representation of an object or event used as a tool for understanding the natural world

B. Models come in _______________ basic types.

1. __________________ models can be seen and touched.
2. __________________ models can be seen on a computer screen but not touched.
3. ______________ models are concepts that describe how someone thinks about something in the natural world.

C. Models have several ______________.

1. Models ______________________ observations and ideas.
2. Models can ______________ predictions.
3. Models can ______________ time, money, and lives.

D. Models ________________ over time as new observations and discoveries are made.

Section 4 Evaluating Scientific Explanation

A. ____________________________—using what is known to decide if new facts should be agreed with or believed

B. ______________ should be evaluated.

1. The data should be ___________________ and exact.
2. Observations should be carefully, accurately, and completely _______________.
3. Data must be _____________________ to be reliable.

C. ______________________ should be evaluated.

1. Conclusions should _____________________.
2. _____________________________ should be considered before a single conclusion is reached.

D. ______________________ claims should be carefully analyzed, since they are designed to sell products rather than to promote scientific evidence impartially.

Assessment

Assessment

Name ______ Date ______ Class ______

Chapter Review

The Nature of Science

Part A. Vocabulary Review

Directions: *Unscramble the letters to form the correct term for each definition. Write the terms on the lines provided.*

______ **1.** *iicitfcens oherty:* an attempt to explain a pattern in nature

______ **2.** *leomd:* a tool for understanding the natural world

______ **3.** *ccefiiinst awl:* a rule to explain a pattern in nature

______ **4.** *nastscotn:* the variables in an experiment that stay the same

______ **5.** *eifl eeiccns:* the study of living systems

______ **6.** *semyts:* a collection of structures that relate to one another

______ **7.** *nienfrcees:* attempts at explanations of what is seen

______ **8.** *itaccril ignkhitn:* using knowledge and thinking skills to decide if you agree with an explanation

______ **9.** *cnothlgyoe:* the application of knowledge learned through science

______ **10.** *aibvrale:* the factor that can be changed in an experiment

______ **11.** *ocnroledlt xermeentip:* observing the effect of one thing while keeping all other things constant

______ **12.** *ssyhtpoeih:* a prediction about a problem that can be tested

______ **13.** *inccese:* a process used to investigate the world around you

Directions: *Complete the following sentences using the terms listed below. Some terms will not be used.*

Earth science	**computer model**	**physical science**
inference	**theory**	**idea model**

14. A(n) ______ is one that cannot be touched but can be seen.

15. A ______ is a reasonable and educated guess based on what you know and what you observe.

16. The study of nonliving things such as rocks, soil, planets, and stars is called ______.

17. A(n) ______ could never be built as a physical model.

Assessment

Chapter Review (continued)

Part B. Concept Review

Directions: *Fill in the blanks with the correct term.*

1. Einstein's famous equation $E = mc^2$ is a(n) ______________________.
2. A conclusion based on observations is a(n) ______________________.
3. Science can never answer questions with absolute ______________________, but can give us the best answer based on the knowledge at the time.
4. ______________________ help you organize your observations and test results.
5. Scientists can use ______________________ to obtain data from a hostile environment.
6. Engineers apply science to develop ______________________.
7. Although science does not follow a particular series of steps, investigations often follow a general ______________________.
8. Scientists must be very careful when they are gathering ______________________.
9. Hypotheses can be based on observations or prior ______________________.

Directions: *Answer the following questions using complete sentences.*

10. Why is critical thinking important in science?

____

____

____

____

____

11. Explain why a hypothesis could still be correct even though an experiment says the hypothesis is wrong.

____

____

____

____

____

Assessment

Transparency Activities

Name Date Class

SECTION 1 Section Focus Transparency Activity

Dress for the Occasion

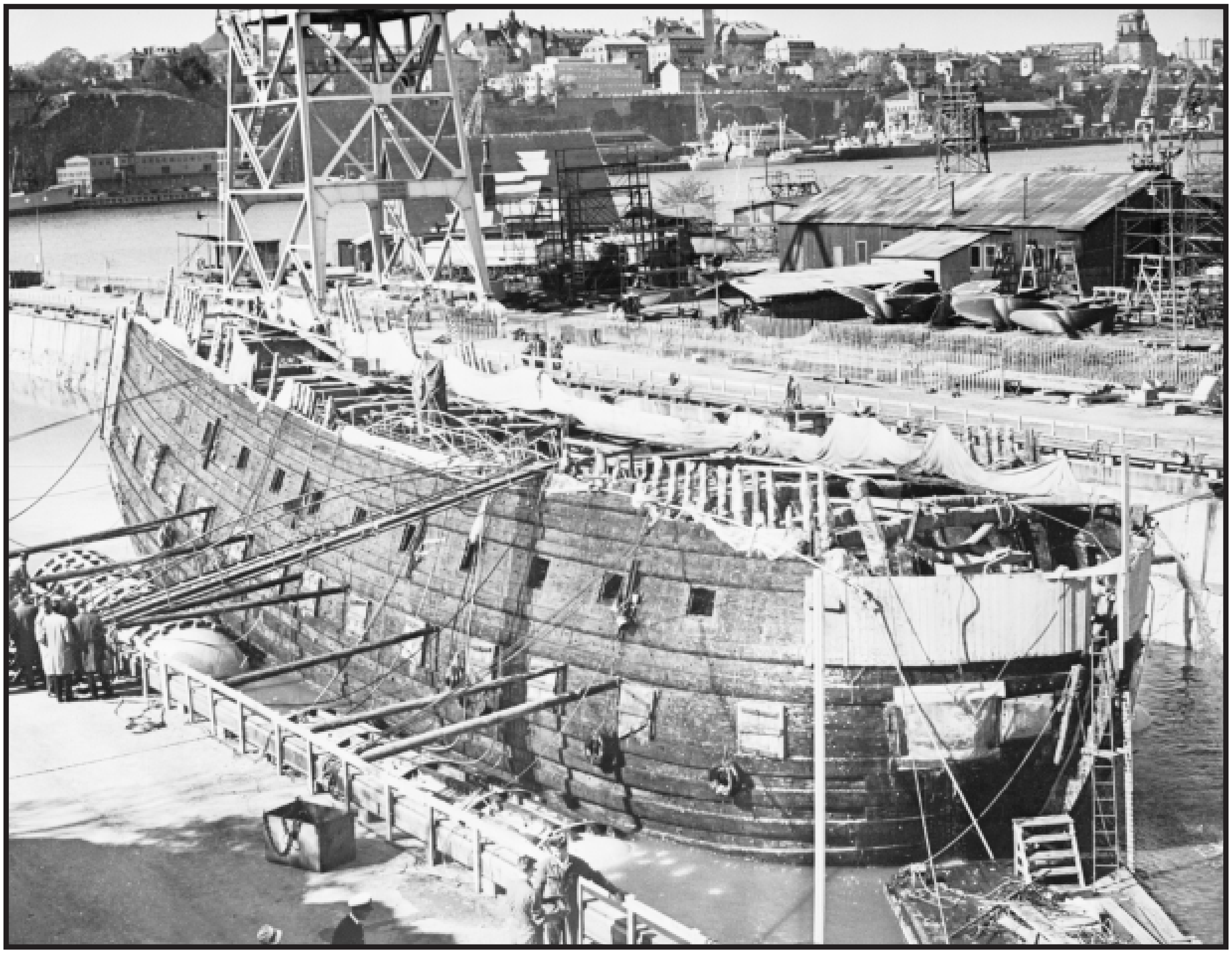
Researching the area around an active volcano requires special precautions. High temperatures and gases like sulfur dioxide make this a hostile environment, but the safety suit enables the scientist to collect data.

1. **What are some other hostile environments that scientists explore?**
2. **What special equipment helps this scientist gather information?**
3. **How might work in a laboratory compare with work in the field?**

SECTION 2 Section Focus Transparency Activity

Did we skip a step?

These are the remains of the *Vasa*, the largest warship of its time. Due to improper testing, it sank on its maiden voyage in 1625. In 1961, the ship was salvaged and a museum built to house it.



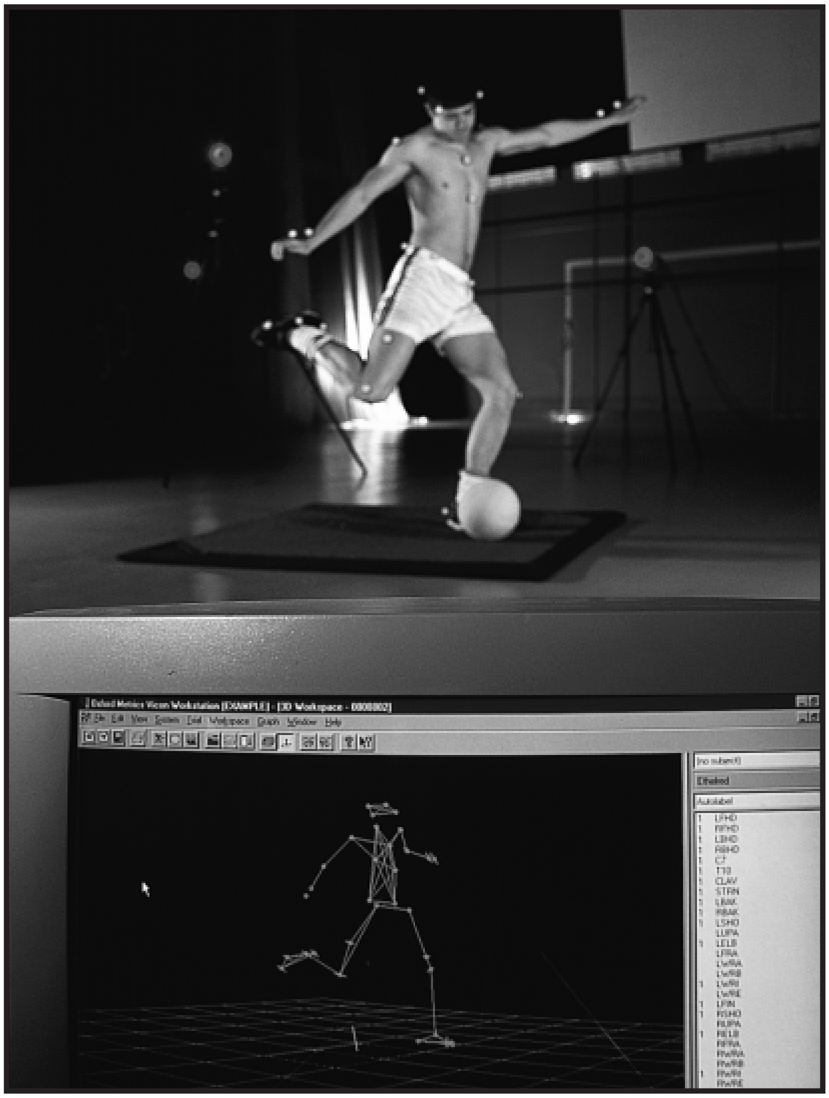
1. Prior to the *Vasa's* maiden voyage an admiral ordered a test for stability. The ship failed the test, but the admiral kept the result a secret. What would a scientist have done with this result?
2. How could you test a new ship design without actually building the ship?

Name Date Class

SECTION 3 Section Focus Transparency Activity

Connect the Dots

Scientists often need help to visualize and understand everyday events. In the example below, scientists are using a computer to view and analyze movement.



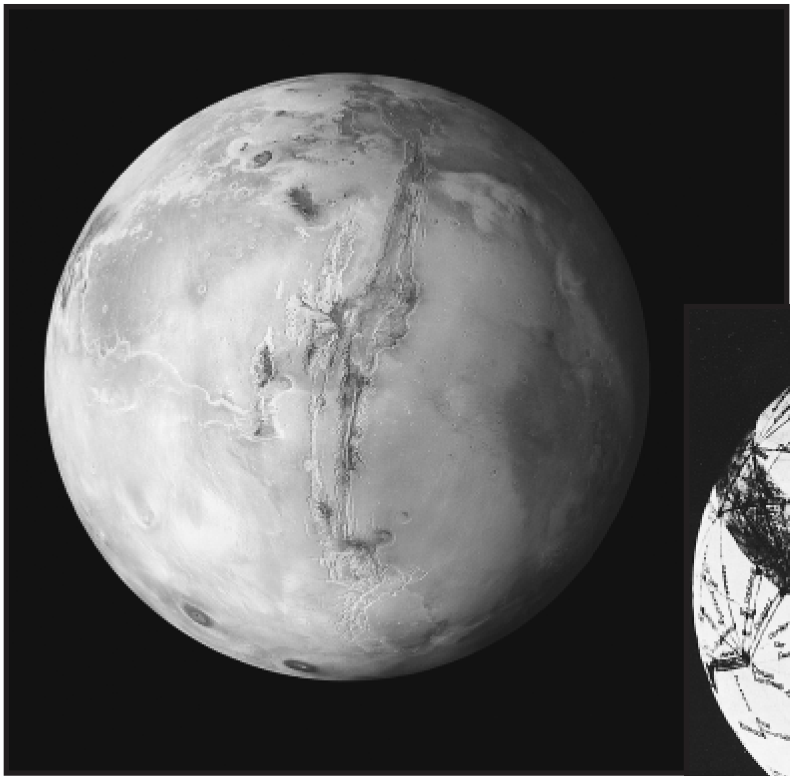
1. **How might this type of computer program be used?**
2. **What activity or movement would you be interested in seeing on a computer like this?**

Name Date Class

SECTION 4 Section Focus Transparency Activity

A View of Mars

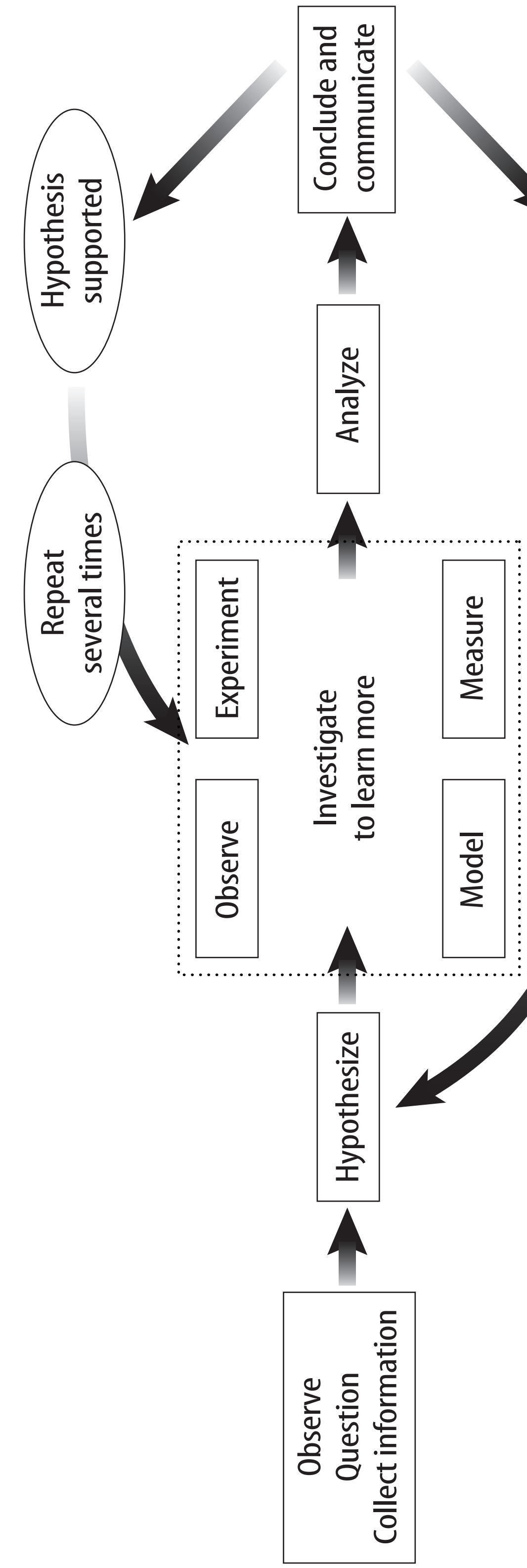
In 1895, Percival Lowell began a series of observations of Mars. He claimed to see a vast system of canals that transported water from the melting polar ice caps to Martian cities. His books on the subject fascinated the public and made him famous. Scientists, however, eventually proved that the canals and the cities were figments of Lowell's imagination.



1. Can you see any features in the photograph of Mars that might be canals or cities?
2. How might two people looking at the same image of Mars reach different conclusions?

SECTION 2 Teaching Transparency Activity

Scientific Method



Name Date Class

Teaching Transparency Activity (continued)

1. How is the scientific method helpful to use when investigating a topic or problem?

2. Why is it important to list what you already know about a topic?

3. After you state your hypothesis, what should you do next?

4. If testing does not support your hypothesis, what would you do next?

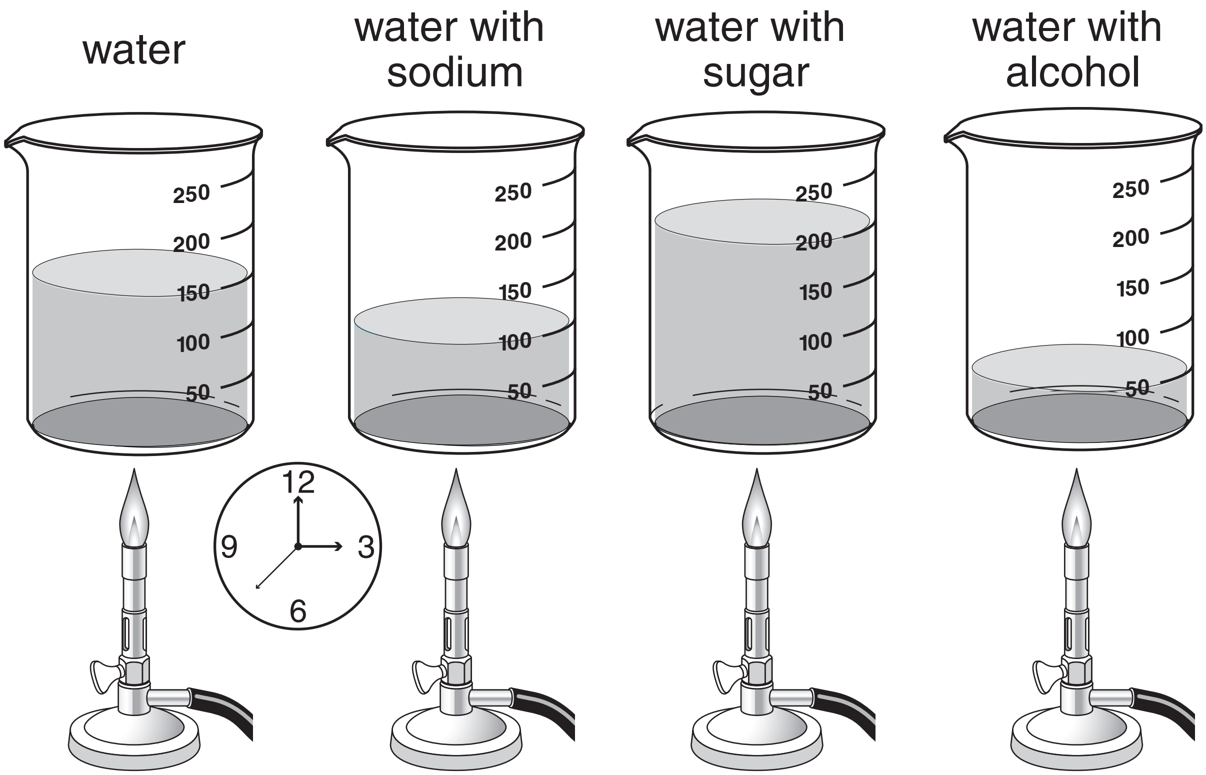
5. Why should you record your information?

6. What are some different ways you could share what you learned with others?

Assessment Transparency Activity

The Nature of Science

Directions: *Carefully review the diagram and answer the following questions.*



1. Which of these questions might the experiment best answer?
A **What is the boiling point of water?**
B **What effect do solvents in water have upon the time it takes for each solution to boil?**
C **How much sodium chloride can completely dissolve in room temperature water?**
D **What is the density of water when it boils?**

2. This experiment would give more accurate results if ___.
F **each container of water were boiled one at a time**
G **greater amounts of each solvent were added to the containers**
H **the amount of water in each container were equal**
J **a fifth container with a different solvent were added**

Transparency Activities