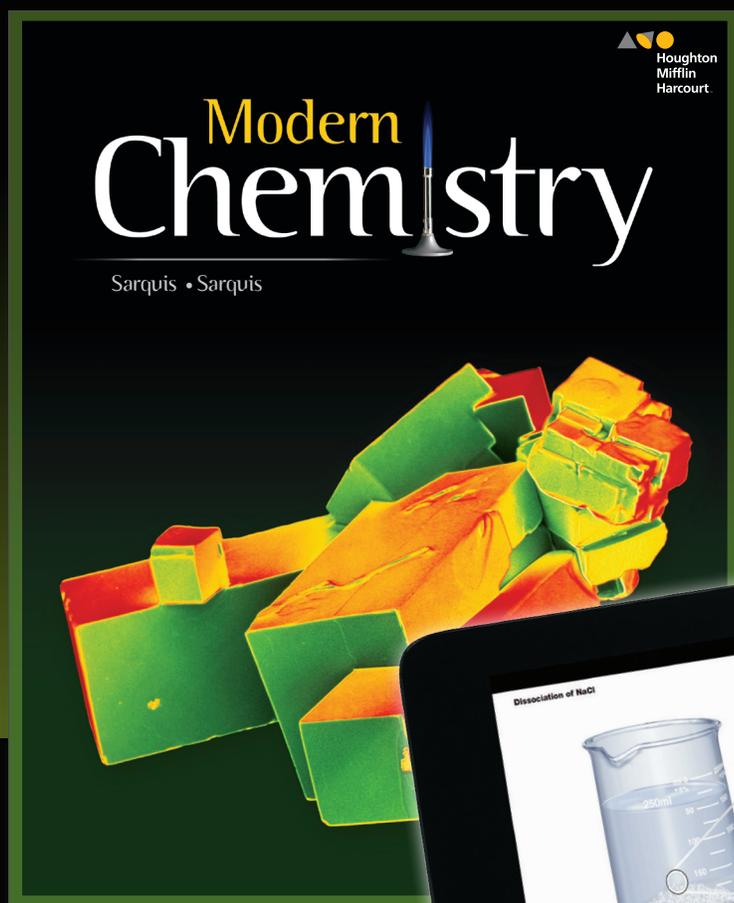


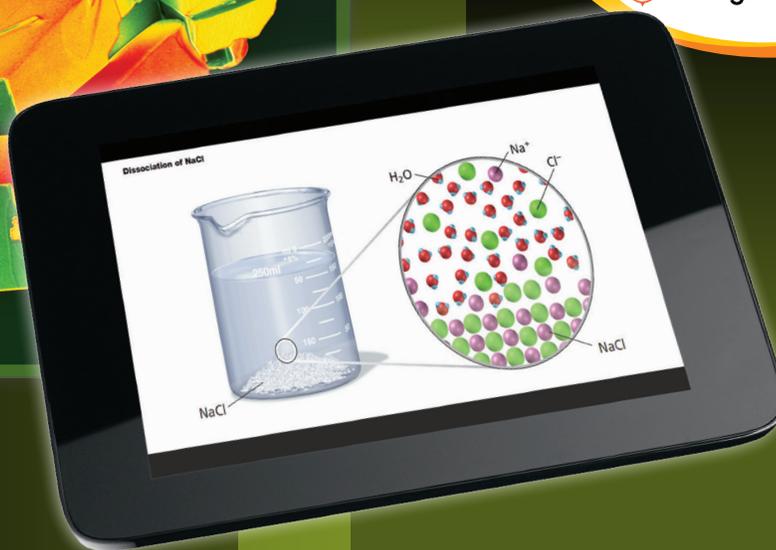
# Modern Chemistry



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Featuring content  
from **THING** and  
**EXPLAINER** and  
 Google Expeditions



Houghton Mifflin Harcourt

# Modern Chemistry®

Less paper, more **convenience**

Everything you need—now in one convenient online location!

The Interactive Online Edition gives students and teachers 24/7 point-of-use access to all program components.



## Dashboard

Classrooms using **Modern Chemistry © 2017** will now have the benefit of the **improved** online interface provided by the HMH Dashboard. This also includes *mySmartPlanner*, enabling teachers to combine calendar functionality with curriculum mapping and program resources.

## Try it now!

Just follow these steps to see how interactive and engaging online resources can be!

1	Go to:	HMHSience.com
2	Click on	<input type="button" value="PREVIEW"/>
3	Enter Sample Word and Click Next:	<input type="button" value="HSNASC17"/>
4	Fill in the Required Personal Information, Click the Checkbox to Agree to the Terms of Use and Privacy Policy, and Click:	<input type="button" value="Register"/>
5	Write Down Your User Name and Password and Log in at:	HMHSience.com

# Any Device, Anytime, Anywhere

## Why It Matters

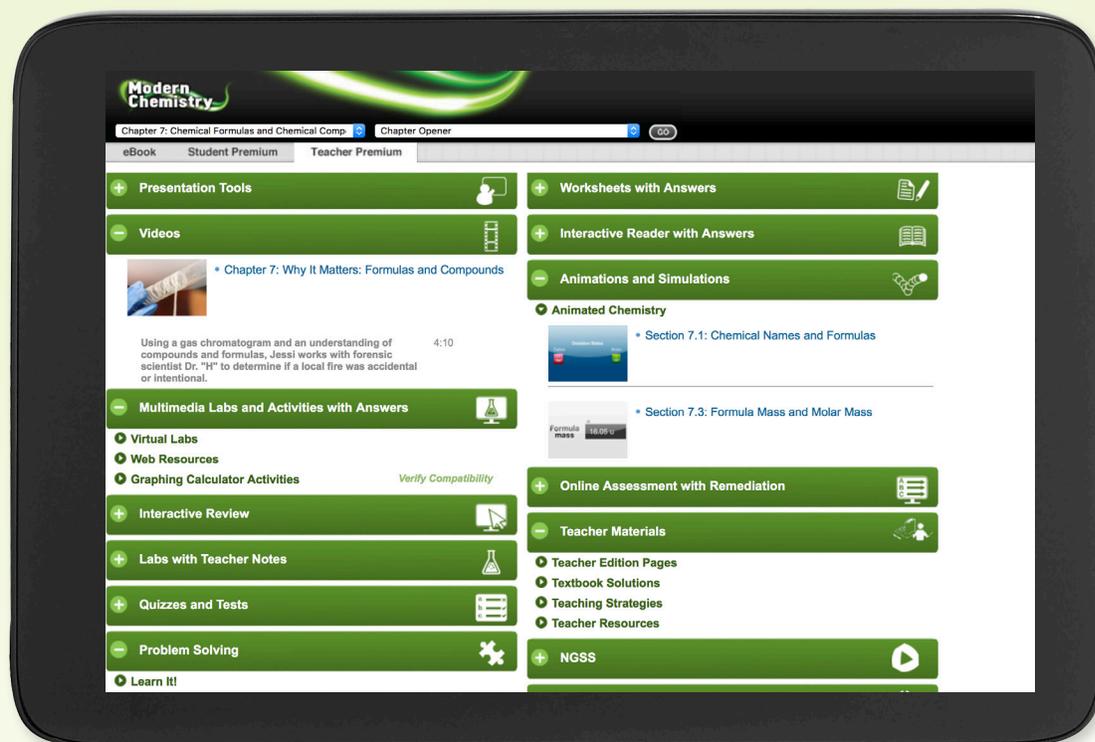
Each chapter opens with a dynamic video that relates the content to everyday life.

## Virtual Labs

Students can conduct meaningful experiments in a simulated lab or field setting without the expense, time, or risk of traditional lab settings.

## Animated Chemistry

Animations and simulations help students visualize and comprehend complex concepts.

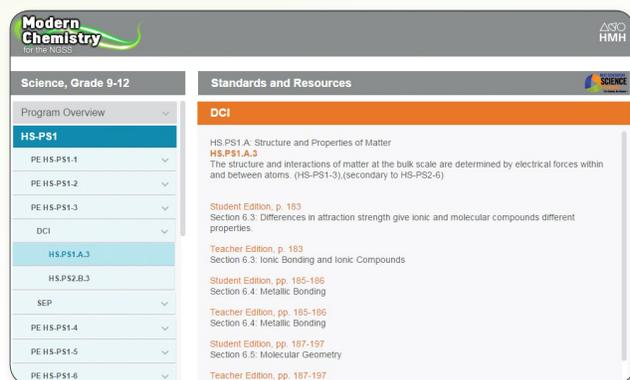


## Learn It! Videos

Tutorial videos walk students through challenging problems and offer tips for success.

## Solve It! Cards

Portable reference cards offer quick access to strategies for solving almost any chemistry problem.



## NGSS\* Correlations

Correlations both online and in the TE facilitate standards implementation.



# Print components **designed** and **aligned** for easy access

**HMH Modern Chemistry** enables you to reach all learners by providing time-saving, easy-to-use resources to help students of all abilities achieve understanding and success.

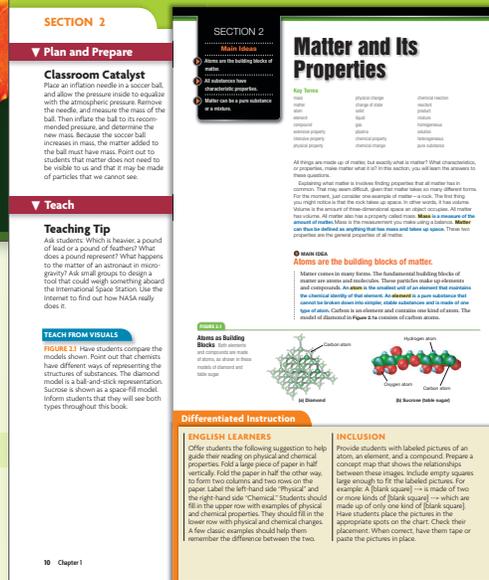


## Student Edition

Offers features that make chemistry concepts more accessible, such as **highlighted vocabulary, problem-solving support**, and references to online student support tools.

## Teacher Edition

Packed with a wide variety of **strategies** to help all students master chemistry concepts, plus **extended learning** opportunities for advanced students.



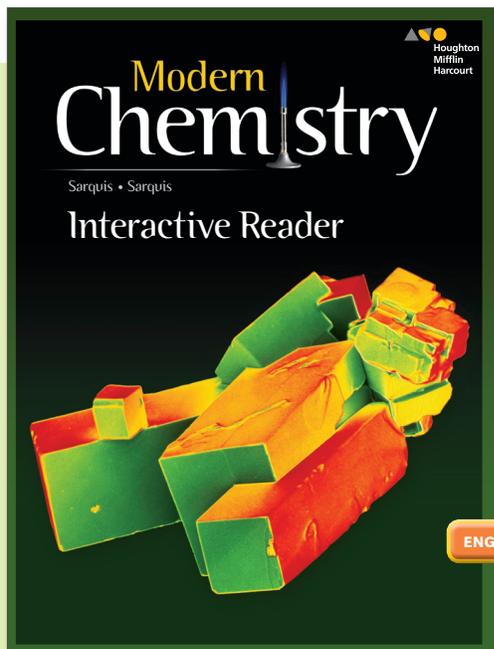
**Dr. Jerry Sarquis**,  
Professor Emeritus,  
Chemistry Education,  
Miami University



**Mickey Sarquis**,  
Professor Emerita,  
Chemistry Education,  
Miami University

## Meet the Authors

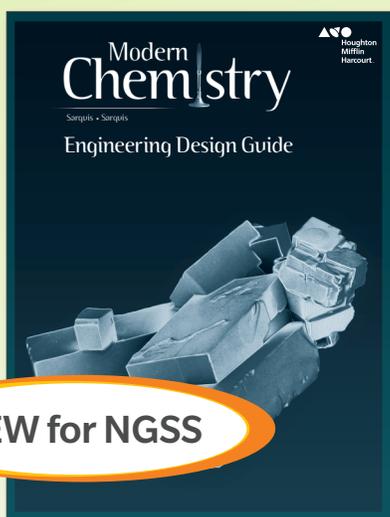
**Dr. Jerry Sarquis** and **Mickey Sarquis** were both professors in the Department of Chemistry at Miami University in Oxford, Ohio. These renowned authors were motivated to contribute to **Modern Chemistry** because they had a desire to give back to the community, and they wanted to influence students whom they couldn't even see, through the unfolding of a textbook and all the resources that support such a book. Jerry and Mickey Sarquis got into teaching because of their love of learning, and the more they taught, the more they learned from their interactions with their students.



### Interactive Reader and Answer Key

A **write-in worktext** that provides all of the essential content and vocabulary of the Student Edition at a reading level one to two grades below the text. A great resource for students of all ability levels, the Interactive Reader is both a core instructional tool for **struggling students** and a useful **study guide** for all students. The Answer Key provides teacher notes and answers for every section of the Interactive Reader.

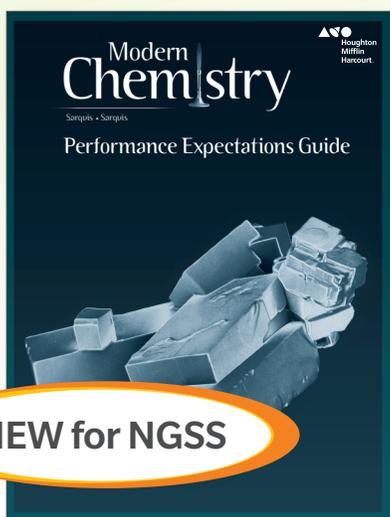
ENGLISH & SPANISH



NEW for NGSS

### Engineering Design Guide Student Edition and Teacher Edition

This Engineering Design Guide provides an overview of the **engineering design process**, along with activities and checklists that can help foster students' **critical-thinking** and **problem-solving skills**. For curriculums aligned to NGSS\*, this guide can also help support the engineering-related Performance Expectations.



NEW for NGSS

### Performance Expectations Guide Student Edition and Teacher Edition

Designed to integrate easily into any curriculum, a separate Performance Expectations Guide is available to ensure that students meet the NGSS Performance Expectations. Also included is an **overview of NGSS** and **teacher tips** for integrating each activity into the classroom.

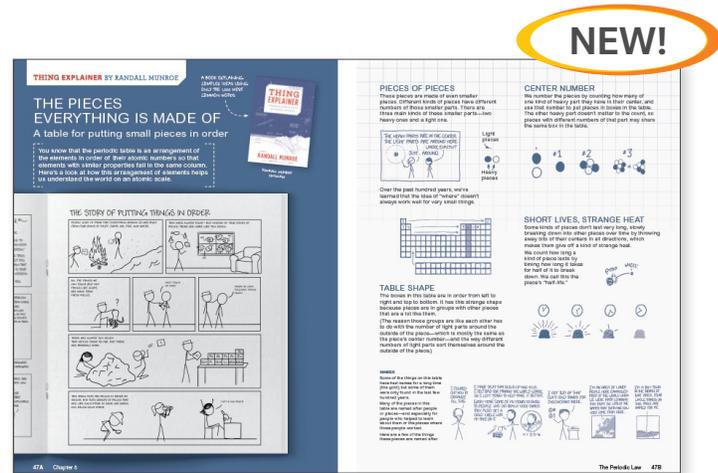


# Print and Digital Tools That Motivate and Engage

HMH *Modern Chemistry* offers the latest print and multimedia resources that speak directly to your students in a visual language they understand—ensuring that they will stay engaged.

## Thing Explainer

Through an exclusive partnership with author and Internet sensation **Randall Munroe**, HMH has incorporated highly engaging and educational material from Randall's latest book, *Thing Explainer*, into our print and digital editions. Randall's webcomic style, as seen on **xxcd.com**, humorously explains complex topics in easy-to-understand language.



NEW!

## Google Expeditions

Through its alliance with Google®, HMH is developing content for Google® Expeditions. Using a simple Google Cardboard™ device and a smartphone, students are swept away into **immersive virtual worlds** where learning and engagement are maximized. These virtual field trips are 3D, 360-degree experiences in fascinating locations, directly tied to content! A **Teacher Guide** provides ideas for incorporating the Expeditions into your lessons, as well as tips on **how to guide and customize the experience**.



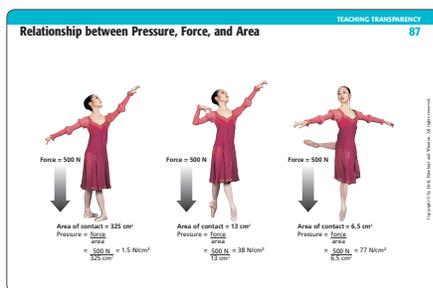
NEW!

## On the Job STEM Videos

As part of our Premium offering, HMH now includes **29 On the Job STEM** videos that **profile STEM careers** in today's fastest-growing industries. Our energetic hosts shadow passionate professionals in a day "on the job." These short segments are inspirational and entertaining with the hosts actually performing parts of the job! These videos will **motivate students** to enter emerging STEM fields.

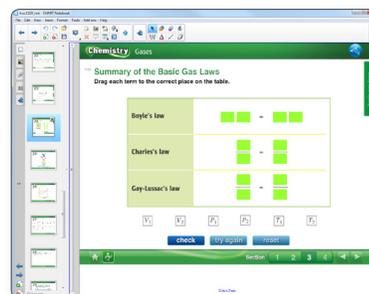
## Why It Matters Videos

Seventeen chapter-introductory videos are an effective way to begin a new topic of chemistry study. Each video is designed to take the content of the chapter and relate it to everyday objects or situations that are familiar to students.



### Teaching Visuals

Digital versions of key illustrations and diagrams are ideal for **whole-class instruction**.



### Interactive Whiteboard Resources

IWB resources include interactive **teaching visuals** and **content-reinforcement lessons** for each chapter of the textbook.



## Animated Chemistry

Each Animated Chemistry includes 3 parts—an overview of the concept, an interactive simulation, and assessment.

# Unparalleled resources for Differentiated Instruction

Students approach chemistry with a wide variety of skills and levels of preparation. **HM Modern Chemistry** gives teachers what they need to help all students succeed.

## Teacher Edition

The **Instruction and Intervention** feature located in each chapter of the Teacher Edition provides **strategies for every lesson** to assist you in helping students with a wide range of needs. To simplify lesson planning, these support pages at the beginning of each chapter provide a full listing of the activities and classroom resources available for each section.

The wrap margin includes a **Differentiated Instruction** feature with a wide variety of strategies to help all students master chemistry concepts. Material categories include Below Level, English Learners, Pre-AP®, and Inclusion.

## Chapter and Section Study Guide

The student worksheets in this guide cover the content in each section of the textbook using a variety of questioning strategies.

Editable!

## Interactive Reader Audio Files

The entire Interactive Reader has been professionally read and is available to students to help **bolster learning comprehension**.

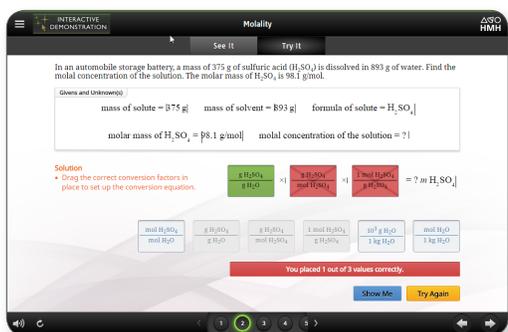


# and Problem Solving

Nearly half of the sample problems in *HMH Modern Chemistry* have been refreshed to give even the most loyal program users something new and different to challenge and strengthen their students' problem-solving skills.

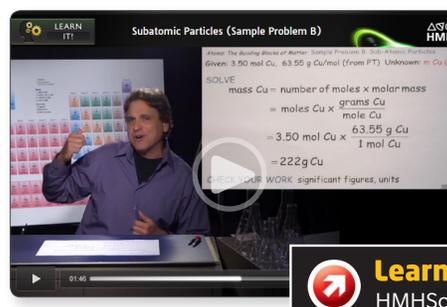


**Solution Tutor**  
Guides students step-by-step through selected problems, recognizes their error patterns, then provides hints and targeted remediation to improve their problem-solving skills.



## Interactive Demonstrations

Each sample problem in the textbook has an accompanying Interactive Demonstration that **walks through the steps of solving** that type of chemistry problem. The Try It Yourself feature helps students apply what they have learned. Each includes a full audio narrative.



## Learn It! Videos

Forty professional tutorial videos **walk students through challenging chemistry problems**, with tips and strategies for success.

## Sample Problem Sets

These skills worksheets provide **problem-solving strategies** and an extensive bank of student **practice problems** for every type of chemistry problem in the textbook.

Skills Worksheet  
**Sample Problem Set**

**The Ideal Gas Law**

In 1811 the Italian chemist Amedeo Avogadro proposed the principle that equal volumes of gases at the same temperature and pressure contain equal numbers of molecules. He determined that at standard temperature and pressure, one mole of gas occupies 22.4 L (usually rounded to 22.4 L). At this point, if you know the number of moles of a gas, you can use the molar volume of 22.4 L/mol to calculate the volume that amount of gas would occupy at STP. Then you could use the combined gas law to determine the volume of the gas under any other set of conditions. However, a much simpler way to accomplish the same task is by using the ideal gas law.

The *ideal gas law* is a mathematical relationship that has the conditions of standard temperature (273 K) and pressure (1 atm or 101.3 kPa) plus the molar gas volume (22.4 L/mol) already combined into a single constant. The following equation is the mathematical statement of the ideal gas law.

$$PV = nRT$$

in which  
 $P$  = the pressure of a sample of gas  
 $V$  = the volume of a sample of gas  
 $n$  = the number of moles of gas present  
 $R$  = the Kelvin temperature of the gas  
 $R$  = the ideal gas constant, which combines standard conditions and molar volume into a single constant  
 The value of the ideal gas constant,  $R$ , depends on the units of  $P$  and  $V$  being used in the equation. Temperature is always in kelvins and amount of gas is always in moles. The most common values used for  $R$  are shown below.

Units of $P$ and $V$	Value of $R$
Atmospheres and liters	$0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}$
Kilopascals and liters	$8.314 \frac{\text{L} \cdot \text{kPa}}{\text{mol} \cdot \text{K}}$

Skills Worksheet  
**Sample Problem Set continued**

If you have volume units other than liters or pressure units other than atmospheres or kilopascals, it is best to convert volume to liters and pressure to atmospheres or kilopascals.

**General Plan for Solving Ideal-Gas-Law Problems**

1. The equation for the ideal gas law is  $PV = nRT$ . Determine from the data which is the unknown quantity. Rearrange the equation algebraically to solve for the unknown quantity.
2. An equation that can be used to calculate the unknown quantity. Choose the gas constant,  $R$ , that best fits the units of the data. Substitute each of the data values in the equation and calculate.
3. Unknown  $P$ ,  $V$ ,  $n$ , or  $T$ .

Editable!

## Solve It! Cards

These printable and **portable reference cards** provide students with quick access to effective problem-solving strategies and guidelines.

**Writing and Balancing Equations**

Properly balanced reactions are necessary before you can fully understand chemical reactions.

Do you know the formula of the reactant?

Do you know the formula of the product?

Do you know the formula of the product?

**Solve It! Troubleshooting**

**Troubleshooting Guide**

If you cannot balance the equation, try the following:

- Check to see if you have the correct formula for the reactants and products.
- Make sure that the number of atoms of each element is the same on both sides of the equation.
- Try balancing the equation by starting with the most complex molecule.
- Try balancing the equation by starting with the element that appears in the fewest compounds.
- Check your work!

Solve It! Cards

# Wide-ranging support for Reading and Vocabulary

Your students will get the most out of their reading with numerous student and teacher print and multimedia point-of-use resources that enable them to build understanding and retain more information on key concepts.

CHAPTER 14  
**Acids and Bases**



**BIG IDEA**  
Acids are substances that donate hydrogen ions in aqueous solutions. Bases are substances that accept hydrogen ions in aqueous solutions.

**NEW!**

## Student Edition

**Big Ideas** in every Chapter Opener & Summary help students concentrate on key concepts.

## Main Idea

Chapter content has been organized around main ideas.

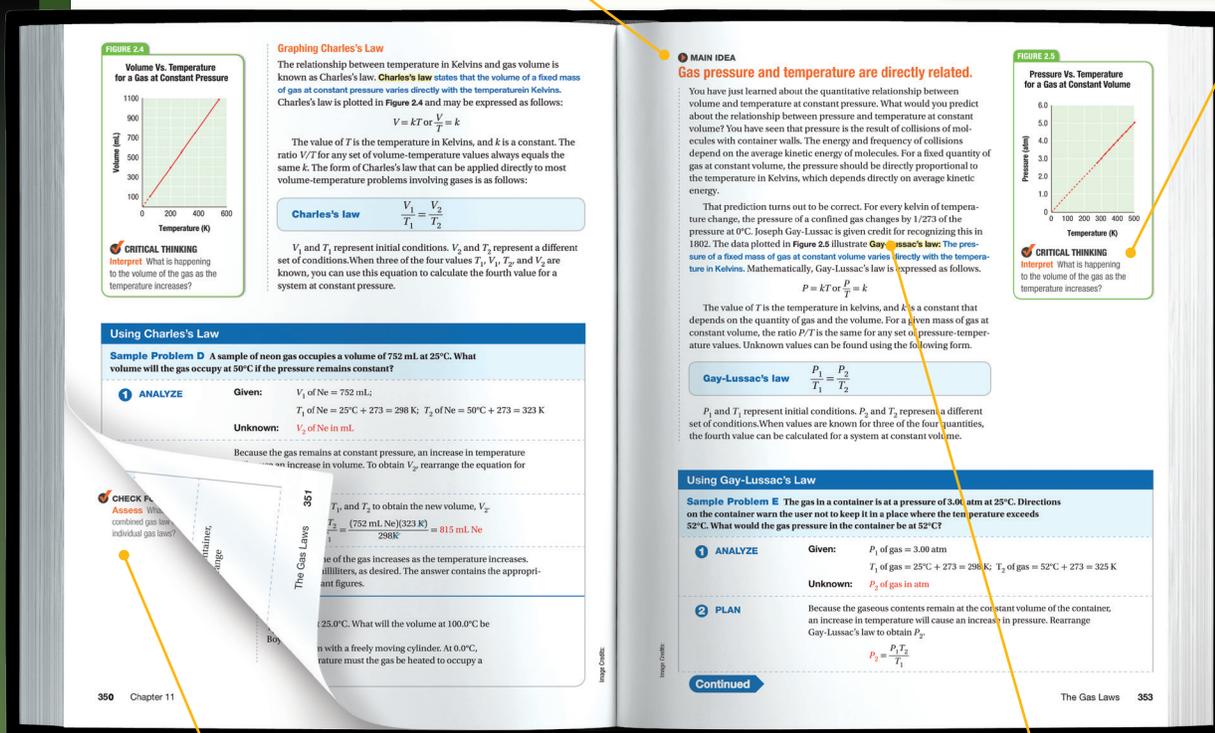
## Critical Thinking

Critical-Thinking questions prompt your students to think deeply.



## CRITICAL THINKING

**Interpret** What is happening to the volume of the gas as the temperature increases?



**FIGURE 2.4**  
**Volume Vs. Temperature for a Gas at Constant Pressure**

The relationship between temperature in Kelvins and gas volume is known as Charles's law. Charles's law states that the volume of a fixed mass of gas at constant pressure varies directly with the temperature in Kelvins. Charles's law is plotted in Figure 2.4 and may be expressed as follows:

$$V = kT \text{ or } \frac{V}{T} = k$$

The value of  $T$  is the temperature in Kelvins, and  $k$  is a constant. The ratio  $V/T$  for any set of volume-temperature values always equals the same  $k$ . The form of Charles's law that can be applied directly to most volume-temperature problems involving gases is as follows:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

**Charles's law**

$V_1$  and  $T_1$  represent initial conditions.  $V_2$  and  $T_2$  represent a different set of conditions. When three of the four values  $T_1$ ,  $V_1$ ,  $T_2$ , and  $V_2$  are known, you can use this equation to calculate the fourth value for a system at constant pressure.

**Using Charles's Law**

**Sample Problem D** A sample of neon gas occupies a volume of 752 mL at 25°C. What volume will the gas occupy at 50°C if the pressure remains constant?

**1 ANALYZE** Given:  $V_1$  of Ne = 752 mL;  
 $T_1$  of Ne = 25°C + 273 = 298 K;  $T_2$  of Ne = 50°C + 273 = 323 K  
Unknown:  $V_2$  of Ne in mL

Because the gas remains at constant pressure, an increase in temperature will cause an increase in volume. To obtain  $V_2$ , rearrange the equation for Charles's law:

$$V_2 = \frac{V_1 T_2}{T_1}$$

Substitute the values and solve for  $V_2$ :

$$V_2 = \frac{752 \text{ mL} (323 \text{ K})}{298 \text{ K}} = 815 \text{ mL Ne}$$

The volume of the gas increases as the temperature increases. Round the answer to the appropriate number of significant figures.

Bo... (25.0°C. What will the volume at 100.0°C be...  
n with a freely moving cylinder. At 0.0°C, ...  
ature must the gas be heated to occupy a

**FIGURE 2.5**  
**Pressure Vs. Temperature for a Gas at Constant Volume**

You have just learned about the quantitative relationship between volume and temperature at constant pressure. What would you predict about the relationship between pressure and temperature at constant volume? You have seen that pressure is the result of collisions of molecules with container walls. The energy and frequency of collisions depend on the average kinetic energy of molecules. For a fixed quantity of gas at constant volume, the pressure should be directly proportional to the temperature in Kelvins, which depends directly on average kinetic energy.

That prediction turns out to be correct. For every kelvin of temperature change, the pressure of a confined gas changes by 1/273 of the pressure at 0°C. Joseph Gay-Lussac is given credit for recognizing this in 1802. The data plotted in Figure 2.5 illustrate Gay-Lussac's law: The pressure of a fixed mass of gas at constant volume varies directly with the temperature in Kelvins. Mathematically, Gay-Lussac's law is expressed as follows:

$$P = kT \text{ or } \frac{P}{T} = k$$

The value of  $T$  is the temperature in kelvins, and  $k$  is a constant that depends on the quantity of gas and the volume. For a given mass of gas at constant volume, the ratio  $P/T$  is the same for any set of pressure-temperature values. Unknown values can be found using the following form:

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

**Gay-Lussac's law**

$P_1$  and  $T_1$  represent initial conditions.  $P_2$  and  $T_2$  represent a different set of conditions. When values are known for three of the four quantities, the fourth value can be calculated for a system at constant volume.

**Using Gay-Lussac's Law**

**Sample Problem E** The gas in a container is at a pressure of 3.00 atm at 25°C. Directions on the container warn the user not to keep it in a place where the temperature exceeds 52°C. What would the gas pressure in the container be at 52°C?

**1 ANALYZE** Given:  $P_1$  of gas = 3.00 atm  
 $T_1$  of gas = 25°C + 273 = 298 K;  $T_2$  of gas = 52°C + 273 = 325 K  
Unknown:  $P_2$  of gas in atm

**2 PLAN** Because the gaseous contents remain at the constant volume of the container, an increase in temperature will cause an increase in pressure. Rearrange Gay-Lussac's law to obtain  $P_2$ :

$$P_2 = \frac{P_1 T_2}{T_1}$$

Substitute the values and solve for  $P_2$ :

$$P_2 = \frac{3.00 \text{ atm} (325 \text{ K})}{298 \text{ K}} = 3.27 \text{ atm}$$

Continued



## CHECK FOR UNDERSTANDING

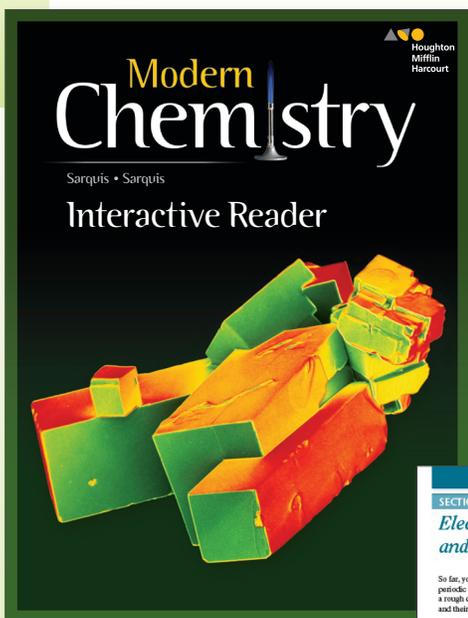
**Assess** What advantage does the combined gas law have over the three individual gas laws?

## Check for Understanding

These reading comprehension questions help reinforce the important points of the section.

## In-text definitions

As students study, they'll find key vocabulary has been highlighted in context.



**Interactive Reader**

This write-in worktext presents all the vocabulary and essential content from the textbook in a lower-level, easy-to-read text, with instructional visuals and frequent comprehension checks. This unique component is a great tool for all students—the core content for struggling students and a useful study guide for others.

**SECTION 5.3**  
*Electron Configuration and Periodic Properties*

So far, you have learned that elements are arranged in the periodic table according to their atomic number. There is also a rough correlation between the arrangement of the elements and their electron configurations.

In this section, the relationship between the periodic law and electron configurations will be further explored. This relationship allows several properties of an element to be predicted simply from its position relative to other elements on the periodic table.

**Atomic radii are related to electron configuration.**  
Identify the size of an atom as defined by the edge of its outermost orbital. However, the location of this boundary is difficult to determine, and can vary under different conditions. Therefore, to estimate the size of an atom, the conditions to which it is subjected must be described.

One way to define the atomic radius is as one-half the distance between the nuclei of identical atoms that are bonded together. For example, a molecule of chlorine gas contains two atoms of chlorine bonded together. The distance between the two chlorine nuclei is 198 pm. Therefore, the atomic radius of a chlorine atom is 99 pm.

**Critical Thinking**

1. Apply In a gold block, individual atoms of gold are bonded together through metallic bonding. How would you use the gold block to determine the atomic radius of an atom of gold?

**KEY TERMS**

atomic radii: distance between nuclei of identical atoms  
atomic radius: distance between nuclei of identical atoms  
atomic energy: energy of an atom

**FIGURE 5.3**  
Diagram showing two chlorine atoms bonded together. The distance between the two chlorine nuclei is 198 pm. The atomic radius of a chlorine atom is 99 pm.

**SECCIÓN 5.3**  
*La configuración electrónica y las propiedades periódicas*

Hasta ahora, has aprendido que los elementos están distribuidos en la tabla periódica en función de su número atómico. También hay una correlación aproximada entre la distribución de los elementos y su configuración electrónica.

En esta sección, se explorará la relación entre la ley periódica y la configuración electrónica. Esta relación permite predecir fácilmente varias propiedades de un elemento a partir de su ubicación en relación con otros elementos de la tabla periódica.

**El radio atómico se relaciona con la configuración electrónica.**  
Identificar el tamaño de un átomo está definido por el borde de su orbital más externo. Sin embargo, la ubicación de ese borde es difícil de determinar y puede variar en diferentes condiciones. Por lo tanto, para estimar el tamaño de un átomo, se deben describir las condiciones a las que está sometido.

Una manera de definir el radio atómico es como la mitad de la distancia entre el núcleo de dos átomos idénticos que están relacionados. Por ejemplo, una molécula de gas cloro contiene dos átomos de cloro unidos. La distancia entre los dos núcleos de cloro es 198 pm. Por lo tanto, el radio atómico de un átomo de cloro es 99 pm.

**Razonamiento crítico**

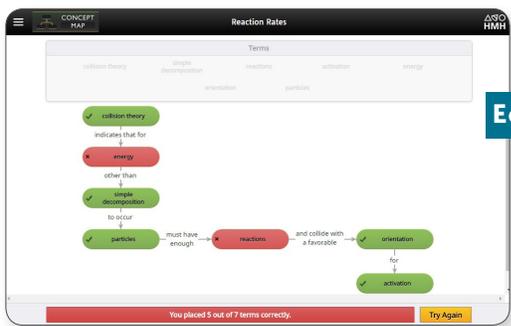
1. Aplicar En un bloque de oro, los distintos átomos de oro están unidos mediante un enlace metálico. ¿Cómo usarías el bloque de oro para determinar el radio atómico de un átomo de oro?

**TÉRMINOS CLAVE**

radio atómico: distancia entre núcleos de átomos idénticos  
radio atómico: distancia entre núcleos de átomos idénticos  
energía atómica: energía de un átomo

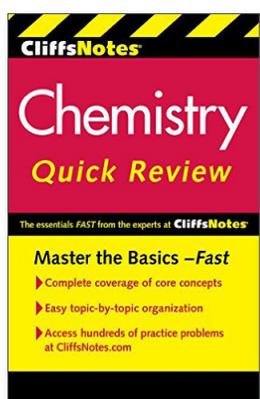
**FIGURA 5.3**  
Diagrama que muestra dos átomos de cloro unidos. La distancia entre los dos núcleos de cloro es 198 pm. El radio atómico de un átomo de cloro es 99 pm.

ENGLISH & SPANISH



**Interactive Concept Maps**

Each chapter includes an interactive, advanced **graphic organizer** that shows the relationships among concepts covered and helps students develop logical thinking and study skills.



**CliffsNotes® Chemistry Quick Review**

With a Premium package purchase, a class set of these study guides provides **essential reinforcement of core concepts** in an easy-to-use format.

**eBook**

This **online version** of the print Student Edition features a wealth of **built-in tools** to help students access the content, including the chunking of content around Main Ideas, with frequent comprehension checks, superior support for problem-solving, high-quality instructional visuals, point-of-use references to online animations, Problem-Solving tutorials, and virtual labs that make abstract concepts more concrete. Features include data persistence, on-page media links, bookmarking, search, notes, and highlighting functionality.

# Flexible Assessment Tools to Track Student Progress

The comprehensive assessment options located on [HMHScience.com](http://HMHScience.com) bring together all HMH *Modern Chemistry* assessment tools into one convenient place, giving you many choices for the best way to assess your students' learning.



## ExamView® Banks

A complete ExamView Software Suite includes all assessment questions for the program and more than **2,300 additional questions** in Bonus Banks.

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Assessment  
**Gases**

**Section Quiz: Gases and Pressure**

In the space provided, write the letter of the term or phrase that best completes each sentence or best answers each question.

1. What causes a gas to exert pressure?
  - a. collisions
  - b. density
  - c. temperature
  - d. elevation
2. The SI unit for pressure is
  - a. newton.
  - b. mm Hg.
  - c. pascal.
  - d. liter.
3. The pressure exerted by a gas does *not* depend on
  - a. temperature.
  - b. volume.
  - c. number of moles present.
  - d. the identity of the gas.
4. At sea level, the average height of mercury in a barometer is
  - a. 760 mm.
  - b. 101 325 atm.
  - c. 1.01 325 Pa.
  - d. All of the above.
5. Standard temperature and pressure are
  - a. 32°F and 10 atm.
  - b. 0°C and 1 atm.
  - c. 10 K and 1 atm.
  - d. 0°F and 1 atm.

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Editable!

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Assessment  
**Chapter Test A**

**Chapter: Chemical Bonding**

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

1. The charge on an ion is
  - a. always positive.
  - b. always negative.
  - c. either positive or negative.
  - d. zero.
2. According to the octet rule, a calcium atom has a tendency to
  - a. lose one electron.
  - b. lose two electrons.
  - c. gain one electron.
  - d. gain two electrons.
3. If a compound
  - a. A positive charged ion.
  - b. The use of
  - c. The comp
  - d. Several is
4. The only po

ENGLISH & SPANISH

Editable!

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Assessment  
**Chapter Test B**

**Chapter: Chemical Bonding**

**PART 1** On the line at the left of each statement, write the letter of the choice that best completes the statement or best answers the question.

1. An ionic bond results from electrical attraction between
  - a. cations and anions.
  - b. atoms.
  - c. dipoles.
  - d. orbitals.
2. A nonpolar covalent bond is unlikely when two atoms of different elements join because the atoms are likely to differ in
  - a. density.
  - b. state of matter.
  - c. electronegativity.
  - d. polarity.
3. Bond length is the distance between two bonded atoms at
  - a. their minimum potential energy.
  - b. their maximum kinetic energy.
  - c. their maximum potential energy.
  - d. one-half the diameter of the electron cloud.
4. To draw a Lewis structure, it is not necessary to know
  - a. which atoms are in the molecule.
  - b. bond energies.

## Section Quizzes

A 10-question multiple-choice and short-answer quiz for each section of the textbook. These are designed for student **formative assessment** to aid in remediation.

## Chapter Test A & B

Two **full-length** chapter tests include multiple-choice and short-answer questions. Test B is similar to but more challenging than Test A.

## Review and Assessment in the Student Edition

The Student Edition contains **multiple levels of assessment** from Formative to Summative along with helpful review questions that assess students' understanding of chapter and section material.

**CHAPTER REVIEW**

26. An unknown element is shiny and is found to be a good conductor of electricity. What other properties would you predict for it?
27. Use the periodic table to identify the group numbers and general location of the following elements:
  - a. carbon, C
  - b. oxygen, O
  - c. aluminum, Al
  - d. barium, Ba
28. Review the information on three elements in the Elements Handbook (Appendix B):
  - a. What are the functions of these elements in the body?
  - b. What transition metal plays an important role in oxygen transport throughout the body?
  - c. What non-transition metal is an important part of the structure of hemoglobin in the body?

**READING MAIN IDEAS**

29. How can you tell the difference between an element and a compound?
30. Identify each of the following as either a physical change or a chemical change. Explain your answers.
  - a. a paper of wood is used to build a table.
  - b. Milk turns sour.
  - c. Methyl bromide is added to the refrigerant.
31. Write a paragraph that shows that you understand the following terms and the relationship between them: atom, molecule, compound, and element.
32. Pick an object you can see right now. List three of the object's physical properties that you can observe. Can you also observe a chemical property of the object? Explain your answer.

**CRITICAL THINKING**

33. **Interpreting Concepts** One way to make materials is to melt by combining known metal and nonmetal atoms together to melt your specific design for metals. How is this combination different from a compound or a mixture? Explain.
34. **Analyzing Details** Look for the table and write correct units.

**SECTION 2 FORMATIVE ASSESSMENT**

**Reviewing Main Ideas**

1. What is the main difference between physical properties and chemical properties?
2. Give an example of each.
3. Classify each of the following as either a physical change or a chemical change.
  - a. tearing a sheet of paper
  - b. melting a piece of wax
  - c. burning a log

**Standards-Based Assessment**

Record your answers on a separate piece of paper.

**MULTIPLE CHOICE**

1. A student investigates how adding a solute to water affects the water's freezing point. The data are shown below.

Amount of solute	Freezing point
0 g	-0.7°C
10 g	-1.4°C
20 g	-2.1°C
30 g	-2.8°C

Which scientific explanation can the student logically draw from the data she collected?

- a. As solute is added, the freezing point decreases.
- b. As solute is added, the boiling point increases.
- c. The freezing point of the water solution is always  $-2.1^{\circ}\text{C}$ .
- d. There is a trend of 0.7 grams of solute per added degree that leads to development points.

You find an unknown substance that cannot be separated by filtration, evaporation, or distillation. Would the explanation that the substance is an element be scientifically valid?

- a. Yes, because elements cannot be separated by ordinary chemical means.
- b. Yes, because elements are pure substances made of one type of atom.
- c. No, because the substance could be a homogeneous mixture.
- d. No, because the substance could be a compound, which also cannot be separated by physical means.

**GRIDDED RESPONSE**

5. A student collects the following data about a particular substance.

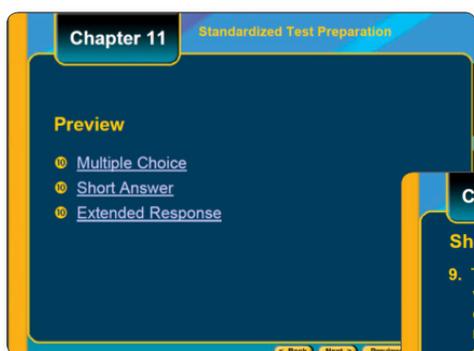
Substance's Properties	
temperature	12°C
state of matter	solid
mass	89.3 grams
length	2.5 cm
width	2 cm
volume	100 cm <sup>3</sup>
conductivity	excellent

Based on these data, calculate the substance's density, expressed with the unit g/cm<sup>3</sup>. For this substance.



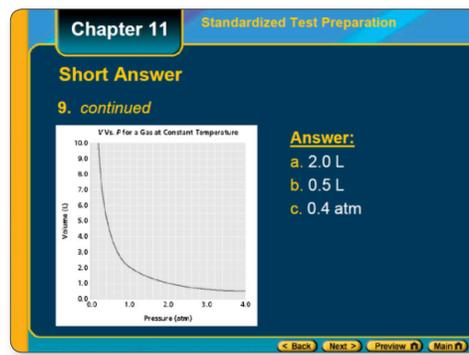
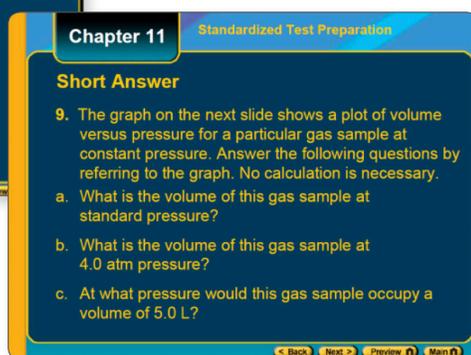
## Interactive Review Games

Three different styles of vocabulary and concept review games help reinforce the material learned in each chapter in a fun and engaging format.



## PowerPresentations: Standardized Test Preparation

Multiple-Choice, Short-Answer, and Extended-Response questions that you can use for **whole-class review** of chapter materials.



## Online Assessment and Remediation

An advanced, automated assessment and remediation engine enables teachers to assign section quizzes to students. The assessments are **automatically graded**, and remediation that uses materials from the program is prescribed. A post-test is offered to determine student mastery. Critical student **performance data** are recorded and made readily available to the teacher.

**Individualized remediation**

# Convenient access to

# Labs, Data Analysis and STEM

HMH *Modern Chemistry* includes the most comprehensive lab resources with its wide variety of print and digital lab options for every classroom, along with the most robust data-analysis strand to help students develop these critical skills.

**Editable!**



Over 200  
Editable Labs!

## Laboratory Experiments

Wide variety of labs located at point of use on **HMHSscience.com**:

- Editable lab sheets
- Teacher notes and answer keys
- Referenced on Instruction and Intervention pages in Teacher Edition

### QuickLabs

Designed for reinforcement of key concepts using easy-to-obtain materials.

### Standard Labs

Focus on experimental skills and application of chapter concepts through the use of scientific methods.

### Core Skill Labs

Provide practice of inquiry skills and scientific methods.

### STEM Labs

Science, Technology, Engineering, and Mathematics problem-based labs that emphasize inquiry and the engineering design process.

### Open Inquiry Labs

Specifically designed to be short project-based labs that encourage students to collaborate, strategize, construct, and evaluate a lab challenge of their own creation.

### Probeware Labs

Labs that use Vernier® probeware and Pasco® probeware and SPARK® technology.

### Forensic Labs

Application labs that have students demonstrating laboratory skills through the exploration of forensic and applied science scenarios.

### Labeled Labs

Lab activities are labeled online by **class time**, **prep time**, **difficulty** to help teachers choose appropriate activities to fit their classroom needs.

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**OPEN INQUIRY LAB**  
**Studying What You Can't See**

In this lab, you will determine the topography of a distant planet and create a map of its surface for the purpose of identifying a good landing site for a spaceship on an exploratory mission.

**PURPOSE**  
Determine a distant planet's unknown surface, using remote sensing and measuring techniques that are used for objects that cannot be seen.

**OBJECTIVES**  
**Hypothesize** the type of planetary surface features that will yield a good landing site.  
**Design** an experiment that uses premade topography surface boxes.  
**Measure** the topography, using remote measuring techniques.  
**Organize** and map data according to location and surface depth.

**Relate** the use of topographic data to the location and surface depth of an exploratory spaceship to the topography of a distant planet.

**POSSIBLE MATERIAL:**

- aluminum foil
- awl
- colored pencils
- crayons

**Inquiry labs**

Name \_\_\_\_\_ Class \_\_\_\_\_ Date \_\_\_\_\_

**STEM LAB**  
**Allergic to Color**

**Teacher Notes and Answers**  
**TIME REQUIRED** Two 45-minute class periods and 15 minutes of a third period

**LAB RATINGS** Easy 1 2 3 4 Hard

Teacher Preparation—2  
Student Setup—2  
Concept Level—3  
Cleanup—2

**SKILLS ACQUIRED**  
Analyzing data  
Applying concepts  
Collecting data  
Communication  
Comparing and contrasting  
Experimenting  
Identifying patterns  
Inferring  
Interpreting  
Organizing data  
Teamwork

**PREPARATION**  
Prior to the lab, heat some water. Assemble all necessary materials.

**NOTES ON TECHNIQUE**  
When each chromatography strip is lowered into a solvent, the dot of dye that was placed on the strip must rest above the surface of the solvent. Do not allow the dot of dye to come into direct contact with, or become submerged in, the solvent.

**TIPS AND TRICKS**  
This lab works best with pairs of students.

**CHECKPOINTS**  
1. By the end of the first class period, have students turn in a detailed one-page plan/procedure for approval.  
2. During the second class period, have students revise procedures according to your comments and begin the procedure.

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HMH Modern Chemistry  
STEM Lab

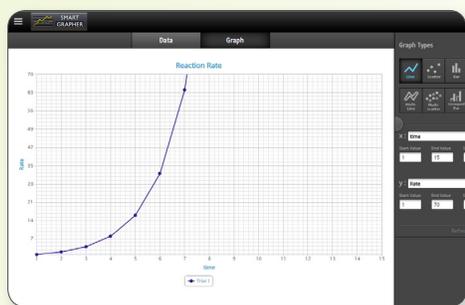
**STEM labs**

## STEM in the Student Edition

Select STEM features now include an Engineering Design feature in the Student Edition. This feature encourages students to follow the engineering design process and think about problems in an innovative way.

## Data Analysis Support for Students

To help students develop the data analysis skills necessary to collect, graph, and analyze data like scientists, [HMScience.com](http://HMScience.com) includes resources to support the data analysis lesson in every chapter.



### Smart Grapher

A powerful, easy-to-use **online graphing tool** that encourages students to use their own data to create line graphs, circle graphs, and more.

### Scientific Reasoning Skill Builder

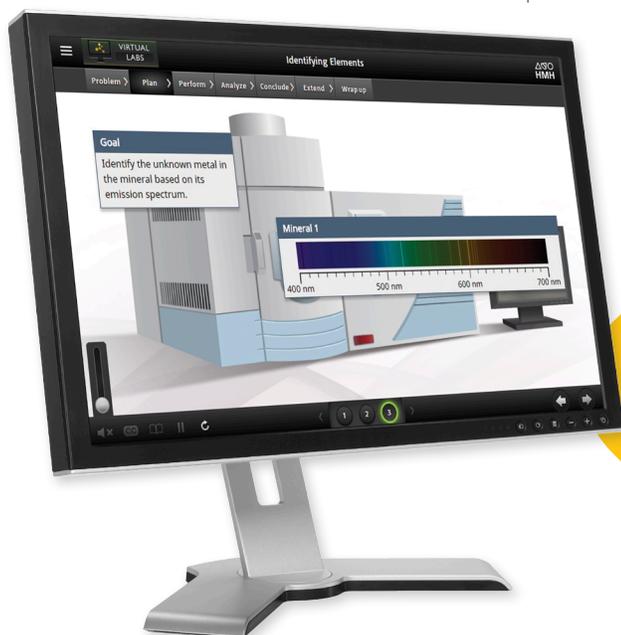
Over **100 exercises** that strengthen students' scientific reasoning skills. Sample topics include classifying and categorizing, cause-and-effect relationships, hypothesis, generalizations and analogies, and summarizing and reviewing.

### Pre-Lab Procedures

This resource provides **Teacher Resource Pages** and worksheets to help students develop the skills necessary to complete chapter labs.

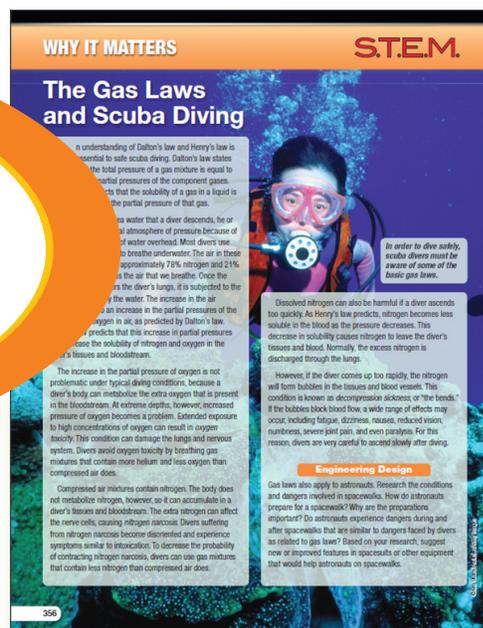
### Graphing Calculator Activities

HMH has partnered with Texas Instruments to present nine **graphing activities** for use with the TI-Nspire™ graphing calculator.



## Virtual Labs

Students can hone their lab skills in a virtual environment. Fun, safe and highly interactive, these labs focus on experiments for which equipment and materials are often expensive or difficult to acquire.



The © 2017 **Modern Chemistry** program is available in five configurations: Premium, Hybrid, Digital, Digital Enhanced, and Class Set packages. The Hybrid bundle is the base option, with the print Student Edition and Teacher Edition, the student eBook, and all worksheets, labs, and Spanish resources. The Premium bundle provides added print resources, such as Interactive Readers and CliffsNotes® Study Guides. Digital bundles offer a low-cost, digital-only option. The Premium, Hybrid, Digital Enhanced, and Class Set bundles include the *On the Job* STEM videos and rich multimedia, animations, and simulations. Common Cartridge® options are also available for purchase.

	Student*** 	Teacher 	Print	Digital
<b>Student Edition</b>				
<b>Teacher Edition</b>				
<b>Interactive Reader</b> (and Answer Key for Teacher)** • Online Audio Files (English only)			 	 
<b>Performance Expectations Guide SE/TE</b>			 	 
<b>Engineering Design Guide SE/TE</b>			 	 
<b>CliffsNotes Chemistry Quick Review</b> (with Premium package only)				
<b>Interactive Online Edition</b>				
• NGSS* Correlation Tool				
• Teacher Guide for Google Expeditions				
• Student eBook: Chapter Summaries Audio files and SE pages**				
• Worksheets (Section Study Guides, Chapter Study Guides, Graphing Calculator Activities)				
• Labs** (STEM, Open Inquiry, QuickLabs, Standard, Challenge, Biotechnology, Probeware, Forensic, Virtual Labs)				
• Lab Resources (Labs with Teacher Notes, Laboratory Manager's Professional Reference, Probeware Instruction Sheet, Pre-Lab Procedures, Comprehensive Materials List, Graphing Calculator Instructions)				
• Student Toolkit (Scientific Reasoning Skill Builder, Project Resources, Smart Grapher, FoldNotes, Periodic Table, Glossary, Scientific Calculator, Graphing Calculator)				
• Teacher Toolkit (Teaching Strategies, Classroom Management Resources, Lesson Plans, Project Resources)				
• Multimedia and Activities (Animated Chemistry, Virtual Labs, Why it Matters Videos, Weblinks)				
• Presentation Tools (Teaching Visuals, Interactive Whiteboard Resources, PowerPresentations)				
• <i>On the Job</i> STEM Videos (with Premium package only)				
• Problem Solving Support (Learn It! Videos, Solve It! Cards, Sample Problem Sets, Interactive Demonstrations, Solution Tutor)				
• Interactive Review (Interactive Concept Maps, Interactive Review Games)				
• Online Assessments (ExamView, Section Quizzes, Chapter Tests A&B, Online Assessment with Remediation)				

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\*\*Also available in Spanish. \*\*\*All of the student-facing resources are available to the teacher via the Teacher's Interactive Online Edition.

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