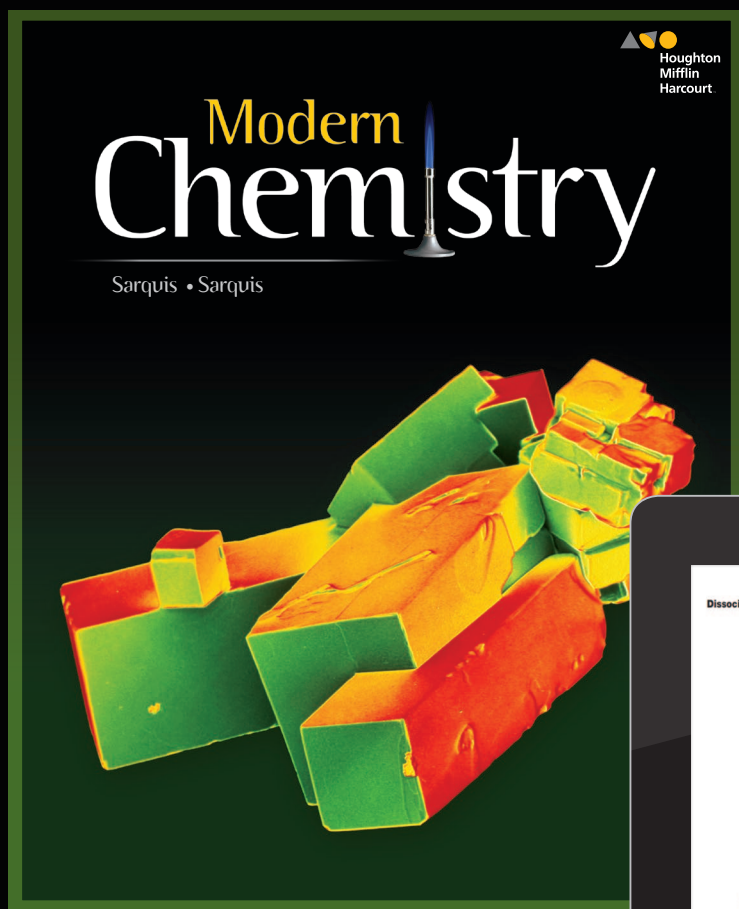


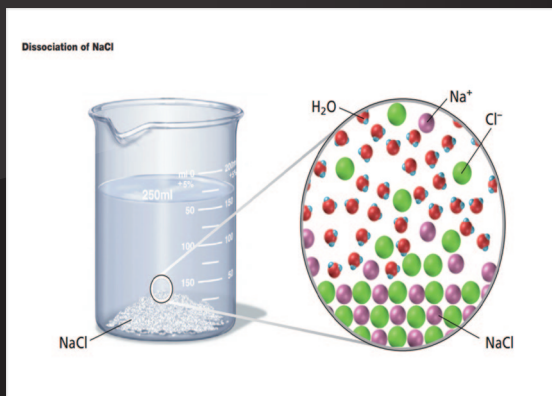
# Modern Chemistry



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Featuring connections to **THING & EXPLAINER**  
 Google Expeditions



**“Education is  
the most  
powerful tool  
which you can  
use to change  
the world.”**

— Nelson Mandela

HMH *Modern Chemistry*® empowers teachers to deliver effective, engaging, and motivating instruction with an abundance of print and digital resources, including rich multimedia, animations and simulations.



**Try it now!**



**1**

**Go to:** [preview.hrw.com](http://preview.hrw.com)

**2**

**Enter Sample Word:**

**3**

**Enter your registration information, select “Register” and follow the on-screen instructions to receive your credentials and get started**

### Dashboard

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

# 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.

## Why it Matters

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

## Solve It! Cards

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

## Learn It! Videos

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



## 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.

Modern Chemistry for the NGSS	
Science, Grade 9-12	Standards and Resources
Program Overview	
HS-PS1	
PE HS-PS1-1	
PE HS-PS1-2	
PE HS-PS1-3	
DCI	
HSP1.A.3	
HSP2.B.3	
SEP	
PE HS-PS1-4	
PE HS-PS1-5	
PE HS-PS1-6	

## NGSS\* Correlations

Correlations both online and in the TE facilitate standards implementation.

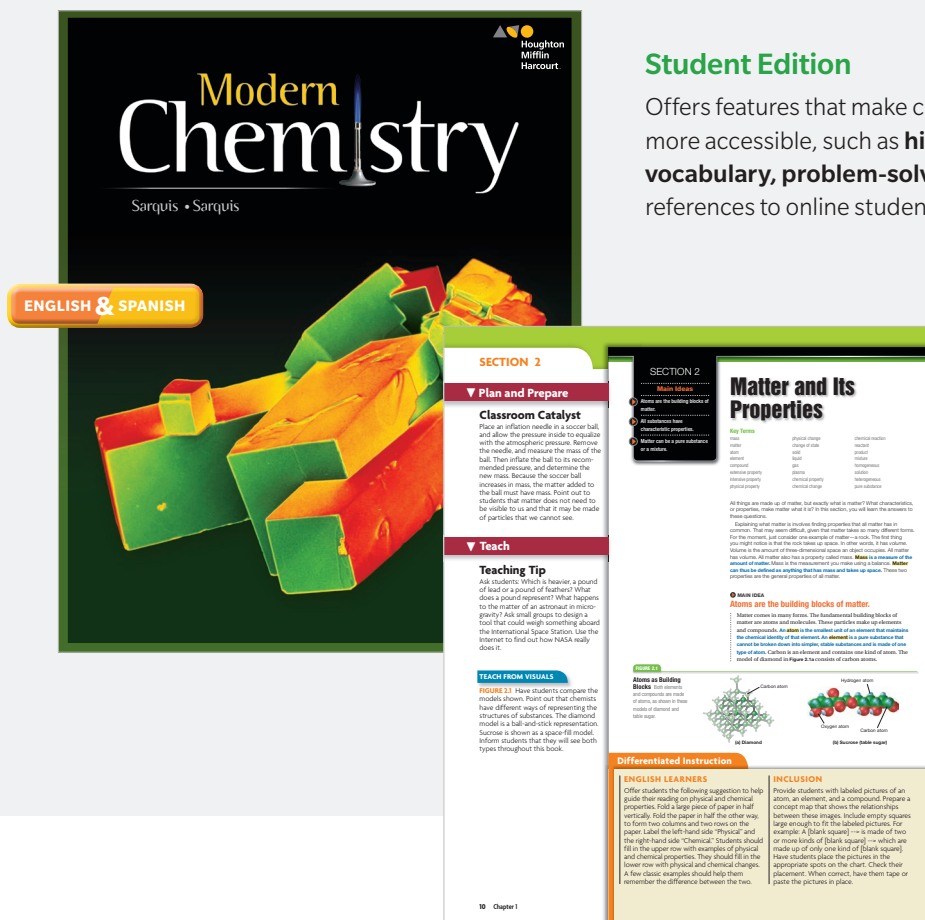


\*Next Generation Science Standards and logo are registered trademarks of Achieve. Neither Achieve nor the lead states and partners that developed the Next Generation Science Standards was involved in the production of, and does not endorse, this product.



# 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.



The image shows the front cover of the *Modern Chemistry* textbook by Sarquis and Sarquis, available in English and Spanish. Below the cover is a preview of the Student Edition page for Section 2, 'Matter and Its Properties'. The preview includes a 'Classroom Catalyst' activity, a 'Teach' section with a 'Teaching Tip', a 'TEACH FROM VISUALS' section with a figure, and a 'Differentiated Instruction' section with 'ENGLISH LEARNERS' and 'INCLUSION' sub-sections.

## 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

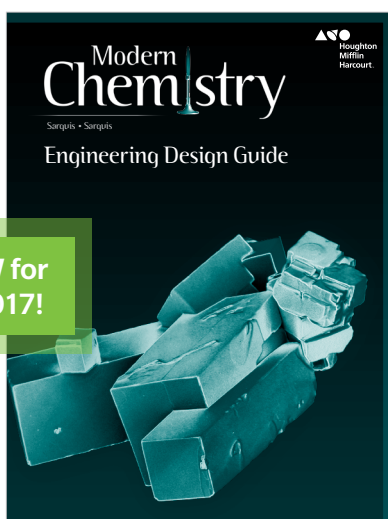
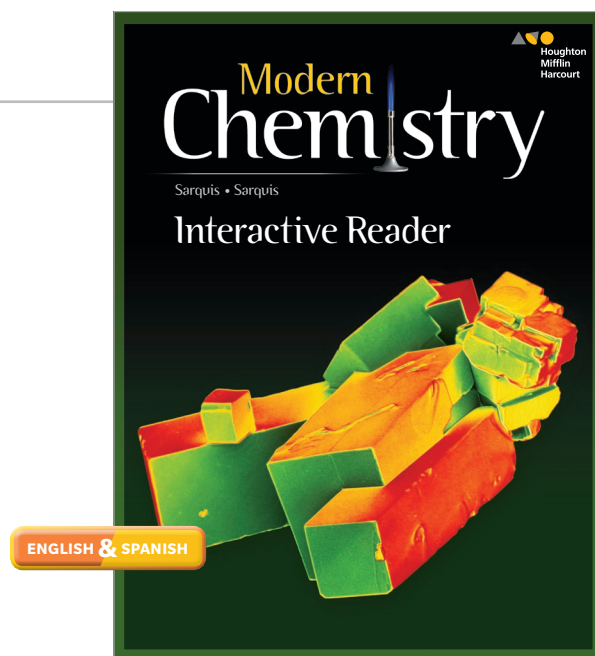
## Meet the Authors

**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

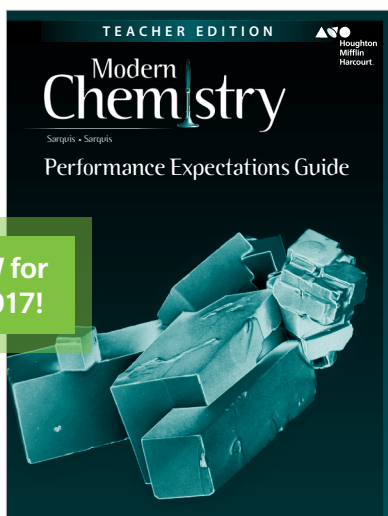
A **write-in worktext** that provides all of the essential content and vocabulary of the Student Edition at a reading level one to two grades below the text. A great resource for students of all ability levels, the Interactive Reader is both a core instructional tool for **struggling students** and a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



### 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.



### 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.



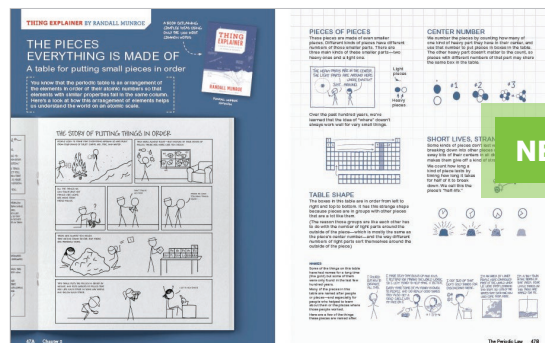
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# Print and Digital Tools that **Motivate** and **Engage**

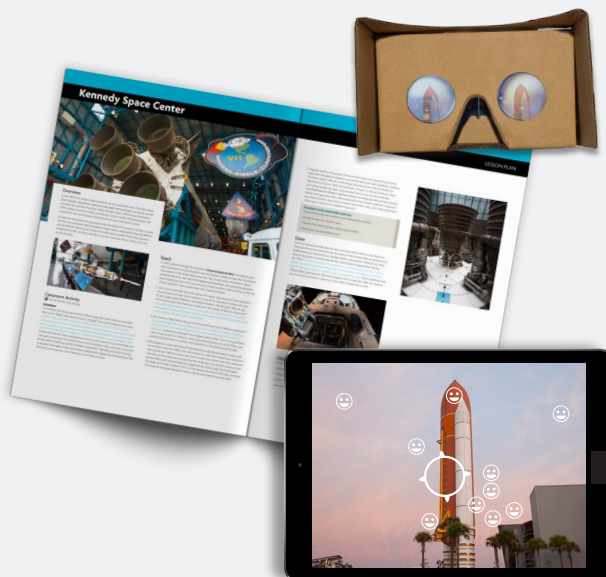
**HMH Modern Chemistry** offers the latest print and multimedia resources that speak directly to your students in a visual language they understand—ensuring that they will stay engaged.

## 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 **xkcd.com**, humorously explains complex topics in easy-to-understand language.



As a Google® content partner, HMH® has developed K–12 field trips for Google Expeditions. Using a virtual reality viewer—like Google Cardboard™—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 panoramas from fascinating locations, directly tied to science content! An **HMH Teacher Guide** provides ideas for incorporating the Expeditions into your lessons, as well as tips on how to guide and customize the experience.

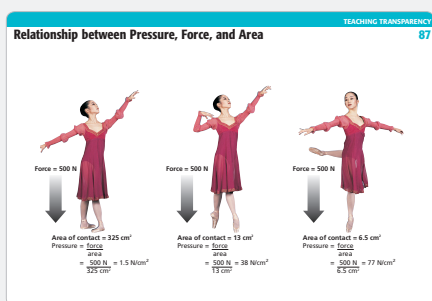
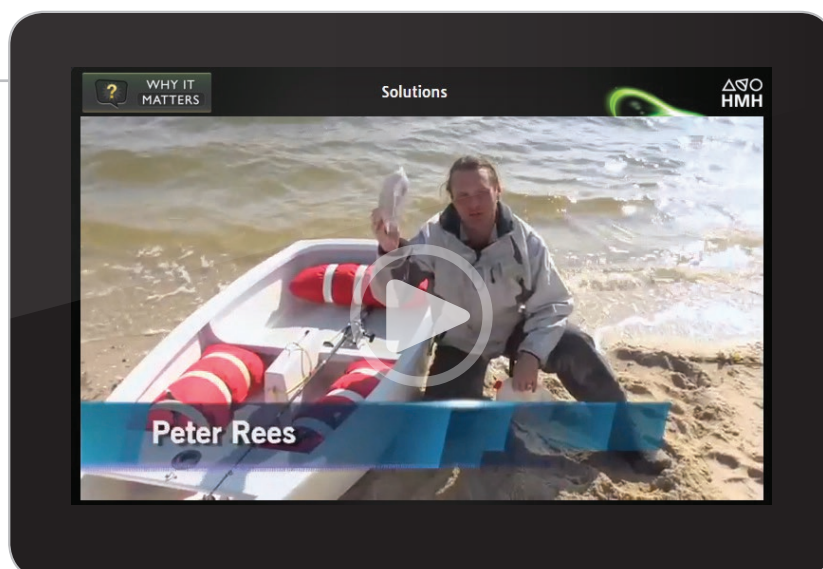


## On the Job STEM Videos

As part of our Premium, Hybrid, Digital Enhanced, and Class Set offerings 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.

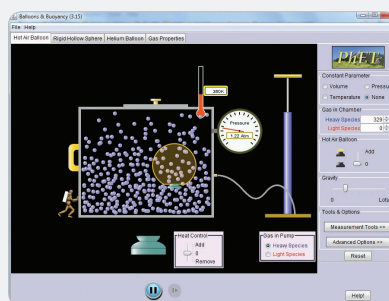
## Why It Matters Videos

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.



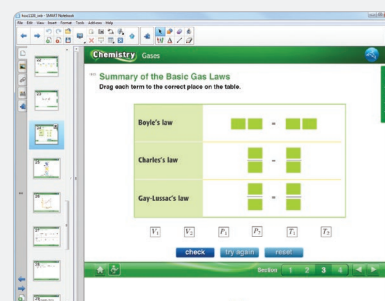
## Teaching Visuals

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



## PhET Simulations

Interactive online simulations produced under Creative Commons licensing by the University of Colorado at Boulder. They provide fun, interactive, **research-based simulations** of real-life phenomena.



## Interactive Whiteboard Resources

IWB resources include interactive **teaching visuals** and **content-reinforcement lessons** for each chapter of the textbook in SMART Notebook™ and ActivInspire® Flipchart formats.



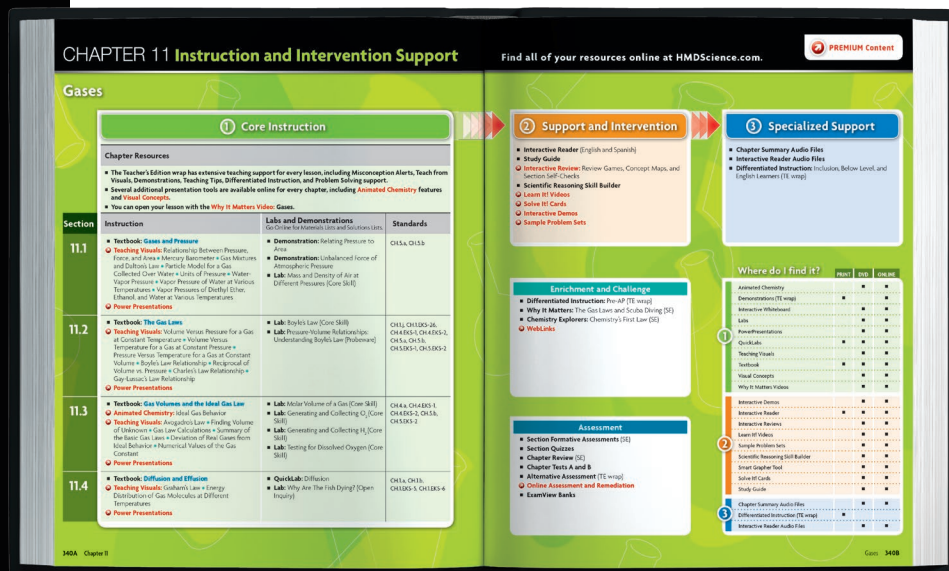
## Animated Chemistry

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



# Unparalleled resources for Differentiated Instruction

Students approach chemistry with a wide variety of skills and levels of preparation. **HMH Modern Chemistry** provides you with the tools you 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.

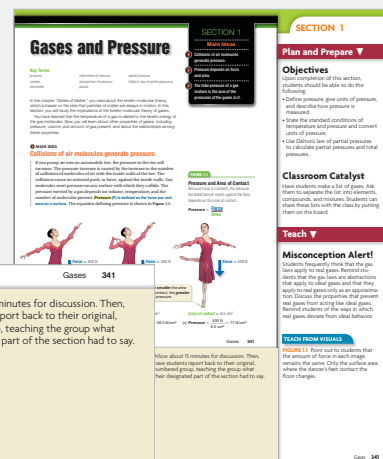
The wrap margin includes a **Differentiated Instruction** feature with a wide variety of strategies to help all students master chemistry concepts. Material categories include Below Level, English Learners, Pre-AP®, and Inclusion.

### Differentiated Instruction

#### BELOW LEVEL

Have students do a *jigsaw* activity to introduce this chapter. Divide the class into groups of 3–4 students and give each group a number. Divide Section 1 of this chapter into 3 or 4 parts, and name them A, B, C, etc. Give each student in a group a letter designation in addition to their group number. For example, a student might be designated as 1A. Have the A students from all groups discuss and determine the major concepts within part A of the section. The B students will do the same with part B, and so on.

Allow about 15 minutes for discussion. Then, have students report back to their original, numbered group, teaching the group what their designated part of the section had to say.



## 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!**

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

### CHAPTER 11 REVIEW

#### Gases

##### MIXED REVIEW

**SHORT ANSWER** Answer the following questions in the space provided.

1. Consider the following data table.

Approximate pressure (kPa)	Altitude above sea level (km)
101	0 (sea level)
80	1.5 (Denver, CO)
55	3.0 (Mount Everest)

a. Explain briefly why the pressure decreases as the altitude increases.

b. A few places on Earth are below sea level (the Dead Sea). What would be true about the average atmospheric pressure there?

2. Explain how the ideal gas law can be simplified to give  $P \propto T$ , when the pressure and temperature are constant.

**PROBLEMS** Write the answer on the line to the left. Show all work.

3. Convert a pressure of 0.400 atm to the following units:

a. kPa \_\_\_\_\_

b. Pa \_\_\_\_\_

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

### CHAPTER 11 REVIEW

#### Gases

##### SECTION 1

**SHORT ANSWER** Answer the following questions in the space provided.

1. \_\_\_\_\_ Pressure =  $\frac{\text{force}}{\text{area}}$  For a constant force, when the surface area is tripled the pressure is \_\_\_\_\_

(a) doubled  
(b) a third as much  
(c) tripled  
(d) unchanged

2. Rank the following pressures in increasing order.

(a) 50 kPa  
(b) 2 atm  
(c) 70 torr  
(d) 100 N/m<sup>2</sup>

3. Explain how to calculate the partial pressure of a dry gas that is collected over water when the total pressure is atmospheric pressure.

**PROBLEMS** Write the answer on the line to the left. Show all work in the space provided.

4. Use five to six data points from Appendix Table A-8 in the text to sketch the curve for water vapor's partial pressure versus temperature on the graph provided below.

Temperature (°C)	Vapor pressure (kPa)
0	0.611
5	0.678
10	0.750
15	0.833
20	0.929
25	1.038
30	1.161
35	1.307
40	1.472
45	1.658
50	1.867
55	2.099
60	2.354
65	2.643
70	2.967
75	3.336
80	3.758
85	4.234
90	4.766
95	5.356
100	6.000

b. Do the data points lie on a straight line?

c. Based on your sketch, predict the approximate partial pressure for water at 11°C.

## Interactive Reader Audio Files

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

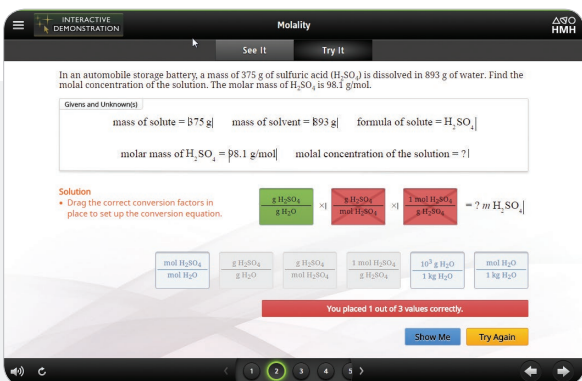


# and Problem Solving

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.

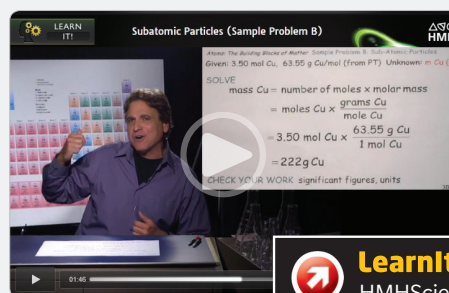
## Solution Tutor

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.

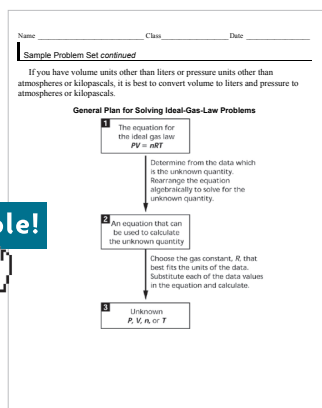
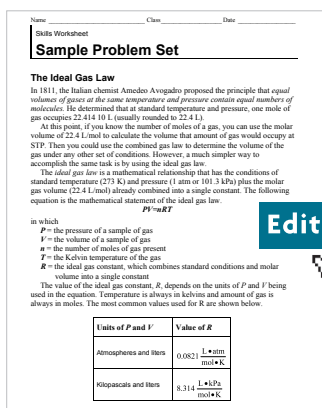


## Learn It! Videos

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

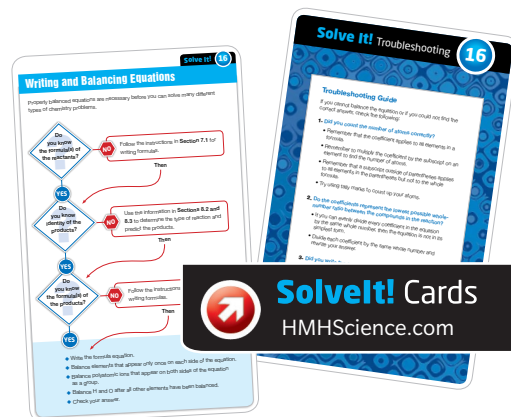
## Sample Problem Sets

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



## Solve It! Cards

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



# Wide-ranging support for Reading and Vocabulary

Your students will get the most out of their reading with numerous 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:

**Charles's law**  $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_1$  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 causes an increase in volume. To obtain  $V_2$ , rearrange the equation for Charles's law:

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \Rightarrow V_2 = \frac{V_1 T_2}{T_1} = \frac{(752 \text{ mL})(323 \text{ K})}{298 \text{ K}} = 815 \text{ mL Ne}$$

As the temperature of the gas increases as the temperature increases, milliliters, as desired. The answer contains the appropriate significant figures.

25.0°C. What will the volume at 100.0°C be?

Boyle's law with a freely moving cylinder. At 0.0°C, the pressure 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:

**Gay-Lussac's law**  $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$P_1$  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  $P_2$ :

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

**Continued**



### CHECK FOR UNDERSTANDING

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

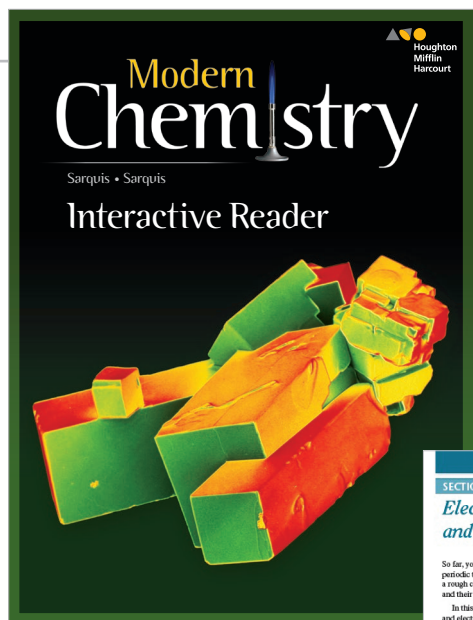
### Check for Understanding

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 is 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 chlorine atoms 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 radius  
radius  
bonding energy  
electron affinity

atomic  
radius  
bonding  
energy  
electron  
affinity

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### 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 determinado 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 enlazados. Por ejemplo, una molécula de gas cloro contiene dos átomos de cloro enlazados. 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 átomos de oro están unidos mediante su enlace metálico. ¿Cómo usarías el bloque de oro para determinar el radio atómico de un átomo de oro?

#### TERMINOS CLAVE

radio atómico  
radio  
energía de enlace  
energía de ionización  
afinidad electrónica

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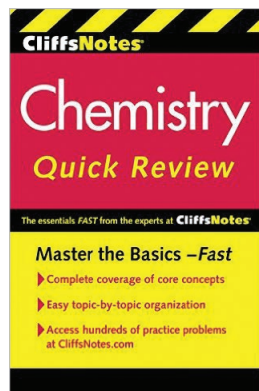
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Editable!

## 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 **HMHSscience.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.

ENGLISH & SPANISH

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. is positively charged.  
b. has the net of.  
c. The comp.  
d. Several so
4. The only po

ENGLISH & SPANISH

Editable!

## 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 Tests 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 number and general properties of the following elements:  
a. carbon, C  
b. argon, Ar  
c. chlorine, Cl  
d. sodium, Na

28. How can you tell the difference between an element and a compound?

29. Identify each of the following as either a physical change or a chemical change. Explain your answers.  
a. a piece of wood is sawed in half.  
b. milk sours.  
c. sodium metal reacts with the atmosphere.  
d. a metal wire conducts electricity.

30. Write a paragraph that shows that you understand the following terms and the relationships between them: atom, molecule, compound, and element.

31. 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**

32. **Interpreting Concepts** One way to make ammonia is to start by combining nitrogen gas and water, then adding sugar to and your specific choice for next step. Is this combination classified as a compound or a mixture? Explain your answer.

33. **Applying Concepts** A pure white, solid material that looks like white when you heat it turns brown under certain conditions. There is a change in \_\_\_\_\_.

34. **Interpreting Concepts** A. In breaking an egg on a example of a physical or chemical change? Explain your answer.  
B. What are the functions of these elements in the body?  
C. What are the functions of these elements in the body?  
D. What are the functions of these elements in the body?

**RESEARCH AND WRITING**

35. Research any current technological product of your choosing. Find out about its materials, how it was developed, and how it is used. Write a paragraph that describes the product and its uses. Also find out about the basic research and applied research that made its development possible.

36. **Applying Concepts** A. In breaking an egg on a example of a physical or chemical change? Explain your answer.  
B. What are the functions of these elements in the body?  
C. What are the functions of these elements in the body?  
D. What are the functions of these elements in the body?

**STANDARDS-BASED ASSESSMENT**

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

Amount of solute	Boiling point
0 g	100.0°C
10 g	100.5°C
20 g	101.0°C
30 g	101.5°C
40 g	102.0°C

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

A. As solute is added, the boiling point decreases.  
B. As solute is added, the boiling point increases.  
C. The boiling point of the water solution is always 101.5°C.  
D. Water is saturated if 10 grams of solute are added.

2. You find an unknown substance that cannot be \_\_\_\_\_.

3. The label on a bottle of hydrochloric acid says it is a "strong" acid. What does this mean? What would be the best way for you to test to determine this claim?

4. Compare the color of the hydrochloric acid with the color of the water. What does this tell you about the acid?

5. Research what ingredients actually make up acids, and how they work. Write a paragraph that describes the ingredients and how they work.

6. Use a pH indicator to determine the pH of the acid. Write a paragraph that describes the pH of the acid and how it relates to the acid's strength.

**GRIDDED RESPONSE**

7. A student collects the following data about a substance:

Substance's Properties
Boiling point: 100°C

8. How do you decide whether a sample of matter is a solid, a liquid, or a gas?

9. Contrast mixtures with pure substances.

**Critical Thinking**

10. **ANALYZING INFORMATION** Compare the composition of sucrose purified from sugar cane with the composition of sucrose purified from sugar beets. Explain your answer.

**SECTION 2 FORMATIVE ASSESSMENT**

**Reviewing Main Ideas**

1. What is the main difference between physical properties and chemical properties?  
a. Give an example of each.

2. 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

3. How do you decide whether a sample of matter is a solid, a liquid, or a gas?

4. Contrast mixtures with pure substances.



## 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.

**Chapter 11** Standardized Test Preparation

**Short Answer**

9. The graph on the next slide shows a plot of volume versus pressure for a particular gas sample at constant pressure. Answer the following questions by referring to the graph. No calculation is necessary.

- What is the volume of this gas sample at standard pressure?
- What is the volume of this gas sample at 4.0 atm pressure?
- At what pressure would this gas sample occupy a volume of 5.0 L?

Navigation: < Back Next > Preview Main

**Chapter 11** Standardized Test Preparation

**Short Answer**

9. continued

**Answer:**

- 2.0 L
- 0.5 L
- 0.4 atm

Navigation: < Back Next > Preview Main

**Chapter 11** Standardized Test Preparation

**Preview**

- Multiple Choice
- Short Answer
- Extended Response

Navigation: < Back Next > Preview Main

## 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

**1 Assess**

Modern Chemistry

Section 8.1 Tutorial/Post-Test

2. Which equation below violates the law of conservation of mass?

- ☐  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
- ☐  $\text{KCl} + \text{Br} \rightarrow \text{KBr} + \text{Cl}_2$
- ☐  $2\text{Fe} + \text{O}_2 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2$
- ☐  $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

Navigation: 1 2 3 4 5

**2 Prescribe**

Modern Chemistry

Section 8.1 Tutorial/Post-Test

Choose one or more Tutorials, then click the Post-Test tab.

Tutorials:

- Student Edition
- Interactive Reader
- Study Guide
- Visual Concept 1
- Visual Concept 2
- Visual Concept 3
- Visual Concept 4
- Visual Concept 5
- Visual Concept 6
- Visual Concept 7
- Learn It! Video 1
- Learn It! Video 2

**3 Re-assess**

Modern Chemistry

Section 8.1 Tutorial/Post-Test

5. Which set of coefficients will balance the equation below?

$$\text{NaOH} + \text{Cu}(\text{NO}_3)_2 \rightarrow \text{Cu}(\text{OH})_2 + \text{NaNO}_3$$

- ☐ 1, 1, 1, 1
- ☐ 1, 2, 2, 1
- ☐ 2, 1, 2, 1
- ☐ 2, 1, 1, 2

Navigation: 1 2 3 4 5



# 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.

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

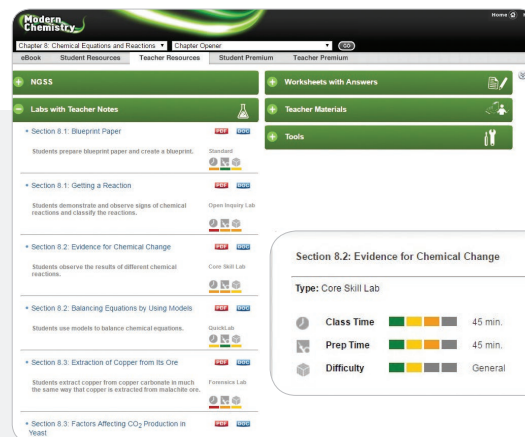
Specifically designed to be short project-based labs that encourage students to collaborate, strategize, construct, and evaluate a lab challenge of their own creation

### Probeware Labs

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

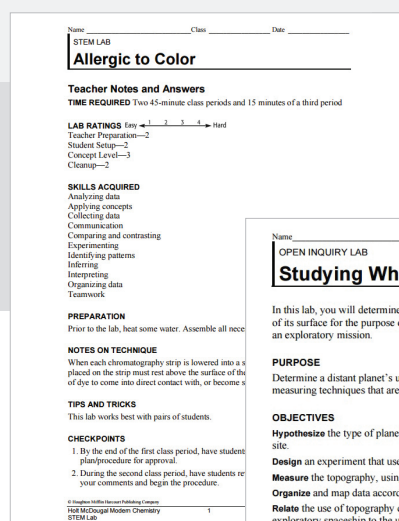
### Forensic Labs

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

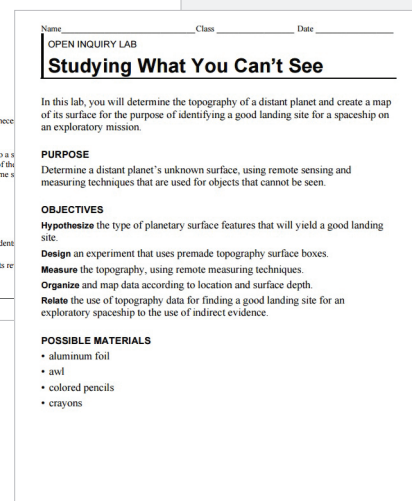


## Labeled Labs

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



## STEM labs



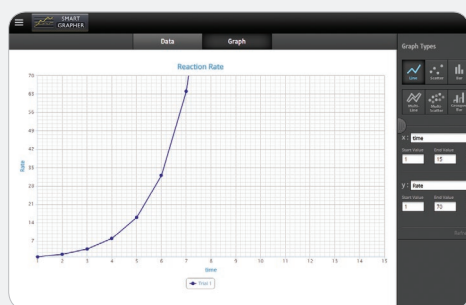
## Inquiry labs

## S.T.E.M. in the Student Edition

Select STEM features 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, **HMHSscience.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.

WHY IT MATTERS
**S.T.E.M.**

### The Gas Laws and Scuba Diving

**A**n understanding of Dalton's law and Henry's law is essential to safe scuba diving. Dalton's law states that the total pressure of a gas mixture is equal to the sum of the partial pressures of the component gases. Henry's law predicts that the solubility of a gas in a liquid is a direct function of the partial pressure of that gas.

For every 33 ft of sea water that a diver descends, he or she feels one additional atmosphere of pressure because of the increasing weight of water overhead. Most divers use compressed air tanks to breathe underwater. The air in these tanks, which contains approximately 78% nitrogen and 21% oxygen, is the same as the air that we breathe. Once the compressed air enters the diver's lungs, it is subjected to the pressure caused by the water. The increase in the air pressure leads to an increase in the partial pressures of the nitrogen and oxygen in air, as predicted by Dalton's law. Henry's law predicts that this increase in partial pressures will increase the solubility of nitrogen and oxygen in the diver's tissues and bloodstream.

The increase in the partial pressure of oxygen is not problematic under typical diving conditions, because a diver's body can metabolize the extra oxygen that is present in the bloodstream. At extreme depths, however, increased pressure of oxygen becomes a problem. Extended exposure to high concentrations of oxygen can result in oxygen toxicity. This condition can damage the lungs and nervous system. Divers avoid oxygen toxicity by breathing gas mixtures that contain more helium and less oxygen than compressed air does.

Compressed air mixtures contain nitrogen. The body does not metabolize nitrogen. However, as it can accumulate in a diver's tissues and bloodstream. The extra nitrogen can affect the nerve cells, causing nitrogen narcosis. Divers suffering from nitrogen narcosis become disoriented and experience symptoms similar to intoxication. To decrease the probability of contracting nitrogen narcosis, divers can use gas mixtures that contain less nitrogen than compressed air does.

*In order to dive safely, scuba divers must be aware of some of the basic gas laws.*

Dissolved nitrogen can also be harmful if a diver ascends too quickly. As Henry's law predicts, nitrogen becomes less soluble in the blood as the pressure decreases. This decrease in solubility causes nitrogen to leave the diver's tissues and blood. Normally, the excess nitrogen is discharged through the lungs.

However, if the diver comes up too rapidly, the nitrogen will form bubbles in the tissues and blood vessels. This condition is known as decompression sickness, or "the bends." If the bubbles block blood flow, a wide range of effects may occur, including fatigue, dizziness, nausea, reduced vision, numbness, severe joint pain, and even paralysis. For this reason, divers are very careful to ascend slowly after diving.

**Engineering Design**

Gas laws also apply to astronauts. Research the conditions and dangers involved in spacewalks. How do astronauts prepare for a spacewalk? Why are the preparations important? Do astronauts experience dangers during and after spacewalks that are similar to dangers faced by divers as related to gas laws? Based on your research, suggest new or improved features in spacesuits or other equipment that would help astronauts on spacewalks.

## 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, Class Set, and Digital Enhanced 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, PhET Simulations, Virtual Labs, Why it Matters Videos, Weblinks)				■
• Presentation Tools (Teaching Visuals, Interactive Whiteboard Resources, PowerPresentations)				■
• <i>On the Job</i> STEM Videos (with Premium, Hybrid, Digital Enhanced, and Class Set packages 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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