

## Introduction to Chemistry, 5e

Rich Bauer, James Birk and Pamela Marks

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### Detailed List of New Features

#### Student Hot Spot and Student-Centered Refinements Using Heat Maps:

Using heat maps from the adaptive reading tool SmartBook<sup>®</sup>, and the detailed analysis of student performance it provides, we were able to target specific learning objectives for minor re-wording, further explanation, or better illustration. Because SmartBook is a dynamic learning tool, we have a multitude of live data that show us exactly where students have been struggling with content; and we have direct insight into student learning that may not always be evident through other assessment methods. The data, such as average time spent answering each question and the percentage of students who correctly answered the question on the first attempt, revealed the learning objectives that students found particularly difficult. For example, the heat map below indicates that students struggled with questions related to the concept of density.

42%  
0.56  
3.2150


**Density** The **density** of an object is the ratio of its mass to its volume. While mass and volume both depend on the size of the object or sample, density does not. Density is an unvarying property of a substance no matter how much of it is present, as long as temperature and pressure are constant. The densities of a few substances are listed in Table 1.6.

Analysis of results like this allowed our revisions to be truly student-centered. For example, given specific known topics where students are struggling, we are able to clarify our description of density as shown below.

**Density** The **density** of an object is the ratio of its mass to its volume. While mass and volume both depend on the size of the object or sample, density does not. Density is an unvarying property of a substance no matter how much of it is present, as long as temperature and pressure are constant. For example, the density of water at 4°C is 1.00 g/mL. It doesn't matter if we have 10 mL or 10 L; the ratio of mass to volume would be the same, 1.00 g/mL. However, if the temperature increases, the water would expand to a larger volume, while the mass stays the same. The density of liquid water would decrease as the temperature increases. The densities of water and a few other substances are listed in Table 1.6.

Further, armed with this powerful insight into the places many students struggle with content, we are able to provide strategically timed access to additional learning resources. In the text, we have identified areas of particularly difficult content as “Student Hot Spots”—and use them to direct students to a variety of learning resources specific to that content. Students will be able to access over 800 digital learning resources throughout this text’s SmartBook. These learning resources present summaries of concepts and worked examples, including over 200 videos of chemistry faculty solving problems or modeling concepts that students can view over and over again. In the electronic version of the text, learning resources for these Student Hot Spots are embedded with the content for immediate access.

Guided by student results of conceptual understanding, we edited the content in all the chapters. While some changes are subtle, others are more extensive. Our ability to employ live student-assessment data for revisions to address areas of common misunderstanding is unprecedented and has afforded us the opportunity to change how we provide the best possible learning materials.

**Student Hot Spot**

Student data indicate you may struggle with writing balanced equations for combination reactions. Access the SmartBook to view additional Learning Resources on this topic.

## Chapter by Chapter Changes

### ALL CHAPTERS

Since the fourth edition of this book, elements 113, 115, 117, and 118 have been named: nihonium (Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og), respectively. Where applicable, periodic tables have been revised to include these elements names or symbols.

### CHAPTER ONE Matter and Energy

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Description of metal properties
- Description of compound
- General descriptions of physical and chemical properties
- Converting units, including Example 1.5

- Description of volume units
- Description of density and relationship to temperature
- Description of electric energy to include discussion of a battery
- Description of metric conversions and negative exponents
- A new margin note was added making a distinction between heating, cooking, and burning.
- An in-text calculation was added for determining the density of a cube of an unknown metal.
- A Student Hot Spot was added for unit conversions.

## **CHAPTER TWO** Atoms, Ions, and the Periodic Table

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Description isotopes
- Transition to Example 2.4 for interpreting isotope symbols
- Description of ions
- A new margin note was added, using grade point average as an example of a weighted average.
- Concept Review Question 2.147 was modified to remove premature reference to ionic radius.
- Student Hot Spots were added for relative atomic mass, classifying elements in the periodic table, and predicting ionic charges.

## **CHAPTER THREE** Chemical Compounds

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Figure 3.1 caption
- General descriptions of electrolyte and nonelectrolyte
- General descriptions of ionic and molecular compounds and their similarities and differences in properties and molecular-level structure
- Difference between atoms and monatomic ions
  - Naming ionic compounds, including Example 3.9
- Naming binary and oxoacids using bulleted points
- Practice Problem 3.2 was modified to ask about melting point instead of boiling point. The compounds were also changed to emphasize the difference between ionic and molecular compounds.
- A transition to Example 3.5 was added to emphasize that ion ratios remain the same when an ionic compounds dissolves in water.
- The difference in naming hydrogen halides such as HCl as molecular compounds or as acids when dissolved in water was noted with a new margin note.
- The difference in naming hydrogen halides such as HCl as molecular compounds or as acids when dissolved in water was noted with a new margin note.
- Student Hot Spots were added for writing formulas for ionic compounds, writing formulas for ionic compounds that contain polyatomic ions, and naming an ionic compound from its formula.

## **CHAPTER FOUR** Chemical Composition

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- In-text problem calculating number of ions
- General description of molar mass and description of molar mass determination for a compound
- General description of empirical and molecular formulas
- Description of empirical formulas from percent composition
- Description of molecular formulas from empirical formulas
- Description of ionic compound in solution, including the molecular-level image shown in Example 4.14
- Description of percent by mass and molarity

- Approach for molarity calculations, including dilution problems
- Rewording in Math Toolbox 4.1
- An in-text calculation was added for converting moles to mass for a compound as in Example 4.6.
- The ionic compound in Example 4.22 was changed from NaCl to MgCl<sub>2</sub>.
- Student Hot Spots were added for converting grams to formula units and molarity.

## **CHAPTER FIVE** Chemical Reactions and Equations

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Predicting products of combination reactions between a metal and a nonmetal
- Description of single-displacement reactions
- Predicting the precipitate in precipitation reactions
- General description of gas-forming reactions
- Description of an ionic equation
- Some photos in Figure 5.8 were updated.
- Figure 5.12 was updated to include rubidium in the series of alkali metals reacting with water.
- The photo in end-of-chapter Question 5.15 was updated.
- Context was added to Practice Problem 5.14.
- Student Hot Spots were added for writing a balanced equation for a combination reaction between a metal and a nonmetal, predicting and writing equations for single-displacement reactions, and writing net ionic equations and determining spectator ions.

## **CHAPTER SIX** Quantities in Chemical Reactions

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Discussion of a balanced equation in Example 6.1
- Magnesium was changed to potassium in the box on exact amounts of reactants
- Example 6.9 was modified to indicate that the energy produced is electricity
- Figure 5.12 was updated to include rubidium in the series of alkali metals reacting with water.
- Consider This 6.11 was replaced with a new question.
- Student Hot Spots were added for interpreting chemical equations, limiting reactants at a molecular level, determining the mass of product when there is a limiting reactant, calculating percent yield of a reaction, and calorimetry calculations.

## **CHAPTER SEVEN** Electron Structure of the Atom

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Description of electromagnetic radiation, frequency, and wavelength
- Description of Bohr model
- Description of valence level
- The caption for Figure 7.6 was revised for clarity.
- Students Hot Spots were added for calculations involving photon energy, wavelength, and frequency; and the Bohr model of the atom.

## **CHAPTER EIGHT** Chemical Bonding

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- General descriptions of ionic and covalent bonding, including the caption to Figure 8.2
- Descriptions of covalent bonds and unshared electron pairs
- Drawing Lewis structures for polyatomic ions and oxoacids
- Molecules and ions with similar Lewis structures
- Determining the shape of molecule or polyatomic ion from its Lewis structure
- Determining the structures of molecules with more than one central atom

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- The key term Lewis formula was changed to Lewis structure throughout chapter and later chapters.
- The Consider This question that follows Example 8.7 was modified to emphasize when resonance is not possible.
- Table 8.6 was reorganized to emphasize the importance of electron domains in determining molecular shapes.
- Modified text, including captions in Figures 8.32 and 8.24 and explanation in Example 8.11.
- Student Hot Spots were added for describing the difference between polar and nonpolar covalent bonds, drawing Lewis structures, determining shape of a molecule from its Lewis structure, and determining if a molecule is polar from its molecular shape.

## **CHAPTER NINE** The Gaseous State

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Specified that the given density of water is for the liquid
- Margin note added on air density and temperature
- A reference to Math Toolbox 9.2 was added to the discussion of combined gas law calculations.
- The Avogadro's Hypothesis discussion and the caption to Figure 9.20 were modified to indicate that the simple direct relationship works only at constant temperature and pressure.
- A margin note was added to emphasize that temperature must be in units of kelvins in gas law calculations.
- Student Hot Spots were added for volume-temperature relationships, pressure-volume-temperature relationships, application of Dalton's law, and relative rates of diffusion.

## **CHAPTER TEN** The Liquid and Solid States

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Description of liquid-gas phase changes
- Description of solid-gas phase changes
- Description of surface tension
- Table 10.2 was revised for clarity.
- Student Hot Spots were added for energy for phase changes and the relationship between strength of intermolecular forces and boiling point.

## **CHAPTER ELEVEN** Solutions

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Description of solution composition, including a transition for Example 11.1
- General description of factors that affect solubility
- Margin note added to provide context to the definition of solubility
- Descriptions of unsaturated and supersaturated solutions
- Description of precipitation reactions
- The margin note about the ppm unit was revised to include the ppb unit with examples.
- The brief description of normality and its use in some commercial labs was modified and moved into the text.
- In Example 11.8, the balanced equation for the reaction was added and the solution was modified to improve clarity.
- The definition of the term saturated solution was modified to be more precise and applicable to usage in this textbook.
- A margin note was added about the solubility of sucrose in water.
- Student Hot Spots were added for representing a dissolving process with a balanced equation, understanding the changes in attractive forces when an ionic compound dissolves, and predicting

solubility in polar and nonpolar solvents.

## **CHAPTER TWELVE** Reaction Rates and Chemical Equilibrium

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- In Example 12.3, “hydronium ions” was changed to “aqueous hydrogen ions.”
- Description of effect of temperature on the position of equilibrium and the direction of a shift
- New photos were used in the chapter introduction and Figures 12.2 and 12.20.
- Student Hot Spots were added for collision theory, identifying intermediates and catalysts, equilibrium constant expressions, reactions quotients and predicting the direction of a reaction, and applying Le Chatelier’s principle.

## **CHAPTER THIRTEEN** Acids and Bases

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Description of weak acid and its conjugate base
- Description of weak base and its conjugate acid
- Clarified solution to Example 13.5
- Clarified caption to Figure 13.21
- The description of an amphoteric substance was modified to include  $\text{HSO}_3$ .
- Student Hot Spots were added for determining hydronium and hydroxide concentration for solutions of strong acids or strong bases and determining hydronium and hydroxide concentration from pH or pOH.

## **CHAPTER FOURTEEN** Oxidation-Reduction Reactions

- Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:
- The wordings to the caption of Figure 14.6 and to the solution of Example 14.1 were modified.
- The solution to Example 14.4 was modified.
- The solution to Example 14.7 was modified.
- The cost of corrosion repair and prevention was updated.
- New photos were used in the chapter introduction and Figures 14.2, 14.9, and 14.26.
- Student Hot Spots were added for assigning oxidation numbers, identifying oxidation-reduction reactions and changes in oxidation number, balancing simple oxidation-reduction reaction equations, balancing complex oxidation-reduction reaction equations, and predicting spontaneous reactions in voltaic cells.

## **CHAPTER FIFTEEN** Nuclear Chemistry

- Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:
- A transition was added before Example 15.2 to clarify the usage of beta radiation as electron and positron particles.
- The solution to Example 15.2 was modified.
- The caption to Figure 15.23 was modified to include a brief description of the purpose of the control rods and moderator in the reactor core in a fission reactor.
- Student Hot Spots were added for writing balanced equations for radioactive decay processes, predicting the method of radioactive decay by which an unstable nuclide will undergo, and using half-lives to determine the amount of nuclide remaining after a given amount of time.

## **CHAPTER SIXTEEN** Organic Chemistry

- A margin note was added to help students recall that carbon generally forms four covalent bonds

because carbon atoms have four valence electrons and needs eight to obtain an octet.

- Student Hot Spots were added for representing organic molecules in different ways, determining if a compound is saturated or unsaturated from its formula, writing names for alkanes and drawing structural formula, and determining names and structures for alkenes and alkynes.

## **CHAPTER SEVENTEEN** Biochemistry

Based on Smartbook Heat Maps, the following changes were made for clarification of important concepts:

- Caption for Figure 17.5
- Caption for Figure 17.9
- Caption for Figure 17.16
- Description of glycosidic linkage formation
- The solution for Example 17.4 was modified for clarity.

Student Hot Spots were added for hydrolysis of peptide bonds and converting the open-chain form of a monosaccharide to the ring form.

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