Student Study Guide

to accompany

Biology

Eighth Edition

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PREFACE
Getting the Most Out of This Study Guide and Your Studying

Welcome to the world of introductory biology! It is a fascinating and exciting world, but one that can also seem overwhelming at times. This study guide is designed to help you appreciate the fascination and excitement without being overwhelmed. By reading this preface, you are taking a first and very important step toward helping yourself do as well as possible in your biology endeavors. In the next few pages we will explain the philosophy behind the way we have written this study guide, what is in the study guide, and the best way to use it. Our philosophies and suggestions come from over 60 combined years of helping students learn about biology and seeing what works well and what doesn't. We believe that working through this study guide will help you master and truly understand the material in each chapter of the text, rather than just memorizing seemingly random facts.

In addition to this study guide, the *Biology, Eighth Edition*, website, also can be used to test your knowledge and practice your skills. Related material for each chapter can be found by going to: www.ravenbiology.com.

This study guide was written specifically to accompany the eighth edition of *Biology* by Raven, Johnson, Losos, Mason, and Singer. Just as the textbook has changed between the seventh and eighth editions, so has the study guide. Each chapter in the textbook has an accompanying chapter in this study guide. To help you organize the material, each of our chapters follows a consistent format.

A section called **Mastering Key Concepts** sets the scene for you. It provides a brief overview of the chapter and then runs through the chapter's concept outline, summarizing key points and giving helpful hints on topics to notice or consider.

The concepts section is followed by the **Challenging Your Understanding** section, which is designed to help you recognize the relationships or connections between the major concepts in the chapter. This helps ensure that you don't compartmentalize your new knowledge as random, isolated bits of information.

Next, the **Key Terms** section focuses on the new vocabulary. Every specialized discipline has its own terminology and biology is no exception. Studying introductory biology is similar in many ways to studying a foreign language. You must know the vocabulary in order to communicate. To understand all the concepts and how they relate to each other, you must first know what the words mean. We have listed the key terms in the sequence in which they are presented in the textbook to maintain the coherency of the material and the flow of ideas. This should help you remember the development of the various concepts more easily than if the list of terms were alphabetized. We have included in our key terms every word in the chapter that is in boldface type. These words are taken from the figure captions as well as the text.
Web Component: Test your knowledge of key terms by using the flashcard vocabulary.

The remaining sections of each study guide chapter are designed to help you actively test yourself and make sure you have mastered the material in the chapter. Active rather than passive learning is one of the guiding philosophies behind the way we have written this study guide. The more actively you are involved with this study guide, the more likely you are to learn and retain the information. That is why we have you fill in charts, make drawings, label drawings, make lists, stage discussions, and answer questions rather than just passively reading text summaries to yourself. We want you to understand, apply, synthesize, and work with the material, not just memorize it.

* I have removed these pages.
* Use the online flashcar instead.
* Figures & diagrams are importan

The **Learning by Experience** section is intended to reinforce important concepts or topics in the chapter. The exact nature of each activity varies with the different chapters, but all are designed to have you actively *use* the knowledge you have acquired.
The other active section, **Exercising Your Knowledge**, is your chance to test yourself and practice for your class exams. Answering these questions not only will let you know if you have thoroughly learned the material, but also will help you overcome test anxiety by practicing at your own speed and as often as you wish. This section begins with 10 short-answer essay questions designed to help you articulate your understanding of the key concepts, as well as apply the understanding to new situations or make connections between concepts.

Next come 20 multiple choice questions; some of these test for understanding of concepts, while others test for knowledge of specific detail. Although you need to know the detail and the specific meanings of the words, just memorizing the new vocabulary is not enough. You must be able to put those words into meaningful sentences, and you must understand the concepts as well. For each multiple choice question, we have provided four or five answer choices; only one of them is correct. One of the most effective ways to study and take a multiple choice test is to read the question and all the choices carefully and make sure you know what each is saying. Then ask yourself not only which is the correct answer, but also *why* is it correct and why are the other choices wrong?

We do not provide true/false questions because we believe that the short-answer and multiple choice formats are better study tools for you. If you can answer them, you should not have trouble handling true/false questions if your biology instructor uses them. Remember, each multiple choice question is essentially four or five true/false questions; you have to decide if each choice is true or not.
Web Component: Test your knowledge further by using online multiple choice and animation quizzing.

Focusing Your Study
The answers for each of the questions in the Learning by Experience and Exercising Your Knowledge sections are listed in **Assessing Your Knowledge** at the end of each chapter. For Exercising Your Knowledge, we have listed the text chapter section number to help guide your review if necessary.

The answers also indicate whether each Exercising Your Knowledge question is either:

- a concept question (denoted by an asterisk) or
- a detail question.

By looking at which questions you get right and which ones you miss, you may see a pattern (e.g., do you tend to miss more detail questions or more concept questions?). This is valuable information for helping focus your studies.

1. If you consistently miss **detail questions**, you can use the electronic flashcards to help you master the vocabulary.
2. If you have more trouble with the **concept questions**, you need to know how to put all the details into a bigger, integrated picture. One of the best aids to really understanding is explaining. Try explaining the process or concept—it really doesn't matter to whom. Sometimes it's even better if your audience knows nothing about the material. It is the act of explaining that is important; if you can explain fully and easily, you understand. If you reach a point in the explanation where you feel uneasy or simply can't complete it, you have identified a problem in understanding. This is the point you need to study more. If rereading doesn't solve the problem, it is time to consult with the professor, a teaching assistant, or a classmate you have identified as one who usually gets it right.

In addition to using this study guide, there are many other ways you can help yourself do well in your biology course. First, *go to class*. Your instructor will help guide you and help you

focus on the most important aspects of the material. If you could master everything on your own just by reading the textbook, colleges and universities wouldn't bother scheduling lectures and paying faculty!

Second, *keep up with your reading and studying*. Leaving it all until the weekend or the night before the exam is *not* a good strategy. It will prevent you from getting the most from the weekly lectures and from taking advantage of your instructors' office hours or help sessions. It will also put tremendous stress on you right before the exam, and will probably result in poor grades.

Third, *ask questions*. Ask your instructor, your graduate teaching assistant, or your classmates. It is better to clear up any confusion as you go along. Remember that you are trying to build a solid foundation from the very beginning. A point you don't understand early in the semester may come back to haunt you later. You may feel shy about asking, but many of your classmates probably have the same question and will be glad you asked. You may not want to interrupt the instructor in the middle of a lecture to ask your questions, but most instructors set aside some class time just for questions or have office hours or help sessions. And they are usually thrilled to help students who are trying to learn more.

Fourth, *study actively, not passively*. Don't just sit and read your textbook and lecture notes; do something active. Study with your classmates; make up and ask each other questions. Active participation makes learning easier.

We hope this preface has given you good ideas about how to enjoy biology and do well in your course. We also hope this study guide will prove to be a valuable aid in your learning. We cannot predict exactly how your instructor will give tests in your course, but by successfully working through each section in the study guide chapters, you will be well on your way toward mastering the material in *Biology* and doing well on tests. You should check with your instructor, however, to make sure you understand the format of the exams that will be given to you and the level of detail you are expected to know.

We wish you good luck, excitement, and appreciation of life as you explore the world of biology.

Brian L. Olson
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CHAPTER 1 THE SCIENCE OF BIOLOGY

MASTERING KEY CONCEPTS

Biology is the scientific study of life. This is a neat and simple definition, but it covers a fascinating and diverse world, including what living organisms are made of, how they function, and how they have evolved and continue to do so. All the information, hypotheses, and theories presented in your textbook have been derived by countless scientists asking questions; collecting data; making, testing, and refining hypotheses; and formulating and refining theories.

1.1 Biology is the science of life.

- Overview: There are seven **characteristics of living organisms--cellular organization, ordered complexity, sensitivity, growth/development/reproduction, energy utilization, homeostasis,** and **evolutionary adaptation**. Living systems display **hierarchical organization** at the **cellular, organismal, populational, ecosystem,** and **biosphere** levels. **Emergent properties** exist at each of these levels.
- Details: Know the definitions of each of the seven characteristics shared by living systems. Know the **building blocks** for each of **the levels of hierarchical organization**, and how **emergent properties** can affect each level.

1.2 Scientists form generalizations from observations.

- Overview: Scientists question the world by making objective observations, noting unexplained phenomena, and developing explanations called **hypotheses,** which are then tested by **experiments** that, when properly controlled, are designed to discriminate between alternative explanations.
- Details: Know the differences between **deductive** and **inductive reasoning**. Understand the concept of **reductionism** to study complex systems and when this approach is useful. Know the two definitions of a **scientific theory** and the difference between **basic** and **applied research**.

1.3 Darwin's theory of evolution illustrates how science works.

- Overview: **Darwin** proposed the idea of **natural selection** to describe how life on Earth **evolved**. Darwin noted that the characteristics of the descendants of a common ancestor varied from place to place. These variations represented **evolutionary adaptations** that improved an organism's ability to survive in a particular geographical location.
- Details: Be familiar with the observations that **Darwin** made that help to develop his **theory of natural selection**. Understand the concepts of **geometric and arithmetic progressions** described by **Thomas Malthus**. Know how the **age of the Earth, fossil records, comparative anatomy,** and **molecular evidence** support Darwin's idea that all living things evolved from a single ancestor.

1.4 Four themes unify biology as a science.

- Overview: The **cell theory** developed by **Schleiden and Schwann** concluded that all living organisms consist of **cells,** which process information, can sense their environments, and are the basis for reproduction and growth of all organisms. **DNA**, consisting of multiple genes, specifies a cell's makeup. **Evolutionary conservation** suggests that a specific gene plays a critical function in an organism.
- Details: Understand the concepts behind the **unifying themes of biology,** which state that **life is organized, life has a molecular basis of heredity, life changes over time,** and **life displays its evolutionary past**. Know how a similar structure, or function, of two or more molecules can imply relationships among different organisms. Recognize how the diversity of life is organized by first dividing organisms into three **domains** and then subdividing each domain into **kingdoms** consisting of organisms that all share similar characteristics.

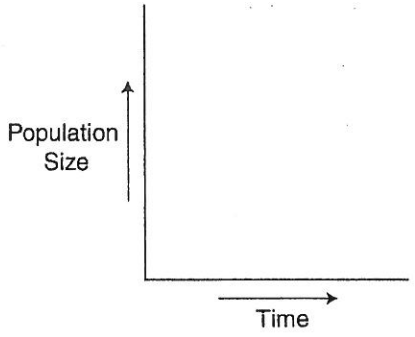
CHALLENGING YOUR UNDERSTANDING

Draw a flowchart detailing the scientific method that is used to formulate and test a hypothesis. Your flowchart should begin with an observation, and end with the hypothesis becoming a scientific theory.

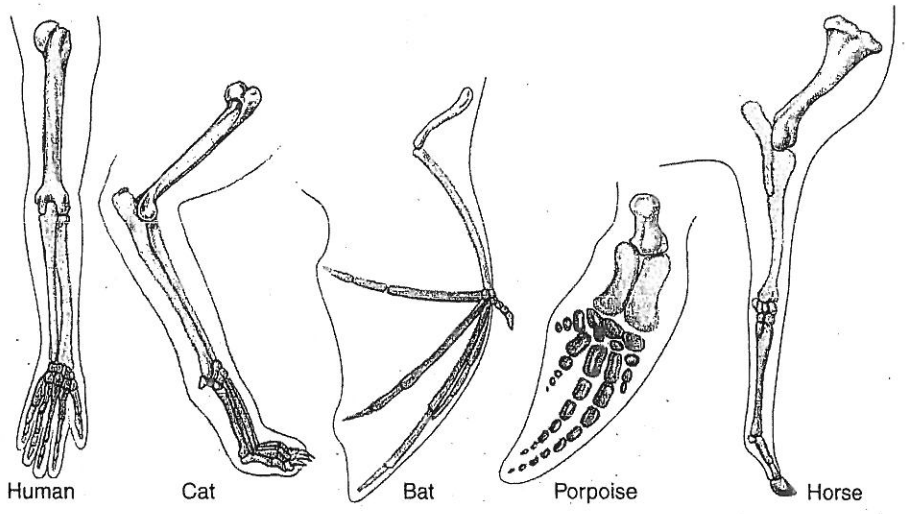
LEARNING BY EXPERIENCE

1. Arrange the following terms to show the proper hierarchical organization of life: *biological community, cell, ecosystem, molecule, organ, organelle, organism, organ system, population, species, tissue.* What does it mean to say that life is organized hierarchically?

2. Make a flowchart that diagrams the scientific method by using these terms: *experiments, hypotheses, observations, questions, theory.* Briefly explain how the method works. On the following graph, draw a line representing a geometric progression and a line representing an arithmetic progression. Then explain in the space below the implications of the two lines with regard to rates of increase.



3. Color the homologous bones in these vertebrate forelimbs the same color. For example, color the upper arm bone (the humerus) green in all five limbs, use yellow for the two lower arm bones (the radius and ulna) in all five limbs, and use purple for all the bones of the wrist and hand in all five limbs. Note: Human anatomy is being used as the reference point here, but some fusion of bones has occurred in different species.



4. Why is biology important?

EXERCISING YOUR KNOWLEDGE

Briefly answer each of the following questions in the space provided.

1. We seem to know intuitively if something qualifies as living, but defining life precisely can be difficult. Is there any one characteristic that defines life? If not, what does?

2. What is the difference between deductive and inductive reasoning? Is either used by scientists?

3. Can a scientific theory ever be proven 100% true?

4. You are conducting an experiment to test the hypothesis that dairy cows give more milk if they listen to classical music while being milked. You have 20 cows listen to classical music during milking and then collect all their milk and measure how much there is. What would you do for your control experiment?

5. What is the difference between basic and applied research? Which do you think is more important?

6. It took Darwin many years to formulate his theory of evolution by natural selection, and he used many different pieces of evidence and ideas from different people in the process. Briefly describe the contribution made by each of the following to Darwin's thoughts: fossils, geographic distribution of species, oceanic islands, Lyell, Malthus.

7. How has molecular biology contributed to our current understanding of evolution?

8. Explain the statement "species evolve, but selection acts on individuals."

9. Explain Darwin's theory of evolution by natural selection in your own words.

10. Biologists often talk about the seemingly contradictory unity and diversity of life. What do they mean by that? What is uniform about life and what is diverse?

Circle the letter of the one best answer in each of the following questions.

11. According to the hierarchical organization of life, organelles are made up of
    a. organs.
    b. molecules.
    c. populations.
    d. tissues.
    e. organ systems.

12. Which of the following did not provide strong evidence for Darwin's theory of evolution?
    a. comparative anatomy
    b. mechanisms of heredity
    c. age of the Earth
    d. comparison of genomes
    e. microscopic fossils

13. If a scientist collects data and then formulates a general hypothesis that explains all of the observations, the scientist has engaged in
    a. inductive reasoning.
    b. deductive reasoning.
    c. natural selection.
    d. artificial selection.
    e. applied research.

14. To be of use in science, a hypothesis must be
    a. testable.
    b. able to yield predictions.
    c. proven true beyond a shadow of a doubt.
    d. a and b are correct.
    e. All of these are correct.

15. A control experiment has all of the conditions identical to the primary experiment except that it
    a. uses twice as many experimental subjects.
    b. runs for a longer period of time.
    c. does not have the variable being tested.
    d. has more of the variable being tested.
    e. None of these are correct; it is completely different.

16. When scientists talk about a scientific theory, they are talking about something that
    a. has been tested frequently and is supported by a lot of evidence.
    b. has been proven true.
    c. is wild speculation.
    d. is likely to never change.

17. Research designed to solve specific problems is called
    a. basic research.
    b. applied research.
    c. peer review.
    d. the scientific method.
    e. progression.

18. Which of the following represents a geometric progression?
    a. 4, 8, 12, 16
    b. 2, 4, 6, 8
    c. 2, 4, 16, 256
    d. 4, 16, 64, 256
    e. 1, 2, 3, 4

19. The hierarchical organization of life leads to which of the following?
    a. survival of the fittest
    b. emergent properties
    c. natural selection
    d. the cell theory
    e. evolution

20. Darwin explained his theory of evolution in a book called
    a. *The Principle of Population.*
    b. *Survival of the Fittest.*
    c. *The Descent of Man.*
    d. *On the Origin of Species.*
    e. *Around the World in Eighty Days.*

21. According to Darwin's theory of evolution,
    a. all individuals have an equal chance of surviving and reproducing.
    b. species are immutable.
    c. tortoises are the modern descendants of glyptodonts.
    d. All of these are correct.
    e. None of these are correct.

22. By finding molecules similar to the insulin receptor in different organisms, we may be able to discern which of the following about glucose uptake in humans and other organisms?
    a. population levels
    b. emergent properties
    c. comparative anatomy
    d. ordered complexity
    e. evolutionary relationship

23. The numbers 3, 6, 9, 12, and 15 represent
    a. emergent properties.
    b. a phylogenetic tree.
    c. a geometric progression.
    d. an arithmetic progression.
    e. a molecular clock.

24. Who else came up with the idea of evolution by natural selection at the same time as Darwin?
    a. Charles Lyell
    b. Alfred Russel Wallace
    c. Thomas Malthus
    d. Eratosthenes
    e. no one

25. Based on conservation of the hemoglobin polypeptide, which of the following vertebrates are most closely related?
    a. dogs and birds
    b. humans and frogs
    c. dogs and frogs
    d. humans and birds
    e. monkeys and frogs

26. Structures that have the same evolutionary origin even though they may now have different structures or functions are said to be
    a. phylogenetic.
    b. analogous.
    c. homologous.
    d. immutable.
    e. geometric.

27. Scientists currently classify life into three major groups called
    a. genomes.
    b. kingdoms.
    c. phylogenetic trees.
    d. domains.
    e. biological communities.

28. Which of the following are analogous structures?
    a. the front leg of a horse and a human arm
    b. the front leg of a frog and a bat wing
    c. the front flipper of a porpoise and a human arm
    d. the wing of a bird and a bat wing
    e. the wing of a bird and a butterfly wing

29. In the hierarchy of life, species are made up of
    a. populations.
    b. variables.
    c. ecosystems.
    d. biological communities.
    e. phylogenetic trees.

30. The more closely related two species are, the
    a. less similar their DNA is.
    b. more similar their DNA is.
    c. Neither of these is correct; no pattern is found.
    d. None of these are correct; we don't have the technology to analyze DNA.

CHAPTER 2 THE NATURE OF MOLECULES

MASTERING KEY CONCEPTS

Living things are composed of chemicals, and life processes follow chemical rules. All matter, living and nonliving, is made up of atoms. Atoms can interact by transferring electrons and forming ions or by sharing electrons and forming molecules. The single most important molecule for life as we know it is water, whose unique and vital properties are a direct consequence of its chemistry.

2.1 Atoms are nature's building material.

- Overview: The basic structure of an **atom** is a **nucleus** consisting of **positively charged protons, neutrons** with no charge, and **negatively charged electrons** located in **orbitals** that surround the nucleus. The number of electrons and their orbital arrangement determine the chemical behavior of an atom. Each **element** is defined by its **atomic number,** which is the number of protons found in the nucleus.
- Details: Understand the relationship between **atomic number**, the number of **protons, neutrons, electrons**, and **atomic mass**. Understand how these numbers are affected in different **isotopes** and in **ions**. Know the contributions of Niels **Bohr**. Understand how the number of electrons in the outermost energy level determines the behavior of an atom and how electrons are transferred between atoms in **oxidation/reduction** reactions.

2.2 The atoms of living things are among the smallest.

- Overview: The **periodic table** organizes **elements** based on **atomic number** and orders them such that the elements in each column belong to the same family having similar **chemical properties** determined by the **number of valence electrons** that the atom has.
- Details: Know the contribution of Dmitri **Mendeleev** and the concept behind the observation of **eight-element periodicity**. Understand how electrons are assigned to orbitals and how the number of **valence electrons** determines an atom's reactivity.

2.3 Chemical bonds hold molecules together.

- Overview: **Chemical bonds** form when two atoms interact based on an electrical interaction that stabilizes valence electrons by satisfying the **octet rule** either by transfer of an electron, sharing of electron pairs, or sharing a hydrogen atom. Chemical reactions form or break bonds and are influenced by temperature, concentration of the reactants and products, and catalysts.
- Details: Know the basis and strength of **covalent, ionic**, and **hydrogen bonds; hydrophobic interactions;** and **van der Waals attractions**. Understand how many bonds an atom must form to satisfy the **octet rule**. Understand how **electronegativity** of an atom establishes its **polarity**.

2.4 Water is the cradle of life.

- Overview: Life depends on **water,** a molecule consisting of **two hydrogen atoms** bound to **one oxygen atom** by two single **covalent bonds**. Water is highly **polar** allowing it to be **cohesive** and establishing many of its physical properties. Water can form **hydrogen bonds** with other molecules of water or with other polar substances.
- Details: Know the **properties of water**, the **molecular structure**, and the **forms** that water can take at different temperatures. Know why the properties of water are so beneficial and are essential to life.

2.5 Properties of Water

- Overview: A number of the properties of water are a result of its polar nature and are critical to life. Water can **moderate temperature** because it has a **high specific heat** allowing organisms to maintain constant natural temperature. Water has a **high heat of vaporization** allowing organisms to get rid of excess body heat. Water acts as a **solvent** for polar molecules and can cause hydrophobic molecules to **aggregate**. The dissociation of water results in one H^+ ion and one OH^- ion.
- Details: Know the nature of **hydrophobic** and **hydrophilic** molecules and what happens to each in water. Know the chemical reaction for the **dissociation of water**. Understand why salt dissolves in water.

2.6 Acids and Bases

- Overview: A solution with a balance between H^+ ions and OH^- ions, such as that which exists in water, is neutral and has a pH value of 7. Solutions with a pH value < 7 are acidic and have a high $[H^+]$ concentration relative to the concentration of OH^- ions, and solutions with a pH value > 7 are basic and have a low $[H^+]$ concentration relative to the concentration of OH^- ions. Buffers are used to stabilize the pH of a solution. A difference of 1 pH unit is equal to a 10-fold change in $[H^+]$.
- Details: Know how pH correlates with the $[H^+]$ concentration of a solution. Know an example of an acid and a base. Understand how buffers can resist changes in pH, and how organisms resist pH changes in the blood.

CHALLENGING YOUR UNDERSTANDING

1. Identify the number of protons, neutrons, electrons, and valence electrons for potassium, chlorine, nitrogen, and argon. Explain the reactivity of these atoms.

2. List five properties of water and describe why these properties are beneficial to living organisms.

3. Fill in the missing values in the following chart, indicate in the last column whether each is acidic, basic, or neutral.

Solution	pH	$[H^+]$ mol/L	$[OH^-]$ mol/L	Category
1. human blood	7	a._____	b._____	neutral
2. stomach acid	c.____	10^{-2}	d._____	e._____
3. saliva	f.____	g._____	10^{-8}	h._____
4. sodium hydroxide	14	i._____	j._____	k._____

4. Fill in the blanks in the following statements.

a. A solution with a pH of 4 has 10 times the $[H^+]$ of a solution with a pH of _____.

b. A _____ solution has a pH value above _____.

c. An acidic substance _____ in water to _____ the concentration of H^+ ions.

d. The _____ of hydrogen ions in pure water is _____ to the _____ of hydroxide ions making it a _____ solution.

e. A buffer _____ changes in pH by either accepting or donating H^+ ions.

f. The $[H^+]$ concentration of a solution can be _____ by adding an acid or _____ by adding a base.

hh. ____ Weak chemical associations formed between partially negative and partially positive charged atoms.
ii. ____ The weight of a substance in grams corresponding to the atomic masses of all of the atoms in a molecule.
jj. ____ The molecules that are formed as the result of a chemical reaction.
kk. ____ The amount of energy required to change 1 gram of substance from a liquid to a gas.
ll. ____ Nonpolar molecules that are forced into association with one another when placed in a solution of water.
mm. ____ Indicates the identity and the number of atoms present in any particular molecule.
nn. ____ The polarity of water is a property that allows water molecules to be attracted to one another.
oo. ____ An oxygen atom bound to two hydrogen atoms by two single covalent bonds.
pp. ____ A substance that combines with H^+ ions when dissolved in water and lowers the $[H^+]$ of a solution.
qq. ____ The concentration of a given element in a solution that is expressed as the number of moles per liter.
rr. ____ A bond formed when two atoms share one or more pairs of valence electrons.
ss. ____ Lines drawn between atoms of a compound to indicate how many electron pairs are shared.
tt. ____ Polar molecules that readily form hydrogen bonds with water.
uu. ____ A bond that satisfies the octet rule by two atoms sharing two electron pairs.
vv. ____ The original molecules present before a chemical reaction takes place.
ww. ____ The negative logarithm of the hydrogen ion concentration of a solution.
xx. ____ Shifting atoms from one molecule or ionic compound to another without change in number or identity of atoms.
yy. ____ Molecules that contain regions of partial positive charge and regions of partial negative charge.
zz. ____ The amount of heat that must be absorbed or lost by 1 gram of a substance to change its temperature by 1°C.
aaa. ____ Any substance that can resist changes in pH by releasing or absorbing hydrogen ions.
bbb. ____ The strongest covalent bond in which the octet rule is satisfied by sharing three electron pairs.

omit

LEARNING BY EXPERIENCE

1. Draw and label a picture of a carbon-12 atom and a carbon-14 atom. Your diagram should show energy levels, electrons, the nucleus, protons, and neutrons. List the atomic number and atomic mass of each atom.

2. Use atomic diagrams to illustrate what happens when an ionic bond is formed and when a single covalent bond is formed.

3. Write the structural formulas and molecular formulas for hydrogen gas, oxygen gas, and nitrogen gas. What type of bond forms each of these molecules? Which is the strongest of these bonds?

4. Draw a drop of water containing five (5) water molecules. Show the hydrogen and oxygen atoms within each water molecule, and use a (+) or (–) to indicate the electronegativity of each atom. Use solid lines to indicate covalent bonds and dotted lines to indicate hydrogen bonds.

EXERCISING YOUR KNOWLEDGE

Briefly answer each of the following questions in the space provided.

1. Why is the chemical behavior of an atom determined more by the electrons than by the protons or neutrons?

2. For any particular element, which of the three subatomic particles (protons, neutrons, electrons) never varies in number? Explain.

3. Carbon-14 has a half-life of about 5,600 years. Archaeologists analyze a piece of wood found at an ancient village site and determine that, of the initial 100 grams of C-14 in the wood, only 3.125 grams are left. How old is the wood?

4. In a periodic table of elements, the elements in any given vertical column tend to behave chemically the same way. Why?

5. What three major tendencies guide the interactions of all atoms?

6. Explain the differences in the types of substances or compounds formed by ionic bonds versus covalent bonds.

7. Why do crystals such as table salt (NaCl) dissolve in water?

8. Why do you think so many of the molecules that make up organisms (for example, proteins, carbohydrates, lipids) are large molecules with covalent bonds rather than ionic bonds?

9. If you dip a corner of a paper towel into a drop of water, why does the water spread along the paper towel?

10. Why does sweating cool us off?

Circle the letter of the one best answer in each of the following questions.

11. The atomic mass of an atom is determined by its total number of
    a. nuclei.
    b. orbitals.
    c. electrons and protons.
    d. electrons and neutrons.
    e. protons and neutrons.

12. The greater the energy of an electron,
    a. the larger it is.
    b. the closer it orbits to the nucleus.
    c. the farther it orbits from the nucleus.
    d. the more likely it is to be transferred rather than shared.
    e. the greater the number of other electrons that can share its orbital.

13. Most of the volume of an atom is taken up by
    a. empty space.
    b. electrons.
    c. protons.
    d. neutrons.
    e. none of the above; atoms have no volume.

14. Which of the following atoms would you expect to behave similarly to oxygen (atomic number = 8)?
    a. carbon (atomic number = 12)
    b. sulfur (atomic number = 16)
    c. argon (atomic number = 18)
    d. all of these
    e. none of these

15. During oxidation, molecules
    a. disintegrate.
    b. lose carbon.
    c. gain electrons.
    d. lose electrons.
    e. are converted to oxygen atoms.

16. Isotopes of the same element differ in their number of
    a. protons.
    b. neutrons.
    c. electrons.
    d. energy levels.
    e. bonds.

17. Which of the following elements is *least* common in living organisms?
    a. carbon
    b. hydrogen
    c. nitrogen
    d. oxygen
    e. sodium

18. Dmitri Mendeleev
    a. created the periodic table of elements.
    b. discovered the first known isotopes.
    c. developed the pH scale.
    d. discovered the structure of atoms.
    e. discovered that water is a polar molecule.

19. Consider atoms with the atomic numbers listed below. Assuming the atoms were neutral, which of them would be inert?
    a. 1
    b. 4
    c. 8
    d. 10
    e. 16

20. In general, electronegativities among the elements in the periodic table
    a. increase as the number of electrons decreases.
    b. increase down the columns.
    c. increase from left to right.
    d. increase as the number of protons decreases.
    e. increase with increasing atomic number.

21. Regions of partial negative charge in polar covalent bonds are found near
    a. the more electronegative atom.
    b. the atom with more protons.
    c. the atom with a larger atomic mass.
    d. the atom with electrons in higher energy levels.
    e. the atom that loses more electrons.

22. In ionic bonds,
    a. electrons are shared unequally between atoms.
    b. electrons are shared equally between atoms.
    c. electrons are transferred between atoms.
    d. protons are transferred between atoms.
    e. neutrons are transferred between atoms.

23. In a crystal of table salt (NaCl), each sodium ion is surrounded by
    a. other sodium ions.
    b. chlorine ions.
    c. water molecules.
    d. buffers.

24. Which of the following will increase the rate of chemical reactions?
    a. lowering the temperature of the reactants
    b. decreasing the number of reactants present
    c. making sure no catalyst gets into the reaction
    d. all of these
    e. none of these

25. Ammonia has a higher specific heat than water because it is _____ than water.
    a. a larger molecule
    b. more acidic
    c. more basic
    d. more polar
    e. more likely to ionize

26. Which of the following pH values represents the greatest concentration of H^+?
    a. 2
    b. 4
    c. 7
    d. 10
    e. 12

27. Hydrophobic interactions are exhibited by
    a. ions.
    b. hydration shells.
    c. polar molecules.
    d. nonpolar molecules.
    e. all of these.

28. In a single water molecule, the oxygen and hydrogen atoms
    a. are held together by ionic bonds.
    b. are held together by hydrogen bonds.
    c. have the same electronegativity.
    d. have no electrons.
    e. share electrons unequally.

29. Which property of water is responsible for the surface tension that enables some insects to walk on water?
    a. adhesion
    b. cohesion
    c. high specific heat
    d. high heat of vaporization
    e. capillary action

30. Which of the following pH values would require the most buffering to reach a neutral pH?
    a. 2
    b. 4
    c. 7
    d. 9
    e. 11