



Instructor's Guide

ESSENTIAL CHEMISTRY: CORE CONCEPTS VIDEO CLIP LIBRARY

Introduction

This instructor's guide provides information to help you get the most out of *Essential Chemistry: Core Concepts Video Clip Library*. The program covers core chemistry concepts in a fast-paced, straightforward style. After watching the modules, students should have a grasp of atoms, molecules, and compounds, the basics of states of matter, the periodic table, chemical reactions, metals, biochemistry, carbon chemistry, earth chemistry, chemical bonds, and acids and bases. Subject matter experts explain these topics in a clear, concise manner, making them both interesting and transparent to students. Accompanying visuals bring chemical reactions and technical explanations to life. Overall, the modules in this video library are practical, easy to understand, and should help students clarify the building blocks of the science of chemistry.

Also available from Infobase Publishing: the *Essential Chemistry Set* (10-volume book set) and *Essential Chemistry Online* (eLearning Modules). (Visit www.infobasepublishing.com for more information.)

Disc 1:

- Atoms, Molecules, and Compounds (pages 2 - 8)
- Carbon Chemistry (pages 9 - 15)
- The Periodic Table (pages 16 - 22)
- Chemical Bonds (pages 23 - 29)
- Chemical Reactions (pages 30 - 36)

Disc 2:

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ATOMS, MOLECULES, AND COMPOUNDS

Learning Objectives

After viewing this module, students will be able to:

- Define and distinguish atoms, molecules, ions, and compounds
- Define and distinguish electrons, protons, and neutrons
- Understand how electron configuration influences the way in which elements are organized on the periodic table
- Explain different types of energy connected to atoms
- Explain how different compounds affect each other and make up the world around us

Clips

Clip 1: The Atom and the Quantum Model

Topics include the history of the atomic model, the discovery of the electron, the “solar system” model of the atom, and Bohr’s Quantum Model.

Clip 2: The Nucleus

Topics include the properties of neutrons, protons, and electrons, binding energy, and fission and fusion.

Clip 3: The Electrons

Topics include some properties of electrons, the principal quantum number, the angular quantum number, and the Heisenberg uncertainty principle.

Clip 4: The Elements

Topics include the organization of the periodic table, valence, ionization, and electronegativity.

Clip 5: The Energy of Atoms

Topics include endothermic, exothermic, and spontaneous reactions, Gibbs free energy, and activation energy.

Clip 6: Common Compounds

Topics include the ionic bonds of salt, and the polarity and other unique properties of water.

Quiz

- Q1: Niels Bohr proposed that by emitting a specific amount — or _____ — of energy, an electron could move from a higher to a lower energy level while orbiting the nucleus, and that by absorbing energy it could jump to a higher energy level.
- (a) neutron (b) photon
(c) quantum (d) cloud
- Q2: Bohr's model of the atom was not widely accepted until scientists detected that electrons could behave _____.
- (a) both as a particle and as a wave (b) both as a cloud and as a wave
(c) erratically (d) according to a 'solar system' model
- Q3: In the electron cloud model, rather than following fixed orbits, electrons bound to an atom are observed more frequently in certain areas around the nucleus called orbitals; their position in an atom is governed by _____.
- (a) quanta (b) chance
(c) the number of protons in their nucleus (d) probability
- Q4: The nucleus is the center of the atom, a densely packed area of _____.
- (a) protons (b) neutrons
(c) protons and neutrons (d) neutrinos
- Q5: True or False? Protons have a positive charge, neutrons have a negative charge, and electrons have a neutral charge.
- Q6: The process in which the nucleus of an element splits in two is _____.
- (a) called "destabilization" (b) called "fission"
(c) called "fusion" (d) represented by Einstein's equation $E = mc^2$
- Q7: True or False? Although the size of an atom is about ten billionths of an inch, most of it is empty space, due to the even tinier size of the nucleus.
- Q8: The lowest energy level (closest to the nucleus) in an atom is written as _____.
- (a) $1s^1$ (b) $n = 1$
(c) $n = 0$ (d) $s = 1$

- Q9: Quantum numbers are four numbers used to describe electrons in an atom. The number referred to in Q8 is also called the _____, and it refers to how far away an electron is from the nucleus, and the amount of energy contained in its orbital.
- (a) principal quantum number (b) angular quantum number
(c) magnetic quantum number (d) spin quantum number
- Q10: The _____, in part, describes the shape of an atom's orbitals (and where electrons may be distributed within them). It uses the letters s, p, d, and f to refer to these shapes, with "s" being the lowest energy level.
- (a) principal quantum number (b) angular quantum number
(c) magnetic quantum number (d) spin quantum number
- Q11: The Heisenberg uncertainty principle states _____.
- (a) that electrons sometimes act as though they were particles, and sometimes as waves
(b) that the quantum model of the atom has not been proven definitively
(c) that an observer can never determine the exact shape of an atom's orbitals
(d) that an observer cannot know both the exact position and the velocity of a subatomic particle at the same time
- Q12: True or False: The arrangement of elements on the periodic table is due largely to recurring patterns in their electron configurations.
- Q13: _____ are the electrons in an atom's outermost orbital. They govern how atoms combine with each other to form compounds.
- (a) Quark electrons (b) Covalent electrons
(c) Ionic electrons (d) Valence electrons
- Q14: Adding or removing one or more electrons from an atom results in an electrically charged particle called a(n) _____.
- (a) ion (b) valence
(c) photon (d) volt
- Q15: _____ measures the tendency of an atom to attract electrons.
- (a) Ionization (b) Electricity
(c) Electronegativity (d) Reactivity

- Q16: _____ reactions soak up heat as they proceed, cooling the local environment.
- (a) Exothermic (b) Endothermic
(c) Spontaneous (d) Combustion
- Q17: When two elements have similar electronegativities, they can form a(n) _____ bond.
- (a) ionic (b) exothermic
(c) electric (d) covalent
- Q18: _____ energy is the least amount of energy needed for a chemical reaction to take place.
- (a) Potential (b) Activation
(c) Gibbs free (d) Minimal
- Q19: Because of the attraction between salt ions and the electric dipoles of water molecules, salt is said to be _____.
- (a) electromagnetic (b) hydrophobic
(c) hydrophilic (d) crystalline
- Q20: One of the unique properties of water is that it is _____, meaning that part of the molecule has a positive charge, and part has a negative charge.
- (a) polar (b) binary
(c) magnetic (d) dioxic

Answers

Q1: Niels Bohr proposed that by emitting a specific amount — or _____ — of energy, an electron could move from a higher to a lower energy level while orbiting the nucleus, and that by absorbing energy it could jump to a higher energy level.

- (a) neutron (b) photon
(c) quantum (d) cloud

A: (c) *quantum*

Q2: Bohr's model of the atom was not widely accepted until scientists detected that electrons could behave _____.

- (a) both as a particle and as a wave (b) both as a cloud and as a wave
(c) erratically (d) according to a 'solar system' model

A: (a) *both as a particle and as a wave*

Q3: In the electron cloud model, rather than following fixed orbits, electrons bound to an atom are observed more frequently in certain areas around the nucleus called orbitals; their position in an atom is governed by _____.

- (a) quanta (b) chance
(c) the number of protons in their nucleus (d) probability

A: (d) *probability*

Q4: The nucleus is the center of the atom, a densely packed area of _____.

- (a) protons
(b) neutrons
(c) protons and neutrons
(d) neutrinos

A: (c) *protons and neutrons*

Q5: True or False? Protons have a positive charge, neutrons have a negative charge, and electrons have a neutral charge.

A: *False — neutrons have a neutral charge, while electrons are negatively charged.*

Q6: The process in which the nucleus of an element splits in two is _____.

- (a) called "destabilization" (b) called "fission"
(c) called "fusion" (d) represented by Einstein's equation $E = mc^2$

A: (b) *called "fission"*

Q7: True or False? Although the size of an atom is about ten billionths of an inch, most of it is empty space, due to the even tinier size of the nucleus.

A: *True.*

Q8: The lowest energy level (closest to the nucleus) in an atom is written as _____.

- (a) $1s^1$ (b) $n = 1$
 (c) $n = 0$ (d) $s = 1$

A: (b) $n = 1$

Q9: Quantum numbers are four numbers used to describe electrons in an atom. The number referred to in Q8 is also called the _____, and it refers to how far away an electron is from the nucleus, and the amount of energy contained in its orbital.

- (a) principal quantum number (b) angular quantum number
 (c) magnetic quantum number (d) spin quantum number

A: (a) *principal quantum number*

Q10: The _____, in part, describes the shape of an atom's orbitals (and where electrons may be distributed within them). It uses the letters s, p, d, and f to refer to these shapes, with "s" being the lowest energy level.

- (a) principal quantum number (b) angular quantum number
 (c) magnetic quantum number (d) spin quantum number

A: (b) *angular quantum number*

Q11: The Heisenberg uncertainty principle states _____.

- (a) that electrons sometimes act as though they were particles, and sometimes as waves
 (b) that the quantum model of the atom has not been proven definitively
 (c) that an observer can never determine the exact shape of an atom's orbitals
 (d) that an observer cannot know both the exact position and the velocity of a subatomic particle at the same time

A: (d) *that an observer cannot know both the exact position and the velocity of a subatomic particle at the same time*

Q12: True or False: The arrangement of elements on the periodic table is due largely to recurring patterns in their electron configurations.

A: *True.*

Q13: _____ are the electrons in an atom's outermost orbital. They govern how atoms combine with each other to form compounds.

- (a) Quark electrons (b) Covalent electrons
(c) Ionic electrons (d) Valence electrons

A: (d) *Valence electrons*

Q14: Adding or removing one or more electrons from an atom results in an electrically charged particle called a(n) _____.

- (a) ion (b) valence (c) photon (d) volt

A: (a) *ion*

Q15: _____ measures the tendency of an atom to attract electrons.

- (a) Ionization (b) Electricity (c) Electronegativity (d) Reactivity

A: (c) *Electronegativity*

Q16: _____ reactions soak up heat as they proceed, cooling the local environment.

- (a) Exothermic (b) Endothermic (c) Spontaneous (d) Combustion

A: (b) *Endothermic*

Q17: When two elements have similar electronegativities, they can form a(n) _____ bond.

- (a) ionic (b) exothermic (c) electric (d) covalent

A: (d) *covalent*

Q18: _____ energy is the least amount of energy needed for a chemical reaction to take place.

- (a) Potential (b) Activation (c) Gibbs free (d) Minimal

A: (b) *Activation*

Q19: Because of the attraction between salt ions and the electric dipoles of water molecules, salt is said to be _____.

- (a) electromagnetic (b) hydrophobic (c) hydrophilic (d) crystalline

A: (c) *hydrophilic*

Q20: One of the unique properties of water is that it is _____, meaning that part of the molecule has a positive charge, and part has a negative charge.

- (a) polar (b) binary (c) magnetic (d) dioxic

A: (a) *polar*

CARBON CHEMISTRY

Learning Objectives

After viewing this module, students will be able to:

- Discuss the properties of carbon and describe its ability to form compounds
- Identify the four categories of biomolecules, including the specifics of proteins, carbohydrates, lipids, and nucleic acids
- Understand how DNA and RNA work
- Define and describe the carbon cycle, including the impact of human activity on the cycle
- Explain the variety of carbon-based products we use every day

Clips

Clip 1: Carbon Compound Chemistry

Topics include the element carbon, chemical bonds, carbon bonds, hydrocarbon compounds (alkanes, alkenes, alkynes), and functional groups.

Clip 2: Biomolecules

Topics include proteins (enzymes, amino acids, peptide bonds), carbohydrates (sugars, starch, cellulose, glycogen), lipids (fats, waxes, steroids), and nucleic acids (DNA, RNA, nucleotides, protein synthesis)

Clip 3: The Carbon Cycle

Topics include photosynthesis, respiration, decomposition, fossil fuels, carbon sinks, and the role of humans in the carbon cycle.

Quiz

- Q1: True or False? Carbon forms the backbone of all kinds of compounds necessary for life (for instance, DNA, proteins, fats, carbohydrates). It is present in all living things.
- Q2: Carbon is a(n) _____.
(a) metallic element (b) nonmetallic element
(c) alkaline earth metal (d) transition metal
- Q3: A chemical bond is formed when an atom _____.
(a) adds electrons from another atom (b) loses electrons to another atom
(c) shares electrons with another atom (d) All of the above
- Q4: When a carbon atom joins a hydrogen atom they become _____.
(a) a molecule of water (b) a hydrogenated fat
(c) a hydrocarbon compound (d) a carbonated compound
- Q5: Alkenes are _____.
(a) hydrocarbons with a single bond; the major component in natural gases, fuels, and gasoline
(b) hydrocarbons with a double bond; found in plastic grocery bags and milk bottles
(c) hydrocarbons with a triple bond; used in pharmaceuticals and medications
- Q6: Alkanes are _____.
(a) hydrocarbons with a single bond; the major component in natural gases, fuels, and gasoline
(b) hydrocarbons with a double bond; found in plastic grocery bags and milk bottles
(c) hydrocarbons with a triple bond; used in pharmaceuticals and medications
- Q7: Alkynes are _____.
(a) hydrocarbons with a single bond; the major component in natural gases, fuels, and gasoline
(b) hydrocarbons with a double bond; found in plastic grocery bags and milk bottles
(c) hydrocarbons with a triple bond; used in pharmaceuticals and medications
- Q8: There are millions of different carbon compounds, divided into families according to their _____.
(a) atomic number (b) type of hydrocarbon bond
(c) periodic group (d) functional group

- Q9: Biomolecules all contain _____. (*Choose all that apply.*)
- (a) carbon
 - (b) nitrogen
 - (c) hydrogen
 - (d) oxygen
- Q10: The major classes of biomolecules are _____.
- (a) proteins, carbohydrates, and lipids
 - (b) proteins, carbohydrates, lipids, and nucleic acids
 - (c) amino acids, nucleic acids, lipids, and non-lipids
 - (d) acids and lipids
- Q11: _____ serve as energy storage compounds; they can contain twice as much energy as other types of biomolecules.
- (a) Amino acids
 - (b) Carbohydrates
 - (c) Lipids
 - (d) Proteins
- Q12: Enzymes — special _____ found in the body's cells — are necessary for all chemical reactions of life.
- (a) acids
 - (b) carbohydrates
 - (c) lipids
 - (d) proteins
- Q13: Nucleic acids are _____.
- (a) organic polymers that break down waste products in the cell
 - (b) non-lipids that aid in the transport of energy
 - (c) a type of amino acid necessary for cell division
 - (d) organic polymers, such as DNA and RNA, that carry hereditary information
- Q14: Most living things break glucose down for energy, and use starch and glycogen as energy storage compounds. Glucose, starch, and glycogen are all _____.
- (a) peptides
 - (b) polypeptides
 - (c) carbohydrates
 - (d) fats
- Q15: Peptide bonds _____.
- (a) link amino acids together
 - (b) link hydrocarbons together
 - (c) are formed by nucleotides in DNA
 - (d) are formed by proteins and carbohydrates

Q16: True or False? The carbon cycle is the movement of carbon atoms through the atmosphere, oceans, all living organisms (including plants, animals, and humans), and the Earth.

Q17: Scientists identify specific ways in which carbon atoms cycle through the biosphere. These are: _____. (Choose all that apply.)

- (a) photosynthesis
- (b) respiration
- (c) digestion
- (d) decomposition
- (e) reproduction
- (f) burning
- (g) weather

Q18: The main process by which carbon dioxide is removed from the atmosphere is _____.

- (a) photosynthesis
- (b) respiration
- (c) burning
- (d) weathering

Q19: The process that living organisms use to break down nutrients to create energy is called _____.

- (a) photosynthesis
- (b) respiration
- (c) digestion
- (d) decomposition

Q20: Although we may debate the consequences, it is clear that humans have changed the equation of the carbon cycle through _____. (Choose all that apply)

- (a) deforestation (which removes carbon sinks)
- (b) digging up and burning fossil fuels (adding carbon to the atmosphere in an unnatural way)
- (c) mining (which removes carbon sinks)
- (d) All of the above

Q8: There are millions of different carbon compounds, divided into families according to their _____.

- (a) atomic number
- (b) type of hydrocarbon bond
- (c) periodic group
- (d) functional group

A: (d) *functional group*

Q9: Biomolecules all contain _____. (Choose all that apply.)

- (a) carbon
- (b) nitrogen
- (c) hydrogen
- (d) oxygen

A: (a) *carbon*; (c) *hydrogen*; (d) *oxygen*

Q10: The major classes of biomolecules are _____.

- (a) proteins, carbohydrates, and lipids
- (b) proteins, carbohydrates, lipids, and nucleic acids
- (c) amino acids, nucleic acids, lipids, and non-lipids
- (d) acids and lipids

A: (b) *proteins, carbohydrates, lipids, and nucleic acids*

Q11: _____ serve as energy storage compounds; they can contain twice as much energy as other types of biomolecules.

- (a) Amino acids
- (b) Carbohydrates
- (c) Lipids
- (d) Proteins

A: (c) *Lipids*

Q12: Enzymes — special _____ found in the body's cells — are necessary for all chemical reactions of life.

- (a) acids
- (b) carbohydrates
- (c) lipids
- (d) proteins

A: (d) *proteins*

Q13: Nucleic acids are _____.

- (a) organic polymers that break down waste products in the cell
- (b) non-lipids that aid in the transport of energy
- (c) a type of amino acid necessary for cell division
- (d) organic polymers, such as DNA and RNA, that carry hereditary information

A: (d) *organic polymers, such as DNA and RNA, that carry hereditary information*

Q14: Most living things break glucose down for energy, and use starch and glycogen as energy storage compounds. Glucose, starch, and glycogen are all _____.

- (a) peptides (b) polypeptides (c) carbohydrates (d) fats

A: (c) *carbohydrates*

Q15: Peptide bonds _____.

- (a) link amino acids together (b) link hydrocarbons together
(c) are formed by nucleotides in DNA (d) are formed by proteins and carbohydrates

A: (a) *link amino acids together*

Q16: True or False? The carbon cycle is the movement of carbon atoms through the atmosphere, oceans, all living organisms (including plants, animals, and humans), and the Earth.

A: *True*

Q17: Scientists identify specific ways in which carbon atoms cycle through the biosphere. These are: _____ . (Choose all that apply.)

- (a) photosynthesis (b) respiration
(c) digestion (d) decomposition
(e) reproduction (f) burning
(g) weather

A: (a) *photosynthesis*; (b) *respiration*; (d) *decomposition*; (f) *burning*; (g) *weather*

Q18: The main process by which carbon dioxide is removed from the atmosphere is _____.

- (a) photosynthesis (b) respiration
(c) burning (d) weathering

A: (a) *photosynthesis*

Q19: The process that living organisms use to break down nutrients to create energy is called _____.

- (a) photosynthesis (b) respiration (c) digestion (d) decomposition

A: (b) *respiration*

Q20: Although we may debate the consequences, it is clear that humans have changed the equation of the carbon cycle through _____ . (Choose all that apply)

- (a) deforestation (which removes carbon sinks)
(b) digging up and burning fossil fuels (adding carbon to the atmosphere in an unnatural way)
(c) mining (which removes carbon sinks)
(d) All of the above

A: (a) *deforestation (which removes carbon sinks)*; (b) *digging up and burning fossil fuels (adding carbon to the atmosphere in an unnatural way)*

The Periodic Table

Learning Objectives

After viewing this module, students will be able to:

- Describe the contents and general organizational structure of the periodic table
- Understand the history of elements and creation of the periodic table
- Explain how elements are grouped and the like properties they share
- Describe how different elements and groups of elements interact with each other

Clips

Clip 1: The History of the Periodic Table

Topics include the history of the discovery of elements, and their initial organization on the first periodic table.

Clip 2: Metals

Topics include alkali, alkaline earth, and transition metals, and their properties as they relate to the periodic table; and hydrogen.

Clip 3: Lanthanides, Actinides, and Transuranium Elements

Topics include the special properties of lanthanides and actinides; transuranium and super-heavy elements; and uses for uranium.

Clip 4: The BCNOs

Topics include the properties of boron, carbon, nitrogen, and oxygen.

Clip 5: Halogens and Noble Gases

Topics include halogens and noble gases, and their properties as they relate to the periodic table.

Quiz

- Q1: The ancient Greeks classified the fundamental elements as fire, earth, air, and water, and believed that _____.
- (a) the elements were made of tiny invisible particles that could not be broken down any further
 - (b) the elements could not be used to form any new materials
 - (c) the elements had been created by the gods for use by humans
 - (d) the elements themselves could be broken down into infinitesimally smaller substances
- Q2: True or False? Throughout the 18th and early 19th centuries, the list of elements and their atomic weights remained random, each chemist using a different order.
- Q3: The scientist credited with “discovering” the periodic table is _____.
- (a) Sir Humphrey Davy
 - (b) Robert Boyle
 - (c) John Dalton
 - (d) Dmitri Mendeleev
- Q4: The number at the top of each element’s box on the periodic table represents _____.
- (a) its atomic weight (the number of protons contained in an atom of that element)
 - (b) its atomic number (the number assigned to the element when the table was first created)
 - (c) its atomic number (the number of protons contained in an atom of that element)
 - (d) its relative atomic mass
- Q5: Each row on the table is called a(n) _____, and each of the elements within this has the same number of electron shells.
- (a) group
 - (b) period
 - (c) electron group
 - (d) shell
- Q6: Most of the elements are metals, and some of the elements that people know best — iron, nickel, copper, zinc, silver, gold, mercury — are _____.
- (a) alkali metals
 - (b) alkaline earth metals
 - (c) transition metals
 - (d) metalloids
- Q7: The metals in Groups 1 and 2 are known for being _____.
- (a) radioactive
 - (b) very malleable
 - (c) very stable
 - (d) very reactive

- Q8: The element that forms more compounds than any other is _____.
(a) hydrogen (b) sodium
(c) oxygen (d) nitrogen
- Q9: On most periodic tables, lanthanides and actinides are located _____.
(a) on the right side of the table
(b) on the left side of the table
(c) in the middle of the table, after the transition metals
(d) in two rows on the bottom, separate from the rest of the table
- Q10: An unusual property of _____ is that they add electrons to their inner, rather than their outer, shell.
(a) lanthanides (b) actinides
(c) transuranium elements (d) All of the above
- Q11: _____ are used in the manufacture of color TVs, computer monitors, fiber-optic cables, and postage stamps.
(a) lanthanides (b) actinides
(c) transuranium elements (d) All of the above
- Q12: _____ have been discovered during the development and testing of fission, atomic, and hydrogen bombs.
(a) Lanthanides (b) Actinides
(c) Transuranium elements (d) both (b) and (c)
- Q13: The BCNO group on the periodic table is named after _____.
(a) boron, calcium, nitrogen, and oxygen (b) boron, carbon, nitrogen, and oxygen
(c) barium, cesium, neon, and oxygen (d) bromine, chlorine, neon, and oxygen
- Q14: Elements in the BCNO group are _____.
(a) metals (b) nonmetals
(c) metalloids (d) some of each of the above
- Q15: Some important metalloids, such as _____, are also called semiconductors. These can conduct heat and electricity, but can also act like nonconductors or insulators (these properties make semiconductors 'the brains' behind computers and other electronic devices).
(a) carbon (b) aluminum
(c) silicon (d) radium

- Q16: The most abundant element on earth is _____.
(a) carbon (b) oxygen
(c) hydrogen (d) calcium
- Q17: True or False? The noble gases were named for their “royal” way of staying apart from other elements (they are the least reactive of the elements).
- Q18: Halogens are among the _____ elements.
(a) rarest (b) least chemically reactive
(c) most chemically reactive (d) most stable
- Q19: The reason that halogens behave as they do in regards to different elements (especially those in Group 1) is because _____.
(a) they have 7 electrons in their outer shell
(b) they have 8 electrons in their outer shell
(c) some of them are solids and some are gases
(d) they are among the lightest of the elements
- Q20: The noble gases have also been called _____.
(a) heavy metals (b) radon gases
(c) xenons (d) inert gases

Answers

Q1: The ancient Greeks classified the fundamental elements as fire, earth, air, and water, and believed that _____.

- (a) the elements were made of tiny invisible particles that could not be broken down any further
- (b) the elements could not be used to form any new materials
- (c) the elements had been created by the gods for use by humans
- (d) the elements themselves could be broken down into infinitesimally smaller substances

A: *(a) the elements were made of tiny invisible particles that could not be broken down any further*

Q2: True or False? Throughout the 18th and early 19th centuries, the list of elements and their atomic weights remained random, each chemist using a different order.

A: *False. At this time the list of elements was arranged from lightest to heaviest, and some scientists started to recognize patterns within the list.*

Q3: The scientist credited with “discovering” the periodic table is _____.

- (a) Sir Humphrey Davy
- (b) Robert Boyle
- (c) John Dalton
- (d) Dmitri Mendeleev

A: *(d) Dmitri Mendeleev*

Q4: The number at the top of each element’s box on the periodic table represents _____.

- (a) its atomic weight (the number of protons contained in an atom of that element)
- (b) its atomic number (the number assigned to the element when the table was first created)
- (c) its atomic number (the number of protons contained in an atom of that element)
- (d) its relative atomic mass

A: *(c) its atomic number (the number of protons contained in an atom of that element)*

Q5: Each row on the table is called a(n) _____, and each of the elements within this has the same number of electron shells.

- (a) group
- (b) period
- (c) electron group
- (d) shell

A: *(b) period*

Q6: Most of the elements are metals, and some of the elements that people know best — iron, nickel, copper, zinc, silver, gold, mercury — are _____.

- (a) alkali metals
- (b) alkaline earth metals
- (c) transition metals
- (d) metalloids

A: *(c) transition metals*

Q7: The metals in Groups 1 and 2 are known for being _____.
(a) radioactive (b) very malleable
(c) very stable (d) very reactive

A: (d) *very reactive*

Q8: The element that forms more compounds than any other is _____.
(a) hydrogen (b) sodium
(c) oxygen (d) carbon

A: (a) *hydrogen*

Q9: On most periodic tables, lanthanides and actinides are located _____.
(a) on the right side of the table
(b) on the left side of the table
(c) in the middle of the table, after the transition metals
(d) in two rows on the bottom, separate from the rest of the table

A: (d) *in two rows on the bottom, separate from the rest of the table*

Q10: An unusual property of _____ is that they add electrons to their inner, rather than their outer, shell.
(a) lanthanides (b) actinides
(c) transuranium elements (d) All of the above

A: (a) *lanthanides*

Q11: _____ are used in the manufacture of color TVs, computer monitors, fiber-optic cables, and postage stamps.

- (a) lanthanides (b) actinides
(c) transuranium elements (d) All of the above

A: (a) *lanthanides*

Q12: _____ have been discovered during the development and testing of fission, atomic, and hydrogen bombs.
(a) Lanthanides (b) Actinides
(c) Transuranium elements (d) both (b) and (c)

A: (d) *both transuranium elements and other actinides*

Q13: The BCNO group on the periodic table is named after _____.
(a) boron, calcium, nitrogen, and oxygen (b) boron, carbon, nitrogen, and oxygen
(c) barium, cesium, neon, and oxygen (d) bromine, chlorine, neon, and oxygen

A: (b) *boron, carbon, nitrogen, and oxygen*

Q14: Elements in the BCNO group are _____.

- (a) metals (b) nonmetals
(c) metalloids (d) some of each of the above

A: (d) *some of each of the above*

Q15: Some important metalloids, such as _____, are also called semiconductors. These can conduct heat and electricity, but can also act like nonconductors or insulators (these properties make semiconductors 'the brains' behind computers and other electronic devices).

- (a) carbon (b) aluminum
(c) silicon (d) radium

A: (c) *silicon*

Q16: The most abundant element on earth is _____.

- (a) carbon (b) oxygen
(c) hydrogen (d) calcium

A: (b) *oxygen*

Q17: True or False? The noble gases were named for their "royal" way of staying apart from other elements (they are the least reactive of the elements).

A: *True.*

Q18: Halogens are among the _____ elements.

- (a) rarest (b) least chemically reactive
(c) most chemically reactive (d) most stable

A: (c) *most chemically reactive*

Q19: The reason that halogens behave as they do in regards to different elements (especially those in Group 1) is because _____.

- (a) they have 7 electrons in their outer shell
(b) they have 8 electrons in their outer shell
(c) some of them are solids and some are gases
(d) they are among the lightest of the elements

A: (a) *they have 7 electrons in their outer shell*

Q20: The noble gases have also been called _____.

- (a) heavy metals (b) radon gases
(c) xenons (d) inert gases

A: (d) *inert gases*

CHEMICAL BONDS

Learning Objectives

After viewing these clips, students will be able to:

- Explain the role that electrons play in chemical bonds
- Describe ionic, covalent, and metallic bonds
- Explain the properties of metals
- Define intermolecular bonding

Clips

Clip 1: Ionic Bonds

Topics include the electronegativities of atoms, Coulomb's law, and the bond polarity chart.

Clip 2: Covalent Bonds

Topics include polar covalent bonds, coordinate covalent bonds, Lewis dot structures, ionic-bonded salts, double and triple bonds, resonance structures, and electron delocalization.

Clip 3: Metallic Bonds

Topics include the properties of metals, conductivity, ion cores, delocalized electrons, substitutional and interstitial alloys, and slip planes.

Clip 4: Intermolecular Bonding

Topics include van der Waals forces, dipoles, dipole moment, electronegativity, hydrogen bonds, unbounded electrons, and polar covalent bonds.

Quiz

- Q1: The migration of an electron changes the nature of the atoms involved. Thus, they are no longer called atoms — instead, they are called _____.
(a) cations (b) protons
(c) ions (d) compounds
- Q2: An ionic bond is _____.
(a) a chemical bond between two ions with opposite charges
(b) a chemical bond between two ions with the same charge
(c) a chemical bond between two ions that repel each other
(d) a chemical bond between two cations
- Q3: True or False? In an ionic bond, the migration of electrons generates an electrical force that holds the atoms together.
- Q4: What does Coulomb's law help explain?
(a) How gravity affects atoms (b) Why some ions are electrically charged
(c) Why ions behave differently than atoms (d) Why some chemical reactions give off heat
- Q5: Which of these factors is used to determine if a bond is ionic?
(a) Electronegativity (b) Mass
(c) Bond polarity (d) Number of migrated electrons
- Q6: True or False? Covalent bonds form between atoms of opposite electronegativities.
- Q7: In compounds held together by covalent bonds, electrons _____.
(a) are shared (b) migrate from one atom to another
(c) are removed (d) create unique electrical charges
- Q8: When both electrons in a bonding pair come from one atom, the bond that forms is called _____.
(a) a weak bond (b) a polar covalent bond
(c) an ionic bond (d) a coordinate covalent bond

- Q9: The type of bond that gives water its unique properties is _____.
 (a) a resonance structure bond (b) a polar covalent bond
 (c) an ionic bond (d) a coordinate covalent bond
- Q10: _____ are used for compounds that can be drawn more than one way (due to electron delocalization).
 (a) Quantum diagrams (b) Resonance structures
 (c) Covalence-ionic bonds (d) Ionic-bonded salts
- Q11: Substances with metallic bonds _____. (*Choose all that apply.*)
 (a) have higher conductivity than nonmetals
 (b) are usually denser than nonmetals
 (c) emit electrons when exposed to electromagnetic radiation
 (d) tend to fracture under pressure
- Q12: Metals are made of tightly packed lattices of positively charged ion cores in a sea of freely moving, or _____, valence electrons.
 (a) covalent (b) resonating
 (c) ionized (d) delocalized
- Q13: True or False? Pure metals are rare in nature — they usually occur as oxides or sulfides or are mixed with other compounds.
- Q14: What process can extract metals from their ores?
 (a) Mining (b) Firing
 (c) Stress heating (d) Smelting
- Q15: Steel is an example of a(n) _____.
 (a) pure alloy (b) substitutional alloy
 (c) interstitial alloy (d) slip plane
- Q16: Ionic bonds _____; covalent bonds _____; metallic bonds _____.
 (a) are varied and complicated; tend to be simple and powerful; feature freely moving valence electrons
 (b) tend to be simple and powerful; are varied and complicated; feature freely moving valence electrons
 (c) feature freely moving valence electrons; tend to be simple and powerful; are varied and complicated
 (d) feature freely moving valence electrons; are varied and complicated; tend to be simple and powerful

- Q17: The attractive forces between molecules are called _____.
(a) covalent bonds (b) dipole-dipole bonds
(c) van der Waals forces (d) Heisenberg forces
- Q18: In a molecule, a pair of opposite electrical charges separated by distance is called _____.
(a) a dipole-dipole bond (b) a dipole
(c) electronegativity (d) polar covalent
- Q19: When the positive end of one molecule aligns with the negative end of another, it produces a(n) _____, which holds the two molecules together.
(a) strong lattice structure (b) hydrogen bond
(c) electrical charge (d) van der Waals force
- Q20: Hydrogen bonding occurs in _____.
(a) water (b) alcohols
(c) DNA (d) All of the above

Answers

Q1: The migration of an electron changes the nature of the atoms involved. Thus, they are no longer called atoms — instead, they are called _____.

- (a) cations
- (b) protons
- (c) ions
- (d) compounds

A: *(c) ions*

Q2: An ionic bond is _____.

- (a) a chemical bond between two ions with opposite charges
- (b) a chemical bond between two ions with the same charge
- (c) a chemical bond between two ions that repel each other
- (d) a chemical bond between two cations

A: *(a) a chemical bond between two ions with opposite charges*

Q3: True or False? In an ionic bond, the migration of electrons generates an electrical force that holds the atoms together.

A: *True.*

Q4: What does Coulomb's law help explain?

- (a) How gravity affects atoms
- (b) Why some ions are electrically charged
- (c) Why ions behave differently than atoms
- (d) Why some chemical reactions give off heat

A: *(c) Why ions behave differently than atoms*

Q5: Which of these factors is used to determine if a bond is ionic?

- (a) Electronegativity
- (b) Mass
- (c) Bond polarity
- (d) Number of migrated electrons

A: *(a) Electronegativity*

Q6: True or False? Covalent bonds form between atoms of opposite electronegativities.

A: *False (they form between atoms that have similar electronegativities).*

Q7: In compounds held together by covalent bonds, electrons _____.

- (a) are shared
- (b) migrate from one atom to another
- (c) are removed
- (d) create unique electrical charges

A: *(a) are shared*

Q8: When both electrons in a bonding pair come from one atom, the bond that forms is called _____.

- (a) a weak bond
- (b) a polar covalent bond
- (c) an ionic bond
- (d) a coordinate covalent bond

A: (d) a coordinate covalent bond

Q9: The type of bond that gives water its unique properties is _____.

- (a) a resonance structure bond
- (b) a polar covalent bond
- (c) an ionic bond
- (d) a coordinate covalent bond

A: (b) a polar covalent bond

Q10: _____ are used for compounds that can be drawn more than one way (due to electron delocalization).

- (a) Quantum diagrams
- (b) Resonance structures
- (c) Covalence-ionic bonds
- (d) Ionic-bonded salts

A: (b) Resonance structures

Q11: Substances with metallic bonds _____. (Choose all that apply.)

- (a) have higher conductivity than nonmetals
- (b) are usually denser than nonmetals
- (c) emit electrons when exposed to electromagnetic radiation
- (d) tend to fracture under pressure

A: (a) have higher conductivity than nonmetals; (b) are usually denser than nonmetals; (c) emit electrons when exposed to electromagnetic radiation

Q12: Metals are made of tightly packed lattices of positively charged ion cores in a sea of freely moving, or _____, valence electrons.

- (a) covalent
- (b) resonating
- (c) ionized
- (d) delocalized

A: (d) delocalized

Q13: True or False? Pure metals are rare in nature — they usually occur as oxides or sulfides or are mixed with other compounds.

A: True.

Q14: What process can extract metals from their ores?

- (a) Mining
- (b) Firing
- (c) Stress heating
- (d) Smelting

A: (d) Smelting

Q15: Steel is an example of a(n) _____.

- (a) pure alloy
- (b) substitutional alloy
- (c) interstitial alloy
- (d) slip plane

A: (c) *interstitial alloy*

Q16: Ionic bonds _____; covalent bonds _____; metallic bonds _____.

- (a) are varied and complicated; tend to be simple and powerful; feature freely moving valence electrons
- (b) tend to be simple and powerful; are varied and complicated; feature freely moving valence electrons
- (c) feature freely moving valence electrons; tend to be simple and powerful; are varied and complicated
- (d) feature freely moving valence electrons; are varied and complicated; tend to be simple and powerful

A: (b) *tend to be simple and powerful; are varied and complicated; feature freely moving valence electrons*

Q17: The attractive forces between molecules are called _____.

- (a) covalent bonds
- (b) dipole-dipole bonds
- (c) van der Waals forces
- (d) Heisenberg forces

A: (c) *van der Waals forces*

Q18: In a molecule, a pair of opposite electrical charges separated by distance is called _____.

- (a) a dipole-dipole bond
- (b) a dipole
- (c) electronegativity
- (d) polar covalent

A: (b) *a dipole*

Q19: When the positive end of one molecule aligns with the negative end of another, it produces a(n) _____, which holds the two molecules together.

- (a) strong lattice structure
- (b) hydrogen bond
- (c) electrical charge
- (d) van der Waals force

A: (d) *van der Waals force*

Q20: Hydrogen bonding occurs in _____.

- (a) water
- (b) alcohols
- (c) DNA
- (d) All of the above

A: (d) *All of the above*

Chemical Reactions

Learning Objectives

After viewing this module, students will be able to:

- Define what a chemical reaction is and provide several examples
- Distinguish between a change of state and a chemical reaction
- Define and describe 'reactants' and 'products'
- Depict a basic equation for a chemical reaction
- Understand various chemical bonds and types of chemical reactions

Clips

Clip 1: Chemical Reactions

Topics include chemical equations, reactants, products, changes of state, diatomic elements, and the law of conservation of mass.

Clip 2: Chemical Bonding

Topics include subatomic particles, the octet rule, ions, and ionic and covalent bonds.

Clip 3: Types of Chemical Reactions

Topics include acids and bases, synthesis and decomposition reactions, single and double displacement reactions, exothermic and endothermic reactions, combustion reactions, and safety equipment.

Clip 4: Reaction Rates

Topics include moles, kinetic and activation energy, solutions, and chemical catalysts.

Clip 5: Reactions All Around Us

Topics include digestion, photosynthesis, autotrophs, chemosynthesis, patina, and luminol.

Quiz

Q1: In a chemical reaction, the new substance(s) created, plus any ash, water vapor, or carbon dioxide, are called _____.

- (a) products
- (b) reactants
- (c) compounds
- (d) resultants

Q2: Changes of state involve a(n) _____ change, rather than a chemical one.

- (a) endothermic
- (b) physical
- (c) gaseous
- (d) biological

Q3: Diatomic elements _____.

- (a) contain two atoms of the same element, and are usually liquids
- (b) consist of two molecules joined to each other by chemical bonds
- (c) consist of chemicals joined by diatomic bonds
- (d) contain two atoms of the same element, joined by chemical bonds

Q4: Because matter cannot be created or destroyed in a chemical reaction, the mass of all the reactants will always add up to the total mass of all the products. This is called _____.

- (a) the law of conservation of mass
- (b) the octet rule
- (c) a chemical equation
- (d) the Heisenberg Certainty Principle

Q5: _____ are key players in chemical bonding, and move around in energy levels called shells or orbitals.

- a) Protons
- b) Octets
- c) Electrons
- d) Valences

Q6: A(n) _____ is when two atoms or more atoms share their electrons. Most molecules are made up of these.

- (a) ionic bond
- (b) covalent bond
- (c) diatomic bond
- (d) metallic bond

Q7: A(n) _____ is when one atom gives up its electrons and the other atom receives those electrons. This usually occurs between a metal and a nonmetal.

- (a) ionic bond
- (b) covalent bond
- (c) diatomic bond
- (d) metallic bond

- Q8: In 1916, American chemist Gilbert Newton Lewis observed that elements are most stable when _____. His idea is called the octet rule.
- (a) they are grounded by equal charges
 - (b) they have eight protons in their nucleus
 - (c) they are found in the eighth row on the Period Table
 - (d) they have eight electrons in their highest energy level
- Q9: Any reaction that gives off heat is called _____.
- (a) endothermic
 - (b) exothermic
 - (c) combustible
 - (d) catalytic
- Q10: _____ reactions are chemical reactions that must absorb energy in order to occur.
- (a) Catalytic
 - (b) Exothermic
 - (c) Endothermic
 - (d) Synthesis
- Q11. In what kind of reaction does one reactant break apart to form two or more products?
- (a) Single displacement
 - (b) Double displacement
 - (c) Synthesis
 - (d) Decomposition
- Q12: A(n) _____ yields a hydrogen ion when dissolved in water.
- (a) acid
 - (b) hydrogen bond
 - (c) base
 - (d) oxide
- Q13: A(n) _____ yields a hydroxide or an OH ion when dissolved in water.
- (a) acid
 - (b) hydrogen bond
 - (c) base
 - (d) oxide
- Q14: In order for atoms, ions, or molecules to react, two conditions must be met: they must come into contact with one another, and _____.
- (a) they must conform to the octet rule
 - (b) they must have a catalyst
 - (c) they must have enough activation energy
 - (d) they must have enough kinetic energy
- Q15: When temperature increases, what happens to most chemical reactions?
- (a) They become combustible
 - (b) They melt down
 - (c) They speed up
 - (d) They slow down

- Q16: A chemical that speeds up a chemical reaction without actually being involved in the reaction is called a(n) _____.
a) inhibitor
b) catalyst
c) rate of reaction
d) enzyme
- Q17: _____ speed up chemical reactions by lowering the activation energy so that the reactions can occur at a lower temperature.
(a) Enzymes
(b) Coolants
(c) Acids
(d) Catalysts
- Q18: True or False? Increasing the concentration of a solution increases the reaction rate because the particles collide with each other more often.
- Q19: Which unit is used to measure the amount of product produced or reactant used up in a chemical reaction? (*Choose all that apply.*)
a) Grams
b) Kilograms
c) Moles
d) All of the above
- Q20: Which of these are involved with chemical reactions? (*Choose all that apply.*)
(a) Chemosynthesis
(b) Digestion
(c) Photosynthesis
(d) Autotrophs

Answers

Q1: In a chemical reaction, the new substance(s) created, plus any ash, water vapor, or carbon dioxide, are called _____.

- (a) products
- (b) reactants
- (c) compounds
- (d) resultants

A: (a) *products*

Q2: Changes of state involve a(n) _____ change, rather than a chemical one.

- (a) endothermic
- (b) physical
- (c) gaseous
- (d) biological

A: (b) *physical*

Q3: Diatomic elements _____.

- (a) contain two atoms of the same element, and are usually liquids
- (b) consist of two molecules joined to each other by chemical bonds
- (c) consist of chemicals joined by diatomic bonds
- (d) contain two atoms of the same element, joined by chemical bonds

A: (d) *contain two atoms of the same element, joined by chemical bonds*

Q4: Because matter cannot be created or destroyed in a chemical reaction, the mass of all the reactants will always add up to the total mass of all the products. This is called _____.

- (a) the law of conservation of mass
- (b) the octet rule
- (c) a chemical equation
- (d) the Heisenberg Certainty Principle

A: (a) *the law of conservation of mass*

Q5: _____ are key players in chemical bonding, and move around in energy levels called shells or orbitals.

- a) Protons
- b) Octets
- c) Electrons
- d) Valences

A: (c) *Electrons*

Q6: A(n) _____ is when two atoms or more atoms share their electrons. Most molecules are made up of these.

- (a) ionic bond
- (b) covalent bond
- (c) diatomic bond
- (d) metallic bond

A: (b) *covalent bond*

Q7: A(n) _____ is when one atom gives up its electrons and the other atom receives those electrons. This usually occurs between a metal and a nonmetal.

- (a) ionic bond
- (b) covalent bond
- (c) diatomic bond
- (d) metallic bond

A: (a) *ionic bond*

Q8: In 1916, American chemist Gilbert Newton Lewis observed that elements are most stable when _____. His idea is called the octet rule.

- (a) they are grounded by equal charges
- (b) they have eight protons in their nucleus
- (c) they are found in the eighth row on the Period Table
- (d) they have eight electrons in their highest energy level

A: (d) *they have eight electrons in their highest energy level*

Q9: Any reaction that gives off heat is called _____.

- (a) endothermic
- (b) exothermic
- (c) combustible
- (d) catalytic

A: (b) *exothermic*

Q10: _____ reactions are chemical reactions that must absorb energy in order to occur.

- (a) Catalytic
- (b) Exothermic
- (c) Endothermic
- (d) Synthesis

A: (c) *Endothermic*

Q11. In what kind of reaction does one reactant break apart to form two or more products?

- (a) Single displacement
- (b) Double displacement
- (c) Synthesis
- (d) Decomposition

A: (d) *Decomposition*

Q12: A(n) _____ yields a hydrogen ion when dissolved in water.

- (a) acid
- (b) hydrogen bond
- (c) base
- (d) oxide

A: (a) *acid*

Q13: A(n) _____ yields a hydroxide or an OH ion when dissolved in water.

- (a) acid
- (b) hydrogen bond
- (c) base
- (d) oxide

A: (c) *base*

Q14: In order for atoms, ions, or molecules to react, two conditions must be met: they must come into contact with one another, and _____.

- (a) they must conform to the octet rule (b) they must have a catalyst
(c) they must have enough activation energy (d) they must have enough kinetic energy

A: (d) *they must have enough kinetic energy*

Q15: When temperature increases, what happens to most chemical reactions?

- (a) They become combustible (b) They melt down
(c) They speed up (d) They slow down

A: (c) *They speed up*

Q16: A chemical that speeds up a chemical reaction without actually being involved in the reaction is called a(n) _____.

- a) inhibitor b) catalyst
c) rate of reaction d) enzyme

A: (b) *catalyst*

Q17: _____ speed up chemical reactions by lowering the activation energy so that the reactions can occur at a lower temperature.

- (a) Enzymes (b) Coolants
(c) Acids (d) Catalysts

A: (a) *Enzymes*

Q18: True or False? Increasing the concentration of a solution increases the reaction rate because the particles collide with each other more often.

A: *True.*

Q19: Which unit is used to measure the amount of product produced or reactant used up in a chemical reaction? (*Choose all that apply.*)

- a) Grams b) Kilograms
c) Moles d) All of the above

A: (d) *All of the above*

Q20: Which of these are involved with chemical reactions? (*Choose all that apply.*)

- (a) Chemosynthesis (b) Digestion
(c) Photosynthesis (d) Autotrophs

A: *All of these are involved with chemical reactions.*

ACIDS AND BASES

Learning Objectives

After viewing these clips, students will be able to:

- Identify the properties of acids and bases
- Understand dissociation
- Understand valence electrons and the octet rule of thumb
- Understand the pH scale, and name several acid-base indicators
- Explain strong and weak acids and bases, and how these are determined
- Identify several examples of acids and bases in the natural world and in manufactured products

Clips

Clip 1: Introduction to Acids and Bases

Topics include the properties of acids and bases, ionization and dissociation of acids and bases, valence electrons, the octet rule of thumb, and amphoteric substances.

Clip 2: Determining Acids and Bases

Topics include self-ionization of water, dynamic equilibrium, the pH scale, and acid-base indicators.

Clip 3: Acids and Bases in Chemistry

Topics include strong and weak acids and bases, reversible reactions, acid and base dissociation constants, and the neutralization reaction.

Clip 4: Acids and Bases in Our World

Topics include some places that acids and bases occur in the natural world, in the human body, and as chemically manufactured products; and acid rain.

Quiz

Q1: Most chemical substances are either an acid or a base.

Q2: If a substance tastes bitter and feels slippery, it is a(n) _____.

- (a) acid
- (b) base
- (c) soda
- (d) amphoteric substance

Q3: Ammonia, soap, and baking soda are all examples of _____.

- (a) acids
- (b) bases
- (c) acid-base indicators
- (d) salts

Q4: A substance is determined to be an acid or a base through _____, which occurs after the substance is dissolved in water; when acids do this, they give off a hydrogen ion, while bases accept a hydrogen ion.

- (a) association
- (b) a litmus test
- (c) hydrogenation
- (d) dissociation

Q5: The octet rule, which has to do with atoms achieving a state of stability, helps explain why acids and bases may gain, lose, or share _____.

- (a) valence electrons
- (b) an eighth hydrogen bond
- (c) a stabilizing inner shell
- (d) eight electrons

Q6: When an acid is added to water that is in a state of _____, the number of hydronium ions in the water increases, and the number of hydroxide ions decreases (and vice versa if a base is added).

This allows us to measure not only the presence of, but the strength of an acid or base.

- (a) self-ionization
- (b) flux
- (c) disassociation
- (d) dynamic equilibrium

Q7: What is pH?

- (a) The measure of a litmus strip
- (b) The measure of a substance's balance
- (c) The measure of a substance's acidity based on levels of hydrogen ion concentration
- (d) The measure of a substance's acidity based on its reaction with bases

- Q8: When there's a lower concentration of hydrogen ions in a solution, its pH will be _____, and the substance more _____.
- (a) lower; basic
(b) lower; acidic
(c) higher; basic
(d) higher; acidic
- Q9: True or False? On a strip of litmus paper, the numbers from 0 to 6 and colors yellow through red indicate an acid; the numbers from 8 to 14 and blue/green colors indicate a base.
- Q10: On a strip of litmus paper, "neutral" is _____.
- (a) 0
(b) 14
(c) 5
(d) 7
- Q11: Which of the following is NOT an acid-base indicator?
- (a) Baking soda
(b) Phenolphthalein
(c) A pH meter
(d) A universal indicator
- Q12: Acids and bases that completely ionize (or dissociate) in water are called _____.
- (a) weak acids and bases
(b) strong acids and bases
(c) dissociative
(d) neutral (or neutralized)
- Q13: The breakdown of any acid or base in water to form its ions is a(n) _____; this happens more often in a weak acid or base than in a strong one.
- (a) reversible reaction
(b) ionic reaction
(c) neutralization reaction
(d) double displacement reaction
- Q14: The symbols pK_b represent the _____, which is the extent to which most bases will dissociate in water.
- (a) ionization factor constant
(b) pH balance
(c) universal indicator
(d) base dissociation constant
- Q15: The strength of an acid or base is measured by _____.
- (a) its chemical formula
(b) how much acid or base is in the solution relative to the amount of water it is dropped in
(c) how it dissociates in water
(d) how diluted it becomes in water

Q16: To make strong acids weaker requires a chemical reaction with _____. This is called a neutralization reaction.

- (a) bases
- (b) neutrals
- (c) chlorine
- (d) a double displacement reaction

Q17: What is the number one chemical produced worldwide?

- (a) Sodium chloride
- (b) Sodium hydroxide
- (c) Sulfuric acid
- (d) Hydrochloric acid

Q18: Acids and bases are used in which of the following? (Choose all that apply)

- (a) fertilizers
- (b) rust removers
- (c) cleaning solvents
- (d) food and beverage flavorings

Q19: True or False? The human body uses acids and bases to regulate its blood pH levels.

Q20: Acid rain results from chemical interactions with _____.

- (a) auto and power plant emissions only
- (b) emissions from autos, power plants, volcanoes, and decaying plants
- (c) emissions from chemical factories only
- (d) None of the above

Answers

Q1: Most chemical substances are either an acid or a base.

A: *True.*

Q2: If a substance tastes bitter and feels slippery, it is a(n) _____.

- (a) acid (b) base
(c) soda (d) amphoteric substance

A: *(b) base*

Q3: Ammonia, soap, and baking soda are all examples of _____.

- (a) acids (b) bases
(c) acid-base indicators (d) salts

A: *(b) bases*

Q4: A substance is determined to be an acid or a base through _____, which occurs after the substance is dissolved in water; when acids do this, they give off a hydrogen ion, while bases accept a hydrogen ion.

- (a) association (b) a litmus test
(c) hydrogenation (d) dissociation

A: *(d) dissociation*

Q5: The octet rule, which has to do with atoms achieving a state of stability, helps explain why acids and bases may gain, lose, or share _____.

- (a) valence electrons (b) an eighth hydrogen bond
(c) a stabilizing inner shell (d) eight electrons

A: *(a) valence electrons*

Q6: When an acid is added to water that is in a state of _____, the number of hydronium ions in the water increases, and the number of hydroxide ions decreases (and vice versa if a base is added). This allows us to measure not only the presence of, but the strength of an acid or base.

- (a) self-ionization (b) flux
(c) disassociation (d) dynamic equilibrium

A: *(d) dynamic equilibrium*

Q7: What is pH?

- (a) The measure of a litmus strip
- (b) The measure of a substance's balance
- (c) The measure of a substance's acidity based on levels of hydrogen ion concentration
- (d) The measure of a substance's acidity based on its reaction with bases

A: (c) *The measure of a substance's acidity based on levels of hydrogen ion concentration*

Q8: When there's a lower concentration of hydrogen ions in a solution, its pH will be _____, and the substance more _____.

- (a) lower; basic
- (b) lower; acidic
- (c) higher; basic
- (d) higher; acidic

A: (c) *higher; basic*

Q9: True or False? On a strip of litmus paper, the numbers from 0 to 6 and colors yellow through red indicate an acid; the numbers from 8 to 14 and blue/green colors indicate a base.

A: *True.*

Q10: On a strip of litmus paper, "neutral" is _____.

- (a) 0
- (b) 14
- (c) 5
- (d) 7

A: (d) *7*

Q11: Which of the following is NOT an acid-base indicator?

- (a) Baking soda
- (b) Phenolphthalein
- (c) A pH meter
- (d) A universal indicator

A: (a) *Baking soda*

Q12: Acids and bases that completely ionize (or dissociate) in water are called _____.

- (a) weak acids and bases
- (b) strong acids and bases
- (c) dissociative
- (d) neutral (or neutralized)

A: (b) *strong acids and bases*

Q13: The breakdown of any acid or base in water to form its ions is a(n) _____; this happens more often in a weak acid or base than in a strong one.

- (a) reversible reaction
- (b) ionic reaction
- (c) neutralization reaction
- (d) double displacement reaction

A: (a) *reversible reaction*

Q14: The symbols pK_b represent the _____, which is the extent to which most bases will dissociate in water.

- (a) ionization factor constant
- (b) pH balance
- (c) universal indicator
- (d) base dissociation constant

A: (d) *base dissociation constant*

Q15: The strength of an acid or base is measured by _____.

- (a) its chemical formula
- (b) how much acid or base is in the solution relative to the amount of water it is dropped in
- (c) how it dissociates in water
- (d) how diluted it becomes in water

A: (c) *how it dissociates in water*

Q16: To make strong acids weaker requires a chemical reaction with _____. This is called a neutralization reaction.

- (a) bases
- (b) neutrals
- (c) chlorine
- (d) a double displacement reaction

A: (a) *bases*

Q17: What is the number one chemical produced worldwide?

- (a) Sodium chloride
- (b) Sodium hydroxide
- (c) Sulfuric acid
- (d) Hydrochloric acid

A: (c) *Sulfuric acid (used in auto batteries)*

Q18: Acids and bases are used in which of the following? (Choose all that apply)

- (a) fertilizers
- (b) rust removers
- (c) cleaning solvents
- (d) food and beverage flavorings

A: *All of these are correct.*

Q19: True or False? The human body uses acids and bases to regulate its blood pH levels.

A: *True.*

Q20: Acid rain results from chemical interactions with _____.

- (a) auto and power plant emissions only
- (b) emissions from autos, power plants, volcanoes, and decaying plants
- (c) emissions from chemical factories only
- (d) None of the above

A: (b) *emissions from autos, power plants, volcanoes, and decaying plants*

Metals

Learning Objectives

After viewing this module, students will be able to:

- Describe how metals play a role in many areas of everyday life
- Distinguish between alkali, alkaline earth, and transition metals
- Describe individual elements in each metal group
- Explain chemical reactions involving metals
- Define compounds and alloys

Clips

Clip 1: Metals in Our World

Topics include some properties of metals, and uses for potassium, sodium, lithium, iron, uranium, silver, zinc, mercury, and magnesium.

Clip 2: Alkali Metals

Topics include the history of alkali metals, some of their properties, and ways in which alkali metals are used in the environment, technology, and health and medicine.

Clip 3: Alkaline Earth Metals

Topics include the history of alkaline earth metals, some of their properties, and ways in which alkali metals are used in medicine and industry, and for everyday use.

Clip 4: Transition Metals

Topics include some properties of the transition metals, and uses for cobalt, nickel, copper, silver, gold, zinc, cadmium, and mercury.

Clip 5: Metals and Chemical Reactions

Topics include endothermic and exothermic reactions, oxidation, combustion, and acids and bases.

Quiz

- Q1: On the Periodic Table, _____% of the elements are classified as metals.
- (a) 25 (b) 50
(c) 75 (d) 90
- Q2: True or False? Because metals are so reactive, they are only found in compounds when found in nature.
- Q3: Sodium is present in the well-known compound sodium chloride, or salt. More than half of the salt produced annually is used _____.
- (a) by the food industry as an ingredient in convenience foods
(b) by chemical industries to make other compounds
(c) as common table salt
(d) in pesticides
- Q4: _____ has more uses and applications than any other metal.
- (a) Zinc (b) Silver
(c) Mercury (d) Iron
- Q5: The alkali metals are _____, and this property increases with their atomic number.
- (a) highly reactive (b) low in reactivity
(c) radioactive (d) prone to oxidation
- Q6: Which alkali metal is used both in batteries, and as treatment for mood disorders?
- (a) Nickel (b) Cadmium
(c) Lithium (d) Silver nitrate
- Q7: Cesium is very useful for firefighters because _____.
- (a) it acts as a salve for burns
(b) pouring it onto burning substances helps reduce the flames
(c) it functions as a natural flame retardant, so is used in the manufacture of their uniforms
(d) pouring carbon dioxide on it releases oxygen, so they have breathable air despite the presence of toxic fumes

- Q8: On the Periodic Table, alkali metals are _____.
(a) Group 1 (the first vertical column) (b) Row 1 (the first vertical column)
(c) Group 1 (the first row) (d) grouped with the actinoids
- Q9: Which alkaline earth metal helps ensure that the body's enzymes function correctly?
(a) Calcium (b) Magnesium
(c) Strontium (d) Barium
- Q10: _____ discovered many alkali and alkaline earth metals, such as potassium, sodium, calcium, and barium.
(a) Marie Curie (b) Robert Bunsen
(c) Nikola Tesla (d) Humphrey Davy
- Q11: Like most metals, the alkaline earth metals are ductile, which means _____.
(a) they are shiny (b) they are malleable
(c) they can be thinly hammered (d) they can be made to float in water
- Q12: Along with the discovery of the electron, and the Theory of Relativity, the discovery of _____ in 1898 marked the beginning of the modern era of science.
(a) radium (b) strontium
(c) barium (d) uranium
- Q13: The transition metals are _____.
(a) more reactive than the alkali and alkaline earth metals
(b) more stable than the alkali and alkaline earth metals
(c) rarely found in nature in their pure form
(d) a bridge between the alkali and alkaline earth metals
- Q14: Of all the metals, which is the best conductor of heat and electricity?
(a) Copper (b) Nickel
(c) Silver (d) Zinc
- Q15: Of all the metals, which is the most malleable?
(a) Gold (b) Silver
(c) Copper (d) Zinc

Q16: True or False? One of the unusual properties of mercury is its ability to dissolve other metals.

Q17: Chemical reactions that give off energy are called _____ reactions.

- (a) endothermic
- (b) exothermic
- (c) combustible
- (d) acidic

Q18: Most chemical reactions are _____, meaning they require an input of energy to cause the reaction.

- (a) endothermic
- (b) exothermic
- (c) energetic
- (d) basic

Q19: Many metals are highly reactive with air and water, hence they are vulnerable to _____.

- (a) inflammation
- (b) endothermic reactions
- (c) combustion
- (d) oxidation

Q20: When a metal with greater reactivity than hydrogen comes into contact with an acid, the atoms from the metal replace the acid's hydrogen atoms. The hydrogen is released as a gas, and the the solution that remains is _____.

- (a) a base
- (b) a salt
- (c) an ion
- (d) neutral

Answers

Q1: On the Periodic Table, _____% of the elements are classified as metals.

- (a) 25 (b) 50
(c) 75 (d) 90

A: (c) 75

Q2: True or False? Because metals are so reactive, they are only found in compounds when found in nature.

A: *False. Some metals are found in their pure forms, while the very reactive metals exist in nature only in compounds.*

Q3: Sodium is present in the well-known compound sodium chloride, or salt. More than half of the salt produced annually is used _____.

- (a) by the food industry as an ingredient in convenience foods
(b) by chemical industries to make other compounds
(c) as common table salt
(d) in pesticides

A: (b) *by chemical industries to make other compounds*

Q4: _____ has more uses and applications than any other metal.

- (a) Zinc (b) Silver
(c) Mercury (d) Iron

A: (d) *Iron*

Q5: The alkali metals are _____, and this property increases with their atomic number.

- (a) highly reactive (b) low in reactivity
(c) radioactive (d) prone to oxidation

A: (a) *highly reactive*

Q6: Which alkali metal is used both in batteries, and as treatment for mood disorders?

- (a) Nickel (b) Cadmium
(c) Lithium (d) Silver nitrate

A: (c) *Lithium*

Q7: Cesium is very useful for firefighters because _____.

- (a) it acts as a salve for burns
- (b) pouring it onto burning substances helps reduce the flames
- (c) it functions as a natural flame retardant, so is used in the manufacture of their uniforms
- (d) pouring carbon dioxide on it releases oxygen, so they have breathable air despite the presence of toxic fumes

A: (d) *pouring carbon dioxide on it releases oxygen, so they have breathable air despite the presence of toxic fumes*

Q8: On the Periodic Table, alkali metals are _____.

- (a) Group 1 (the first vertical column)
- (b) Row 1 (the first vertical column)
- (c) Group 1 (the first row)
- (d) grouped with the actinoids

A: (a) *Group 1 (the first vertical column)*

Q9: Which alkaline earth metal helps ensure that the body's enzymes function correctly?

- (a) Calcium
- (b) Magnesium
- (c) Strontium
- (d) Barium

A: (b) *Magnesium*

Q10: _____ discovered many alkali and alkaline earth metals, such as potassium, sodium, calcium, and barium.

- (a) Marie Curie
- (b) Robert Bunsen
- (c) Nikola Tesla
- (d) Humphrey Davy

A: (d) *Humphrey Davy*

Q11: Like most metals, the alkaline earth metals are ductile, which means _____.

- (a) they are shiny
- (b) they are malleable
- (c) they can be thinly hammered
- (d) they can be made to float in water

A: (c) *they can be thinly hammered*

Q12: Along with the discovery of the electron, and the Theory of Relativity, the discovery of _____ in 1898 marked the beginning of the modern era of science.

- (a) radium
- (b) strontium
- (c) barium
- (d) uranium

A: (a) *radium*

Q13: The transition metals are _____.

- (a) more reactive than the alkali and alkaline earth metals
- (b) more stable than the alkali and alkaline earth metals
- (c) rarely found in nature in their pure form
- (d) a bridge between the alkali and alkaline earth metals

A: (b) more stable than the alkali and alkaline earth metals

Q14: Of all the metals, which is the best conductor of heat and electricity?

- (a) Copper
- (b) Nickel
- (c) Silver
- (d) Zinc

A: (c) Silver

Q15: Of all the metals, which is the most malleable?

- (a) Gold
- (b) Silver
- (c) Copper
- (d) Zinc

A: (a) Gold

Q16: True or False? One of the unusual properties of mercury is its ability to dissolve other metals.

A: True.

Q17: Chemical reactions that give off energy are called _____ reactions.

- (a) endothermic
- (b) exothermic
- (c) combustible
- (d) acidic

A: (b) exothermic

Q18: Most chemical reactions are _____, meaning they require an input of energy to cause the reaction.

- (a) endothermic
- (b) exothermic
- (c) energetic
- (d) basic

A: (a) endothermic

Q19: Many metals are highly reactive with air and water, hence they are vulnerable to _____.

- (a) inflammation
- (b) endothermic reactions
- (c) combustion
- (d) oxidation

A: (d) oxidation

Q20: When a metal with greater reactivity than hydrogen comes into contact with an acid, the atoms from the metal replace the acid's hydrogen atoms. The hydrogen is released as a gas, and the the solution that remains is _____.

- (a) a base
- (b) a salt
- (c) an ion
- (d) neutral

A: (b) a salt

BIOCHEMISTRY

Learning Objectives

After viewing these clips, students will be able to:

- Define and describe amino acids, proteins, and nucleic acids, and explain how they contribute to making life possible
- Define and describe enzymes, lipids, and biological membranes, and explain how they contribute to making life possible
- Define carbohydrates and metabolic pathways, and explain how they contribute to the generation of energy
- Define the Krebs Cycle and explain its role as a metabolic pathway

Clips

Clip 1: Amino Acids

Topics include peptides, polypeptides, peptide bonds, amino groups, carboxylic acid groups, side chains (R groups), alpha carbons, and alpha amino acids.

Clip 2: Proteins and Nucleic Acids

Topics include the four protein structures, protein sequencing, nucleotides, and DNA and RNA.

Clip 3: Enzymes

Topics include substrates, the active site, the ES complex, products, factors affecting enzyme reactions, enzyme specificity, and how DNA is used for forensic analysis

Clip 4: Lipids and Biological Membranes

Topics include triglycerides, fatty acids, saturated and unsaturated fats, phospholipids and lipid bilayers, steroids, and cholesterol.

Clip 5: Carbohydrates

Topics include monosaccharides (glucose, fructose, galactose), disaccharides (sucrose), and polysaccharides (starch, cellulose, glycogen, chitin, peptin, heparin).

Clip 6: Metabolic Pathways

Topics include catabolism and anabolism, ATP, cellular respiration, aerobic respiration, the aerobic pathway (glycolysis, the Krebs Cycle, and the electron transport chain).

Quiz

- Q1: Amino acids are the building blocks of _____, and are present in all living organisms.
- (a) proteins (b) carbohydrates
(c) lipids (d) oxygen
- Q2: Amino acids are linked together via _____.
- (a) DNA strands (b) fatty lipids
(c) hydrogen bonds (d) chains called peptides
- Q3: There are 20 or so _____. These are special to biochemistry because they play a role in biomolecules that are involved in _____.
- (a) amino acids; storing genetic information (b) alpha carbons; r groups
(c) alpha amino acids; nutrition (d) side chains; nutrition
- Q4: True or False? The human body makes about 50,000 different proteins, each with a primary, secondary, and tertiary structure, and each with a specific function.
- Q5: The information the body requires in order to produce different proteins is contained in large molecules called _____.
- (a) nucleotides (b) nucleic acids
(c) enzymes (d) RNA
- Q6: Each _____ contains millions of _____, such as DNA and RNA.
- (a) nucleic acid; nucleotides (b) nucleotide; nucleic acids
(c) nucleic acid; proteins (d) nucleotide; proteins
- Q7: _____ are proteins that increase the speed of complex reactions in living organisms by a million times or more, making life possible.
- (a) Mitochondria (b) Lysozymes
(c) Enzymes (d) Glucides
- Q8: There are about 40,000 enzymes in human cells, each controlling _____.
- (a) a different bodily process (b) its own group of chemical reactions
(c) a substrate (d) a different chemical reaction

- Q9: A number of factors affect enzyme reactions, including _____. (*Choose all that apply*)
- (a) temperature
 - (b) acidity
 - (c) concentrations of enzymes and substrates
 - (d) enzyme effectors
- Q10: While there are many different kinds of lipids, they all share one property — _____.
- (a) having a high glycemic index
 - (b) sensitivity to light
 - (c) being insoluble in water
 - (d) being heat resistant
- Q11: Fats are found in the body in the form of _____.
- (a) triglycerides
 - (b) lipids
 - (c) steroids
 - (d) phospholipids
- Q12: _____ are an important class of lipids that typically occur as hormones, controlling the action of certain cells and organs.
- (a) Triglycerides
 - (b) Steroids
 - (c) Phospholipids
 - (d) Enzymes
- Q13: Cholesterol, a waxy fatty substance found in all body cells, _____.
- (a) regulates the distribution of saturated and unsaturated fats in the body
 - (b) is a type of steroid that sends messages of 'fullness' to the brain while eating
 - (c) occurs in the body due to a diet high in unsaturated fats
 - (d) acts as part of the cell membrane while helping to make hormones
- Q14: Most carbohydrates in food are broken down into _____ in the course of digestion, making them a major energy source for living organisms.
- (a) polysaccharides
 - (b) starch
 - (c) ATP
 - (d) glucose
- Q15: Monosaccharides (e.g., glucose, fructose, honey), disaccharides (e.g., table sugar), and polysaccharides (e.g., starch, cellulose) are all types of _____.
- (a) simple sugars
 - (b) carbohydrates
 - (c) complex starches
 - (d) saccharides
- Q16: Plants store food in the form of starch, which is made up of _____.
- (a) glucose molecules
 - (b) cellulose
 - (c) chitin
 - (d) pectins

- Q17: The cell walls in plants are made of a carbohydrate called ____.
- (a) glycogen (b) cellulose
(c) starch (d) pectin
- Q18: All metabolic reactions are complex, multistep processes each controlled by specific enzymes that produce particular substances. These multistep processes are called ____.
- (a) metabolic pathways (b) catabolic reactions
(c) metabolic lifecycles (d) enzymatic pathways
- Q19: The two types of metabolic reaction are ____ (breaking down molecules to release energy, such as in digestion) and ____ (using energy to create larger molecules from smaller ones).
- (a) inverse; converse (b) anabolic; catabolic
(c) catabolic; anabolic (d) endothermic; exothermic
- Q20: ____ is a metabolic pathway that results in energy for the body's cells by breaking glucose down into ATP.
- (a) Cellular respiration (b) Aerobic respiration
(c) The Krebs Cycle (d) Glycolysis

Answers

Q1: Amino acids are the building blocks of _____, and are present in all living organisms.

- (a) proteins (b) carbohydrates
(c) lipids (d) oxygen

A: (a) *proteins*

Q2: Amino acids are linked together via _____.

- (a) DNA strands (b) fatty lipids
(c) hydrogen bonds (d) chains called peptides

A: (d) *chains called peptides*

Q3: There are 20 or so _____. These are special to biochemistry because they play a role in biomolecules that are involved in _____.

- (a) amino acids; storing genetic information (b) alpha carbons; r groups
(c) alpha amino acids; nutrition (d) side chains; nutrition

A: (c) *alpha amino acids; nutrition*

Q4: The human body makes about 50,000 different proteins, each with a primary, secondary, and tertiary structure, and each with a specific function.

A: *True.*

Q5: The information the body requires in order to produce different proteins is contained in large molecules called _____.

- (a) nucleotides (b) nucleic acids
(c) enzymes (d) RNA

A: (b) *nucleic acids*

Q6: Each _____ contains millions of _____, such as DNA and RNA.

- (a) nucleic acid; nucleotides (b) nucleotide; nucleic acids
(c) nucleic acid; proteins (d) nucleotide; proteins

A: (a) *nucleic acid; nucleotides*

Q7: _____ are proteins that increase the speed of complex reactions in living organisms by a million times or more, making life possible.

- (a) Mitochondria (b) Lysozymes
(c) Enzymes (d) Glucides

A: (c) *Enzymes*

- Q8: There are about 40,000 enzymes in human cells, each controlling _____.
(a) a different bodily process (b) its own group of chemical reactions
(c) a substrate (d) a different chemical reaction

A: (d) a different chemical reaction

- Q9: A number of factors affect enzyme reactions, including _____. (Choose all that apply)
(a) temperature (b) acidity
(c) concentrations of enzymes and substrates (d) enzyme effectors

A: All of these factors affect enzyme reactions

- Q10: While there are many different kinds of lipids, they all share one property — _____.
(a) having a high glycemic index (b) sensitivity to light
(c) being insoluble in water (d) being heat resistant

A: (c) being insoluble in water

- Q11: Fats are found in the body in the form of _____.
(a) triglycerides (b) lipids
(c) steroids (d) phospholipids

A: (a) triglycerides

- Q12: _____ are an important class of lipids that typically occur as hormones, controlling the action of certain cells and organs.

- (a) Triglycerides
(b) Steroids
(c) Phospholipids
(d) Enzymes

A: (b) Steroids

- Q13: Cholesterol, a waxy fatty substance found in all body cells, _____.
(a) regulates the distribution of saturated and unsaturated fats in the body
(b) is a type of steroid that sends messages of 'fullness' to the brain while eating
(c) occurs in the body due to a diet high in unsaturated fats
(d) acts as part of the cell membrane while helping to make hormones

A: (d) acts as part of a cell membrane while helping to make hormones

Q14: Most carbohydrates in food are broken down into ____ in the course of digestion, making them a major energy source for living organisms.

- (a) polysaccharides (b) starch
(c) ATP (d) glucose

A: (d) *glucose*

Q15: Monosaccharides (e.g., glucose, fructose, honey), disaccharides (e.g., table sugar), and polysaccharides (e.g., starch, cellulose) are all types of ____.

- (a) simple sugars (b) carbohydrates
(c) complex starches (d) saccharides

A: (b) *carbohydrates*

Q16: Plants store food in the form of starch, which is made up of ____.

- (a) glucose molecules (b) cellulose
(c) chitin (d) pectins

A: (a) *glucose molecules*

Q17: The cell walls in plants are made of a carbohydrate called ____.

- (a) glycogen (b) cellulose
(c) starch (d) pectin

A: (b) *cellulose*

Q18: All metabolic reactions are complex, multistep processes each controlled by specific enzymes that produce particular substances. These multistep processes are called ____.

- (a) metabolic pathways (b) catabolic reactions
(c) metabolic lifecycles (d) enzymatic pathways

A: (a) *metabolic pathways*

Q19: The two types of metabolic reaction are ____ (breaking down molecules to release energy, such as in digestion) and ____ (using energy to create larger molecules from smaller ones).

- (a) inverse; converse (b) anabolic; catabolic
(c) catabolic; anabolic (d) endothermic; exothermic

A: (c) *catabolic; anabolic*

Q20: ____ is a metabolic pathway that results in energy for the body's cells by breaking glucose down into ATP.

- (a) Cellular respiration (b) Aerobic respiration
(c) The Krebs Cycle (d) Glycolysis

A: (c) *The Krebs Cycle*

STATES OF MATTER

Learning Objectives

After viewing this module, students will be able to:

- Describe the three common states of matter: solids, liquids, and gases
- Understand the processes of evaporation and condensation
- Understand the processes of melting and freezing
- Understand the processes of sublimation and deposition
- Demonstrate knowledge of other states of matter beyond solids, liquids, and gases

Clips

Clip 1: Solids, Liquids, and Gases

Topics include the molecular properties of solids, liquids, and gases; intermolecular forces, and the Ideal Gas Law.

Clip 2: Evaporation and Condensation

Topics include the mechanics of evaporation and condensation, and the factors affecting these.

Clip 3: Melting and Freezing

Topics include the mechanics of melting and freezing, and ionic and covalent bonds.

Clip 4: Sublimation and Deposition

Topics include the processes by which matter changes directly between the solid and gaseous states.

Clip 5: Other States of Matter

Topics include plasma, liquid crystals, Bose-Einstein condensates, superfluids, and supersolids.

Quiz

- Q1: The most common state of matter in the universe is _____.
(a) gases (b) liquids
(c) solids (d) plasmas
- Q2: Which state of matter has molecules loosely bonded together and taking on the shape of the container into which it is placed?
(a) Solid (b) Liquid
(c) Gas (d) Plasma
- Q3: In solids made up of only one element, the atoms are of equal size. This results in what chemists call _____.
(a) uniformity (b) tight-knit structure
(c) close-packed structure (d) a lattice structure
- Q4: Which of the following is NOT an intermolecular force?
(a) dispersion forces (b) dipole-dipole forces
(c) dipole-anapole forces (d) hydrogen bonds
- Q5: Three factors determine the movements of atoms or molecules in a gas: temperature, pressure, and _____.
(a) humidity (b) concentration
(c) mass (d) volume
- Q6: Which of the following equations represents the ideal gas law?
(a) $G = PTn$ (b) $PV = nRT$
(c) $N = VPG$ (d) $P = nT^2$
- Q7: The process by which gas converts to a liquid is called _____.
(a) condensation (b) evaporation
(c) melting (d) transvaporation

- Q8: When the kinetic energy of a molecule is great enough to overcome the molecular force holding it to other molecules in a liquid state, the state of matter changes from a liquid to a _____.
(a) solid (b) more viscous liquid
(c) molecule (d) gas
- Q9: The temperature at which liquid becomes a gas is called _____.
(a) the boiling point (b) the ideal gas law
(c) the melting point (d) the dew point
- Q10: True or False? Two factors involved in evaporation and condensation are intermolecular forces, and air pressure
- Q11: Which process creates fog?
(a) condensation (b) evaporation
(c) melting (d) transvaporation
- Q12: How fast or slow the particles that make up a solid vibrate depends on the amount of energy they contain. That energy is measured in terms of _____.
(a) thermodynamics (b) speed
(c) velocity (d) temperature
- Q13: The temperature at which a solid becomes a liquid is known as its melting point. The freezing point of a solid is _____.
(a) inversely proportionate to its melting point
(b) lower by varying degrees than its melting point
(c) sometimes higher than its melting point
(d) the same as the melting point
- Q14: Forces created when electrons are gained or lost are called _____.
(a) ionic bonds (b) covalent bonds
(c) anionic bonds (d) cationic bonds
- Q15: A _____ bond occurs when two atoms, both in need of electrons to become stable, share electrons.
(a) ionic (b) covalent
(c) anionic (d) cationic

- Q16: _____ occurs when a solid changes directly into a gas (the liquid state of matter is skipped).
- (a) Condensation (b) Sublimation
(c) Deposition (d) Melting
- Q17: _____ occurs when a gas changes directly into a solid (e.g., frost).
- (a) Condensation (b) Sublimation
(c) Deposition (d) Freezing
- Q18: Sublimation and deposition phase changes occur when the effects of temperature are combined with _____.
- (a) mass (b) kinetic energy
(c) pressure (d) activation energy
- Q19: _____ is/are something between a liquid and a solid; its molecules are arranged in a structured pattern, but are still able to flow and move like liquids.
- (a) Liquid crystals (b) Plasma
(c) Superliquids (d) Supersolids
- Q20: At the molecular level, _____ have more energy than any other state of matter.
- (a) plasmas (b) solids
(c) liquids (d) gases

Answers

Q1: The most common state of matter in the universe is _____.

- (a) gases (b) liquids
(c) solids (d) plasmas

A: (d) *plasmas*

Q2: Which state of matter has molecules loosely bonded together and taking on the shape of the container into which it is placed?

- (a) Solid (b) Liquid
(c) Gas (d) Plasma

A: (b) *Liquid*

Q3: In solids made up of only one element, the atoms are of equal size. This results in what chemists call _____.

- (a) uniformity (b) tight-knit structure
(c) close-packed structure (d) a lattice structure

A: (c) *close-packed structure*

Q4: Which of the following is NOT an intermolecular force?

- (a) dispersion forces (b) dipole-dipole forces
(c) dipole-anapole forces (d) hydrogen bonds

A: (c) *dipole-anapole forces*

Q5: Three factors determine the movements of atoms or molecules in a gas: temperature, pressure, and _____.

- (a) humidity (b) concentration
(c) mass (d) volume

A: (d) *volume*

Q6: Which of the following equations represents the ideal gas law?

- (a) $G = PTn$ (b) $PV = nRT$
(c) $N = VPG$ (d) $P = nT^2$

A: (b) $PV = nRT$

Q7: The process by which gas converts to a liquid is called _____.
(a) condensation (b) evaporation
(c) melting (d) transvaporation

A: (a) condensation

Q8: When the kinetic energy of a molecule is great enough to overcome the molecular force holding it to other molecules in a liquid state, the state of matter changes from a liquid to a _____.
(a) solid (b) more viscous liquid
(c) molecule (d) gas

A: (d) gas

Q9: The temperature at which liquid becomes a gas is called _____.
(a) the boiling point (b) the ideal gas law
(c) the melting point (d) the dew point

A: (c) the boiling point

Q10: True or False? Two factors involved in evaporation and condensation are intermolecular forces, and air pressure

A: True.

Q11: Which process creates fog?
(a) condensation (b) evaporation
(c) melting (d) transvaporation

A: (a) condensation

Q12: How fast or slow the particles that make up a solid vibrate depends on the amount of energy they contain. That energy is measured in terms of _____.
(a) thermodynamics (b) speed
(c) velocity (d) temperature

A: (d) temperature

Q13: The temperature at which a solid becomes a liquid is known as its melting point. The freezing point of a solid is _____.
(a) inversely proportionate to its melting point
(b) lower by varying degrees than its melting point
(c) sometimes higher than its melting point
(d) the same as the melting point

A: (d) the same as the melting point

Q14: Forces created when electrons are gained or lost are called _____.

- (a) ionic bonds (b) covalent bonds
(c) anionic bonds (d) cationic bonds

A: (a) ionic bonds

Q15: A _____ bond occurs when two atoms, both in need of electrons to become stable, share electrons.

- (a) ionic (b) covalent
(c) anionic (d) cationic

A: (b) covalent

Q16: _____ occurs when a solid changes directly into a gas (the liquid state of matter is skipped).

- (a) Condensation (b) Sublimation
(c) Deposition (d) Melting

A: (b) Sublimation

Q17: _____ occurs when a gas changes directly into a solid (e.g., frost).

- (a) Condensation (b) Sublimation
(c) Deposition (d) Freezing

A: (c) Deposition

Q18: Sublimation and deposition phase changes occur when the effects of temperature are combined with _____.

- (a) mass (b) kinetic energy
(c) pressure (d) activation energy

A: (c) pressure

Q19: _____ is/are something between a liquid and a solid; its molecules are arranged in a structured pattern, but are still able to flow and move like liquids.

- (a) Liquid crystals (b) Plasma
(b) Superliquids (d) Supersolids

A: (a) Liquid crystals

Q20: At the molecular level, _____ have more energy than any other state of matter.

- (a) plasmas (b) solids
(c) liquids (d) gases

A: (a) plasmas

EARTH CHEMISTRY

Learning Objectives

After viewing these clips, students will be able to:

- Discuss the chemical composition of the atmosphere, hydrosphere, and lithosphere
- Understand how the atmosphere makes life on earth possible
- Define greenhouse gases, the greenhouse effect, the ozone layer, and air pollution
- Discuss the unique properties of water's chemical formula
- Identify different types of weathering

Clips

Clip 1: Chemical Processes in the Atmosphere

Topics include the chemical composition of the atmosphere, the atmosphere's role in life on earth, trace (greenhouse) gases, the greenhouse effect, fossil fuels, the ozone layer, air pollution, and acid rain.

Clip 2: Chemical and Physical Processes in the Hydrosphere

Topics include the forms that water takes above, on, and below the earth, the unique properties of water's chemical formula (including polarity), water as a universal solvent, salinity, and water pollution.

Clip 3: Chemical Processes in the Lithosphere

Topics include the chemical composition of the lithosphere, types of physical weathering and its results, and types of chemical weathering and its results.

Quiz

- Q1: The atmosphere _____. (*Choose all that apply.*)
- (a) contains oxygen that is critical for both animals' and plants' respiration
 - (b) contains oxygen that is critical for animals' respiration
 - (c) contains carbon dioxide that plants use to make food molecules
 - (d) contains nitrogen that provides nutrients to plants for making food
 - (e) keeps most of the planet's water warm enough to remain liquid (hence, oceans)
- Q2: The atmosphere is primarily made up of _____.
- (a) oxygen and hydrogen
 - (b) water vapor and oxygen
 - (c) oxygen and carbon dioxide
 - (d) nitrogen and oxygen
- Q3: The _____ is the layer of the atmosphere closest to Earth's surface.
- (a) lithosphere
 - (b) troposphere
 - (c) mesosphere
 - (d) stratosphere
- Q4: Trace gases, also called greenhouse gases, _____.
- (a) are a direct result of human activity
 - (b) allow the atmosphere to heat up or cool down
 - (c) are of interest to scientists as a potential source of energy
 - (d) allow the atmosphere to absorb heat, making life on earth possible
- Q5: When fossil fuels are burned, it results in excess carbon dioxide in the atmosphere, _____ and raising Earth's temperature with potentially drastic consequences.
- (a) reducing the greenhouse effect
 - (b) decreasing nitrogen in the troposphere
 - (c) enhancing the greenhouse effect
 - (d) increasing nitrogen in the troposphere
- Q6: The ozone layer is important because _____.
- (a) ozone molecules absorb ultraviolet radiation from the sun that can harm plants and animals
 - (b) ozone molecules absorb ultraviolet radiation from the sun that can harm all animal life, including humans
 - (c) it absorbs excess greenhouse gases that are raising Earth's temperature
 - (d) it serves as a protective barrier between the troposphere and greenhouse gases

- Q7: The hydrosphere includes _____. (*Choose all that apply.*)
- (a) all water above, on, and below the earth
 - (b) water in all its forms within the atmosphere, such as clouds
 - (c) snow and ice, but not permafrost
 - (d) gaseous water
- Q8: What percent of Earth is covered by water?
- (a) 40%
 - (b) 50%
 - (c) 70%
 - (d) nearly 90%
- Q9: Q8: What percent of Earth's water is salt water?
- (a) 18%
 - (b) 28%
 - (c) 54%
 - (d) 97%
- Q10: True or False? Most of Earth's water is locked up as snow, ice, and permafrost.
- Q11: Water's chemical formula gives it several unique properties, such as _____.
- (a) polarity (which helps to make water a universal solvent)
 - (b) extreme sensitivity to temperature changes
 - (c) polarity (which makes water molecules repel each other)
 - (d) salinity
- Q12: Most water pollutants take part in chemical reactions. Being _____ means that pollutants rely on microbes to break matter up into smaller units.
- (a) degradable
 - (b) biodegradable
 - (c) organic
 - (d) oxi-degradable
- Q13: The lithosphere includes _____.
- (a) the Earth's core, crust, and upper mantle
 - (b) the Earth's crust and upper mantle (including tectonic plates)
 - (c) the Earth's crust and upper mantle (excluding tectonic plates)
 - (d) the rocky portions of Earth directly below the mesosphere
- Q14: True or False? The "oceanic crust" is also part of the lithosphere.

- Q15: Weathering is the breakdown of _____ through a variety of processes.
- (a) rock
 - (b) organic and inorganic materials
 - (c) biomaterials
 - (d) rocks, plants, and remains of animals
- Q16: Soil results due to the breakdown of _____.
- (a) weathering
 - (b) regolith
 - (c) oxides
 - (d) limestone
- Q17: At what point are broken rock and mineral fragments considered to be soil?
- (a) When plants are able to send roots down into the fragments to extract nutrients
 - (b) When the minerals have been entirely depleted from the rock fragments
 - (c) When the fragments measure less than one micron across
 - (d) When microbes and small insects begin to inhabit the fragments
- Q18: There are two types of weathering: _____.
- (a) organic and inorganic
 - (b) organic and chemical
 - (c) physical and ionic exchange
 - (d) physical and chemical
- Q19: Freezing of water, formation of crystals, penetration by plant roots, and abrasion are all examples of _____.
- (a) physical weathering
 - (b) organic weathering
 - (c) the lithosphere
 - (d) chemical motion
- Q20: Oxidation and dissolution are examples of _____.
- (a) rusting
 - (b) chemical weathering
 - (c) ion exchange
 - (d) biodegradability

Answers

Q1: The atmosphere _____. (*Choose all that apply.*)

- (a) contains oxygen that is critical for both animals' and plants' respiration
- (b) contains oxygen that is critical for animals' respiration
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- (d) contains nitrogen that provides nutrients to plants for making food
- (e) keeps most of the planet's water warm enough to remain liquid (hence, oceans)

A: *(a) contains oxygen that is critical for both animals' and plants' respiration; (c) contains carbon dioxide that plants use to make food molecules; (d) contains nitrogen that provides nutrients to plants for making food; (e) keeps most of the planet's water warm enough to remain liquid (hence, oceans)*

Q2: The atmosphere is primarily made up of _____.

- (a) oxygen and hydrogen
- (b) water vapor and oxygen
- (c) oxygen and carbon dioxide
- (d) nitrogen and oxygen

A: *(d) nitrogen and oxygen*

Q3: The _____ is the layer of the atmosphere closest to Earth's surface.

- (a) lithosphere
- (b) troposphere
- (c) mesosphere
- (d) stratosphere

A: *(b) troposphere*

Q4: Trace gases, also called greenhouse gases, _____.

- (a) are a direct result of human activity
- (b) allow the atmosphere to heat up or cool down
- (c) are of interest to scientists as a potential source of energy
- (d) allow the atmosphere to absorb heat, making life on earth possible

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A: *(c) enhancing the greenhouse effect*

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A: (a) ozone molecules absorb ultraviolet radiation from the sun that can harm plants and animals

Q7: The hydrosphere includes _____. (Choose all that apply.)

- (a) all water above, on, and below the earth
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A: (a) all water above, on, and below the earth; (b) water in all its forms within the atmosphere, such as clouds; (d) gaseous water

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- (d) 97%

A: (d) 97%

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A: False. Most of Earth's water is in liquid form.

Q11: Water's chemical formula gives it several unique properties, such as _____.

- (a) polarity (which helps to make water a universal solvent)
- (b) extreme sensitivity to temperature changes
- (c) polarity (which makes water molecules repel each other)
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A: (a) polarity (which helps to make water a universal solvent)

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- (b) biodegradable
- (c) organic
- (d) oxi-degradable

A: (b) *biodegradable*

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- (b) the Earth's crust and upper mantle (including tectonic plates)
- (c) the Earth's crust and upper mantle (excluding tectonic plates)
- (d) the rocky portions of Earth directly below the mesosphere

A: (b) *the Earth's crust and upper mantle (including tectonic plates)*

Q14: True or False? The "oceanic crust" is also part of the lithosphere.

A: *True.*

Q15: Weathering is the breakdown of _____ through a variety of processes.

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- (b) organic and inorganic materials
- (c) biomaterials
- (d) rocks, plants, and remains of animals

A: (a) *rock*

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- (d) When microbes and small insects begin to inhabit the fragments

A: (a) *When plants are able to send roots down into the fragments to extract nutrients*

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- (b) organic weathering
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A: (a) *physical weathering*

Q20: Oxidation and dissolution are examples of_____.

- (a) rusting
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- (c) ion exchange
- (d) biodegradability

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