Ohio Science - Extended Learning Standards

Chemistry

Structure and Properties of Matter

1 Atomic structure • Evolution of atomic models/ theory • Electrons • Electron configurations C.PM.1

Complexity a

a Identify the location of a valence electron and/or how valance electrons affect an atom's interactions. C.PM.1.A

Complexity b

b Identify part(s) of an atom (i.e., protons, neutrons, electrons). C.PM.1.B

Complexity c

c Identify a diagram or model of an atom. C.PM.1.C

Learning Progression

- Build a model of an atom including protons, neutrons or electrons. C.PM.1.LP.A
- Identify the valence electrons on a drawing or model on an atom. C.PM.1.LP.B
- Recognize that an atom's reactivity is based on its valence electrons. C.PM.1.LP.C
- Recognize that valence electrons are in the outside layer of an atom. C.PM.1.LP.D
- Identify that protons have a positive charge, neutrons are neutral, and electrons have a negative charge. C.PM.1.LP.E
- Place labels (protons, neutrons, electrons) on a drawing of an atom. C.PM.1.LP.F
- Select the diagram that shows an atom from a set of drawings. C.PM.1.LP.G
- Engage with a model of an atom. C.PM.1.LP.H

2 Periodic table • Properties • Trends C.PM.2

Complexity a

a Use the periodic table to answer questions about types of elements and the properties of elements (e.g., number of outer electrons, groupings). C.PM.2.A

Complexity b

b Recognize that elements are organized on the periodic table by their properties, number of protons, and number of outer electrons. C.PM.2.B

Complexity c

c Identify an element(s) on the periodic table. C.PM.2.C

Learning Progression

- Follow the progression of atomic numbers on the Periodic Table and note their reactivity. C.PM.2.LP.A
- Identify various categories of elements on the Periodic Table (e.g., groups, families, periods, metals, nonmetals and metalloids). C.PM.2.LP.B
- Know that elements in the same column have the same number of valence electrons. C.PM.2.LP.C
- Given an element, find another element on the Periodic Table that will have similar properties (choose one in the same column). C.PM.2.LP.D
- Recognize that elements in the same column have similar properties. C.PM.2.LP.E
- Identify atoms based on their atomic number (given a number find the name of an element). C.PM.2.LP.F
- Recognize the location of the atomic number of an element on the Periodic Table. C.PM.2.LP.G
- Use a Periodic Table's key to recognize elements. C.PM.2.LP.H
- Recognize the Periodic Table. C.PM.2.LP.I

3 Chemical bonding • Ionic • Polar/covalent C.PM.3

Complexity a

a Identify the type of chemical bonding that has occurred in a given compound. C.PM.3.A

Complexity b

b Compare the characteristics of an ionic bond and a covalent bond. C.PM.3.B

Complexity c

c Identify bonding as an interaction between atoms. C.PM.3.C

Learning Progression

- Combine (baking soda and vinegar, glue and laundry starch) or observe a simple compound (salt, water, sugar) identify that it is composed of more than one type of atom bonded together. C.PM.3.LP.A
- Use an atomic model and/or video to investigate that atoms interact to achieve 8 valence electrons (view the product). C.PM.3.LP.B
- Identify common substances that are bonded ionically and covalently. C.PM.3.LP.C
- Recognize an ion as an atom that has gained or lost valence electrons (which changes their electrical charge). C.PM.3.LP.D
- Recognize that ionic bonding is an attraction between oppositely charged ions. C.PM.3.LP.E
- Recognize that in covalent bonding atoms share valence electrons so that each have 8. C.PM.3.LP.F
- Recognize that different atoms react in different ways (ionic and covalent bonding). C.PM.3.LP.G

4 Representing compounds • Formula writing • Nomenclature • Models and shapes (Lewis structures, ball-and-stick, molecular geometries) C.PM.4

Complexity a

a Represent a chemical compound with a ball-and-stick model or chemical formula. C.PM.4.A

Complexity b

b Build a model of a chemical compound in a variety of ways (e.g., balland-stick model). C.PM.4.B

Complexity c

c Identify a compound as two or more elements coming together (combining). C.PM.4.C

Learning Progression

- Use symbols for elements and subscripts to represent a compound observed in a ball and stick model (observe a model of water to discover the formula H2O). C.PM.4.LP.A
- Look at ball and stick or other models to identify the parts (atoms of elements) that make up a compound. C.PM.4.LP.B
- Use a ball and stick model to represent a chemical formula. C.PM.4.LP.C
- Match common elements and their symbols to develop compounds and formulas (hydrogen, oxygen, carbon , nitrogen). C.PM.4.LP.D
- Use a model to investigate that two or more elements can join to form a compound. C.PM.4.LP.E

5 Quantifying matter C.PM.5

Learning Progression

Complex and advanced learning standards in Ohio's New Learning Standards are not included in the extended standards.

6 **Intermolecular chemical bonding forces of attraction • Types and strengths • Implications for properties of substances • Melting and boiling point • Solubility • Vapor pressure** C.PM.6

Complexity a

a Explore the properties of water and how they change when water is part of a solution (e.g., salt water solutions). C.PM.6.A

Complexity b

b Perform a task with a fixed amount of water and given amounts of a solute (e.g., powdered drink mix) to observe solutions and supersaturated solutions. C.PM.6.B

Complexity c

c Identify a solution when given a field of choices. C.PM.6.C

Learning Progression

- Recognize that saturated means the maximum amount of a substance possible is dissolved (e.g., salt or sugar begins to visibly collect in the water; (Use a set amount of water, find the maximum amount of salt that can dissolve (saturated solution), change the temperature and see if more or less can be dissolved (hotter water will dissolve more salt). C.PM.6.LP.A
- Make a solution by combining two substances (sugar and water, salt water, powdered drink mix). C.PM.6.LP.B
- Understand that fresh water differs from salt water and that humans cannot drink salt water for hydration (some sea creatures can use salt water). C.PM.6.LP.C
- Observe a set of mixtures (can be pictures or virtual) and choose the ones that are solutions (salt water, rubbing alcohol from the drug store). C.PM.6.LP.D
- Recognize that dissolve means to distribute the particles of one substance throughout another substance. C.PM.6.LP.E
- Recognize solutions as mixtures that are evenly distributed throughout and show components visually (sugar, water, sugar, water, sugar, water). C.PM.6.LP.F
- Recognize that a mixture is two more more substances combined but not chemically joined. C.PM.6.LP.G

Interactions of Matter

1 Chemical reactions • Types of reactions • Kinetics • Energy • Equilibrium • Acids/bases C.IM.1

Complexity a

a Use litmus paper to test and determine the pH of a substance. C.IM.1.A

Complexity b

b Given a pH scale with common ingredients (e.g., orange juice, water, baking soda), determine if they are acid, neutral, or basic. C.IM.1.B

Complexity c

c Identify acid, neutral, and/ or base on a pH scale. C.IM.1.C

Learning Progression

- Visually show that combustion is fuel + oxygen + a small energy source to form water, carbon dioxide, and ash while releasing larger amounts of energy in the form of heat and light. C.IM.1.LP.A
- Observe combustion (burning a candle, starting a grill, having a campfire, household furnace) in class or virtually to recognize a combustion reaction. C.IM.1.LP.B
- Observe mixing an acid with a base to recognize a neutralization reaction (many cosmetology processes such as perms or dyes involve neutralization). C.IM.1.LP.C
- Recognize that there are a variety of ways that chemical reactions can happen, two of which are combustion and neutralization. C.IM.1.LP.D
- Watch a chemical reaction (in class or virtually), identify that bonds are being broken and formed using models. C.IM.1.LP.E
- Test various acids and bases with universal indicator (liquid or strips are easily purchased from science suppliers) to find the pH of the substance. C.IM.1.LP.F
- Represent the pH scale with pictures of products that range from 1-14 (e.g., orange juice to water to soap). C.IM.1.LP.G
- Categorize everyday objects (or pictures) into groups of acides, bases, and neutral. C.IM.1.LP.H
- Recognize that acidity is measured on a scale (pH) that goes from very acidic (1) to very basic (14) and that the center point (7) is considered neutral. C.IM.1.LP.I
- Relate everyday experiences to the pH scale (how acidic foods like lemons taste, how bases like soap feel slippery). C.IM.1.LP.J

2 Gas laws • Pressure, volume, and temperature • Ideal gas law C.IM.2

Complexity a

a Identify types of measurements used for measuring gases (volume, temperature, and pressure). C.IM.2.A

Complexity b

b Define gas as having no definite shape or volume. C.IM.2.B

Complexity c

c Identify a gas. C.IM.2.C

Learning Progression

- Recognize that when the temperature of a gas is increased its volume will increase (tire pressure on a hot day, hot air balloon rises). C.IM.2.LP.A
- Recognize that when the volume of a gas is decreased the pressure will increase (popping a balloon by squeezing it). C.IM.2.LP.B
- Recognize that temperature, volume and pressure impact behavior of gases. C.IM.2.LP.C
- Use a balloon to demonstrate how temperature affects the volume of a gas (freezing a balloon with air will cause the molecules to move slowly and deflate the balloon; bringing balloon to room temperature will increase the size of the ballon because the molecules are moving faster hitting the edges of the balloon, increasing size). C.IM.2.LP.D
- Identify that empty containers are filled with gas (air). C.IM.2.LP.E
- Identify common gases (air, water vapor, oxygen, helium, carbon dioxide). C.IM.2.LP.F

3 Stoichiometry • Molar calculations • Solutions • Limiting reagents C.IM.3

Learning Progression

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