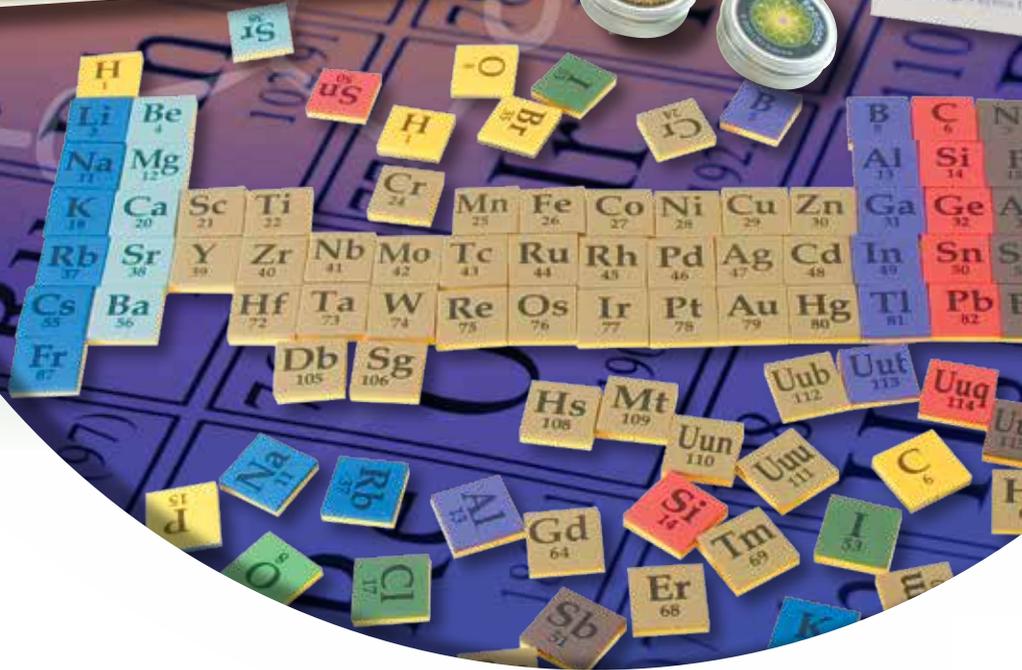


Atoms and the Periodic Table

Chemistry Models



Overview Chart for Investigations—Chemistry Models

Investigation	Key Question	Summary	Learning Goals	Vocabulary
A1 Atomic Structure Pages 1–8 50 minutes	What is inside an atom?	Students build atom models, describe the relationship between the number of protons, neutrons, and electrons in an atom to its atomic and mass numbers, and learn that not all atoms of an element are identical.	<ul style="list-style-type: none"> Model the structure of atoms. Distinguish how an atom of one element is different from an atom of another element. Model different isotopes of the same element and determine if they are stable or unstable. 	atomic number electron isotopes mass number neutron nucleus periodic table of elements proton subatomic particles
A2 Building the Periodic Table Pages 9–14 50 minutes	How is the periodic table organized?	Students use the Periodic Table Tiles to build the periodic table. They will become familiar with the periodic table structure and organization, and learn the meanings of the symbols and numbers. They will then work through guided questions about the arrangement of the elements and the difference between a period and group.	<ul style="list-style-type: none"> Describe the basic organization of the periodic table. Compare and contrast groups and periods. Identify trends of elements in groups. 	alkali metals atomic number chemical properties chemical symbol element group halogens noble gases period periodic table of elements transition metals
A3 Periodic Table Challenge Pages 15–20 50 minutes	What information can you get from the periodic table?	Students play Periodic Table Group Challenge, a bingo-like game that helps them understand the arrangement of elements on the periodic table.	<ul style="list-style-type: none"> Apply an understanding of the periodic table arrangement. Locate specific groups and periods on the periodic table. Locate metals, nonmetals, and metalloids on the periodic table. 	electron energy level group period periodicity
A4 Valence Electrons Pages 21–26 50 minutes	What are valence electrons and how are they related to the structure of the periodic table?	Students learn about valence electrons and what the location of an element on the periodic table reveals about an atom's valence electrons.	<ul style="list-style-type: none"> Model atoms, showing electrons in their energy levels. Model how atoms form chemical bonds to achieve a stable number of valence electrons. Identify the relationship between valence electrons and the structure of the periodic table. 	chemical bonds electron energy level noble gas outermost shell periodicity periodic table of elements valence electron
A5 Elements and Compounds Pages 27–32 50 minutes	What is the difference between an element and a compound?	Students learn to differentiate between elements and compounds. Students also learn how to read and interpret chemical formulas. They then apply their knowledge of chemical formulas to model compounds using the Periodic Table Tiles.	<ul style="list-style-type: none"> Recognize the difference between elements and compounds. Read and interpret chemical formulas. Model compounds and recognize how the models correspond to the chemical formulas. 	chemical bond chemical formula compound subscript

Overview Chart for Investigations—Chemistry Models

	Investigation	Key Question	Summary	Learning Goals	Vocabulary
A6	Chemical Formulas Pages 33–40 50 minutes	Why do atoms combine in certain ratios?	Students make predictions about the oxidation numbers of elements based on their positions on the periodic table, and use oxidation numbers to determine chemical formulas of compounds.	<ul style="list-style-type: none"> Determine the relationship between charge and oxidation number in an ion. Calculate the number of atoms of each element in a neutral compound. Predict chemical formulas using the periodic table. 	chemical bond chemical formula compound ion ionic bond oxidation number
A7	Chemical Reactions Pages 41–46 50 minutes	How do we model a chemical reaction using chemical symbols?	Students practice writing chemical equations and model the products and reactants with the Periodic Table Tiles. Students will then use the tiles to balance the chemical equations.	<ul style="list-style-type: none"> Model the parts of a chemical equation. Recognize whether a chemical equation containing coefficients is balanced or not. Explain how a balanced chemical equation relates to the conservation of atoms. 	chemical equation chemical reaction coefficient law of conservation of mass product reactant
A8	Know Your Element Pages 47–52 50 minutes	What are the properties of different elements?	Students research an element, build it using the Atom Building Game, create presentation slides about the element, and present the element to the class.	<ul style="list-style-type: none"> Describe the relationship between elements and atoms. Model the atomic structure of an element. Use the periodic table to identify and predict properties and characteristics of elements. 	atomic number electron element nucleus periodic table of elements proton
B1	Atomic Structure Pages 53–60 50 minutes	What is inside an atom?	Students build atom models, describe how the number of protons, neutrons, and electrons in an atom relates to its atomic and mass numbers, and learn that not all atoms of an element are identical.	<ul style="list-style-type: none"> Model the structure of atoms. Distinguish how an atom of one element is different from an atom of another element. Model different isotopes of the same element and determine if they are stable or unstable. 	atomic number electron isotopes mass number neutron nucleus periodic table of elements proton subatomic particles
B2	Radioactivity Pages 61–68 50 minutes	How do we model radioactive decay?	Students model the radioactive decay of an isotope using 50 pennies to represent 50 atoms. Students plot their data and then analyze the graph to determine whether or not they were able to correctly predict the isotope's attributes. Students then use the Atom Building Game to build the radioactive carbon-14 atom and model its beta decay.	<ul style="list-style-type: none"> Determine the fraction of a radioactive sample that remains in its original isotope after an integer number of half lives. Explain how probability and half life are related concepts. Describe the three types of radioactive decay (alpha, beta, and gamma decay). 	alpha decay beta decay gamma decay half-life radioactive radioactive dating radioactive decay

Overview Chart for Investigations—Chemistry Models

	Investigation	Key Question	Summary	Learning Goals	Vocabulary
B3	Nuclear Reactions Game Pages 69–76 100 minutes	How are elements organized on the periodic table?	Students conduct their own exploration of the concept of radioactivity. They discover how atomic structure is related to the placement of elements on the periodic table and how the stability of isotopes relates to nuclear reactions and radioactivity.	<ul style="list-style-type: none"> • Explain why atoms undergo nuclear reactions. • Predict the stability of an atomic nucleus. • Compare nuclear fusion and nuclear fission. 	fission fusion nuclear reaction radioactivity
B4	Electrons and Chemical Bonds Pages 77–82 50 minutes	Why do atoms form chemical bonds?	Students build models of atoms and discover how electrons are involved in the formation of chemical bonds. Students explain the role of oxidation numbers in chemical bonding and infer that atoms bond by sharing or transferring electrons.	<ul style="list-style-type: none"> • Explain the role of valence electrons and oxidation numbers in chemical bonding. • Infer that atoms form chemical bonds by sharing or transferring electrons. • Model the formation of a simple chemical bond. 	covalent bond ion ionic bond molecule outermost shell oxidation number valence electrons
B5	Valence Electrons and Molecules Pages 83–90 50 minutes	What is the role of electrons in forming molecules?	Students discover why atoms form bonds. They learn the role of valence electrons in forming molecules. Then, they use the octet rule and Lewis dot diagrams to predict the ratios in which atoms form molecules. Finally, students model the formation of molecules using the Atom Building Game.	<ul style="list-style-type: none"> • Explain the role of valence electrons in bonding. • Draw Lewis dot diagrams to represent the valence electrons of atoms. • Use the octet rule to predict the ratio of atoms in a compound. 	chemical bond chemical formula compound Lewis dot diagram octet octet rule outermost shell valence electrons
B6	A Tour of the Periodic Table Pages 91–98 100 minutes	How is the periodic table organized?	Students build each group on the periodic table using Periodic Table Tiles. As they build each group, they read information about the elements in the group, and predict chemical formulas of compounds formed by those elements. In addition, they learn more about the transition metals, lanthanides, and actinides.	<ul style="list-style-type: none"> • Describe the organization and patterns of the periodic table of elements. • Describe the common chemical properties of the elements in periodic table groups. • Predict chemical formulas for compounds made of elements from different groups. 	atomic number element energy level group main group elements outermost shell period periodic table of elements
B7	Carbon and Its Chemistry Pages 99–104 50 minutes	What are some common molecules that contain carbon?	Students are introduced to organic chemistry. They discover more details about carbon and its importance to living organisms. They also model common carbon molecules and complete guided questions about these organic compounds.	<ul style="list-style-type: none"> • Describe the significance of carbon to living organisms. • Model organic compounds, identifying the elements that make them up. • Become familiar with the structure, formulas, and uses of some organic compounds. 	amino acids carbohydrates lipids nucleic acids organic chemistry proteins

Overview Chart for Investigations—Chemistry Models

	Investigation	Key Question	Summary	Learning Goals	Vocabulary
B8	Organic Compounds Pages 105–112 50 minutes	What do organic compounds have in common?	Students explore elements and compounds that compose living things. Students learn about carbohydrates, proteins, lipids, and nucleic acids.	<ul style="list-style-type: none"> Identify the elements that make up organic compounds. Describe the types of organic compounds that compose living organisms. Model organic compounds. 	amino acids carbohydrates DNA enzyme lipids nucleic acids organic compound proteins
B9	Balancing Chemical Equations Pages 113–118 50 minutes	How are atoms conserved in a chemical reaction?	In this investigation, students explore the concept of conservation of atoms and how to interpret chemical equations. Students will identify the parts of a chemical reaction, explain what it means when a chemical equation is balanced, and use the Periodic Table Tiles to model chemical reactions.	<ul style="list-style-type: none"> Model the parts of a chemical equation. Recognize whether a chemical equation containing coefficients is balanced or not. Explain how a balanced chemical equation relates to the conservation of atoms. 	chemical equation chemical reaction coefficient law of conservation of mass product reactant
C1	Energy and the Quantum Theory Pages 119–124 50 minutes	How do atoms absorb and emit light energy?	Students learn how atoms absorb and emit light. They play Photons and Lasers, a game that uses the Atom Building Game board. In the game, students model how electrons are excited to move to higher energy levels and how electrons drop back to the ground state and release light.	<ul style="list-style-type: none"> Learn how elements produce light. Distinguish between an atom at its ground state and in an excited state. Explain how electrons are involved in light absorption and emission. 	energy level excited state ground state photon quantum theory spectrum
C2	Electrons and the Periodic Table Pages 125–132 100 minutes	What do electrons have to do with the periodic table?	Students use the Atom Building Game to discover the arrangement of electrons in orbitals around the nucleus. Students discover that the rows on the periodic table are based on energy levels and the columns are based on valence electrons.	<ul style="list-style-type: none"> Identify the arrangement of electrons in an atom in terms of their energy levels and orbitals. Write electron configurations. Describe how electron configurations relate to rows and columns on the periodic table. 	electron cloud electron configuration energy level orbital quantum number quantum state
C3	Classifying Reactions Pages 133–138 50 minutes	How can you predict the products of a chemical reaction?	In this investigation, students learn to classify chemical reactions by examining how atoms combine, break down, and are rearranged to form a variety of substances.	<ul style="list-style-type: none"> Classify common types of chemical reactions. Predict the products of chemical reactions. Write balanced equations for reactions when given only the reactants. 	addition reaction combustion reaction decomposition reaction double-displacement reaction single-displacement reaction

Next Generation Science Standards Correlation

CPO Science *Link* investigations are designed for successful implementation of the Next Generation Science Standards. The following chart shows the NGSS Performance Expectations and dimensions that align to the investigations in this title.

NGSS Performance Expectations	Chemistry Models Investigations
MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.	A1, A4, A5, B1
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	A8
MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	A6, A7, B9
HS-LS1-6. Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.	B7, B8
HS-PS1-1. Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.	B5, B6
HS-PS1-2. Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.	A2, A3, B4, C2, C3
HS-PS1-8. Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.	B2, B3
HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.	C1

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

Next Generation Science Standards Correlation (cont'd)

NGSS Science and Engineering Practices	Chemistry Models Investigations	NGSS Disciplinary Core Ideas	Chemistry Models Investigations	NGSS Crosscutting Concepts	Chemistry Models Investigations
Analyzing and Interpreting Data	A8	LS1.C Organization for Matter and Energy Flow in Organisms	B7, B8	Energy and Matter	A2, A3, A7, B2, B3, B7, B8, B9
Constructing Explanations and Designing Solutions	B4, B7, B8, C2, C3	PS1.A Structure and Properties of Matter	A1, A2, A3, A4, A5, A6, A8, B1, B4, B5, B6, C2, C3	Patterns	A8, B4, B5, B6, C2, C3
Developing and Using Models	A1, A2, A3, A4, A5, A6, A7, B1, B2, B3, B5, B6, B9	PS1.B Chemical Reactions	A7, B4, B9, C2, C3	Scale, Proportion, and Quantity	A1, A4, A5, A6, B1
Engaging in Argument from Evidence	C1	PS1.C Nuclear Processes	B2, B3	Systems and System Models	C1
		PS4.A Wave Properties	C1		
		PS4.B Electromagnetic Radiation	C1		

Common Core State Standards Correlation

CCSS-Mathematics		Chemistry Models Investigations
MP.2	Reason abstractly and quantitatively.	A1, A4, A5, A6, A7, A8, B1, B9, C1
MP.4	Model with mathematics.	A1, A4, A5, A6, A7, B1, B2, B3, B9
6.RP.A.3	Use ratio and rate reasoning to solve real-world and mathematical problems.	A1, A4, A5, A6, A7, A8, B1, B9
6.SP.B.4	Display numerical data in plots on a number line, including dot plots, histograms, and box plots.	A8
6.SP.B.5	Summarize numerical data sets in relation to their context.	A8
8.EE.A.3	Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other.	A1, A4, A5, B1
HSN-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	A2, A3, B2, B3, B4, C2, C3
HSN-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.	B2, B3
HSN-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	A2, A3, B2, B3, B4, C2, C3
HSA-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.	B9, C1, C2, C3

Common Core State Standards Correlation (cont'd)

CCSS-English Language Arts & Literacy		Chemistry Models Investigations
RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.	A8
RST.6-8.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).	A1, A4, A5, A6, A7, A8, B1, B9
RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	B5, B6
RST.9-10.8	Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.	C1
RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	B7, B8, C1
RST.11-12.8	Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	C1
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.	A2, A3, B4, B7, B8, C2, C3
WHST.9-12.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.	A2, A3, B4, B7, B8, C2, C3
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research.	B7, B8