



## Practice 1

### *Models and Representations* 1

Describe models and representations, including across scales.

## Practice 2

### *Question and Method* 2

Determine scientific questions and methods.

## Practice 3

### *Representing Data and Phenomena* 3

Create representations or models of chemical phenomena.

## SKILLS

**1.A** Describe the components of and quantitative information from models and representations that illustrate particulate-level properties only.

**1.B** Describe the components of and quantitative information from models and representations that illustrate both particulate-level and macroscopic-level properties.

**2.A** Identify a testable scientific question based on an observation, data, or a model.

**2.B** Formulate a hypothesis or predict the results of an experiment.

**2.C** Identify experimental procedures that are aligned to a scientific question (which may include a sketch of a lab setup).

**2.D** Make observations or collect data from representations of laboratory setups or results, while attending to precision where appropriate.

**2.E** Identify or describe potential sources of experimental error.

**2.F** Explain how modifications to an experimental procedure will alter results.

**3.A** Represent chemical phenomena using appropriate graphing techniques, including correct scale and units.

**3.B** Represent chemical substances or phenomena with appropriate diagrams or models (e.g., electron configuration).

**3.C** Represent visually the relationship between the structures and interactions across multiple levels or scales (e.g., particulate to macroscopic).



## Practice 4

**Model Analysis** 4

Analyze and interpret models and representations on a single scale or across multiple scales.

## Practice 5

**Mathematical Routines** 5

Solve problems using mathematical relationships.

## Practice 6

**Argumentation** 6

Develop an explanation or scientific argument.

## SKILLS

**4.A** Predict and/or explain chemical properties or phenomena (e.g., of atoms or molecules) using given chemical theories, models, and representations.

**4.B** Explain whether a model is consistent with chemical theories.

**4.C** Explain the connection between particulate-level and macroscopic properties of a substance using models and representations.

**4.D** Explain the degree to which a model or representation describes the connection between particulate-level properties and macroscopic properties.

**5.A** Identify quantities needed to solve a problem from given information (e.g., text, mathematical expressions, graphs, or tables).

**5.B** Identify an appropriate theory, definition, or mathematical relationship to solve a problem.

**5.C** Explain the relationship between variables within an equation when one variable changes.

**5.D** Identify information presented graphically to solve a problem.

**5.E** Determine a balanced chemical equation for a given chemical phenomenon.

**5.F** Calculate, estimate, or predict an unknown quantity from known quantities by selecting and following a logical computational pathway and attending to precision (e.g., performing dimensional analysis and attending to significant figures).

**6.A** Make a scientific claim.

**6.B** Support a claim with evidence from experimental data.

**6.C** Support a claim with evidence from representations or models at the particulate level, such as the structure of atoms and/or molecules.

**6.D** Provide reasoning to justify a claim using chemical principles or laws, or using mathematical justification.

**6.E** Provide reasoning to justify a claim using connections between particulate and macroscopic scales or levels.

**6.F** Explain the connection between experimental results and chemical concepts, processes, or theories.

**6.G** Explain how potential sources of experimental error may affect the experimental results.