Rhode Island Interim Assessment

Performance Task

2013-2014

Grade 6–8, Physical Science

**Modeling Chemical Compounds**

NGSS Performance Expectations Addressed:

MS-PS1-1. **Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.]

**Teacher Guidance Document**

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**Introduction**

**Overview:**

This performance task is intended to be used primarily as a formative assessment instrument but also features a summative component to evaluate individual student achievement. It should be administered to inform, supplement, support, and extend appropriate instruction as defined in the Rhode Island state science standards. Every effort should be made to accommodate a range of student modalities/learning styles in both administrative delivery and the application of evaluation criteria.

**Background from the Framework for K-12 Science Education (Framework) and the Next Generation Science Standards (NGSS)**

The *Framework for K-12 Science Education (NRC, 2012)* provides a description of some aspects of the specific dimensions used in the development of this performance task. This includes (a) Disciplinary Core Ideas, (b) Progression for Practice, and (c) Crosscutting Concepts.

*Framework:*

(a) *Disciplinary Core Idea:* Structure and Properties of Matter

In middle school, students gain an understanding of the relationship between the structure of matter and its chemical and physical properties. These ideas build on earlier investigations into the properties of substances in grades K–5.

By the end of grade 5, students understand that matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means (e.g., by weighing or by its effects on other objects). For example, a model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including the inflation and shape of a balloon; the effects of air on larger particles or objects (e.g., leaves in wind, dust suspended in air); and the appearance of visible scale water droplets in condensation, fog, and, by extension, also in clouds or the contrails of a jet. The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish (e.g., sugar in solution, evaporation in a closed container). Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify particular materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.) (NRC 2012, page 108)

By the end of grade 8, students understand that substances are made up of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Pure substances are made from a single type of atom or molecule; each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (NRC 2012, page 108)

Completion of this task will build on this learning, as students model the molecular structures of several simple substances.

Physical Science Disciplinary Core Idea Progression of the NGSS cites the following ([Appendix E, page 7](http://www.nextgenscience.org/sites/ngss/files/Appendix%20E%20-%20Progressions%20within%20NGSS%20-%20052213.pdf)):

|  |  |  |  |
| --- | --- | --- | --- |
|  | K-2 | 3-5 | 6-8 |
| PS1.A  Structure of matter  (includes PS1.C  Nuclear  processes) | Matter exists as different substances that have observable different properties. Different properties are suited to different purposes. Objects can be built up from smaller parts. | Because matter exists as particles that are too small to see, matter is always conserved even if it seems to disappear. Measurements of a variety of observable properties can be used to identify particular materials. | The fact that matter is composed of atoms and molecules can be used to explain the properties of substances, diversity of materials, states of matter, phase changes, and conservation of matter. |

(b) *Progression for Practice:* Developing and Using Models:

Scientists construct and use models of phenomena to represent their current understanding of a system (or parts of a system) under study, to aid in the development of questions and explanations, and to communicate ideas to others. (NRC 2012, p. 57)

Modeling can begin in the earliest grades, with students’ models progressing from concrete “pictures” and/or physical scale models (e.g., a toy car) to more abstract representations of relevant relationships in later grades, such as a diagram representing forces on a particular object in a system. Students should be asked to use diagrams, maps, and other abstract models as tools that enable them to elaborate on their own ideas or findings and present them to others. Young students should be encouraged to devise pictorial and simple graphical representations of the findings of their investigations and to use these models in developing their explanations of what occurred.

More sophisticated types of models should increasingly be used across the grades, both in instruction and curriculum materials, as students progress through their science education. The quality of a student-developed model will be highly dependent on prior knowledge and skill and also on the student’s understanding of the system being modeled, so students should be expected to refine their models as their understanding develops. Curricula will need to stress the role of models explicitly and provide students with modeling tools (e.g., Model-It, agent-based modeling such as NetLogo, spreadsheet models), so that students come to value this core practice and develop a level of facility in constructing and applying appropriate models. (NRC 2012, pages 58–59)

Science and Engineering Practices in the NGSS cites the following ([Appendix F, page 6](http://www.nextgenscience.org/sites/ngss/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf)):

|  |  |  |
| --- | --- | --- |
| Grades K-2 | Grades 3-5 | Grades 6-8 |
| Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing,  physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.   * Distinguish between a model and the actual object, process, and/or events the model represents. * Compare models to identify common features and differences. * Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or patterns in the natural and designed world(s). * Develop a simple model based on evidence to represent a proposed object or tool. | Modeling in 3–5 builds on K–2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.   * Identify limitations of models. * Collaboratively develop and/or revise a model based on evidence that shows the relationships among variables for frequent and regular occurring events. * Develop a model using an analogy, example, or abstract representation to describe a scientific principle or design solution. * Develop and/or use models to describe and/or predict phenomena. * Develop a diagram or simple physical prototype to convey a proposed object, tool, or process. * Use a model to test cause and effect relationships or interactions concerning the functioning of a natural or designed system | Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.   * Evaluate limitations of a model for a proposed object or tool. * Develop or modify a model—based on evidence – to match what happens if a variable or component of a system is changed. * Use and/or develop a model of simple systems with uncertain and less predictable factors. * Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. * Develop and/or use a model to predict and/or describe phenomena. * Develop a model to describe unobservable mechanisms. * Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. |

(c) *Crosscutting Concepts:* Scale, Proportion, and Quantity

The concept of scale builds from the early grades as an essential element of understanding phenomena. Young children can begin understanding scale with objects, space, and time related to their world and with explicit scale models and maps. They may discuss relative scales—the biggest and smallest, hottest and coolest, fastest and slowest—without reference to particular units of measurement.

Typically, units of measurement are first introduced in the context of length, in which students can recognize the need for a common unit of measure—even develop their own before being introduced to standard units—through appropriately constructed experiences. Once students become familiar with measurements of length, they can expand their understanding of scale and of the need for units that express quantities of weight, time, temperature, and other variables. (NRC 2012, pages 90–91)

Crosscutting Concepts in the NGSS cites the following ([Appendix G, page 16](http://www.nextgenscience.org/sites/ngss/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf)):

|  |
| --- |
| In grades K-2, students use relative scales (e.g., bigger and smaller; hotter and colder; faster and slower) to describe objects. They use standard units to measure length. |
| In grades 3-5, students recognize natural objects and observable phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, temperature, and volume. |
| In grades 6-8, students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale, and the function of natural and designed systems may change with scale. They use proportional relationships (e.g., speed as the ratio of distance traveled to time taken) to gather information about the magnitude of properties and processes. They represent scientific relationships through the use of algebraic expressions and equations. |

Targeted Next Generation Science Standards:

*Performance Expectations:* MS-PS1-1

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| --- | --- | --- |
| **Performance Expectation:**  **MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.** [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete depiction of all individual atoms in a complex molecule or extended structure.] | | |
| **Science and Engineering Practice:**  **Developing and Using Models**  Modeling in 6–8 builds on K–5 and progresses to developing, using and revising models to describe, test, and predict more abstract phenomena and design systems.   * Develop a model to predict and/or describe phenomena. (MS-PS1-1) | **Disciplinary Core Idea:**  **PS1.A: Structure and Properties of Matter**   * Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) * Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) | **Crosscutting Concept:**  **Scale, Proportion, and Quantity**   * Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1) |

*Common Core State Standards Connections:*

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| --- |
| *Connections to other DCIs in* ***MS.ESS2.A*** *(MS-PS1-2)* |
| *Articulation of DCIs across grade-levels:* ***5.PS1.A*** *(MS-PS1-1);* ***HS.PS1.A*** *(MS-PS1-1);* ***HS.ESS1.A*** *(MS-PS1-1)* |
| *Common Core State Standards Connections:*   |  |  |  | | --- | --- | --- | | *ELA/Literacy -* | | | | **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). (MS-PS1-2) | | | *Mathematics -* | | | | **MP.2** | Reason abstractly and quantitatively. (MS-PS1-1) | | | **MP. 4** | Model with mathematics (MS-PS1-1) | | **6.RP.A.3** | Use ratio and rate reasoning to solve real-world and mathematical problems. (MS-PS1-2) | | | **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. (MS-PS1-1) | | |

*Associated K-12 NECAP Assessment Target*:

This task also aligns with the following NECAP Assessment Targets (GSE Assessment targets) and Rhode Island Grade Span Expectations.

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| --- | --- |
| ***PS1 (5-8) INQ+POC –2***  *Given data about characteristic properties of matter (e.g., melting and boiling points, density, solubility) identify, compare, or classify different substances.* | |
| **Grade Span Expectations (5-8)** | |
| **PS1 (5-6) –2**  **Students demonstrate an understanding of characteristic properties of matter by …**  **2a** recognizing that different substances have properties, which allow them to be identified regardless of the size of the sample.  **2b** classifying and comparing substances using characteristic properties (e.g., solid, liquid, gas). | **PS1 (7-8) –2**  **Students demonstrate an understanding of characteristic properties of matter by …**  **2a** identifying an unknown substance given its characteristic properties.  **2b** classifying and comparing substances using characteristic properties (e.g., solid, liquid, gas; metal, non-metal). |

**The Performance Task:**

*Task Description*

Students will demonstrate skills in using models to describe some pure compounds and some of their crystalline structures.

Throughout the task students will be engaged in a wide range of practices such as:

* Asking questions
* Carrying out investigations
* Analyzing and interpreting data
* Developing and/or using a model to describe the structure of compounds and their crystalline structures.
* Constructing explanations

This hands-on task is presented in three parts:

* **Part 1: Engagement -** Students will use the process of evaporation to separate an impure substance (salt water) into its pure components (salt and water). Students will study the atomic structures of the components of salt water by using chemical formulas to construct and sketch their molecular models.
* **Part 2:** **Investigation** - Student will continue to investigate the molecular structure of other compounds by sketching and making additional models based on their structural formulas. They will examine the process of crystallization by evaporation through the use of a process model to illustrate how salt crystals form and grow. Students will then create a second model that shows how salt crystals can grow.
* **Part 3: Application:** Students will review and analyze the information in Parts 1 and 2 to construct an explanation for the following question:

*Describe how atomic models were developed to describe the atomic composition of simple molecules and their crystalline structures?*

*Time Allotment*

This task requires approximately 90 minutes of instructional time, divided into three parts. Adjustments can be made to accommodate alternate divisions of time. Teachers might find other time allotments (option 3) that better suits their schedule or classroom needs.

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|  | **Time Allotment for Student Completion (Minutes)** | | | |
| Option 1 | 30 (Part 1) | 30 (Parts 1 and 2) | 30 (Part 2 and 3) |  |
| Option 2 | 30 (Parts 1 ) | 40 (Parts 1 and 2) | 20 (Part 3) |  |
| Option 3 | Time allotted at the teacher or administrators suggestion | Time allotted at the teacher or administrators suggestion | Time allotted at the teacher or administrators suggestion | Time allotted at the teacher or administrators suggestion |

Given that there are many options for the task administration, it is the teacher’s decision as to where the parts should be divided. An estimate of the teacher set-up and the time needed by students to complete each part is given below. These estimates may vary based on student abilities.

**Part 1:**

Estimate of teacher set-up time: 15- 20 minutes

Estimate of student completion time: 30 minutes

**Part 2:**

Estimate of teacher set-up time: 15–20 minutes

Estimate of student completion time: 40 minutes

**Part 3:**

Estimate of teacher set-up time: 15–20 minutes

Estimate of student completion time: 20 minutes

*Key Vocabulary*

The Word Bank can be used as a supplement for reading or visual displays and teacher instruction if needed. (See Appendix B)

**Teacher Guidance in Task Administration**

The following pages are designed to provide guidance to the teacher in the administration of the task. This guidance portion is divided into two columns with the contents of the student task (What the Student Will Do) listed in the left column and suggestions for teacher implementation (What the Teacher Will Do) listed in the right hand column. Wherever possible the teacher guidance is listed directly opposite the student document where the teacher should provide interaction. Additionally the practices that the students will be engaged in are listed in the teacher portion in yellow highlighted text. The specific practices used are listed in detail at the end of the Teacher Guidance Document.

This task is designed to provide both formative and summative assessment capabilities but should be viewed as instruction by the student. Teacher interaction with the students during this task would be the same as would normally be implemented within the regular instructional setting.

|  |  |
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| **What the Student Will Do** | **What the Teacher Will Do** |
| **Student Introduction**  **Salty Water**  The oceans are basically made up of salt and water molecules. Salt and water are both pure substances that can be mixed together to form an impure substance called a salt water solution. A salt water solution is a homogeneous mixture that has a constant composition of salt molecules and water molecules evenly mixed together. Both salt and water molecules are each made up of two different elements that are chemically combined and are therefore classified as pure substances called compounds. Since these compounds have the same proportion of atoms, they are also considered to be homogeneous substances.  In this task, you will investigate how to develop models that describe these and other simple compounds, as well as, use models to show how crystallization take place by the process evaporation.  **Student Instructions: Part 1:**  **Introduction:**  **“Pulling it Apart”**  Investigation question: **How can models be developed to describe to composition of salt and water molecules?**  In part 1 your group will dissolve salt into water to form a solution and then use the process of evaporation to separate the components of salt water. You will make observations and use chemical formulas to create molecular models of the salt and water molecules. The chemical formulas you will use for salt and water are shown below:  Chemical formula for Salt = NaCl  Chemical formula for Water = H2O  **Part 1: Student Instructions**  Materials:  • Safety glasses  • approximately 1/8 cup (34.13g) table salt  • ½ cup (125ml) of warm water (H2O)  • Measuring cup  • Medium beaker   * Stirring rod * Microscope or hand lens * Molecular model kits * *1 copy of the Student lab Sheet per student*   **Procedure:**   1. Fill your beaker with ½ cup of warm water. 2. Add a spoonful of salt and stir until the salt dissolves. 3. Repeat step 2 until you can no longer dissolve more salt. 4. Record your observations in Table 1 on the *Student Lab Sheet.* 5. Your teacher will lead a class discussion about the observations recorded by each group by asking the question:   **“What happens to the atoms that make up salt when the crystal is added to the water?”**   1. Leave the beaker of salt on a window sill in in some place where maximum evaporation will occur for approximately 3 days. 2. After 3 days, observe the contents of the beaker. You may use a microscope or a hand lens to get a better view of the substance in the beaker. 3. Record your observations in Table 1 of *Student Lab Sheet.* 4. Use the molecular model kits to build both the salt and the water molecules 5. Sketch the salt and water molecules in the final column of the *Student Lab Sheet.* 6. Your teacher will lead a class discussion of the question found in the *Student Lab Sheet*.   *How did you make models that describe the composition of salt and water molecules?*   1. Write your answer to the question on the sheet based on the class discussion. | * Prior to beginning the task use the Word Bank, to review the terms pure and impure substances and homogeneous and heterogeneous substances with the class. * Emphasize that a pure is made up of only one type of element (atom) or compound. * Have students read “Salty Water.” * Inform students that they will be constructing models to help them understand how impure substances can be made up pure substances and what these substances look like at the molecular level.   **Teacher Instructions: Part 1: Engagement**  **Introduction:**  **“Pulling it Apart”**  Inform students that they are going to investigate the following question: **How can models be developed to describe to composition of salt and water molecules?**   * Refer students to the introduction. * Explain to the students they will work in groups to:   + Make a salt solution;   + Make observations about dissolving salt in water and crystal formation during evaporation;   + Make and sketch models that show the molecular composition of salt and water.     **Part 1: Teacher Instructions**   * If necessary, review the materials and procedure with the students. * You may use a standard molecular model kit or alternative materials (e.g. small sticks and modeling clay, foam balls and sticks, etc.)   *(This next portion will engage students in the Practice of Planning and Carrying Out Investigations2)*   * Instruct students to complete the first 4 steps of the procedure   *(This next portion will engage students in the Practice of Asking questions and defining problems 3)*   * In step 5, ask students the following question: **“What happens to the atoms that make up salt when the crystal is added to the water?”** * Facilitate a class discussion about the results, guiding students to an understanding that when the salt dissolves it is breaking down into its smaller particles of sodium and chlorine and mixes evenly throughout the water molecules. Additional emphasis should be placed on how this process forms a homogeneous mixture that is impure substance. * Explain to students that you will continue with the experiment in three to four days depending on when the water has evaporated.   *(This next portion will engage students in the Practice of Analyzing and Interpreting Data1)*   * After 3 or 4 days allow students to look at the contents of   the beaker. They may use a microscope or hands lens to examine the crystals that have formed, or they may simply use the naked eye.  *This next portion will engage students in the Practice of Developing and Using Models4)*   * Instruct students to use the molecular model kits to build salt and water molecules. They should then sketch the molecules in the final column of Table 1 in their *Student Lab Sheet*. Emphasize that these sketches are types of models that help us to visualize the differences between molecules (which are extremely small)of the two different pure substances. * Engage students in a discussion about how molecular models were developed to describe the composition of the salt and water molecules. This will help them answer to the question on page 1 of the *Student Lab Sheet:*   *How did you make models that describe the composition of salt and water molecules?*   * Explain to students in Part 2 they will construct models of other pure substances to determine if they are similar to sodium chloride. They will also use a model to show how evaporation leads to the formation and growth of sodium chloride crystals. |

**Referred Practices**

**1. Analyzing and interpreting data** in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

* Analyze and interpret data to provide evidence for phenomena.

**2. Planning and carrying out investigations** in 9-12 builds on K-8 experiences and progresses to include investigations that

provide evidence for and test conceptual, mathematical, physical, and empirical models.

* Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
* Plan and conduct an investigation or test a design solution in a safe and ethical manner including considerations of environmental, social, and personal impacts.

**3. Asking questions and defining problems** in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

* Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.

**4. Developing and using models** in 6-8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

* Develop and/or use a model to predict and/or describe phenomena.
* Develop a model to describe unobservable mechanisms.

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| **What the Student Will Do** | **What the Teacher Will Do** |
| **Part 2: Student instructions:**  **Introduction:**  **“Making and Using Models”**  In Part 2 of this activity, you will:  (i) use the chemical formulas of other substances to create more 3-dimensional models.  (ii) use a model that explains how the elements of a salt in the salt water solution interact during evaporation to form large crystal structures.  Materials:  • Molecular model kits   * *1 copy of the Student Lab Sheets per student* * A small bowl of nuts and bolts that fit together, and blue buttons. * Colored modeling clay and small sticks   **Procedure:**   1. Your group will construct and sketch models in Table 2 of the *Student Lab Sheet* for the following substances:  * Potassium chloride (KCl) * Methane (CH4) * Hydrogen (H2)  1. Once you have completed your models, determine which molecule has a structure most similar to the sodium chloride. 2. Mix the nuts and bolts in a small bowl. The nuts represent chlorine atoms, the bolts represent sodium atoms and the buttons represent water molecules. 3. Discuss with your group how this model could be used to show the crystallization of salt form during evaporation. 4. Use modeling clay and sticks to create a model of a large salt crystal formed by evaporating salt water. 5. Sketch your model in the student lab sheets on page XX | **Part 2: Teacher Instructions**  **Introduction:**  **“Making and Using Models”**  *This next portion will engage students in the Practice of Developing and Using Models1)*   * Explain to the students they will be using chemical formulas to make and sketch models of other types of compounds. They will also use a model to explain how crystallization of sodium chloride takes place during the process of evaporation.   **Procedure:**   * Review the materials and procedure with the students. * Allow students to work in small groups if possible * Assist students who are having trouble building the molecules from the chemical formulas. * Students should identify potassium chloride as having a similar structure (linear composed of two different atoms) * Facilitate group or class discussions which lead to an understanding of how the model for crystallization works. Students should understand that as water molecules (blue buttons) evaporated (removed) the chlorine atoms (nuts) and sodium atoms (bolts) move closer together. As they move closer together, they join to form crystals. As more water molecules are removed, more sodium and chlorine atoms join causing the crystals to grow.   **NOTE:** Remind students that the shape of the sodium chloride crystal remains cubic no matter how big or small the crystal is. This is due to the atomic structure of the sodium chloride molecule.  *(This next portion will engage students in the Practice of Constructing explanations and designing solutions2)*   * Ask students:   *Do you think it is possible to use this crystallization model for other compounds?*  Guide the student discussion to recognize that the model for potassium chloride has a similar number of atoms and has the similar linear shape, therefore it may have similar characteristics or properties as sodium chloride. As a result, students should recognize that this same process might be used in models that are similar in composition to sodium chloride such as potassium chloride. |

**Referred Practices**

**1. Developing and using models** in 6-8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

* Develop and/or use a model to predict and/or describe phenomena.
* Develop a model to describe unobservable mechanisms.

**2. Constructing explanations and designing solutions** in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

* Construct an explanation using models or representations.
* Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.

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| **What the Student Will Do** | **What the Teacher Will Do** |
| **Part 3: Student Instructions**  **Introduction**  **“Putting it together”**  In Part 3 you will review and use the information you have gathered in your *Student Lab Sheets* for parts 1 and 2 to answer a final question about this task. You will be given the opportunity to discuss your answers with your class and revise it if necessary before your teacher collects page 4 of the *Student Data Sheets.*  Materials:  *Copy of Student Data Sheets*  Procedure:  1. Answer the following Final question on page 4 of your *Student Data Sheets*.  *Describe how atomic models were developed to describe the atomic composition of simple molecules and their crystalline structures?*  2. Discuss the possible answers with your class.  3. Revise your answers based on the class discussion.  4. Your teacher will collect Page 4 of your *Student Data Sheets.* | **Part 3: Teacher Instructions:**  **Introduction**  **“Putting it together”**  *(This next portion will engage students in the Practice of Analyzing and Interpreting Data1)*   * Allow students sufficient time to review their data from parts 1 and 2.   *(This next portion will engage students in the Practice of Constructing explanations and designing solutions2)*   * Have them answer, individually, on their own *Student Data Sheets* the following question:   *Describe how atomic models were developed to describe the atomic composition of simple molecules and their crystalline structures?*   * Allow students the opportunity to hare and discuss the answers to this question. * Allow students the opportunity to revise the answer based on the class discussions. * Collect page 4 of the *Student Data Sheets* |

**Referred Practices**

**1. Analyzing and interpreting data** in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

* Analyze and interpret data to provide evidence for phenomena.
* Analyze and interpret data to determine similarities and differences in findings.

**2. Constructing explanations and designing solutions** in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.

* Construct an explanation using models or representations.
* Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.

**Appendix A**

**Scoring Guide for Part 3: Final Question**

|  |  |
| --- | --- |
| **Score** | **Description** |
| **4** | Response demonstrates no errors or omissions in regard to developing models to describe the atomic composition of simple molecules and extended crystalline structures. There are no errors or omissions relative to the content or processes. |
| **3** | Response indicates minor errors or omissions in regard to developing models to describe the atomic composition of simple molecules and extended crystalline structures. There may be errors or omissions relative to the simpler details and processes. |
| **2** | Response indicates major errors or omissions in regard to developing models to describe the atomic composition of simple molecules and extended crystalline structures. There may be errors or omissions regarding the complex content or process. |
| **1** | Response indicates a distinct lack of understanding of developing models to describe the atomic composition of simple molecules and extended crystalline structures There is a minimal understanding of the content or the process. |
| **0** | Response is inaccurate, irrelevant, contains insufficient evidence to demonstrate an understanding of developing models to describe the atomic composition of simple molecules and extended crystalline structures, OR the student has failed to respond to the prompt. |
| **Blank** | No response. |

**Appendix B**

**Word Bank**

**Atoms -** smallest part of element: the smallest portion into which an element can be divided and still retain its properties.

**Compounds -** is a pure substance formed when two or more chemical elements are chemically bonded together

**Element -** is a pure chemical substance consisting of a single type of atom.

**Impure –** substances are having one or more substances that are not chemically combined.

**Homogeneous** **–** having uniform composition: having a uniform composition or structure

**Heterogeneous –** with two or more phases: describes a chemical substance that has two or more phases

**Pure –** are made up of elements and compounds. Elements are made up entirely of the same atom. Compounds are made up of molecules made up of two or more atoms chemically combined.

**Substance –** a sample of matter

**Solution -** a homogeneous mixture of one or more substances (solutes) dispersed molecularly in a sufficient quantity of dissolving medium (solvent).

**Appendix C**

**Comprehensive Task Materials Checklist:**

The following space and equipment per working group are recommended to administer all three parts of the task:

**Part 1:**

Materials:

• Safety glasses

• approximately 1/8 cup (34.13g) table salt

• ½ cup (125ml) of warm water (H2O)

• Measuring cup

• Medium beaker

* Stirring rod
* Microscope or hand lens
* Molecular model kits
* *1 copy of the Student lab Sheet per student*

**Part 2:**

Materials:

• Molecular model kits

* *1 copy of the Student Lab Sheets per student*
* A small bowl of nuts and bolts that fit together, and blue buttons.
* Colored modeling clay and small sticks

**Part 3:**

* *1 copy of the Student lab Sheet per student*