**Overview**: The following rubrics can be used to assess the individual project: a Consumer Report for a Thermal Product. Each rubric is aligned to one section of the *Individual Project Criteria for Success*, located on the Culminating Project Student Instructions. \*If student provides no assessable evidence (e.g., “I don’t know” or leaves answer blank), then that student response cannot be evaluated using the rubric and should be scored as a zero.

Below we provide an alignment table that details the dimensions assessed for each criterion.

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|  | **Student Criteria for Success** | **Science and Engineering Practice** | **Disciplinary Core Idea** | **Crosscutting Concept** |
| 1 | * A definition of the problem the product addresses:   + Where is the region and why is it difficult to live there?   + What criteria would make a successful solution to this problem?   + What makes it difficult to solve this problem? | **Asking Questions and Defining Problems**   * Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. | **ETS1.A: Defining and Delimiting Engineering Problems**   * The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. | **N/A** |
| 2 | * A detailed description of the climate in that region, including model(s) that show:   + Why the location of the region on Earth results in its extreme temperature | **Developing and Using Models**   * Develop and use a model to describe phenomena. | **ESS2.D: Weather and Climate**   * Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography. | **N/A** |
| 3 | * A detailed description of the climate in that region, including model(s) that show:   + How atmospheric and oceanic circulation affect the climate in your region | **N/A** | **ESS2.C: The Roles of Water in Earth’s Surface Processes**   * Variations in density due to variations in temperature and salinity drive a global pattern of interconnected ocean currents.   **ESS2.D: Weather and Climate**   * Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, ~~landforms, and living things~~. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns. * The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents. | **Systems and System Models**   * Models can be used to represent systems and their interactions—such as inputs, processes and outputs—and energy, matter, and information flows within systems. |
| 4 | * A detailed description of the climate in that region, including model(s) that show:   + The processes that create the water conditions in your region | **Developing and Using Models**   * Develop and use a model to describe unobservable mechanisms. | **ESS2.C: The Roles of Water in Earth’s Surface Processes**   * Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. * Global movements of water and its changes in form are propelled by sunlight and gravity. | **Energy and Matter**   * Within a natural or designed system, the transfer of energy drives the motion and/or cycling of matter. |
| 5 | * \*For at least one of the above bullets, cite patterns in data that allowed you to figure out these cause-and-effect relationships | **N/A** | **ESS2.C: The Roles of Water in Earth’s Surface Processes**   * See above 3 rows   OR  **ESS2.D: Weather and Climate**   * See above 3 rows | **Patterns**   * Patterns can be used to identify cause-and-effect relationships. |
| 6 | * Describe your original design: What proportional relationships from the Task 4 investigations inspired the original design of your product? | **N/A**  \*Assessed with a Task-Specific Rubric in Task 4 | **PS3.A: Definitions of Energy**   * Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.   **PS3.B: Conservation of Energy and Energy Transfer**   * The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment. | **Scale, Proportion, and Quantity**   * Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes. |
| 7 | * What data from various tests led you to make improvements for your final design? | **Analyzing and Interpreting Data**   * Analyze and interpret data to determine similarities and differences in findings. | **ETS1.B: Developing Possible Solutions**   * There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. * Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.   **ETS1.C: Optimizing the Design Solution**   * Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. | **N/A** |
| 8 | * A labeled diagram of your product that explains how it works, including:   + A description of how your product helps individuals stay warm or stay cool   + A model that shows how your product affects energy transfer and the kinetic energy of particles | **Designing Solutions**   * Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process, or system. | **PS3.A: Definitions of Energy**   * Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.   **PS3.B: Conservation of Energy and Energy Transfer**   * Energy is spontaneously transferred out of hotter regions or objects and into colder ones. | **Energy and Matter**   * The transfer of energy can be tracked as energy flows through a designed or natural system. |

**Rubric 1**: Student defines the problem of living in a region with extreme temperatures, including criteria of success and constraints that might limit possible solutions.

* Dimensions Assessed: SEP – Asking Questions and Defining Problems, DCI – ETS1.A: Defining and Delimiting Engineering Problems

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student **does not** define the problem of living in a region with extreme temperatures **and/or** includes **inaccurate or irrelevant** criteria of success and constraints that might limit possible solutions. | Student **accurately** defines the problem of living in a region with extreme temperatures, including **accurate** criteria of success **OR** constraints that might limit possible solutions. | Student **accurately** defines the problem of living in a region with extreme temperatures, including **accurate** criteria of success **but partial** constraints that might limit possible solutions. | Student **accurately** defines the problem of living in a region with extreme temperatures, including **accurate and complete** criteria of success and constraints that might limit possible solutions. |
| **Look Fors:**   * Student leaves out a definition of the problem. * And/or the student identifies criteria of success and constraints that are inaccurate or irrelevant. For example, they might identify a criterion of success that aligns with the opposite conditions (ie. keeping someone cool in extreme cold) or an unrealistic constraint as the ability to manipulate weather. | **Look Fors:**   * Student accurately explains that living in regions of extreme temperature poses problems for human bodies’ survival and objects they need (ex: food). * Student accurately defines the criteria for success OR at least one constraint. See *Advanced Look-Fors* for options. | **Look Fors:**   * Student accurately explains that living in regions of extreme temperature poses problems for human bodies’ survival and objects they need (ex: food). * Student accurately defines the criteria for success. For example, student explains that keeping someone/something warm or cool would indicate a successful solution. * Student also accurately defines one, but not multiple constraints. See *Advanced Look-Fors* for options. | **Look Fors:**   * Student accurately explains that living in regions of extreme temperature poses problems for human bodies’ survival and objects they need (ex: food). * Student accurately defines the criteria for success. For example, student explains that keeping someone/something warm or cool would indicate a successful solution. * Student also accurately and completely defines any constraints. For example, safety considerations, limited amount of resources available, cost, etc. |

**Rubric 2**: Student develops and uses a model to describe how the unequal heating of Earth’s surface leads to variations in climates around the world.

* Dimensions Assessed: SEP – Developing and Using Models, DCI – ESS2.D: Weather and Climate

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student develops and uses a model to **inaccurately** describe how the unequal heating of Earth’s surface leads to variations in climates around the world.  OR  Student **partially** describes how the unequal heating of Earth’s surface leads to variations in climates around the world but **does not use a visual model**. | Student develops and uses a model to **incompletely** describe how the unequal heating of Earth’s surface leads to variations in climates around the world.  OR  Student **completely** describes how the unequal heating of Earth’s surface leads to variations in climates around the world but **does not use a visual model**. | Student develops and uses a model to **mostly** describe how the unequal heating of Earth’s surface leads to variations in climates around the world. | Student develops and uses a model to **completely** describe how the unequal heating of Earth’s surface leads to variations in climates around the world. |
| **Look Fors:**   * Student draws a model that inaccurately describes this concept. For example, student shows that different areas of the Earth are farther away from the Sun at different points in its orbit, which causes different climates.   OR   * Student partially describes this concept in words (See *Developing and Proficient Look-Fors*) but does not create a visual model. | **Look Fors:**   * Student draws a model that incompletely describes this concept, using pictures, arrows, and captions. * For example, student shows the Earth at a tilt and the Sun OR with arrows and captions, shows that the Sun’s rays hit an un-tilted Earth at different angles. However, student model has major errors, is missing some of the components/interactions in the *Advanced Look-Fors*, and/or does not include relevant examples.   OR   * Student completely describes this concept in words (See *Advanced Look-Fors*) but does not create a visual model. | **Look Fors:**   * Student draws a model that partially describes this concept, using pictures, arrows, and captions. * For example, student may show the Earth at a tilt and the Sun. With arrows and captions, student shows that the tilt of the Earth causes the Sun’s rays to hit Earth at different angles. Student explains that this leads to some regions with more intense sunlight and warmer climates at certain times of year. However, student model may have minor errors, is missing one of the above components/interactions, or does not include relevant examples. See *Advanced Look-Fors* for relevant examples. | **Look Fors:**   * Student draws a model that completely describes this concept, using pictures, arrows, and captions. * For example, student shows the Earth at a tilt and the Sun. With arrows and captions, student shows that the tilt of the Earth causes the Sun’s rays to hit Earth at different angles. Student explains that this leads to some regions with more intense sunlight and warmer climates at that time of year. For example, the equator always gets the most direct sunlight resulting in warmer climates, whereas the Poles get the least direct sunlight resulting in colder climates. In December, the southern hemisphere gets more direct sunlight than the northern hemisphere. This results in different seasons. |

**Rubric 3**: Student develops a model to explain how patterns of atmospheric and oceanic circulation determine their region’s climate.

* Dimensions Assessed: SEP – Developing and Using Models, DCI – ESS2.C: The Roles of Water in Earth’s Surface Processes and ESS2.D: Weather and Climate, CCC – Systems and System Models

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student develops a model to **inaccurately** explain how patterns of atmospheric and oceanic circulation determine their region’s climate.  OR  Student **does not** develop a visual model toexplain how patterns of atmospheric and oceanic circulation determine their region’s climate. | Student develops a model to **incompletely** explain how patterns of atmospheric and oceanic circulation determine their region’s climate.  OR  Student develops a model to **completely** explain how patterns of atmospheric and oceanic circulation determine climates, **but it is not specific to their region**. | Student develops a model to **mostly** explain how patterns of atmospheric and oceanic circulation determine their region’s climate. | Student develops a model to **completely** explain how patterns of atmospheric and oceanic circulation determine their region’s climate. |
| **Look Fors:**   * Student draws a model that inaccurately explains these patterns specific to their region, using pictures, arrows, and captions. For example, student model only shows that ocean circulation is driven by wind, but does not include any description of where this wind comes from.   OR   * Student explains these patterns specific to their region with at least partial accuracy, but no visual model is present (ie. no pictures or arrows). | **Look Fors:**   * Student draws a model that incompletely explains these patterns specific to their region, using pictures, arrows, and captions. * For example, student explains that due to differential heating caused by the tilt of the Earth, but does not explain that water in the ocean near the equator is warmer than water near the Poles. The student does not explain that temperature differences drive the ocean currents, and thus demonstrates only minimal understanding of how the ocean and atmosphere impact regional climates. | **Look Fors:**   * Student draws a model that mostly explains these patterns specific to their region, using pictures, arrows, and captions. * For example, student explains that due to differential heating caused by the tilt of the Earth, water in the ocean near the equator is warmer than water near the Poles. This temperature difference sets up a convection cell in the ocean which drives ocean currents. However, the student neglects to explain how air circulates through the atmosphere, and thus develops a partial concept of why specific regions have particular climates. | **Look Fors:**   * Student draws a model that completely explains these patterns specific to their region, using pictures, arrows, and captions. * For example, student explains that due to differential heating caused by the tilt of the Earth, water in the ocean near the equator is warmer than water near the Poles. This temperature difference sets up a convection cell in the ocean which drives ocean currents. A similar mechanism forces air to circulate in the atmosphere. When the motion of water and air is combined with the Earth’s rotation, specific regional temperature patterns emerge. |

**Rubric 4**: Student develops a model to describe how water is cycled through Earth systems via various processes driven by energy from the Sun and the force of gravity.

* Dimensions Assessed: SEP – Developing and Using Models, DCI – ESS2.C: The Roles of Water in Earth’s Surface Processes, CCC – Energy and Matter

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student develops an **inaccurate** model to describe how water is cycled through Earth systems via various processes.  OR  Student **partially** describes how water is cycled through Earth systems via various processes driven by energy from the Sun and the force of gravity, **but no model is present.** | Student develops an **incomplete** model to describe how water is cycled through Earth systems via various processes.  OR  Student **completely** describes how water is cycled through Earth systems via various processes driven by energy from the Sun and the force of gravity, **but no model is present.** | Student develops a **partial** model to describe how water is cycled through Earth systems via various processes driven by energy from the Sun **or** the force of gravity. | Student develops a **complete** model to describe how water is cycled through Earth systems via various processes driven by energy from the Sun **and** the force of gravity. |
| **Look Fors:**   * Student draws a model that describes the water cycle as it relates to their region, but does so with major inaccuracies or major missing components (See *Advanced Look-Fors* for accurate descriptions).   OR   * Student partially describes the water cycle as it relates to their region, but no model is present. Or the model partially describes the generic water cycle but it is not specific to the region. See *Proficient Look-Fors* for components of a complete description. | **Look Fors:**   * Student draws a model that incompletely describes the water cycle as it relates to their region, using pictures, arrows, and captions. Model is missing many components and/or interactions. Model also does not identify the Sun or gravity as the energy/forces that drive the cycling of water.   OR   * Student completely describes the water cycle as it relates to their region, but no model is present. Or the model completely describes the generic water cycle but is not specific to the region. See *Advanced Look-Fors* for components of a complete description. | **Look Fors:**   * Student draws a model that partially describes the water cycle as it relates to their region, using pictures, arrows, and captions. * In their model, student shows most of the components of the system (I.e. relevant reservoirs for water). Student also shows and explains most relevant interactions (i.e., transpiration, evaporation, condensation, precipitation, and/or surface runoff). * In the model, student explicitly describes how the cycling of water is driven by energy from the Sun OR the force of gravity, but not both. | **Look Fors:**   * Student draws a model that completely describes the water cycle as it relates to their region, using pictures, arrows, and captions. * In their model, student shows all the components of the system (I.e. relevant reservoirs for water). Student also shows and explains all relevant interactions (i.e., transpiration, evaporation, condensation, precipitation, and/or surface runoff). * In the model, student explicitly describes how the cycling of water is driven by energy from the Sun and the force of gravity. |

**Rubric 5**: Student cites patterns to describe a cause and effect relationship that explains regional climate conditions.

* Dimensions Assessed: DCI – ESS2.C: The Roles of Water in Earth’s Surface Processes and/or ESS2.D: Weather and Climate, CCC – Patterns
* Students may choose to describe patterns related to the Sun-Earth system, atmospheric and oceanic circulation, or the water cycle.

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student cites **irrelevant** patterns to **inaccurately** describe a cause and effect relationship that explains regional climate conditions. | Student cites **relevant** patterns **but does not explicitly connect them to** a cause and effect relationship that explains regional climate conditions. | Student cites **relevant** patterns to **accurately** describe **one** cause and effect relationship that explains regional climate conditions. | Student cites **relevant** patterns to **accurately** describe **multiple** cause and effect relationships that explain regional climate conditions. |
| **Look Fors:**   * Student cites irrelevant patterns to describe one cause and effect relationship. These patterns might be completely irrelevant to all the climate concepts, or the patterns might be connected to the wrong concept. | **Look Fors:**   * Student cites relevant patterns (See *Advanced Look-Fors* for examples) but does not explicitly connect them to the relevant cause and effect relationship. For example, after all the models, student makes a general statement that these are all supported by patterns in data, and then cites sun angles and temperatures for regions in northern and southern hemispheres. This does not explicitly name the Earth’s tilt as the connection required to explain the cause and effect relationship between the Sun’s angle and regional temperatures. | **Look-Fors**   * Student cites relevant patterns to describe one cause and effect relationship. See *Advanced Look-Fors* for examples. | **Look Fors:**   * Student cites relevant patterns to describe multiple cause and effect relationships. For example, student cites patterns in sun angles and temperatures for regions in northern and southern hemispheres to describe the cause and effect relationship between tilt of the Earth and unequal heating. Student also cites patterns in oceanic circulation and temperatures for specific regions to describe the cause and effect relationship between oceanic circulation and climate. |

**Rubric 6**: Student describes the proportional relationships among energy transfer, the type of matter, the mass, and change in temperature, including how these relate to the kinetic energy of particles.

* Dimensions Assessed: DCI – PS3.A: Definitions of Energy and PS3.B: Conservation of Energy and Energy Transfer, CCC – Scale, Proportion, and Quantity

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student **inaccurately** describes the proportional relationships among energy transfer, the type of matter, the mass, **and/or** change in temperature. | Student **incompletely** describes the proportional relationships among energy transfer, the type of matter, the mass, **and/or** change in temperature. | Student **mostly** describes the proportional relationships among energy transfer, the type of matter, the mass, **and/or** change in temperature, including how these relate to the kinetic energy of particles. | Student **completely** describes the proportional relationships among energy transfer, the type of matter, the mass, **and** change in temperature, including how these relate to the kinetic energy of particles. |
| **Look Fors:**   * To describe the inspiration for their original design, student describes relationships from their Task 4 investigations with major errors (See *Advanced Look-Fors* for detailed description of relationships). For example, student states that the more mass a sample has, the less thermal energy is needed to change its temperature. | **Look Fors:**   * To describe the inspiration for their original design, student describes at least one of the relationships from their Task 4 investigations, but it may be lacking detail or have minor errors (See *Advanced Look-Fors* for detailed description of relationships). * Student does not discuss the kinetic energy of particles. | **Look-Fors**   * To describe the inspiration for their original design, student accurately describes at least one of the relationships from their Task 4 investigations (See *Advanced Look-Fors* for detailed description of relationships). * Student discusses the kinetic energy of particles within the context of the relationship they describe. | **Look Fors:**   * To describe the inspiration for their original design, student accurately describes all of the relationships from their Task 4 investigations: the more mass a sample has, the more thermal energy transfer is needed to change the temperature; the type of matter affects the amount of thermal energy transfer needed to change the temperature of the sample. * Student discusses the kinetic energy of particles within both of these relationships. For example, a sample with more mass means more thermal energy transfer is needed because there are more particles in the sample. |

**Additional Notes:**

* An additional rubric is provided in Task 4 to assess the SEP of this Performance Expectation MS-PS3-4, Planning and Carrying Out Investigations.

**Rubric 7**: Student redesigns a thermal product to better meet the criteria for success, referencing the relevant test data of different products to explain why they combine best characteristics.

* Dimensions Assessed: SEP – Analyzing and Interpreting Data; DCI – ETS1.B: Developing Possible Solutions and ETS1.C: Optimizing the Design Solution

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student redesigns a thermal product to better meet the criteria for success, **but does not** explain why they combine best characteristics.  OR  Student redesign a thermal product that **shows no improvement from original design** OR **does not combine best characteristics from other designs** to better meet the criteria for success. | Student redesigns a thermal product to better meet the criteria for success, **but does not reference** the relevant test data of different products to explain why they combine best characteristics. | Student redesigns a thermal product to better meet the criteria for success, **referencing at least one piece** of relevant test data of different products to explain why they combine best characteristics. | Student redesigns a thermal product to better meet the criteria for success, **referencing all** of the relevant test data of different products to explain why they combine best characteristics. |
| **Look Fors:**   * Student’s thermal product shows clear improvement that combines best characteristics from different designs (from own and other groups). However, student provides no explanation of why it combined these design features.   OR   * Student’s thermal product does not show any improvements or does not combine best characteristics from different designs. For example, student might just say that their design was the best and needed no improvements. | **Look Fors:**   * Student’s thermal product shows clear improvement that combines best characteristics from different designs (from own and other groups). * Student explains why they combined these design features, but does not reference any data. | **Look Fors:**   * Student’s thermal product shows clear improvement that combines best characteristics from different designs (from own and other groups). * Student explains why they combined these design features, but only cites one piece of relevant data to justify their redesign. | **Look Fors:**   * Student’s thermal product shows clear improvement that combines best characteristics from different designs (from own and other groups). * Student explains why they combined these design features, using multiple pieces of data to justify their redesign. This explanation and data will vary depending on the types of designs different groups come up with. |

**Rubric 8**: Student shows and explains how their design uses scientific principles to minimize or maximize thermal energy transfer.

* Dimensions Assessed: SEP –Designing Solutions, DCI – PS1.B Chemical Reactions, CCC – Energy and Matter

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student **inaccurately** shows **and/or** explains how their design uses scientific principles to minimize or maximize thermal energy transfer.  OR  Student’s design **does not** minimize or maximize thermal energy transfer. | Student **incompletely** shows **and/or** explains how their design uses scientific principles to minimize or maximize thermal energy transfer. | Student **partially** shows and explains how their design uses scientific principles to minimize or maximize thermal energy transfer. | Student **completely** shows and explains how their design uses scientific principles to minimize or maximize thermal energy transfer. |
| **Look Fors:**   * Student’s diagram and/or explanation inaccurately describes a relevant product that minimizes or maximizes thermal energy transfer. For example, student might draw a diagram that shows thermal energy moving from cold to hot and does not explain the product in terms of kinetic energy of particles.   OR   * Student’s design does not actually minimize or maximize thermal energy transfer (i.e. buying an electric heater). | **Look Fors:**   * Student’s diagram and/or explanation accurately describes a relevant product that minimizes or maximizes thermal energy transfer to keep people/objects warm or cool, depending on the region. * Paragraph, labels, and/or captions describe limited scientific principles behind how the product works or do so with major inaccuracies. See *Advanced Look-Fors* for an example of a correct diagram and explanation. | **Look Fors:**   * Student’s diagram accurately shows a relevant product that minimizes or maximizes thermal energy transfer to keep people/objects warm or cool, depending on the region. * Paragraph, labels, and/or captions describe most of the scientific principles behind how the product works. * However, their diagram and explanation of their product may be missing some detail about one of the following concepts: thermal energy transfers from hot to cold, why thermal energy transfer is minimized/maximized in terms of kinetic energy of particles. See *Advanced Look-Fors* for an example of a correct diagram and explanation. | **Look Fors:**   * Student’s diagram accurately shows a relevant product that minimizes or maximizes thermal energy transfer to keep people/objects warm or cool, depending on the region. For example, a diagram of double-paned windows in a cold region might use arrows to show how thermal energy transfer from the warm region in the house to the cold region outside is minimized. * Paragraph, labels, and/or captions describe the scientific principles behind how the product works, including descriptions of thermal energy transfer and the kinetic energy of particles. For example, student explains that the air pocket between the two windowpanes minimizes thermal energy transfer between the inside and outside of the house. Because air particles are spread so far apart, kinetic energy of the particles is transferred less easily. |