NGSS UNIT SUMMATIVE ASSESSMENT (POETS) MS-PS3-5: CONSTRUCT, USE, AND PRESENT ARGUMENTS

Power Optimization in Electro-thermic Systems

Grade: 6-8	**Topic: MS THERMAL ENERGY FLOW**	**Lesson # 2-3 (90 minutes) in a series of 3 lessons.**

Brief Description of Summative Assessment:

1. The focus of this unit has been on the flow of thermal energy (heat), and using that wasted heat to produce electricity. Expanding on Lesson 1 Thermoelectric Generators: MS-PS3-4, Lesson 2 MS-PS3-3, and previous Performance Expectations MS-PS3-1 and MS-PS3-2, have the students **discuss/brainstorm what they have learned about energy and energy flow by working in groups or as a whole class.**

2. This assessment will/can evaluate student understanding of Lesson 1 and Lesson 2:
   Students to will present oral or written arguments to support or refute the given explanation or model for the phenomenon
   i. Based on changes in the observable features of the object (e.g., motion, temperature), the kinetic energy of the object changed.
   ii. When the kinetic energy of the object increases or decreases, the energy (e.g., kinetic, thermal, potential) of other objects or the surroundings within the system increases or decreases, indicating that energy was transferred to or from the object.

Keep these POETS focused concepts in mind: Automobiles produce a large amount of heat generated by the burning of gasoline. Most of the energy produced is not used to power the automobile, but is lost as heat. Is there a way to use this wasted heat energy? If so, how can we make a device capable of turning this heat back into usable energy. What are some devices that we use in our everyday lives that can use this technology? How can automobiles such as cars, heavy duty industrial vehicles such as Caterpillars, bulldozers, etc. use this technology?

Performance Expectation(s)/Standards:
Lesson Specific Learning Expectations:

Students who demonstrate understanding can:

MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.] [Assessment Boundary: Assessment does not include calculations of energy.]

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Engaging in Argument from Evidence Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed worlds. • Construct, use, and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon. --- Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence • Science knowledge is based upon logical and conceptual connections between evidence and explanations	PS3.B: Conservation of Energy and Energy Transfer • When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	Energy and Matter • Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion).

Specific Learning Outcomes/Including Evidence Statements:

1. Supported claims
   a. Students make a claim about a given explanation or model for a phenomenon. In their claim, students include idea that when the kinetic energy of an object changes, energy is transferred to or from that object.
2. Identifying scientific evidence
   a. Students identify and describe* the given evidence that supports the claim, including the following when appropriate:
      i. The change in observable features (e.g., motion, temperature, sound) of an object before and after the interaction that changes the kinetic energy of the object.
      ii. The change in observable features of other objects or the surroundings in the defined system.
3. Evaluating and critiquing the evidence
   a. Students evaluate the evidence and identify its strengths and weaknesses, including:
      i. Types of sources.
      ii. Sufficiency, including validity and reliability, of the evidence to make and defend the claim.
      iii. Any alternative interpretations of the evidence and why the evidence supports the given claim as opposed to any other claims.
4. Reasoning and synthesis
   a. Students use reasoning to connect the necessary and sufficient evidence and construct the argument. Students describe* a chain of reasoning that includes:
      i. Based on changes in the observable features of the object (e.g., motion, temperature), the kinetic energy of the object changed.
      ii. When the kinetic energy of the object increases or decreases, the energy (e.g., kinetic, thermal, potential) of other objects or the surroundings within the system increases or decreases, indicating that energy was transferred to or from the object.
   b. Students present oral or written arguments to support or refute the given explanation or model for the phenomenon.

Prior Student Knowledge:
MS-PS1-4 Matter and its Interactions: Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
MS-PS3-1 Energy: Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
MS-PS3-2 Energy: Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.
MS-PS3-4: Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Unit Assessment:

Focus:

The focus of this unit has been on the flow of thermal energy (heat), and using that wasted heat to produce electricity. Expanding on Lesson 1 Thermoelectric Generators and Lesson 2 have the students **discuss/brainstorm what they have learned about energy and energy flow by working in groups or as a whole class.**

Keep these POETS focused concepts in mind: Automobiles produce a large amount of heat generated by the burning of gasoline. Most of the energy produced is not used to power the automobile, but is lost as heat. Is there a way to use this wasted heat energy? If so, how can we make a device capable of turning this heat back into usable energy. What are some devices that we use in our everyday lives that can use this technology? How can automobiles such as cars, heavy duty industrial vehicles such as Caterpillars, bulldozers, etc. use this technology?

Individual or Group Assessment:

Students can then make a claim about a given explanation or model for a phenomenon. In their claim, students include ideas that when the kinetic energy of an object changes, energy is transferred to or from that object.

<u>Students present oral or written arguments to support or refute the given explanation or model for the phenomenon including:</u>

1. Supported claims
   a. Students make a claim about a given explanation or model for a phenomenon. In their claim, students include idea that when the kinetic energy of an object changes, energy is transferred to or from that object.

2. Identifying scientific evidence
    a. Students identify and describe* the given evidence that supports the claim, including the following when appropriate:
        i. The change in observable features (e.g., motion, temperature, sound) of an object before and after the interaction that changes the kinetic energy of the object.
        ii. The change in observable features of other objects or the surroundings in the defined system.
3. Evaluating and critiquing the evidence
    a. Students evaluate the evidence and identify its strengths and weaknesses, including:
        i. Types of sources.
        ii. Sufficiency, including validity and reliability, of the evidence to make and defend the claim.
        iii. Any alternative interpretations of the evidence and why the evidence supports the given claim as opposed to any other claims.
4. Reasoning and synthesis
    a. Students use reasoning to connect the necessary and sufficient evidence and construct the argument. Students describe* a chain of reasoning that includes:
        i. Based on changes in the observable features of the object (e.g., motion, temperature), the kinetic energy of the object changed.
        ii. When the kinetic energy of the object increases or decreases, the energy (e.g., kinetic, thermal, potential) of other objects or the surroundings within the system increases or decreases, indicating that energy was transferred to or from the object.

Differentiation: Some students would need to work alone, in pairs, or groups based on their particular learning style. These groups do not need to be the same groups from Lesson 1 and 2.