3D Science Performance Assessment Tasks

4TH GRADE

ENERGY

These materials were developed under a grant awarded by the Michigan Department of Education

Task Title	Pinwheels, Windmills, and Turbines Energy

Standards Bundle Information
Performance Expectations • 4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object. • 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
Science and Engineering Practices • Constructing Explanations and Designing Solutions
Cross-Cutting Concepts • Energy and Matter • Patterns • Cause and Effect
Disciplinary Core Ideas • PS3.A Definitions of energy (faster a given object is moving, more energy it possesses) • PS3.B Conservation and transfer of Energy • ETS1.A Defining Engineering Problems
CCSS ELA: • W.4.2- Write an informative/explanatory text to examine a topic and convey ideas and information clearly. • W.4.8 -Recall relevant information from experiences, or gather relevant information from print and digital sources.
CCSS Mathematics • MP.2 - Reason abstractly and quantitatively. • MP.4- Model with mathematics

Overview / Introduction of the Assessment Task

In this task students will develop a model of a wind turbine. They will present their models to the group. The students will further construct an explanation of the design to support that energy is transferred and converted and that speed is a factor for efficiency.

Teacher Background
Energy causes things to move. The more energy an object has, the faster it can move and vice versa. This can be shown by pushing a toy car hard or soft, throwing a ball, or using wind to turn a pinwheel. Energy can also be moved from one place to another and changed from one form to another in order to accomplish tasks. Examples of this would be using a battery (stored chemical energy) to generate electricity or the turning of a wind turbine to convert wind energy into electricity. As the students work on the activities, be sure they are making claims about what they are thinking about as well as recording their observations and using those observations as evidence to support or change their claims.
Information for Classroom Use
Connections to Instruction: Students will conduct lessons that lead them to understand the relationship between speed and energy. These lessons would include the use of hand flashlights and Hot Wheel type cars to demonstrate the concept that the more energy something has the faster (or brighter in the case of the flashlight) it is. Then conduct the formative assessment 1. Students will then need to conduct lessons on the transfer energy from one thing to another You should include how energy is converted from one form to another. You will want to focus on lessons that involve moving energy conversions to electricity and electricity uses. Possible lessons could include using circuit kits to focus on the conversion of energy from chemical (in batteries) to electrical (in wires) to light (in light bulb). You will then conduct formative assessment two. The teacher could add lessons about natural resources, focus on wind power and renewable energy. The teacher can then use lessons to clarify student thinking and to gather more examples as needed before presentation of the final performance task. Please feel free to change the restraints (supplies, time, and number of turns) to fit the needs of your classroom.
Approximate Duration for the Summative Task: (all components) Each formative task would take 1- 45 minute period. The Summative (Final Performance) Task would take 3-4 days. We suggest 2 days for experimentation of trial and error. One period for presentations and then one for writing as time allots.
Assumptions: Students are familiar with, at least what a toy pinwheel is, and accept that wind energy is alternative energy form. Students are not familiar with building wind turbines/windmills or what they are used for. The 3DSPA was designed to assess students' ability to perform the task by applying previous knowledge learned to the new phenomena in the performance assessment without having been exposed to this specific phenomena in advance.

Materials Needed:

Pinwheels, paper sheets, coffee filters, cups, straws, straight pins, sticks, yarn

The air source will be hair dryer, leaf blower, open window, students full of hot air.

computers , notebooks

Windmill/wind turbine photos

Supplementary Resources:

The Boy who Harnessed the Wind by William Kamkwamba (picture book version) could be used as a read-aloud before beginning project.

Youtube video about William Kamkwamba - https://www.youtube.com/watch?v=arD374MFk4w

Traditional windmill picture https://encrypted-tbn1.gstatic.com/images?q=tbn:ANd9GcQl4SKShIDphbcGrva0LCBmPJqnXkDRDAKeeXBc9oj-rX0_so2d

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Modern Wind turbine

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Wind Energy Information Energhttps://www.studentenergy.org/topics/wind-power?gclid=CjwKEAjwz4u9BRCbioK3stnBznESJADA75xbFzRHSIPBGYwcyHt4RCKaA7rBh8BXwSExQL6hqjXcmhoC3Dfw_wcBy Information

Children's Literature

The Boy who Harnessed the Wind by William Kamkwamba (picture book version) could be used as a read-aloud before beginning project.

https://play.google.com/books/reader?id=zGq7BgAAQBAJ&printsec=frontcover&output=reader&hl=en&pg=GBS.PP1

Diagram of Wind Turbine

https://www.storyjumper.com/book/index/19798038/Renewable-Energy#page/9

Teacher-Student lesson plan:

https://docs.google.com/document/d/1SRnE2THSd8M9eoE0-_LFUAYF3U5lWdOpAPC6YZ6WnNo/edit#

Learning Performances
- Students will explain their evidence, that there is a pattern between the speed of the object and the amount of energy it has. - Students will construct an explanation to demonstrate the transfer of energy as a scientific process through observation. - Students will distinguish between electrical energy, motion, and light as well as moving and stored energy. - Students will construct an explanation to demonstrate the conversion of energy as a scientific process through observation and inference. - When given a problem, students will design a solution whose function is to transfer energy from one type to another.

Performance Assessments

<table>
<tr><th colspan="3">Student Performances</th></tr>
<tr><td rowspan="4">COMPONENT 1

Formative Assessment Task 1</td><td>Learning Performance: Students will explain their evidence, that there is a pattern between the speed of the object and the amount of energy it has.</td><td rowspan="4">Expected Duration:</td></tr>
<tr><td>Description (Phenomena, Scenario, Task)

Pinwheel - observing that the faster the wind blows, the faster the pinwheel spins.</td></tr>
<tr><td>Directions

Question: What patterns do you see?

Explore: Students will move around stations using a leaf-blower, hair dryer, running around the room, walk around the room, blow gently, blow hard on your pinwheel.

Students will decide that pinwheels move at different speeds based on airspeed. Why?

Explain in a paragraph or with models and explanation what happened to the pinwheel in many different “wind speeds”</td></tr>
<tr><td>Scoring / Teacher Look-For’s: C-E-R

I believe that __(there was more energy when the pinwheel moved faster)

What I observed was ___(the stronger the air flow, the faster the pinwheel spun)

I believe this means that____(more wind is more energy and that made the pinwheel speed up)</td></tr>
<tr><td rowspan="2">COMPONENT 2

Formative Assessment Task 2</td><td>● Students will construct an explanation to demonstrate the conversion of energy as a scientific process through observation and inference.
● When given a problem, students will design a solution whose function is to transfer energy from one type to another.</td><td></td></tr>
<tr><td>Description (Phenomena, Scenario, Task)

Phet Simulation - https://phet.colorado.edu/en/simulation/legacy/energy-forms-and-changes</td><td></td></tr>
</table>

<table>
<tr><td rowspan="4"></td><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Directions

Explore: Using this program, students will use the 4 forms of energy and by adjusting the speed of each form, identify and explain how the energy is transferred from moving energy , converted into electricity, which is used to boil water. This is a model using trial and error. Mention or remind students how many tries it took.

Students will explain where energy is transferred (moved) between items. They will also explain when and how energy is changed (converted)</td><td></td></tr>
<tr><td colspan="2">Scoring / Teacher Look-For's:

● The student will explain the path that the energy took from movement to the end.
● Identify the form of energy used at each point (moving energy, electricity, heat)
● Support the claim that energy is converted from one form to another.
● Explain through observation the effect of speed on the amount of energy moved through the model.</td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td rowspan="4">Final Task:</td><td colspan="2">Learning Performance:

Energy can be moved (transferred) from one place to another. Energy can be changed (converted) from one thing to another.</td><td></td></tr>
<tr><td colspan="2">Phenomena: Wind Turbine - Your town is in need of energy reserves</td><td rowspan="3">Expected Duration:</td></tr>
<tr><td>Goal: The students will design a wind turbine to transfer and convert wind to electricity, and explain why their design is best.</td><td>Role: You are an engineer being asked to design a wind turbine to charge the town's power station</td></tr>
<tr><td>Audience: The City council and/or power company for your town.</td><td>Situation: Your town needs power reserves (batteries). You are tasked with designing a turbine that can spin 25-35/min.(adjusted per teacher needs) Charge the town battery. Too fast will explode the town power station, too slow will not charge the reserve.

CONSTRAINTS:

Given: limited supplies and time limit</td></tr>
</table>

		(paper sheets, coffee filters, cups, straws, straight pins,string, etc) The air source will be a low speed hair dryer.	
	Product / Performance: The students will turn a pinwheel (turbine model) which can be counted to turn (25-35-as assigned by teacher) times in a minutes. They will write an explanation of their best choice explaining using data.		
	Scenario - 4th grade Energy Performance Task The town you live in just suffered a major power shortage. You are an engineer. Your team has been asked to design a wind turbine to charge the town's power station and prevent power outages. This turbine will have to transfer and convert energy to a power storage unit for the town to use. You are tasked with designing a turbine that can spin 25-35/min.(adjusted per teacher needs) to charge the town's backup battery. A turbine spinning too fast will explode the town power station, while one spinning too slow will not charge the power reserve battery. You will have 2 days to design and construct your turbine choosing from the available building materials. Once you have built a working model, each team will present their ideas to the other teams. Only one team's model will be presented to the City council and town power company. After the presentations, each student will then select their personal choice and must explain why they chose that model as the best.		

	Directions – 1. Show a picture of a Dutch windmill and a modern windmill, also have a pinwheel. 2. "What commonalities do you see?" "Why would people build these?" 3. Introduce Performance task. 4. Have students draw a model of their design idea. Label the parts. 5. Students will then share these ideas with their teams. 6. Students will work in cooperative groups to complete the performance task. This will be done with trial-and error. Students will test their design with a hair-dryer on LOW. 7. Present your group work to the class. Include data on the number of revolutions, make-up of the pinwheel and characteristics the team would be beneficial. 8. Students will individually write an explanation to demonstration which design is the best to choose. This should include an explanation of how their turbine transferred the energy, what conversions occurred and should take into consideration the efficiency (speed) they obtained. 9. Students will defend they their choice and must take the restraints into consideration.	

CheckBric

Student Name _____

Teacher Name _____

Learning Performance: When given a problem, students will design a solution whose function is to transfer energy from one type to another.					**Comments**
Insert Evidence Statements below:					
Students actively participated with the team to create (build) a working (wind makes blades turn) model of a wind turbine.	**1**	**2**	**3**	**4**	
The model worked within the constraints of the design. ● Used only the supplies given ● Completed within the time allotted ● Windmill turned required number of times	**1**	**2**	**3**	**4**	
Students are able to explain their design process ● Using model, oral presentation, and paragraphs	**1**	**2**	**3**	**4**	
LP Total:					
Learning Performance: Students will construct an explanation to demonstrate the conversion of energy as a scientific process through observation and inference.					**Comments**
Insert Evidence Statements here:					
The student will write an individual report which explains their turbine choice. ● Use of data to support their choice ● Use of reasoning to support their choice	**1**	**2**	**3**	**4**	
The student explanation will include how: ● Energy was transferred in the model ● What types of conversions apply in their model and identify each type	**1**	**2**	**3**	**4**	
The student will explain the effect of speed on the efficiency of the model	**1**	**2**	**3**	**4**	
LP Total:					

4 Exemplary	Work at this level is of exceptional quality. It is both thorough and accurate. It exceeds the standard. It shows a sophisticated application of knowledge and skills.
3 Proficient	Work at this level meets the standard. It is acceptable work that demonstrates application of essential knowledge and skills. Minor errors or omissions do not detract from the overall quality.
2 Developing	Work at this level does not meet the standard. It shows basic, but inconsistent application of knowledge and skills. Minor errors or omissions detract from the overall quality. Your work needs further development.
1 Emerging	Work at this level shows a partial application of knowledge and skills. It is superficial (lacks depth), fragmented or incomplete and needs considerable development. Your work contains errors or omissions.

Item Production Information

Copyrighted Material and Sources

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