

Michigan State University Extension

Tollgate Farm and Education Center

WINTER ON THE FARM:

Heat, Light, and the Transfer of Energy

Big idea: Students search for evidence that energy is being conserved, transferred, and used on the winter farm.

Big questions:

- How are heat and light energy conserved, transferred, and used in times of cold?
- Where does energy come from? How does energy work?
- What path does the sun's energy follow, and how is it transferred from one organism to another?
- How do living organisms on the farm stay warm when it's so cold outside?

Michigan NGSS Performance Expectations:

K-PS3-1	Make observations to determine the effect of sunlight on Earth's surface
K-ESS2-1	Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs
2-PS1-4	Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.
2-PS1-2	Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose
4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric current.
4-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.
4-PS3-4	Apply scientific ideas to solve design problems and refine a device that converts energy from one form to another.
5-PS3-1	Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun.

Common Core ELA and Math Standards:

ELA-LITERACY.SL.K.1a-b	Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups. a. Follow agreed-upon rules for discussions (e.g., listening to others and taking turns speaking about the topics and texts under discussion). b. Continue a conversation through multiple exchanges.
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ELA-LITER ACY.SL.K. 2	Confirm understanding of a text read aloud or information presented orally or through other media by asking and answering questions about key details and requesting clarification if something is not understood.
ELA-LITER ACY.SL.K. 3	Ask and answer questions in order to seek help, get information, or clarify something that is not understood.
ELA-LITER ACY.RI.1.6	Distinguish between information provided by pictures or other illustrations and information provided by the words in a text.
ELA-LITER ACY.SL.1. 1a-c	Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups. <ul style="list-style-type: none"> a. Follow agreed-upon rules for discussions (e.g., listening to others with care, speaking one at a time about the topics and texts under discussion). b. Build on others' talk in conversations by responding to the comments of others through multiple exchanges. c. Ask questions to clear up any confusion about the topics and texts under discussion.
ELA-LITER ACY.SL.1. 3	Ask and answer questions about what a speaker says in order to gather additional information or clarify something that is not understood.
ELA-LITER ACY.SL.2. 1a-c	Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups. <ul style="list-style-type: none"> a. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion). b. Build on others' talk in conversations by linking their comments to the remarks of others. c. Ask for clarification and further explanation as needed about the topics and texts under discussion.
ELA-LITER ACY.SL.2. 3	Ask and answer questions about what a speaker says in order to clarify comprehension, gather additional information, or deepen understanding of a topic or issue.
ELA-LITER ACY.SL.3. 1a-d	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher- led) with diverse partners on grade 3 topics and texts, building on others' ideas and expressing their own clearly. <ul style="list-style-type: none"> a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions (e.g., gaining the floor in respectful ways, listening to others with care, speaking one at a time about the topics and texts under discussion). c. Ask questions to check understanding of information presented, stay on topic, and link their comments to the remarks of others. d. Explain their own ideas and understanding in light of the discussion.
ELA-LITER ACY.SL.3. 3	Ask and answer questions about information from a speaker, offering appropriate elaboration and detail.
ELA-LITER ACY.SL.4. 1a-d	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher- led) with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly. <ul style="list-style-type: none"> a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d. Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
ELA-LITER ACY.SL.5.	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher- led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly. <ul style="list-style-type: none"> a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other

1a-d	<p>information known about the topic to explore ideas under discussion.</p> <p>b. Follow agreed-upon rules for discussions and carry out assigned roles.</p> <p>c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.</p> <p>d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.</p>
Math.Content.K.CC.4-5	<p>Count to tell the number of objects.</p> <p>4. Understand the relationship between numbers and quantities; connect counting to cardinality.</p> <ol style="list-style-type: none"> When counting objects, say the number names in the standard order, pairing each object with one and only one number name and each number name with one and only one object. Understand that the last number name said tells the number of objects counted. The number of objects is the same regardless of their arrangement or the order in which they were counted. Understand that each successive number name refers to a quantity that is one larger. <p>5. Count to answer “how many?” questions about as many as 20 things arranged in a line, a rectangular array, or a circle, or as many as 10 things in a scattered configuration; given a number from 1–20, count out that many objects.</p>
Math.Content.K.MD.1-2	<p>Describe and compare measurable attributes.</p> <ol style="list-style-type: none"> Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object. Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference. For example, directly compare the heights of two children and describe one child as taller/shorter.
Math.Content.1.MD.1	<p>Measure lengths indirectly and by iterating length units.</p> <ul style="list-style-type: none"> Order three objects by length; compare the lengths of two objects indirectly by using a third object.
Math.Content.1.MD.4	<p>Represent and interpret data.</p> <ul style="list-style-type: none"> Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.
Math.Content.1.OA.5-6	<p>Add and subtract within 20. Work with addition and subtraction equations.</p> <ul style="list-style-type: none"> Relate counting to addition and subtraction (e.g., by counting on 2 to add 2). Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., $8 + 6 = 8 + 2 + 4 = 10 + 4 = 14$); decomposing a number leading to a ten (e.g., $13 - 4 = 13 - 3 - 1 = 10 - 1 = 9$); using the relationship between addition and subtraction (e.g., knowing that $8 + 4 = 12$, one knows $12 - 8 = 4$); and creating equivalent but easier or known sums (e.g., adding $6 + 7$ by creating the known equivalent $6 + 6 + 1 = 12 + 1 = 13$).
Math.Content.2.OA.2	<p>Add and subtract within 20.</p> <ul style="list-style-type: none"> Fluently add and subtract within 20 using mental strategies.² By end of Grade 2, know from memory all sums of two one-digit numbers.
Math.Content.2.MD.1-4	<p>Measure and estimate lengths in standard units.</p> <ol style="list-style-type: none"> Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes. Measure the length of an object twice, using length units of different lengths for the two measurements; describe how the two measurements relate to the size of the unit chosen. Estimate lengths using units of inches, feet, centimeters, and meters. Measure to determine how much longer one object is than another, expressing the length difference in terms of a standard length unit.
Math.Content.2.MD.10	<p>Represent and interpret data.</p> <p>10. Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems⁴ using information presented in a bar graph.</p>
Math.Content.3.MD.4	<p>Represent and interpret data.</p> <p>4. Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.</p>

Math.Content.4.NBT.4	Use place value understanding to round multi-digit whole numbers to any place.
Math.Content.4.MD.4	Represent and interpret data. 4. Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Solve problems involving addition and subtraction of fractions by using information presented in line plots. <i>For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.</i>

****See back of Program Guide for Middle School Science and Engineering Practices**

Content Outcomes:

- To explore the scientific processes of the transfer of heat and energy on the farm
- To recognize and explore connections between the processes and mechanisms of winter adaptations in plants and animals and the transfer of heat and energy
- To investigate the internal and external structures that function to support animal survival in winter
- To understand forces and energy transfer in motion of objects

Assessment/Final Reflection:

Revisit the big questions at the end of the program and discuss, in pairs, small groups, or as a large group. What new understandings have students gained? Are they able to describe the process of the transfer of heat and energy after investigating the motion of molecules, properties of insulation, animal adaptations, and the making of yogurt? *What is energy and how does it work? Where does heat go in the winter? How does something go from cold to hot or hot to cold? What path does the sun’s energy follow, and how is it transferred from one organism to another? How do we and the creatures on the farm stay warm in the winter? How do plants get energy in the winter? How is energy transferred when things are moving and what forces are acting on the objects?*

Program Introduction:

Materials:

- Large plastic bowl with ice
- Empty pop bottle

Welcome to Tollgate and to Winter on the Farm. Watch what happens to this bottle of hot water when it is tossed into the snow or bucket of ice water. Why do you think this happens? You have just made a hypothesis! Today, we are going to be scientists and investigate the mystery of something that is all around us. We will explore the science of energy and how energy makes things happen! We will explore how energy is transferred and how heat and light energy help us grow our food. We will look at how energy is conserved, transferred, and used by animals and people!

Tollgate would like to acknowledge that the land we are meeting on today is the original homelands of the Anishinaabe tribal nations. We owe a debt of gratitude to the people who first lived on this land. We honor and respect the many diverse indigenous peoples still connected to this land on which we gather.

Rotations:

- The Mysterious Path of Energy *Lower Barn or Field*
- Yogurt and the Transfer of Heat and Energy *Activity Center*
- Coping with Cold: Animal Adaptations on the Farm *Animal Barn, Pond, Field*
- Insulation Investigations *Barn*

Alternate Rotations:

- Winter Sowing
- STEM: Cardboard Sled

Teacher Resources:

Children's Literature:

- [Sunshine Makes the Seasons](#) by Franklyn M. Branley
- [Solar Energy: Science Explorer](#) by Christine Taylor-Butler
- [Energy Island](#) by Allan Drummond
- [How Heat Moves](#) by Sharon Coan
- [The Shocking Truth About Energy](#) by Loreen Leedy
- [Pass the Energy, Please!](#) by Barbara Shaw McKinney
- [Energy Makes Things Happen](#) by Kimberly Brubaker
- [Energy: Heat, Light, and Fuel \(Amazing Science\)](#) by Darlene R. Stille
- [Winter Survival: Nature's Way of Coping with the Cold](#) by Mari Friend
- [Coping with Cold; World of Wonder](#) by Mary King
- [Oh, Say Can You Say What's the Weather Today? All About Weather](#) by Tish Rabe
- [Over and Under the Snow](#) by Kate Messner

References:

- Winter Sowing is adapted from Penn State Extension's [Winter Seed Sowing](#)

CURIOSITY PHOTOS

Following are photographs and questions intended to inspire curiosity and wonder throughout the days leading up to your Tollgate visit.











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