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School: Whitehills Elementary
Grade Level: Sixth
Science Topic: Physical Science - Energy

Unit Learning Goals and Associated Practices

Michigan Curriculum Framework Benchmarks*	**Example specific practices**
Inquiry Process	
Design and conduct scientific investigations. S.IP.06.12 Use tools and equipment (spring scales, stop watches, meter sticks and tapes, models, hand lens, thermometer, models, sieves, microscopes) appropriate to scientific investigations. S.IP.06.13 Illustrate how energy can be transferred while no energy is lost or gained in the transfer. P.EN.06.42 Demonstrate the transformation between potential and kinetic energy in simple mechanical systems (for example: roller coasters, pendulums). EN.06.12	The learner will generate a definition of energy by comparing and contrasting what is and what is not energy. The learner will compare and contrast energy use between two homes in different locations. The learner will demonstrate the transformation between potential and kinetic energy by conducting an experiment involving driving a nail into a foam block. The learner will analyze the transformation between potential and kinetic energy by reading a role-play about roller coasters. The learner will read an informational text on the Law of Conservation of Energy and illustrate how energy cannot be created nor destroyed.
Inquiry Analysis and Communication	
Evaluate data, claims, and personal knowledge through collaborative science discourse. S.IA.06.12 Draw conclusions from sets of data from multiple trials of a scientific investigation. S.IA.06.14	The learner will evaluate which home features use less or more energy. The learner will analyze the transformation of energy through the results of the nail driving into the foam block. The learner will analyze the transformation of energy in roller coasters. The learner will draw conclusions about energy transformation from the data in the shot shaker experiment.
Reflecting and Social Implications	
Evaluate scientific explanations based on current evidence and scientific principles. S.RS.06.14	The learner will propose ways to make houses more energy efficient and defend his or her suggestions.

Central Question:

What is kinetic and potential energy and how can they be transferred or transformed?

Model Response:

Kinetic is the energy an object possesses in motion. It is dependent on velocity and mass. The faster it is moving and/or the more massive an object is the greater its kinetic energy.

Potential energy is stored energy. It can come in different forms such as mechanical, chemical, or gravitational energy. Gravitational potential energy is a particular type of potential energy that is a result of an object's position above the center of the earth. It depends on mass, height, and the acceleration of gravity. The higher and/ or more massive an object is, the greater its gravitational potential energy.

Energy is an abstract concept and can only be observed during transfer or transformation.

An energy *transformation* occurs when one type of energy changes (transforms) into another type.
Ex. Dropping a rod down the tube and hitting the nail
Potential (holding the rod) > Kinetic (the rod falling)
Ex. A roller coaster at the top of a hill then cruising down the track
Potential (roller coaster at the top of the hill) > Kinetic (the coaster moving down the hill)

An energy *transfer* occurs when one type of energy moves from one object to another.
Ex. The transfer of kinetic energy of a rod driving a nail into a foam block (2^{nd} Activity)
Kinetic (the rod falling down after being dropped) > Kinetic (the nail moving further into the foam block)
E. The roller coaster and the passengers moving along the ride
Kinetic (coaster moving along the track) > Kinetic (the passenger continue moving even after the coaster slows or stops)

Although no energy is completely lost during a transfer or transformation, there is some energy changed into other forms.
Ex. As a roller coaster travels along the track, some of the kinetic energy is lost to sound and heat energy.

EPE Chart for Energy Unit

Experiences	Patterns	Explanations
Everyday experiences using electric energy in lights, T.Vs, computers, and other electronics Comparing home features and their energy use Observing/discussing energy of objects at rest and in motion Experimenting with a nail and block of wood Experimenting with a shot shaker, thermometer, and water Discussing kinetic and potential energy in a role-play about roller coasters Discussing Law of Conservation of Energy through an informational text taking the students through three levels of understanding: literal, interpretive, and applied Students look at a list of statements and determine which ones are supported by the text	Certain home features use more energy than others, such as window panes, kitchen appliances, and heating systems. Dropping a rod onto a nail and a moving train in a roller coaster will show how kinetic energy involves the energy used to move an object. Holding the nail above the tube and a train at the top of a hill before it falls down the slope will show how potential energy involves stored energy. Comparing the different rod sizes, mass, and tube heights will show how higher and/or more massive an object is, the greater its gravitational potential energy. The speed of the rod just before it hits the nail and the position of the roller coaster just before the bottom of the hill will show how a moving object with a greater velocity and/or more mass will have greater kinetic energy. Energy can never be created nor destroyed, such as when a furnace uses oil to heat. The amount of energy is the same before and after. The energy begins as chemical energy and ends as thermal energy.	By making changes in our home features and our behavior, we can us less energy. There are different types of energy, which can be transformed or transferred. Potential is one type of energy that is referred to as stored energy. Gravitational potential energy is a particular type of potential energy that is a result of an object's position above the center of the earth. It depends on mass, height, and the acceleration of gravity. Kinetic energy is the energy an object possesses because of its motion. It is dependent on the mass and velocity of an object. Energy can transform from one type of energy into another and most of the energy turns into the target energy type but some is usually release as heat or thermal energy.

Instructional Approach for *Energy*

No.	Activity Label	Activity Description	Activity Functions*
1	Collaborate on a definition of energy	Students will develop an operational definition of energy by comparing and contrasting what is and what is not energy. They will also fill out the Anticipation Guide on ideas about energy.	*Establish A Question/Elicit Students' Initial Ideas* Establishes the central questions for the sequence, "What is energy and how can it be transferred or transformed?" and elicits student's initial ideas about it.
2	Read & share personal experiences with household energy use	Students will read the introduction story about a boy that owns a solar charger. Then, they will share their own experiences with household energy use.	*Explore Phenomena For Patterns* The students will be exploring the concept of household energy use and looking for patterns in observations.
3	Explore household energy use	Students will discuss the features of two homes in different locations.	*Explore Phenomena For Patterns* The students will be exploring the concept of household energy use and looking for patterns in observations.
4	Share reasons for patterns	Student will give reasons for these features using their personal knowledge and knowledge of geographical locations.	*Students Explain Patterns* The students share their ideas on why the houses use what they use.
5	Make suggestions on ways to be more energy efficient	They will decide which features are more energy efficient and will make suggestions on ways to make the homes more energy efficient given their locations. They will also reflect on ways to they can use less energy in their own homes.	*Apply With Fading Support* The students will suggest ways to be more energy efficient with little support from the teacher.
6	Discuss two energy types	Students will discuss the definitions of potential and kinetic energy and give example in their everyday lives.	*Elicit Students' Initial Ideas* The students give their ideas about the two types of energy.
7	Conduct experiment	Students will conduct an experiment to test how kinetic and potential energy affect an object and how they change as the variables change	*Explore Phenomena For Patterns* Students will conduct an

		(variables - the mass of the rod and the height from which it is dropped).	experiment on kinetic and potential energy.
8	Discuss experiment results	Each group will record their findings and will look at all the results as a class. The student will make generalizations regarding the patterns they observe. Specifically, increasing the mass and height will results in the nail being driven deeper into the rock. Furthermore, they can relate this to the transformation from gravitational potential energy into kinetic.	*Students Explain Patterns* Student will share their own explanations of the results.
9	Generate real-world examples	The students will come up with real-world examples of when gravitational potential energy is transformed to do work following the teacher's example.	*Apply To Near & Distant Contexts With Support* The teacher will give an example to model, then, students will generate examples based on their knowledge.
10	Brainstorm & Illustrate	In pairs, the students will brainstorm energy transformations in an amusement park and identify potential and kinetic energy in their examples. They will also illustrate their ideas about energy before and after reading a role play. Although energy is a rather abstract concept, they will be asked to draw ways it can be represented, not the energy itself. For example, a fast-moving cart indicates that the cart moves with a lot of kinetic energy, but the cart is not the energy itself.	*Elicit Students' Initial Ideas* Brainstorming will elicit their ideas about energy transformations in an amusement park.
11	Roller Coaster Role Play	The students will investigate the transformation of energy, more specifically, how friction transfers kinetic energy from the wheels on the cart to thermal energy and sound through reading a roller coaster role play in small groups. This will also help them develop their illustration regarding the transformation that occurs. The students will try this transformation on their own by rubbing their hands together.	*Explore Ideas about Patterns* The students will explore patterns in the reading and through rubbing their hands together to understand patterns of energy transformations.
12	Analyze Reading	The students will work on the analysis questions to apply their knowledge of energy transformation from this and the previous activity.	*Introduce Scientific Ideas* The students will accurate represent energy transformation from kinetic to thermal.
13	Revise Illustrations	The students will apply what they have learned by revising their pictures from before the reading.	*Apply With Fading Support* The students will revise their

			illustrations with little support or modeling from the teacher.
14	Class Discussion	Discuss the terms heat, thermal energy, and temperature. Discuss how heat describes an energy transfer, whereas, thermal energy describes an energy type, and temperature is a measurement of the average energy per molecule of a substance.	*Elicit Students' Initial Ideas* Through discussion, the students will elicit ideas about the terms.
15	Shot Shaking Experiment	Investigate the conversion of kinetic energy into thermal energy by shaking a container of pellets and observing the temperature change.	*Explore Phenomena For Patterns* Students will conduct an experiment on kinetic and potential energy.
16	Analyze Experiment	The students will answer analysis questions on the patterns they notice in the data trials and how there is a direct relationship between the amount of kinetic energy put into a system and the increase in temperature of that system.	*Students Explain Patterns* Students will explain the patterns they observe in their data.
17	Class Discussion and Anticipation Guide	Discuss what a scientific law entails. Include that it is a general statement about the physical world that is based on empirical observation and evidence. Then, they will fill out a Anticipation Guide on their ideas about the Law of Conservation of Energy	Elicit Students' Initial Ideas The students will start to develop an idea of what a scientific law is and conceptions on the Law of Conservation of Energy.
18	Law of Conservation of Energy Reading	Student will individually read a section of the text and take notes. The informational text on the Law of Conservation of Energy will take the students through three levels of understanding: literal, interpretive, and applied.	*Explore Ideas About Patterns* The students will explore the ideas in the text and look for patterns and evidence.
19	Revise and Analyze	The students will revise their ideas on the Anticipation Guide and will answer the analysis questions involving the trace of energy types through a transformation.	*Compare Student & Scientific Ideas* The students revise their ideas to understand the Law of Conservation.
20	Real World Application	The students will respond to a situation where their friend has an issue with the amount of energy in a battery that violates the Law of Conservation of Energy.	*Apply With Near & Distant Context With Support* Students will answer new questions involving the same patterns and explanation.

Daily Lesson Plan

Date: March 21, 2011

Overall lesson topic/title: Home Energy Use

Rationale: This lesson will introduce the concept of energy. The students will brainstorm ideas of what is and what is not energy to begin developing a working definition that they will build on throughout the unit. This lesson also allows the students to initiate a connection to their own lives by relating energy to their households.

Goals/Objectives for today's lesson:
1. The students will evaluate home energy use by analyzing which features in a home are more energy efficient and suggest and defends ways to make the homes more efficient.
S.IA.06.12 Evaluate data, claims, and personal knowledge through collaborative science discourse.
2. The learner will propose ways to make houses more energy efficient and defend his or her suggestions.
S.RS.06.14 Evaluate scientific explanations based on current evidence and scientific principles.

Materials & supplies needed:

- Textbooks class set
- Journals class set
- PowerPoint
- Computer
- Document Camera
- Projector
- Anticipation Guide
- Solar charger picture
- Popsicle sticks with names
- Easel

• Teacher journal for modeling	
Procedures and approximate time allocated for each event ***• Introduction to the lesson*** *(10 minutes)* Display the solar charger picture on the overhead as students come in to gain their curiosity about the lesson. Ask two students to volunteer to pass out the textbooks and journals or pick two popsicle sticks. Tell the students to open up to Activity 53 in their books. Use the popsicle sticks to call on students to read the introduction story about a teenage boy that buys a solar charger for his phone on the internet. If a poor student is picked as them to read the first paragraph and pick another student for the next paragraph. Display the text using the document camera and overhead projector incase students want to follow along on the board. Make a T-chart on the overhead to identify **what is energy** and **what is not energy**. Have the students brainstorm ideas in their notebook. Tell them to write down four examples, then, take volunteers to put their answer on the board. Discuss common themes from the examples to guide students to a definition of energy. Pull popsicle sticks for student responses. Collaboratively come up with a definition of energy. It is ok if it is not completely accurate. They will learn that energy is an abstract concept and they will be modifying and adding to their definition as they move through the unit. Next, hand out the Anticipation Guides. Give the students a few minutes to read them and determine if the statement is true or false. Tell the students it does not matter if they are wrong because they will come back to these after each lesson to determine the right answer and they will explain below each line how they learned the answer. ***• OUTLINE of key events during the lesson*** *(30-35 minutes)*	***Academic, Social and Linguistic Support during each event*** *(see p. 67 and "Designing Lessons for Diverse Learners" available on the LAET website):* I will write *energy efficient* on the easel under "Word Bank"

In their journals, have the students individually make a list of places they see energy being used in their own homes. Then, they will rank their lists based on the amount of energy each item uses. Ask the students if it was hard to rank their items. Pull popsicle sticks for student responses. Tell the students the purpose of ranking their items is to understand that energy can be quantified or measured and that some items use more energy than others. Guide their thinking to the fact that energy can be quantified and not everything uses the same amount of energy. Read the short story in Activity 53 out loud about Yasmin and her mother getting a more energy efficient water heater. Tell the students to be thinking about the words "energy efficient" and what that might mean based on his story. Discuss this term in the context of the story. Pull popsicle sticks for student responses. Have students write down in their journals the definition of *energy efficient* as *uses less energy*. Give more examples of energy efficiency (ex. hybrid vehicles their parents may have purchase, unplugging appliances, using a solar charger, filling up the dishwasher before running it, etc.). Next, have the students look at the list of features of the two homes on the next page. The students may raise their hand if they have a question about any of the features. Have the students work with the person next to them to determine which house uses less energy. They can do this by giving a point for the house that has the more energy efficient feature, then, they will add the points up at the end. Have the students (with their partner) work on the analysis questions in their journals. • ***Closing summary for the lesson*** *(10 minutes)* Discuss the analysis questions out loud as a class. Pull popsicle sticks for student responses. Display the "teacher journal" on the overhead and write down a collaborative answer for each question.	(this will be left up and we will continue to add the word bank for students to refer back to)

Examples of answers to the analysis questions are below: 1. Home A is in Texas, which has a much warmer climate and may take more energy to cool the house down. Home B is in New York, which has a colder climate year round and may take more energy to heat the home. 2. Energy efficient means to use less energy. One is example is Home B using natural gas, instead of oil, like Home A. 3. Home B uses less energy over all with natural gas, high efficiency appliances, and more compact fluorescent light bulbs. Finally, ask students where else they see energy transfers and transformations occurring. 4. A. Home A could reduce their energy needs by switching their windows to double pane, use all high efficiency appliances, installing more installation, or change to fluorescent light bulbs. B. Home B could reduce their energy needs by switching all of their appliances to high efficiency and changing all the light bulbs to compact fluorescent. Finally, ask students how they can make a difference to becoming more energy efficient, just as Dominique did with his solar charger, in their own homes.	
• ***Transition to next learning activity*** Have students pack up their things and ask one person from each table to put away the books and journals. Once everything is put away and their chairs are pushed in they may line up for their next class.	
Assessment I will monitor their conversations with their partners and the class discussion of the analysis questions at the end. I will look their journals at the end of class to make sure everyone has complete and accurate answers for the analysis questions. If they do not, I will leave guiding questions in their journal to	***Academic, Social, and Linguistic*** Students will be paired up, so they can use the support of their peers during the assessment. I will also be

help with their thinking process. If there are many students missing the same information, I will go over that information at the beginning of the next class.	walking around and checking on the academically lower students with any areas they are struggling in.

Daily Lesson Plan

Date: March 22, 2011

Overall lesson topic/title and purpose: Drive a Nail/Kinetic & Potential Energy

Rationale: The students will learn about energy transfers and transformations through a hands-on experiment. They will analyze how gravity, mass, and velocity affect the amount of potential and kinetic energy. Finally, they will be able to connect the change in energy to other situations in their lives.

Goals/Objectives for today's lesson:
The learner will analyze the transformation of energy from the results of a nail being driven into a foam block with rods of different sizes.
S.IA.06.14 Draw conclusions from sets of data from multiple trials of a scientific investigation.

Materials & supplies needed:

- 15 foam blocks
- 15 nails
- 5 short aluminum rods
- 5 short steel rods
- 5 tall aluminum rods
- 5 tall steel rods
- 10 short tubes
- 10 tall tubes
- Textbooks class set

- Journals class set
- Teacher journal for modeling
- Overhead projector
- Document camera
- Computer
- Template for note taking
- Activity 54 PowerPoint
- Internet access the link: http://www.youtube.com/watch?v=vl4g7T5gw1M

Procedures and approximate time allocated for each event	***Academic, Social and Linguistic Support during each event*** *(see p. 67 and "Designing Lessons for Diverse Learners" available on the LAET website):*
• ***Introduction to the lesson*** *(5-10 minutes)* Have the materials for the experiment set up on the front table for the students to see as they enter. Display the directions on the board to pass out the books and journals and turn to Activity 54. Once the students are settled, display the book on the overhead and read the short story about Yasmin helping her mom install weather stripping. Tell the students to be thinking about what it means to transfer energy and look for examples in the text. Discuss what it means to *transfer* energy in the context of the story. Pull popsicle sticks for student responses. (A formal definition will be shown in the PowerPoint for them to take notes on)	Handout templates to students that struggle with taking notes.
• ***OUTLINE of key events during the lesson*** *(30-35 minutes)* Show the 2 minute YouTube video on kinetic and potential energy. Tell them to look for a definition of kinetic and potential energy and examples of each. Then, go through the PowerPoint for students to writes about the different types of energy, energy transfers and transformations. Introduce the experiment. Model what to do with the supplies in the front. Discuss with the students what they are testing (*mass and height*) and why it is important to only change one variable at a time (*maintain accuracy, avoid error*). Pull popsicle sticks for	I will write *potential* and *kinetic energy, energy transfer* and *transformation* on the easel under "Word Bank"

student responses. Give an scenario if students are confused, such as, “Can I put the nail in this far and hold the rod up this high, then put the nail in this far and hold the rod this low th second time?” Pair students at their tables and send groups by table to get their supplies and begin. As groups finish, record the result in a class table on the board and take the average. Have student put their materials away when they are finished. Discuss the results with the students, (*the long, steel rod and tall tube used the least amount of drops to nail the nail in the block – it has the greatest mass and height*). Pull popsicle sticks for student responses. Have students use the class table to answer the analysis questions. • ***Closing summary for the lesson*** *(10 minutes)* Go over the analysis questions as a class. Use the popsicle sticks for student responses. Display the “teacher journal” on the overhead and write down a collaborative answer for each question. Examples of answers to the analysis questions are below: 1. The tall tube and long, steel rod transferred the most energy to the nail because the taller height created the most gravitational potential energy and the greater mass created the most kinetic energy. The short tube and short, aluminum rod transferred the least energy to the nail because the shorter height created the least gravitational potential energy and the lesser mass created the most kinetic energy. 2. A. There was the most gravitational energy right before the rod was released. B. There was the most kinetic energy when the rod was about to the hit the nail. 3. No, not all the energy was transferred to the nail. Some energy was released as heat and sound when it hit the nail.	

4. A. When released from rest: Potential energy = <u>100 J</u> Kinetic energy = <u>0</u> B. Halfway down: Potential energy = <u>50 J</u> Kinetic energy = <u>50 J</u> C. Just before it hits: Potential energy = <u>0</u> Kinetic energy = <u>100 J</u> Ask students if they have any questions about the activity. Tell them to turn to their table partner and share other examples of gravitational potential and kinetic energy being transferred or transformed into another type of energy. Take 2-3 responses to share out loud.	
• ***<u>Transition to next learning activity</u>*** Have students pack up their things and ask one person from each table to put away the books and journals. Once everything is put away and their chairs are pushed in they may line up for their next class.	
Assessment I will observe their experiments to make sure they are only changing one variable at a time. More importantly, I will monitor their analysis questions. I want to make sure they understand the relationship between moving (kinetic) and stored (potential) energy and how mass, height, gravity, and speed affect them. If I notice the students are not comprehending as we discuss the questions as a class, I will re-model the situation and/or give examples uses other materials, such as, a rock and a tissue.	***Academic, Social, and Linguistic*** Students will be paired up, so they can use the support of their peers during the assessment. I will also be walking around and checking on the academically lower students with any areas they are struggling in.

Daily Lesson Plan

Date: March 23, 2011

Overall lesson topic/title and purpose: Roller Coaster Role-Play

Rationale
This activity provides an authentic situation of a roller coaster that the students can relate to. The students will pick apart this complex structure and learn about it from different perspectives (interviewer, engineer, physics professor, park director). Once they are given information about the roller coaster, they will analyze the energy transfers and transformations that occur along the ride.

Goals/Objectives for today's lesson:
The learner will analyze the transformation between potential and kinetic energy.
EN.06.12 Demonstrate the transformation between potential and kinetic energy in simple mechanical systems (for example: roller coasters, pendulums).

Materials & supplies needed:

- Textbooks class set
- Journals class set
- Teacher journal for modeling
- Picture of a roller coaster
- Document camera
- Projector
- Computer
- Internet access to the link: http://www.youtube.com/watch?v=-dpBVtAbKJU

Procedures and approximate time allocated for each event	***Academic, Social and Linguistic Support during each event*** *(see p. 67 and "Designing Lessons for Diverse Learners" available on the LAET website):*
• ***Introduction to the lesson*** *(3 minutes)* Display the picture of a roller coaster on the board along with the directions to pass out the books and journals and turn to Activity 55. Tell students they will learn about energy transfers and transformations within a roller coaster. • ***OUTLINE of key events during the lesson*** *(25-30 minutes)* Number the students into groups of four with their table. The numbers will correspond to the number of each character. Tell	

them they have approximately 20 minutes to read the role play. Keep track of any intriguing comments along the way. Once students are finished reading, play the YouTube video. http://www.youtube.com/watch?v=-dpBVtAbKJU. Tell the students to look for the different locations of the roller coaster as he is talking about each type of energy. Ask the students what they found interesting or what they noticed as far as common themes between the reading and the video. Pull popsicle sticks for student responses. • ***Closing summary for the lesson*** *(10-15 minutes)* Go over the analysis questions as a class. Pull popsicle sticks for student responses. Display the "teacher journal" on the overhead and write down a collaborative answer for each question. Examples of answers to the analysis questions are below: 1. A. The train has the most gravitational energy at point B in the diagram because it is at the greatest height. B. The train has the most kinetic energy at point C because it used the potential energy built up from the previous hill. C. The train has both kinetic and potential energy half way between point B and C because it is moving, but has not used all of the stored energy. 2. The train is moving faster at point E because it has used all of its stored potential energy and has increased to a greater speed. 3. Some other transformations that occur include mechanical to potential in the initial lift, kinetic to heat and sound through friction from the train rubbing the track. Ask the students if they have any questions about the activity. Then, ask the students, "If you were to make your own roller coaster what you need to do to your first hill to maximize your kinetic energy throughout the ride?" Pull popsicle sticks for	

student responses (make the first hill the tallest). Tell the students there are many interactive websites that allow you to practice building your own roller coaster, which involves you maximizing the kinetic energy including http://www.learner.org/interactives/parkphysics/coaster/	
• ***Transition to next learning activity*** Have students pack up their things and ask one person from each table to put away the books and journals. Once everything is put away and their chairs are pushed in they may line up for their next class.	
Assessment I will monitor their analysis questions. I want to make sure they understand the energy transfers and transformations within the context of a roller coaster and how mass, height, gravity, and speed affect them.	***Academic, Social, and Linguistic*** Students will be paired up, so they can use the support of their peers during the assessment. I will also be walking around and checking on the academically lower students with any areas they are struggling in.