Lesson 2.17: Physical Science – Law of the Conservation of Energy

Weekly Focus: Reading for Comprehension
Weekly Skill: Scientific Method with Experiment

Lesson Summary: This week students will continue to expand their vocabulary in physical science with reading a passage on the law of the conservation of energy. Then, students will review the scientific method with a simple experiment on the law of the conservation of energy.

Remind students that the next lesson is a review quiz of Physical Science. If possible, they should review their notes from lessons 2.8 – 2.17.

Materials Needed:

- "The Law of the Conservation of Energy" **Unit 2.17 Video** (time 1:51 min)
- Comprehension Reading: **Unit 2.17 Handout 1** (Spectrum Science, Grade 6, pages 38-39)
- Scientific Experiment: **Unit 2.17 Handout 2**
- String or yarn (2 feet for each group), scissors, weights (2 or 4 washers or nuts (or something with a hole in it) for each group
- Extra Work/Homework (nice review of previous material): **Unit 2.17 Handout 3**

Objectives: Students will be able to…

- Gain a deeper understanding of concepts related to the law of conservation of energy
- Construct an experiment of the law of conservation of energy

College and Career Readiness Standards: RI, RST, WHST, SL

ACES Skills Addressed: EC, LS, ALS, CT, SM, N

Notes: Please review and be familiar with classroom routine notes for: reading for fluency strategies (**Routine 2**), summarizing techniques (**Routine 4**), and self-management skills (**Routine 1**). The notes will help with making a smooth transition to each activity.

GED 2014 Science Test Overview – For Teachers and Students

The GED Science Test will be 90 minutes long and include approximately 34 questions with a total score value of 40. The questions will have focus on three content areas: life science (~40%), physical science (~40%), and Earth and space science (~20%). Students may be asked to read, analyze, understand, and extract information from a scientific reading, a news brief, a diagram, graph, table, or other material with scientific data and concepts or ideas.

The online test may consist of multiple choice, drop down menu, and fill-in-the-blank questions. There will also be a short answer portion (suggested 10 minutes) where students may have to summarize, find evidence (supporting details), and reason or make a conclusion from the information (data) presented.

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Lesson 2.17: Physical Science – Law of the Conservation of Energy

The work students are doing in class will help them with the GED Science Test. They are also learning skills that will help in many other areas of their lives.

Activities:

Warm-Up: K – W - L	**Time: 5 - 10 minutes**

- As students enter the class, have the following written on the board or overhead **"The Law of the Conservation of Energy states: energy cannot be created or destroyed and can only be transferred from one object to another."** Have students create a **"KWL"** chart on a piece of notebook paper (below). This helps to activate students' prior knowledge by asking them what they already **K**now (column 1); students (collaborating as a classroom unit or within small groups) set goals specifying what they **W**ant to learn (column 2); and after reading students discuss what they have **L**earned (column 3).
- Students apply higher-order thinking strategies which help them construct meaning from what they read and help them monitor their progress toward their goals.

KWL Chart:

K - What (else) do I KNOW?	**W - What do I WANT to know?**	**L - What did I LEARN?**

Activity 1: Video & Unit 2.17 Handout 1	**Time: 45 - 50 minutes**

1) Distribute the handout **(Unit 2.17 Handout 1)** to students.
2) Have them look at the first part (A) to preview the questions prior to watching the video. See if they know or can predict any of the answers. You may wish to point out that the video is from the University of Kentucky, so the professor has a slight "southern" accent.
3) Have students watch the video twice. The first time, instruct them to keep their pencil down. The second time, give students permission to start recording answers to the questions.
4) After the video, give students time to finish writing answers on the handout. Then, have students check their answers with classmates. Review answers as a whole class. You may ask for a volunteer to draw the swing of the pendulum (question #5) on the board.
5) The next part of Unit 2.17 handout 1 (pages from Spectrum Science) is to gain a better understanding of the law of the conservation of energy.
6) Students should read silently and answer the questions. They will stop at "What's next" – that is the experiment for Activity 2.
7) While students are reading, circulate and discuss with students that when reading for comprehension, there are many strategies to use: read the title to predict what the reading is about; look at the words in bold and their definitions within the context of the reading; while reading remember to ask "What is this all about?"
8) Review as a whole class as students are finished. Make sure they understand the law of the

conservation of energy.
9) When finished, students can fill in the **"L"** portion of the KWL chart from the warm up activity.

Break: 10 minutes

Activity 2: The Scientific Method: Experiment (Unit 2.17 Handout 2)	**Time: 45 - 50 minutes**

1) Distribute the handout **(Unit 2.17 Handout 2)** to students.
2) Discuss with students that part of the 2014 GED Science Module will include two short (10 minutes) written responses. One of these written responses will likely ask them to write about a scientific experiment. This lesson is going to give some background knowledge on that process.
3) Ask students if they have conducted any experiments – ask for volunteers to describe any experiments they have done.
4) Ask for a volunteer(s) to describe the experiment Alexis and Miranda did from the reading passage in Unit 2.17 Handout 1 (the swing of the pendulum) – ask if anyone has done a similar pendulum experiment.
5) Ask for volunteers to read each of the paragraphs at the beginning of Handout 2. Make sure students understand what the experiment is going to be (*to determine if the length of the string used in a pendulum will affect the number of swings or oscillations*).
7) Put students into groups of 3 – 4 to work together on the experiment.
8) Circulate while students are conducting the experiment making sure they understand the directions and can write up their experiments in the spaces provided.
9) As a class, go through the results.
10) Remind students to think of ways they can remember the scientific method and its steps. This will be important information to retain and use on the 2014 GED Science module. If needed, review the lessons in Unit 3.1 and Unit 3.2.

Wrap-Up: Summarize	**Time: 5 minutes**

Have students turn to a partner (or write in their journals) about what they have learned today about the law of the conservation of energy. Have them tell a classmate or the whole class one new thing they learned from today's lesson. *Note: Use Routine 4 Handout*
Remind students that the next lesson is a review quiz of Physical Science. If possible, they should review their notes from lessons 2.8 – 2.17.

Extra Work/Homework: Unit 2.17 Handout 3	**Time: 20 minutes outside of class**

Students can continue with work on forms of energy and the law of the conservation of energy. This handout is an excellent opportunity for students who have missed the last few science lessons/units to get an overview of the material covered. It is also a great review for students who have been in class.

Differentiated Instruction/ELL Accommodation Suggestions	Activity
If some students finish early, they can turn their paper over and summarize the reading. **(Unit 2.17 Handout 1)**	**Activity 1**
There may be some new concepts and/or vocabulary for students. Please make sure they are comfortable with the vocabulary. If needed, have students work in groups. (**Unit 2.17 Handout 1 & Unit 2.17 Handout 2**)	**Activity 2**

Online Resources:

If students have Internet connection, they should try to watch another video on conservation of energy. There are some questions to think about before watching the video and the answers are following the video.

http://www.pbs.org/opb/circus/classroom/circus-physics/activity-guide-conservation-energy/

Students can also try to create their own transfer of energy with this interactive site:

http://www.sciencemuseum.org.uk/onlinestuff/games/energy_flows.aspx

The Reading in Handout 2 is about bicycles in New York City. You may want to show students the Nice Ride website for similar bikes in the Twin Cities. Students can learn more about the "green bikes" in the Metro area and see where they are located: https://www.niceridemn.org/

Suggested Teacher Readings:

- GED Testing Service – GED Science Item Sample (to get an idea of what the test *may* be like)

  http://www.gedtestingservice.com/itemsamplerscience/

- Assessment Guide for Educators: A guide to the 2014 assessment content from GED Testing Service:

  http://www.riaepdc.org/Documents/ALALBAASSESSMENT%20GUIDE%20CHAPTER%203.pdf

- Minnesota is getting ready for the 2014 GED test! – website with updated information on the professional development in Minnesota regarding the 2014 GED.

  http://abe.mpls.k12.mn.us/ged_2014_2

- ATLAS: ABE Teaching & Learning Advancement System: 2014 GED ® Classroom: Science: Minnesota's state-wide website for resources for the science module

  http://atlasabe.org/resources/ged/science

Unit 2.17 Handout 1 (3 pages total with Spectrum Science pages)

The Law of the Conservation of Energy

A. University of Kentucky Video

Watch the short video discussing the law of the conservation of energy twice. The first time you watch it, keep your pencils down. While watching it for the **second** time, fill in the blanks with information presented. When you are finished, check with a classmate to see if you have the same information.

1. Why does a pendulum work well to demonstrate the law of the conservation of energy?

2. Why doesn't the pendulum (in the video it's a bowling ball) hit the student?

3. What would happen if the student pushed on the bowling ball instead of just letting it go?

4. What is the "principal of the conservation of energy"?

5. Draw the path of the pendulum (bowling ball) and label the parts of the path where there is potential energy and kinetic energy.

Unit 2.17 Handout 1

The Law of the Conservation of Energy

TEACHER ANSWER KEY

1. Why does a pendulum work well to demonstrate the law of the conservation of energy?

The pendulum works well to demonstrate the law of the conservation of energy because at the top of its swing it has 100% (gravitational) potential energy, at the bottom of the swing, it converts potential energy to kinetic energy and then converts it back to potential energy

2. Why doesn't the pendulum (in the video it's a bowling ball) hit the student?

Answers may vary: The law of the conservation of energy states that energy cannot be created, therefore, the ball cannot gain energy and hit the student.

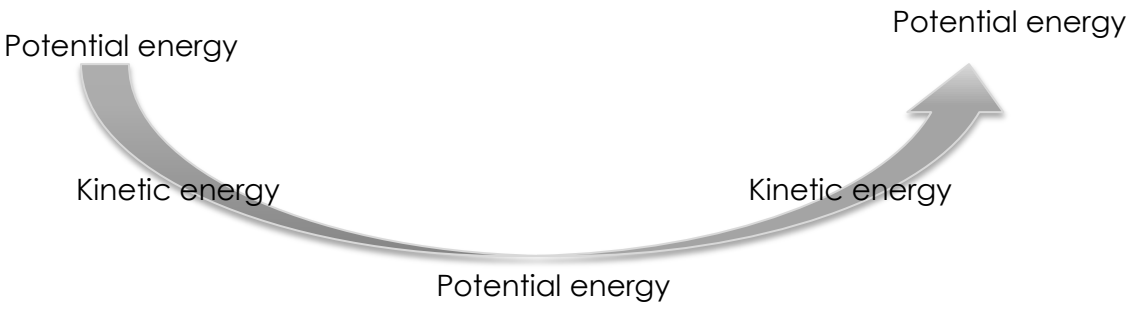
3. What would happen if the student pushed on the bowling ball instead of just letting it go?

Answers may vary: The ball would hit her because she added energy from the push.

4. What is the "principal of the conservation of energy"?

Energy cannot be created or destroyed it can only be transferred from one form to another.

5. Draw the path of the pendulum (bowling ball) and label the parts of the path where there is potential energy and kinetic energy. **(Answers may vary but should look like:**



Answers to page 39 of Spectrum Science

1. b 2. C 3. Potential energy, because the weight is not moving but it is suspended in the air. 4. Answers may vary, suggested answer: As the weight swings, it has to push through the atoms and molecules in the air. This creates drag and friction that take away some of the pendulum's energy.

Unit 2.17 Handout 2 (2 pages total)

What's Next?

As you already know, the law of the conservation of energy states *"energy cannot be created or destroyed it can only be transferred to another form."* Earlier today, you watched a video of an experiment on this law. You have also read a reading passage describing more about this important law in physical science. Now it is time for you to conduct your own experiment on the law of the conservation of energy. We don't have a bowling ball, so you will use string and some weights (washers or something similar) for your experiment.

As stated at the end of the reading from Activity 1 "What's Next": **What effect does the length of the string have on a pendulum's swing?** Create your own pendulum with string and a small weight and then count the number of swings it makes in fifteen seconds. Shorten the string by half and try again. Be sure not to introduce or bring in too many variables *(things that can change the experiment)* or the experiment won't work well. Keep the weight the same, as well as the distance you pull the weight back. You may want to try the original experiment that Alexis and Miranda did in the reading passage to see if your results are the same.

The 2014 GED Science module may have you write (type) a short (10 – 15 minutes) response about an experiment. This is a chance for you to practice this type of response. You can follow along with the guided steps below as you conduct your experiment. When you're finished with the experiment, take time to write up your own response.

The Scientific Method

1. Make observation (What did you notice or observe from the video?)

2. Construct Hypothesis (What is the question you would like to answer?)

3. Test Hypothesis with Experiment (What is the experiment you will conduct to test your hypothesis?)

4. Analyze Data to Draw a Conclusion (What did you observe and note from the experiment?)

5. Accept or Reject Hypothesis (Do you agree or disagree with your original observation after the results from the experiment?)

6. Report Results (Write up the results to report them to others.)

The Scientific Method **TEACHER ANSWER KEY**

1. Make observation (What did you notice or observe from the video?)

Answers may vary – suggested answer: A pendulum can demonstrate the law of the conservation of energy. The amount of potential energy in the pendulum cannot be more than the kinetic (moving) energy of the pendulum.

2. Construct Hypothesis (What is the question you would like to answer?)

Answers may vary – suggested answer: What effect does the length of the string have on a pendulum's swing?

3. Test Hypothesis with Experiment (What is the experiment you will conduct to test your hypothesis

Answers may vary – suggested answer: The experiment will use two object of the same weight. The string on the first weight will be double the length of the string on the second weight. Each weight and string will be used like a pendulum from the same distance. The only difference or variable will be the length of the string. This is how we can test if the length of string affects the pendulum's swing.

4. Analyze Data to Draw a Conclusion (What did you observe and note from the experiment?)

Answers may vary – suggested answer: The weight on the longer length of string had the fewer swings or oscillations of the pendulum. When the length of the string is shortened there are more swings or oscillations.

5. Accept or Reject Hypothesis (Do you agree or disagree with your original observation after the results from the experiment?)

Answers may vary – suggested answer: The weight of the pendulum doesn't seem to change the number of oscillations; however, the length of the pendulum does change the number of oscillations.

6. Report Results (Write up the results to report them to others.)

Answers may vary: Students should take up to 10 minutes to write up their experiment. They should list their hypothesis, materials used in the experiment, what they did in the experiment, their results, and their conclusion.

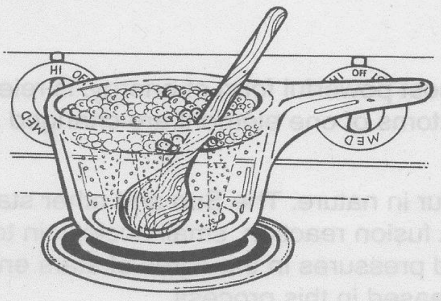
Unit 2.17 Handout 3 (4 pages total)

What Is Conservation of Energy?

Energy Everywhere

Wherever you look, you see the effects of energy. Cars moving, kids playing, and water boiling all depend on some form of energy. Energy is very important to life and to our society.

What is energy? Energy and matter are basic parts of the Universe. Matter is anything that takes up space and has mass. Energy has the ability to do work. Work happens when a force moves an object in the direction of that force. Energy and work are measured using the same unit, the joule (jool).



Energy exists in many forms. Electrical energy is used in homes and workplaces. Many machines change electrical energy into the energy needed to work.

Energy changes also play important roles in nature. Plants use energy from the Sun to grow. The energy we get in our food comes from energy stored in plants or in animals that ate the plants.

Changes in energy are also important. Energy changes follow the law of conservation of energy. This law has two parts: (1) The amount of energy in a closed system always stays the same, and (2) Energy can change forms, but it cannot be created or destroyed.

In every energy transformation, some energy is lost to friction and changed to thermal or heat energy. The energy still exists. But it is not used to do work.

Potential and Kinetic Energy

Changes in energy involve potential energy and kinetic energy. Potential energy is stored energy. Kinetic energy is energy of motion. Anything that is moving has kinetic energy. Thermal energy, electricity, and sound energy also have kinetic energy.

Energy is constantly changing from potential to kinetic and back again. These back-and-forth changes can be seen in your body's motion. In your muscles, your body stores chemical potential energy from the food you eat. When you use your muscles to throw a ball, your body changes some of that chemical potential energy to mechanical kinetic energy—the energy of your moving arm.

In another example, an electric toothbrush has chemical potential energy in its battery. The potential energy changes to electrical, and then mechanical, kinetic energy.

Anything that can be bent or squeezed and then return to its natural shape, or anything that is flexible, such as a rubber band, has elastic potential energy. Think about some other common examples of energy use—a bow and arrow, a wind-up toy with a spring, a car engine powered by gasoline. Think about the forms of energy used.

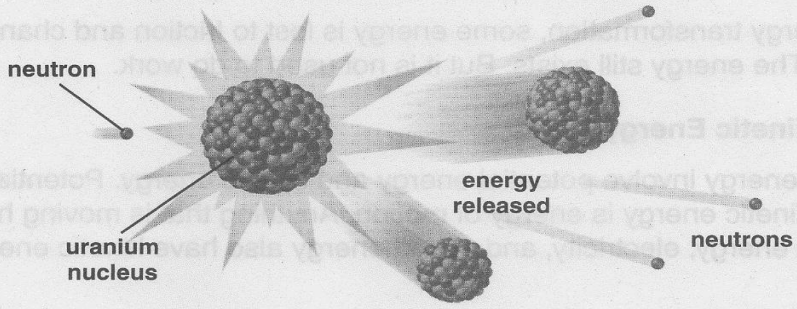
Nuclear Energy

Nuclear energy, the most powerful form of energy, is released in a nuclear reaction. In this reaction, nuclei of atoms of one element are changed into nuclei of atoms of a different element.

Nuclear reactions occur in nature. The Sun and other stars are powered by a nuclear reaction called fusion. In a fusion reaction, small nuclei join together for form new nuclei. Extreme temperatures and pressures in the cores of stars enable fusion reactions. Large amounts of energy are released in this process.

Nuclear power plants use another type of nuclear reaction called fission. Fission involves splitting nuclei of the elements uranium or plutonium to release energy. The heat that results from fission in a nuclear power plant is used to turn water into steam, which is then used to make electricity.

Nuclei are made up of protons and neutrons. But the mass of a nucleus is less than the sum of the masses of its protons and neutrons. This difference in mass represents the energy that holds the nucleus together. In a nuclear reaction, this energy is released.



Name _____ Date _____

What Is Conservation of Energy?

Fill in the blanks.

1. The second part of the law of conservation of energy is that energy can change forms, but it cannot be _____.
2. Moving objects, thermal energy, electricity, and sound energy have _____ energy.
3. Chemical compounds, an object lifted up, a rubber band, and your muscles have _____ energy.
4. When nuclei of atoms of one element are changed into nuclei of atoms of a different element, _____ energy is released.

Fill in the blanks in the table below.

Example	Energy Transformation
5. A rubber band in a toy airplane unwinds.	Elastic potential energy changes to mechanical _____ energy.
6. You throw a ball.	_____ potential energy changes to mechanical kinetic energy.
7. You flip the switch of an electric toothbrush.	Chemical potential energy in the battery changes to electrical _____ energy, which changes to mechanical kinetic energy.

Name _____ Date _____

8. **Main Idea** Describe some properties of energy.

_____

_____

9. **Vocabulary** Explain the difference between potential energy and kinetic energy. Give an example of how one can be transformed into the other.

_____

_____

_____

10. **Reading Skill: Draw Conclusions** Describe how Earth would be affected if it no longer got energy from the Sun.

_____

_____

11. **Critical Thinking: Analyze** A kitchen blender transforms electrical energy into mechanical energy. Why is the amount of mechanical energy produced less than the amount of electrical energy used?

_____

_____

12. **Inquiry Skill: Compare** Nuclear fusion and nuclear fission both release huge amounts of energy. How are the two processes different?

_____

_____

13. **Test Prep** Which of the following can be described as kinetic energy?

A chemical energy

B gravitational energy

C elastic energy

D mechanical energy

Unit 2.17 Handout 3

Teacher Answer Key

1. created or destroyed
2. kinetic
3. potential
4. nuclear
5. kinetic
6. chemical
7. kinetic
8. Answers may vary, suggested answer:

   Energy can't be created or destroyed. It can be transformed from one kind to another, and it can be potential or kinetic.

9. Answers may vary, suggested answer:

   Potential: stored energy kinetic: energy of motion

   A person holding a ball

10. Cells
11. efficient