

Lesson 2.16: Physical Science – Transfer of Energy

Weekly Focus: Reading for Comprehension
Weekly Skill: Vocabulary in Energy & Transfer

Lesson Summary: This week students will brush up on vocabulary on forms of energy and the transfer of energy. They will continue reading for comprehension with a reading passage on the transfer of energy in a context they may understand.

Materials Needed:

- Vocabulary in Energy & Transfer Charts 1: **Unit 2.16 Handout 1**
- Video **Unit 2.16 Transfer of Energy** (time 3:22 min)
- Comprehension Reading: **Unit 2.16 Handout 2**
- Extra Work/Homework: **Unit 2.16 Handout 3**

Objectives: Students will be able to...

- Gain a deeper understanding of vocabulary related to energy and energy transfer
- Understand everyday examples of the transfer of energy.

College and Career Readiness Standards: RI, RST, WHST

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

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.

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.

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Activities:

Warm-Up: Review Various Forms of Energy

Time: 5 - 10 minutes

As students enter the class, have the following written on the board or overhead **“What are some forms of energy?”** Have students write down examples in their notebook. This will help to activate students' prior knowledge by asking them what they may already know about forms of energy. If students are stuck, ask them about how they arrived to school. Did they walk? Did they drive? Did they ride a bike? They used some form of energy to arrive at school, now they have to put a name to the kind of energy. You can explain that today the topic will be on understanding energy forms and how energy transfers.

Activity 1: Video & Unit 2.16 Handout 1

Time: 45 - 50 minutes

- 1) Distribute the handout to students.
- 2) Have the students 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 BBC Science, so they have a British accent. They also refer to “gas” as petrol and a flashlight as a “torch”.
- 3) Have students watch the video.
- 4) After the video, have students check on their answers with classmates. Then review answers as a class.
- 5) The next part of Unit 2.16 Handout 1 is to gain a better understanding of vocabulary and ideas related to the transfer of energy.
- 6) Do the first matching activity together to make sure students understand what to do. This should be a review from Unit 2.11 (Energy). Read # 1 aloud, and see if students remember the earlier lesson. The “position” of the object makes it “potential” energy – the energy is stored in the object and ready to be used.
- 7) Have students work on filling in the blanks on the pages. While students are reading, circulate to discuss vocabulary with students. Assist them if they seem to get stuck. They should pay attention to key words and phrases to help match the actions to the form of energy.
- 8) Review each page as students finish. Make sure they understand the forms of energy and how they transfer energy. Remind students that they should have a good foundational knowledge of kinds of energy and the transfer of energy to answer some questions that may be on the 2014 GED test.

Break: 10 minutes

Activity 2: Energy Transfer Reading (Unit 2.16 Handout 2)

Time: 45 - 50 minutes

- 1) Distribute the handout (**Unit 2.16 Handout 2**) to students.
- 2) 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 image to get more of an idea of what they will be reading about.

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- 3) Remind students that while reading, remember to ask “What is this all about?” Who or what is the all of the passage about and why is it important?
- 4) Have students read the passage and answer the questions independently.
- 5) Circulate class while they are reading to make sure they understand the information presented and to see if there are any questions.
- 6) Review answers as a whole class – note: some answers may vary – ask students with different answers to discuss theirs with the class. Ask the students if they understand more about the transfer of energy after reading the passage. Did it help to bring more meaning to the idea of transfer of energy?
- 7) If there is extra time, have students read the passage in pairs to promote reading fluency.

Wrap-Up: Summarize

Time: 5 minutes

Have students turn to a partner (or write in their journals) about what they have learned today about forms of energy. Have them tell a classmate or the whole class one new thing they learned from today’s lesson on the transfer of energy. *Note: Use Routine 4 Handout*

Extra Work/Homework: Unit 2.16 Handout 3

Time: 20 minutes outside of class

Students can continue with work on forms of energy. This handout has alternative energy forms. It will have students thinking about other areas of energy use.

Differentiated Instruction/ELL Accommodation Suggestions

Activity

If some students finish early, they can turn their paper over and check in a dictionary for the vocabulary definitions. This is a strategy they can use with any new vocabulary they encounter in GED science reading. **(Unit 2.16 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 2.16 Handout 2)**

Activity 2

Online Resources:

If students have Internet connection, they should try to watch and use the interactive BBC website for energy transfer. The website does a great job in explaining energy transfer

http://www.bbc.co.uk/bitesize/ks3/science/energy_electricity_forces/energy_transfer_storage/activit_y/

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

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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.

<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>

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Unit 2.16 Handout 1 (4 pages total)

Transfer of Energy

A. BBC Science Video

Watch the short video discussing the transfer of energy. While watching, 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 can't energy be lost?**

2. **Movement from a car is transferred into what kind of energy?**

3. **What are the other kinds of energy transferred with the movement of a car?**

4. **What percentage of useful energy goes into movement of a car?**

5. **What is the “principal of the conservation of energy”?**

NOTES:

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Name _____ Date _____

The Various Forms of Energy

Match each term in the word box to its definition.

sound energy

mechanical energy

electrical energy

forms

radiant energy

nuclear energy

kinetic energy

thermal energy

chemical energy

potential energy

- 1 _____ This is stored energy of an object or material. It is the energy that an object has due to its position.
- 2 _____ This is the energy associated with movement of electrons through a wire or circuit.
- 3 _____ This is the energy produced when an atom splits apart (fission) or when two atoms join to form one atom (fusion).
- 4 _____ This is the energy of motion. The faster an object moves, the more of this it has.
- 5 _____ This is the energy of an object due to the motion of its atoms and molecules. An object that feels hot has more of this inside it than it does after it has cooled down.
- 6 _____ This is energy that can travel in waves and can move through empty space.
- 7 _____ This is the energy stored in the connections between atoms. As chemical reactions take place to release these connections, this energy is released.
- 8 _____ All energy can change from one of these to another.
- 9 _____ This is the energy of vibrations carried through solids, liquids, or gases. It travels in waves, but it cannot move through empty space.
- 10 _____ This is the energy of an object due to its motion, position, or condition. It is the combined total of potential energy and kinetic energy of an object.

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Energy Transfers

Energy can change from one form to another. We commonly change energy from one form to another as we use it. Match each term in the word box to its description. Some terms are used more than once.

radiant
mechanical

chemical
sound

electrical
nuclear

thermal

- 1 _____ When you shout at a friend, you are changing mechanical energy into this form.
- 2 _____ When you set food under a heat lamp to warm it, you are changing radiant energy into this form.
- 3 _____ When you turn on a CD player, you are using this form of energy to produce sound energy.
- 4 _____ At a power plant nearby, matter is changed into energy to produce this form of energy.
- 5 _____ Eating a healthy breakfast provides this form of energy, which is turned into mechanical and thermal energy as you play, study, and move.
- 6 _____ Plug in a fan to a source of electrical energy. The electrical energy is transformed into this form to move the fan blades.
- 7 _____ Plug a lamp into an electrical socket and you turn electrical energy into this form of energy.
- 8 _____ Radiant energy from the sun is turned into this form when plants undergo photosynthesis.
- 9 _____ As plants decompose, their chemical energy may become stored as coal or natural gas. These chemical energy sources can be turned into this form of energy as they are burned at a power plant.
- 10 _____ As fuel is burned at a power plant, the energy released turns a turbine, whose movement is an example of this kind of energy.
- 11 _____ Energy leaves a power plant in the form of this kind of energy.

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From One Form to Another

Energy can change form, but it cannot be created or destroyed. Under some conditions, such as those that produce nuclear energy, matter and energy can change into each other. However, the total amount of matter and energy does not change. Use the phrases in the word box to label the changes in energy forms.

electrical to sound
chemical to thermal
radiant to thermal

radiant to chemical
mechanical to electrical
electrical to mechanical

thermal to mechanical
electrical to radiant

- 1 _____ Plants use energy from the sun in the process of photosynthesis to manufacture glucose.
- 2 _____ Solar panels placed on the top of a roof use the sun's energy to heat water for a swimming pool.
- 3 _____ A lamp is plugged into a wall socket. Once the lamp is turned on, both light and heat come from the lamp.
- 4 _____ The spinning turbine inside a hydroelectric plant generates electricity.
- 5 _____ Some furnaces burn coal to heat buildings.
- 6 _____ An alarm clock begins to beep and the radio turns on. The display shows it is 7:00 a.m.
- 7 _____ Water is heated until it becomes steam. The pressure of the steam turns a turbine or generator.
- 8 _____ Plug a fan into a wall socket. Turn on the fan and the blades begin to spin.

Unit 2.16 Handout 1

Page 1 Transfer of Energy Video

TEACHER ANSWER KEY

1. Why can't energy be lost?
It can't be lost because it can only be transferred.
2. Movement from a car is transferred into what kind of energy?
Kinetic energy is the kind of energy that makes the car move.
3. What are the other kinds of energy transferred with the movement of a car?
The other kinds of energy are heat and sound energy
4. What percentage of useful energy goes into movement of a car?
30% of energy goes into the movement of a car.
5. What is the "principal of the conservation of energy"?
Energy is not lost it can only be transferred.

Page 2 The Various Forms of Energy

- | | | | |
|---------------------|-----------------------|--------------------|-------------------|
| 1. potential energy | 2. Electrical energy | 3. nuclear energy | 4. Kinetic energy |
| 5. thermal energy | 6. Radiant energy | 7. chemical energy | 8. Forms or kinds |
| 9. sound energy | 10. Mechanical energy | | |

Page 3 Energy Transfers

- | | | | |
|-------------|----------------|----------------|-------------|
| 1. sound | 2. Thermal | 3. Electrical | 4. Nuclear |
| 5. chemical | 6. Mechanical | 7. Radiant | 8. Chemical |
| 9. thermal | 10. Mechanical | 11. Electrical | |

Page 4 From One Form to Another

- | | | |
|-----------------------------|-----------------------------|--------------------------|
| 1. radiant to chemical | 2. Radiant to thermal | 3. electrical to radiant |
| 4. mechanical to electrical | 5. Chemical to thermal | 6. Electrical to sound |
| 7. thermal to mechanical | 8. Electrical to mechanical | |

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Unit 2.16 handout 2

Heat, Energy, and Bicycling in New York City



New York City is one of the densest cities in the world, with millions of people squeezed into a mere 303 square miles. Although it has the world's largest subway system, traffic can still be quite bad, particularly at rush hour. The city decided that it would be a good idea to encourage more people to use bicycles. If more people rode bicycles, the roads would be less clogged with cars. Also, when you ride a bicycle, you are exercising, which makes you healthy. But how can you encourage people to ride more bikes?

The city came up with an innovative solution. In 2013, city workers began installing long racks of bicycles in different neighborhoods. These bicycles were, for a small fee, available for anyone to use. A person could ride the bicycle from one bike rack to another bike rack and park it there. This system was ideal for people who did not own bikes or who wanted to take a bicycle on a short ride without having to return it to the place they took it from. This also made it possible to move quickly between areas that did not connect easily by the subway. The city hoped that people would start using these bicycles instead of taxis or other kinds of cars.

While the city installed the bikes in part because of concerns about traffic, it was also interested in another question: how we use and spend energy. Any time an object is in motion, it is both producing energy and, in many cases, expending energy. For example a car does not just move because we want it to move. It is powered by a special kind of engine, called an internal combustion engine that burns fuel. When this fuel is burned, it causes a cylinder to spin in circles. This cylinder is connected to the wheels of the car. As the cylinder spins, so do the wheels. So, one type of energy – fuel - is transformed into another type of energy – forward motion. Energy contained in the motion of an object is called "motion energy."

Just as cars can be considered a kind of energy conversion device, converting fuel to forward motion, so can bicycles. When you step on the pedals of a bicycle, it causes the wheels of the bicycle to spin, pushing the bicycle forward. Nearly all transportation – airplanes, trains, pogo sticks – can be thought of as devices that take one form of energy and make it into another form of energy.

When there is a change in one of the forms of energy used to power modes of transportation, then the energy generated by these devices changes as well. Let's say you're pedaling very fast on a bicycle. You are exerting a lot of energy as you do this. You can tell because your heart rate may increase, you may breathe harder, and you may begin to sweat – a sign that your body is trying to cool itself. This is producing a lot of motion energy in the bicycle because you are causing it to move very fast. But if you stop pedaling, then the bicycle will begin to slow down, and the motion energy in the bicycle will decrease. You will also be expending less energy. Your heart rate and your

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breathing will slow down, too. The decline in your own motion energy – the movement of your feet – is causing the motion energy of another object – the bicycle – to fall at about the same rate.

In the early days of the program, the bike racks were only moderately popular. People were still getting used to the idea of borrowing a bike for a short time at one location, riding it, and then leaving it in another location. Perhaps another reason that people were initially reluctant to use the bike racks is that they were introduced during a very hot week, at the beginning of summer. As discussed above, when you ride a bicycle, you often sweat. This is particularly true when the temperature is high, because your body produces sweat as a way of trying to keep your body cool. If your body gets too hot, you can get sick, so it's in your body's interest to maintain a constant temperature.

How much the temperature of a body increases when it gets warm depends on a number of different factors. While it makes sense that one person in 100-degree heat will get hotter than a person in 75-degree heat, even if two people are exposed to the same temperature, their bodies may react differently. In fact, one person may get much hotter than the other. This is because the amount of heat – which is a form of energy – needed to change the temperature of another object depends on the properties of that object. For example, a person who is wearing a sweatshirt in summer is likely to get much hotter than a person who is wearing a t-shirt. This is because the sweatshirt insulates the person, trapping heat inside. The t-shirt, which is more open, lets the heat escape. So, even if the amount of heat energy directed at the person is the same, the temperatures of different people will react differently.

That raises another question: why does sweat make people colder? This has to do with a special property of heat. Heat is a kind of energy, and energy moves spontaneously from hotter regions or object to colder ones. So, consider what happens when your body releases sweat. When it is released, sweat is colder than your body's temperature. When it is on the surface of your skin, it draws the heat from your skin into the water, because heat migrates from warm areas to cold ones. This causes the sweat to warm up. Then the sweat rises into the air and takes some of your body heat with it, cooling the body down.

Your body is constantly monitoring its own temperature. Many of the buildings in New York City have air conditioning in the summer. When you walk from the hot street outside to the cool lobby of a tall office building, you can feel the change immediately. After a while, your body temperature will go down. This is because, just as the heat from your body moves to the sweat on your skin, it will also move to the cool air produced by the air conditioning. When your body gets cool enough, it will no longer need to produce sweat to cool you down.

As people continue to ride bicycles, you can expect their collective body temperatures to rise, as their bodies produce energy to power the bicycles and they spend more time outdoors in the

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hot sun. If the city chooses to install more bikes, then it may also want to install more air conditioning – or pass out more sticks of deodorant.

Comprehension Exercises:

1. **What do cars, bicycles, and many other types of transportation do when they are in motion?**
 - A. They take one form of energy and convert it into another form of energy.
 - B. They clog the streets of New York City and create lots of traffic.
 - C. They cause people to sweat because of the energy it takes to use such transportation.
 - D. They make people spend more time outside and increase their body temperatures.
2. **What does the author describe in the passage?**
 - A. The author describes different types of t-shirts.
 - B. The author describes reasons for moving to New York City.
 - C. The author describes two different types of energy.
 - D. The author describes the dangers of riding in taxis.
3. **A person on a bicycle is breathing hard, sweating, and pedaling fast. Based on this evidence, the person is probably**
 - A. moving very slowly
 - B. exerting a lot of energy
 - C. exerting a little energy
 - D. exerting no energy
4. **When you step from a hot street into an air-conditioned room, you feel cooler. Why does this change occur?**
 - A. heat is moving from a cold area (the room) to a hotter area (the street)
 - B. heat leaves your body as it moves from a warm area (your body) to a colder area (the air in the room)
 - C. the motion energy used to walk into the room lowers your body temperature
 - D. the motion energy used to walk into the room raises your body temperature

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5. **What is this passage mainly about?**

- A. forward motion and backward motion
- B. cars and air conditioning
- C. 100-degree heat, t-shirts, and sweatshirts
- D. motion energy and heat energy

6. **Read the following sentences** "... a person who is wearing a sweatshirt in summer is likely to get much hotter than a person who is wearing a t-shirt. This is because the sweatshirt **insulates** the person, trapping heat inside." What does the word **insulates** mean in the sentence above?

- A. protects the person by keeping the person cool
- B. protects the person by preventing the loss of heat
- C. traps the person
- D. makes the person uncomfortable

7. According to the passage, how does the human body get rid of heat energy to keep itself cool when the temperature is high?

8. According to the passage, where does the energy that propels a bicycle forward come from?

9. Why can a bicycle be considered a device that can convert energy?

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Unit 2.16 Handout 2

TEACHER ANSWER KEY

1. **What do cars, bicycles, and many other types of transportation do when they are in motion?**
A. They take one form of energy and convert it into another form of energy.
2. **What does the author describe in the passage?**
C. The author describes two different types of energy.
3. **A person on a bicycle is breathing hard, sweating, and pedaling fast. Based on this evidence, the person is probably**
B. exerting a lot of energy
4. **When you step from a hot street into an air-conditioned room, you feel cooler. Why does this change occur?**
B. heat leaves your body as it moves from a warm area (your body) to a colder area (the air in the room)
5. **What is this passage mainly about?**
D. motion energy and heat energy
6. **Read the following sentences** "... a person who is wearing a sweatshirt in summer is likely to get much hotter than a person who is wearing a t-shirt. This is because the sweatshirt **insulates** the person, trapping heat inside." What does the word **insulates** mean in the sentence above?
B. protects the person by preventing the loss of heat
7. According to the passage, how does the human body get rid of heat energy to keep itself cool when the temperature is high?
Answers may vary, suggested answer: The human sweats to keep itself cool when the temperature is high.
8. According to the passage, where does the energy that propels a bicycle forward come from?
Answers may vary, suggested answer: The energy that propels a bicycle forward comes from the energy of a person pressing down on the pedals.
9. Why can a bicycle be considered a device that can convert energy?
Answers may vary, suggested answer: A bicycle can be considered an energy conversion device because a bicycle takes one form of energy and turns it into another. What starts as the energy of a person's feet pressing the pedals of the bicycle is converted into the energy that propels the bicycle forward.

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Unit 2.16 Handout 3

Name _____ Date _____

Alternative Energy Sources

Alternative energy refers to energy sources that are not based on the burning of fossil fuels or the splitting of atoms. Fossil fuels are nonrenewable and create pollution when burned. Nuclear energy produces harmful radioactive waste products. Alternative sources can provide clean renewable energy for use in homes and communities. Match each term in the word box to its description.

cells	windmill	hydroelectric	geothermal
tidal	solar energy	efficient	sun
wind technology	wind	hotspots	

- _____ The most renewable energy resource, it provides Earth with 35,000 times more energy than human activity uses altogether.
- _____ The apparatus used to capture wind power and turn it into electrical energy.
- _____ An indirect source of solar energy, it is caused by the heating and cooling of Earth's surface.
- _____ This energy is obtained from Earth's internal heat and can be used to generate steam to run a steam turbine.
- _____ This is an area of reduced thickness in Earth's mantle that allows heat from the interior to reach the outer crust. Volcanoes, vents, and geysers are examples.
- _____ One of our earliest energy resources, this technology is dependent upon weather and location.
- _____ This is the origin for radiant energy and most other types of energy in our solar system.
- _____ This form of energy is generated by the effect of gravity between Earth and the moon.
- _____ This energy source comes from rivers by utilizing the potential energy stored in the moving water.
- _____ These are units that convert sunlight directly into electricity.
- _____ This describes resources that produce energy effectively with a minimum of waste, expense, or unnecessary effort.

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Unit 2.16 Handout 3

ANSWER KEY

- | | |
|------------------|--------------------|
| 1. solar energy | 2. Windmill |
| 3. wind | 4. Geothermal |
| 5. hotspots | 6. Wind technology |
| 7. sun | 8. Tidal |
| 9. hydroelectric | 10. Cells |
| 11. efficient | |