SCIENCE

Lesson 2.12: Physical Science – Energy and Work

Weekly Focus: Reading for Comprehension
Weekly Skill: Basic Math to Calculate Work

Lesson Summary: This week students will continue reading for comprehension and review energy and its various forms. Students will then work on basic math skills for calculating "work."

Materials Needed:

- Reading for Comprehension: **Unit 2.12 Handout 1**
- Calculating Work: **Unit 2.12 Handout 2**
- Extra Work/Homework: **Unit 2.12 Handout 3**

Objectives: Students will be able to…

- Gain an understanding of energy and its various forms in physical science
- Apply basic math skills to calculate work

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 4**). 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.

Lesson 2.12: Physical Science – Energy and Work

Activities:

Warm-Up: Energy Forms	**Time: 5 - 10 minutes**
Today's lesson involves an introduction to various forms of energy in physical science. Write on the board, *"What are different forms of energy that you know of and use on a daily basis?"* Ask students to write in their notebook or journal. They can discuss the topic at their table groups or with classmates. Circulate the classroom to get students thinking about forms of energy they use. If students have a hard time getting started, ask them what form of energy they used to get to class (i.e.: gas/oil for bus or driving, food energy for walking or biking).	

Activity 1: Comprehension Reading (Unit 2.12 Handout 1)	**Time: 40 - 45 minutes**
1) Distribute **Unit 2.12 Handout 1** to students. **2)** Explain to students that the purpose of the reading passage is to introduce them to key vocabulary and concepts surrounding energy. **3)** Ask students to review the title and count the number of paragraphs in the reading passage. Ask students how they know where a paragraph begins. Explain that it is important to know how to find a paragraph quickly as some test questions may ask students to refer to a certain paragraph. If you have an overhead, point to it and/or label the indents. **4)** Explain to students they should read all of the paragraphs silently in order to answer the questions that follow. To help students find the main idea of the reading passage, remind them to think *"What are all of the paragraphs about?"* and *"What is the point that the author is trying to make?"* while reading. **5)** 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; while reading remember to ask "What is this all about?" **6)** Review answers as a whole class. Ask students to point out the evidence (proof) from the reading that led them to the answer. **7)** If there is extra time, have students read passage in pairs to promote reading fluency. If there is extra time or to challenge students, they can write a 3 – 5 sentence summary of all of the material presented. Use Routine 4 Summarizing Techniques Handout.	

Break: 10 minutes

Activity 2: Calculating Work (Unit 2.12 Handout 2)	**Time: 40 – 50 minutes**
1) Distribute the handout **(Unit 2.12 Handout 2)** to students. **2)** Explain to students that the purpose of this activity is for them to learn the basic mathematical formula for calculating "work" done, or the energy exerted in moving an object. The work formula is one of the basic formulas students may encounter on 2014 GED Science Module. **3)** Remind students that there is a fair amount of math required for the 2014 GED Science Module; however, today's lesson is working with a formula they should remember and it uses multiplication and/or division. On the 2014 GED Science test students may or may not have access to the 2014 GED calculator, so it's good practice to do the equations long hand and without the use of a calculator.	

4) As a class, read the first page to make sure students understand the concepts of Si: System International, Newtons, Joules, Work, Force, and Distance. **5)** Guide students in looking at the first problem which is completed. Work as a group to complete one or two more problems. **6)** Then, have students work independently. They can check with your answer key for the correct answer when finished, or check with a classmate. Circulate the class while students are working on the problems. **7)** Review answers as a whole class. Ask for volunteers to read or write their own word problems on the board/overhead for the class to work on. You can also use the problems for the next week's warm-up activity.

Wrap-Up: Summarize	**Time: 5 minutes**
Have students turn to a partner (or write in their journals) about what they have learned today about calculating work. They may want to discuss some of the areas that they would like to do further study on in the future. Their summary may include any wonderings they have about the subject. Ask them to tell a partner how to calculate work in one or two sentences. *Note: Use Routine 4 Handout*	

Extra Work/Homework: Unit 2.12 Handout 3	**Time: 15 minutes outside of class**
Students can read and answer questions from the **Unit 2.12 handout 3** (2 pages total). It is a way to incorporate and expand upon the information gained in today's lesson on energy.	

Differentiated Instruction/ELL Accommodation Suggestions	**Activity**
If some student groups finish early, they can turn their paper over and summarize the passage on energy.	**Activity 1 Handout 1**
There may be a lot of new vocabulary and ideas for some students, be prepared to assist by circulating while they are reading.	**Activity 1 & 2**

Online Resources:

Online Quiz of Physical Science: Energy

If students are able to have access to the Internet, there are some online quizzes for them to check on their knowledge of energy. The online components may help with digital literacy skills needed for GED 2014. http://www.proprofs.com/quiz-school/story.php?title=physical-science-energy-unit-quiz

Online PowerPoint about Energy

http://ippex.pppl.gov/interactive/Energy_modFP_final_4.swf

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Online practice in solving work problems:

http://www2.franciscan.edu/academic/mathsci/mathscienceintegation/MathScienceIntegation-1011.htm

Online definitions and mathematics of work:

http://www.physicsclassroom.com/class/energy/Lesson-1/Definition-and-Mathematics-of-Work

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

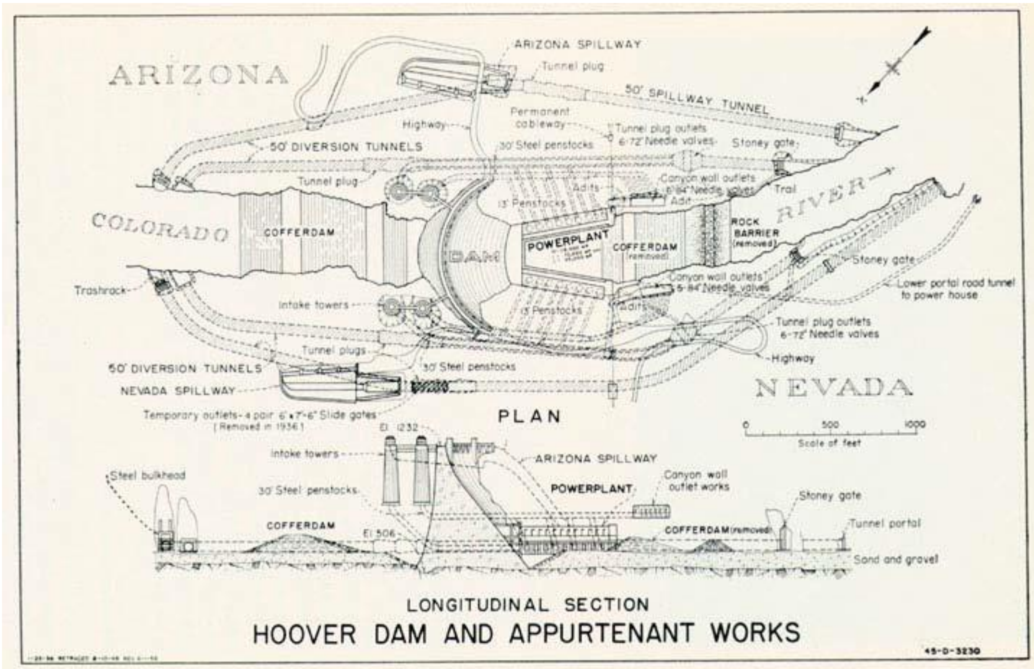
- ATLAS: ABE Teaching & Learning Advancement System: 2014 GED ® Classroom: Science: Minnesota's state-wide website for resources for the science module

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

Unit 2.12 Handout 1 (5 pages total)

Everyday Energy

Edward I. Maxwell



The pitcher gets into her set. Her glove and pitching hand come together by her chin, and she then lowers them to her belt. She looks at the catcher and nods. She brings her front leg up and pauses, standing perfectly balanced on her back leg. Then, in an instant, she steps forward with her front leg. Her whole body lurches toward home plate and her pitching arm swings out after it like a whip. At the furthest point, when a whip would crack, she lets the ball fly toward the catcher's mitt. The batter steps forward with her front leg and rotates her torso, swinging the bat with her eyes fixed on the incoming fastball.

"STRIKE THREE! BATTER'S OUT!"

Moments like these happen all across the physical world, whether on the molecular or cosmic level. Potential energy is the energy, chemical or physical, stored within an object, atom or molecule. Think about a car at the top of a roller-coaster, pausing just before it plunges into the next turn. A log resting in a fireplace just before it is about to be lit, is a treasure trove of potential energy. As the log burns, the connections between carbon atoms that make up the wood are being broken down, and the potential energy stored within those connections is being released as heat and light. As a comet approaches a planet or star, it slows, momentarily affected by the larger body's gravity. The potential energy builds and then reaches a breaking point, as the comet accelerates around the larger body and is slingshotted out the other side.

Sports showcase countless examples every day of potential energy being converted into kinetic energy. Kinetic energy is the energy of movement. When an archer draws and holds her arrow, her bow is brimming with stored potential energy. When she releases the bowstring, all the potential energy is quickly converted into kinetic energy, which is transferred to the arrow that takes flight. The transfer of kinetic energy from the bow to the arrow is not a perfectly efficient process. What this means is that some of the energy does not make it to the arrow. Instead, the energy might be absorbed by the archer's arm, causing it to jerk to the side when the bow twangs. The most important thing to remember is that although the transfer of energy between objects may be inefficient, the energy still exists. It has simply been transferred along a different pathway. Therefore, the total sum of energy is still conserved.

The conversion of stored potential energy into kinetic energy can also be harnessed to power homes, factories and entire cities. The most notable example is the Hoover Dam. The Hoover Dam is an arch-gravity dam by design. This design name is the first clue as to how exactly the dam harnesses energy. Located in the Black Canyon of the Colorado River, the Hoover Dam formed, and now holds back, Lake Mead—the largest reservoir in the United States. The dam was built toward the beginning of the Great Depression. Constructed between 1931 and 1936, the dam had been the subject of planning and design sessions since 1900. Deliberations included discussions of potential catastrophes, should the dam fail or the lake grow beyond expectations.

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Gravity acts as a force upon Lake Mead. Held at bay by the Hoover Dam, the waters of Lake Mead and the Colorado River gain greater potential energy with each passing moment. The Arizona and Nevada spillways are two means by which the waters of Lake Mead can escape the dam. As the lake water tumbles over the walls into a spillway, potential energy is instantly converted into kinetic energy. The channels through which the water normally escapes every day are the four intake towers. These towers funnel the water through sluices, or passageways, to the powerhouse and hydroelectric generators. When the water reaches the intake towers and is allowed to flow down through the sluices, all the stored potential energy created by the force of gravity acting upon the water is converted into kinetic energy, just as when water flows over the wall into a spillway.

By harnessing the converted potential energy of Lake Mead, the Hoover Dam provides power to California, Nevada and Arizona. Well over a dozen turbines are housed within the power plant at the base of the dam. Electricity production varies annually depending on how much water is required downriver from the dam and the water levels of Lake Mead. The greatest amount of energy was produced during 1984; a year after floods brought the lake to its highest levels. As of 2009 the American Southwest has entered a prolonged period of seasonal droughts. As a result, compared to its peak periods of energy production, the Hoover Dam has been recently generating much less energy.

Choose the best and answer from the list provide for each statement or question.

1. A rollercoaster car at the top of the hill, an archer preparing to release an arrow, and a lake that sits above a dam are all examples of what kind of energy?

A. potential energy **B.** kinetic energy
C. gravitational energy **D.** consumption of energy

2. What does the author describe in the passage?

A. the history of human energy use in the United States
B. the ways in which potential energy is converted to kinetic energy
C. the best reasons to build new dams in the American Southwest
D. the consequences of drought for people who rely on dams

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3. The conversion of stored potential energy into kinetic energy can also be harnessed to power homes, factories and entire cities. Which example from the text supports this conclusion?

A. the softball pitcher
B. the slingshotting comet
C. the archer
D. the Hoover Dam

4. Which of the following conclusions is supported by the text?

A. Nuclear power is the most efficient kind of energy for powering cities.
B. Professional athletes should study the science of energy to play better.
C. Dams power cities by converting stored potential energy into kinetic energy.
D. Drought is a serious problem for farmers in the American Southwest.

5. What is this passage mainly about?

A. The movement of comets through our solar system.
B. The scientific forces behind our favorite roller-coasters.
C. The unusual properties of water molecules in rivers.
D. The conversion of potential energy into kinetic energy.

6. Read the following sentences: *"The Arizona and Nevada spillways are two means by which the waters of Lake Mead can escape the dam. As the lake water tumbles over the walls into a spillway, potential energy is instantly converted into kinetic energy."*
As used in the passage, what does the word "spillway" mean?

A. A place where water flows over the top of a dam, creating energy.
B. A place where water accidentally spills, causing problems for engineers.
C. A place where water flows underground, into tunnels.
D. A place where water flows into nearby farms, watering crops.

7. Choose the answer that best completes the sentence below.

"The conversion of stored potential energy into kinetic energy can be harnessed to power homes, factories and entire cities. __________, the Hoover Dam provides power to California, Nevada and Arizona.

A. Even though
B. Initially
C. For instance
D. However

8. How does the Hoover Dam provide power to California, Nevada and Arizona?

9. What two factors determine the energy production of the Hoover Dam?

10. Explain why the prolonged period of drought (a time where there is little rain, and little water flowing into rivers and lakes) would cause the Hoover Dam to generate much less energy since 2009. Use evidence from the text to support your answer.

Unit 2.12 Handout 1 –

Everyday Energy
TEACHER ANSWER KEY

1. A
2. B
3. D
4. C
5. D
6. A
7. C
8. **Answers may vary, suggested answer:**

The Hoover Dam provides power to California, Nevada, and Arizona by harnessing the converted potential energy of Lake Mead.

9. **Answers may vary, suggested answer:**

How much water is required downriver from the dam and the water levels of Lake Mead determine the energy production of the Hoover Dam.

10. **Answers may vary, suggested answer:**

If there is a drought, then Lake Mead will have less water. If Lake Mead has less water, then there will be less potential energy stored in Lake Mead. If there is less potential energy, then there will be less kinetic energy created by water flowing through the Hoover Dam.

(There will be less water to tumble over the walls into the spillway and move through four intake towers into the powerhouse and hydroelectric generators.)

Unit 2.12 Handout 2 (3 pages total)

Think about answers to the following questions while reading:

When is work done on an object? How do you calculate the work done on an object?

Calculating Work

In science, you do **work** on an object when you exert a force on the object that causes the object to move some distance. In order to do work on an object, the object must move some distance as a result of your force. If the object does not move, no work is done no matter how much force is exerted.

In order to do work on an object, the force you exert must be in the same direction as the object's motion. When you carry an object so that it doesn't fall to the ground, the motion of the object is in the horizontal direction. Since the force is vertical and the motion is horizontal you don't do any work on the object as you carry it.

The amount of work you do depends on both the amount of force you exert and the distance the object moves. The amount of work done on an object can be determined by multiplying force times distance. The equation used for work is:

Work = **F**orce **x** **D**istance (w = F x d)

When force is measured in Newtons and distance is measured in meters, the System International (SI) way to measure work unit of work is with the following formula:

Newton x **m**eter = **j**oule (N x m = j).

This unit is also called a **joule**. One joule (J) is the amount of work you do when you exert a force of 1 newton to move an object a distance of 1 meter.

Write a definition for each of the following terms:

Work: ____

____

Joule: ____

____

Calculating work:

As stated earlier, work has a special meaning in science. It is the product of the force applied to an object and the distance the object moves. The unit of work is the called the joule (J). Here is the formula for calculating the amount of work done. This is a formula you may need to use on the GED 2014 science module.

Work = Force x Distance

W = F x d

Force = Newtons

Distance = meters

Solve the following problems with the formula for work. The first one is done for you.

1) Aimee uses 20N of force to push a lawn mower 10 meters. How much work does she do?

Work = Force X Distance

Work = 20N X 10m

Work = 200 J

2) How much work does an elephant do while moving a circus wagon 20 meters with a pulling force of 200N?

Work = Force X Distance **Work = 200N X 20m** **Work = 4000 J**

3) A 900N mountain climber scales a 100m cliff. How much work is done by the mountain climber?

Work = Force X Distance **Work = 900N X 100m** **Work = 90,000 J**

4) Shawn uses 45N of force to stop the cart 1 meter from running his foot over. How much work does he do?

Work = Force X Distance **Work = 45N X 1m** **Work = 45 J**

5) How much work is done when a force of 33N pulls a wagon 13 meters?

Work = Force X Distance **Work = 33N X 13m** **Work = 429 J**

6) How much work is required to pull a sled 5 meters if you use 60N of force?

Work = Force X Distance **Work = 60N X 5m** **Work = 300 J**

7) Derrick does 15 Joules of work to push the pencil over 1 meter. How much force did he use? (hint: solve the problem with division)

Force = Work / Distance **Force = 15 J / 1 m** **Force = 15 N**

8) Angela uses a force of 25 Newtons to lift her grocery bag while doing 50 Joules of work. How far did she lift the grocery bags?

Distance = Work / Force **Distance = 50 J / 25 N** **Distance = 2 m**

9) The baseball player does 1234 Joules of work when hitting a baseball into left field. Assuming the baseball landed 100 meters away from home plate, how much force did the player use to hit the ball?

Force = Work / Distance **Force = 1234 J / 100 m** **Force = 12.34 N**

10) Write your own word problem for your classmates to work on.

____

____

____

11) Write your own word problem for your classmates to work on.

____

____

____

12) Write your own word problem for your classmates to work on.

____

____

____

Unit 2.12 Handout 2

Calculating work:
TEACHER ANSWER KEY

1) Aimee uses 20N of force to push a lawn mower 10 meters. How much work does she do?

Work = Force X Distance ***Work = 20N X 10m*** ***Work = 200 J***

2) How much work does an elephant do while moving a circus wagon 20 meters with a pulling force of 200N?

Work = Force X Distance **Work = 200N X 20m** **Work = 4000 J**

3) A 900N mountain climber scales a 100m cliff. How much work is done by the mountain climber?

Work = Force X Distance **Work = 900N X 100m** **Work = 90,000**

4) Shawn uses 45N of force to stop the cart 1 meter from running his foot over. How much work does he do?

Work = Force X Distance **Work = 45N X 1m** **Work = 45 J**

5) How much work is done when a force of 33N pulls a wagon 13 meters?

Work = Force X Distance **Work = 33N X 13m** **Work = 429 J**

6) How much work is required to pull a sled 5 meters if you use 60N of force?

Work = Force X Distance **Work = 60N X 5m** **Work = 300 J**

7) Derrick does 15 Joules of work to push the pencil over 1 meter. How much force did he use? (hint: solve the problem with division)

Force = Work / Distance **Force = 15 J / 1 m** **Force = 15**

8) Angela uses a force of 25 Newtons to lift her grocery bag while doing 50 Joules of work. How far did she lift the grocery bags?

Distance = Work / Force **Distance = 50 J / 25 N** **Distance = 2 m**

9) The baseball player does 1234 Joules of work when hitting a baseball into left field. Assuming the baseball landed 100 meters away from home plate, how much force did the player use to hit the ball?

Force = Work / Distance **Force = 1234 J / 100 m** **Force = 12.34 N**

10) 11) 12) **Have students share their word problems for classmates to answer.**

Unit 2.12 Handout 3 (2 pages total)

Name ______________________________

Daily Science
Big Idea 6
WEEK 2

Day 3

Weekly Question

What makes popcorn pop?

Any change in matter requires energy. The energy that causes popcorn to change from kernels to fluffy white puffs is thermal energy. Thermal energy is the energy produced by the movement and attractions of the molecules within a substance. When it is cooked, popcorn's thermal energy increases. We sense this change in thermal energy as heat.

Although we experience thermal energy as heat, the two are distinctly different. **Heat** is the *transfer* of thermal energy. When an object feels warm to the touch, it is because the object contains more thermal energy than your fingertips do. When heat flows from the object to your fingers, you feel this gain of thermal energy as warmth. When an object feels cold, it is because the object contains less thermal energy than your fingertips. As heat flows from your fingers to the object, you feel this loss of thermal energy as coldness.

Vocabulary

heat
heet
the transfer of thermal energy

A. Answer the questions.

1. When you touch a warm object, do your fingertips gain or lose thermal energy? ______________

2. If you touch a cold object, in which direction does heat flow—from the object to your fingers, or from your fingers to the object?

____

B. Identify each clue as either *heat* or *thermal energy*.

1. the internal energy of a popcorn kernel ______________

2. the flow of energy from hot oil to a popcorn kernel ______________

C. Explain the difference between heat and thermal energy.

____

____

Name ______________________________

Daily Science
Big Idea 6
WEEK 2

Day 4

Weekly Question

What makes popcorn pop?

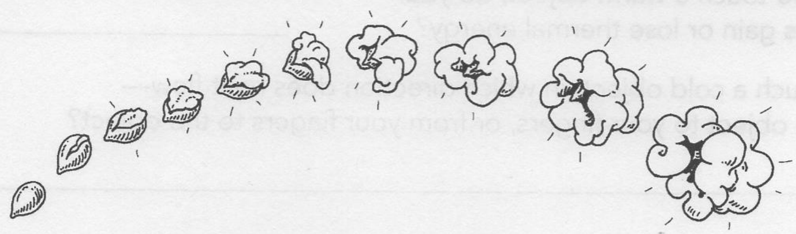
In order for popcorn to pop, energy must be applied to the kernels. This energy may take the form of thermal energy, such as when popcorn is popped on the stove or in an air-popper. Or it may take the form of *radiant energy*, which is energy emitted as electromagnetic waves or particles. This is how popcorn is popped in a **microwave** oven.

When an outside source of energy is applied to a kernel of popcorn, thermal energy in the kernel increases as the molecules of water in the starch vibrate. The temperature of the kernel increases and the water molecules move faster and farther apart, until the water turns to steam. But because the hull is waterproof, the steam can't escape, and the pressure builds. The starch **liquefies**, increasing the pressure even further. Ultimately, the pressure becomes so intense that the hull gives way. The starch and steam come bursting out of the kernel, turning it inside out. As this happens, the jelly-like starch expands into bubbles that freeze upon contact with the air, forming the characteristic spongy white blobs we all know and love.

Vocabulary

liquefy
LIH-kwih-fy
to turn into a liquid

microwave
MY-kroh-wayv
a short vibration of electric and magnetic fields that can move through space



Number the events below in the correct order to explain how popcorn pops.

____ The kernel explodes.

____ Energy is applied to the popcorn kernel.

____ Pressure builds within the kernel.

____ The bubbling starch freezes.

____ Thermal energy within the kernel increases.

Unit 2.12 Handout 3   ANSWER KEY

Page 1

A. 1. gain thermal energy

2. from fingers to the object

B. 1. Thermal energy

2. heat

C. Thermal energy is the internal energy of a substance. Heat is the transfer of thermal energy from a warmer object to a colder one.

Page 2

In order:

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1

3

5

2