

## Sixth Grade “Energy, Heat, and Energy Transfer” Assessment

- 1a. Which of the following is not one of the six forms of energy? Circle the answer.
- electrical      chemical      petroleum      wave (light, sound)      mechanical      nuclear
- 1b. Name three of the six forms of energy:
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- 1c. Identify the six forms of energy:
1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
  4. \_\_\_\_\_
  5. \_\_\_\_\_
  6. \_\_\_\_\_
- 2a. The Law of Conservation of Energy states that energy cannot be created or destroyed, it can only change forms. What is an example of such a change?
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- 2b. The Law of Transformation of Energy states that:
- a. A rocket must produce greater energy than Earth’s gravity to escape its atmosphere.
  - b. Energy cannot be created or destroyed, it can only change forms.
  - c. A body at rest will stay at rest unless acted upon by an outside force.
  - d. Energy equals mass times the speed of light squared.
- 2c. State the Law of Conservation of Energy:
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- 3a. There are many sources of energy, including using heat from the Earth, burning fossil fuels, and wind power. Why are some sources better to use in some places than in others?
- a. Some people need less energy than others
  - b. Not every source is always available or affordable
  - c. All sources are good no matter where you are
- 3b. Match the following geographic locations to their most logical source of energy:
- |  |                  |
|--|------------------|
| a. Iceland (volcanic activity, geysers, hot springs) | 1. coal          |
| b. Wyoming (open plains, gusty weather)              | 2. geothermal    |
| c. Along the Colorado River                          | 3. nuclear       |
| d. Phoenix (325 sunny days each year)                | 4. solar         |
| e. France (few natural resources, small area)        | 5. hydroelectric |
| f. Denver (many railroads, large area to supply)     | 6. wind          |

3c. What are some of the considerations in deciding what energy source is best for a certain area. (For instance, why choose coal over nuclear, or solar over hydroelectric because of where people live?)

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4a. Alternatives must be found for fossil fuels (oil, natural gas, coal) because:

- a. It will run out
- b. It can't be used everywhere
- c. Some people don't like it

4b. What does it mean to say that fossil fuels (oil, natural gas, coal) are a "finite resource?"

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4c. Explain why we may begin relying on alternative energies before all the fossil fuels are used up:

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5a. What is one of the negative environmental impacts of fossil fuels use?

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5b. Give two examples of negative environmental consequences of using fossil fuels for energy:

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

5c. Name one negative environmental problem associated with each type of fossil fuel:

- Coal \_\_\_\_\_
- Natural gas \_\_\_\_\_
- Oil \_\_\_\_\_

6a. Which of the following terms relating to nuclear energy does not belong? Circle your answer.

- fission      uranium      radioactive waste      global warming      nuclear reaction

- 6b. What part of the following description of nuclear energy production doesn't fit?  
*(1) In a nuclear power plant, uranium pellets are formed into rods. (2) Inside these fuel rods, the uranium atoms react by splitting two or three neutrons from one another in a process called fission, and producing heat. (3) The nuclear reaction is controlled using neutron-absorbing rods and water or graphite as a coolant, while the heat is used to make steam to turn huge turbines. (4) The process is completely clean and produces no waste.*
- \_\_\_\_\_
- 6c. What is the difference between a fusion reaction and a fission reaction and how could these be used to produce energy?
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- 7a. Where did the worst nuclear power accident in the world take place during an experiment in 1986?
- a. Three Mile Island, PA
  - b. Paris, France
  - c. Chernobyl, USSR
- 7b. The most significant nuclear power accidents occurred at Three Mile Island, PA., and at Chernobyl in the Ukraine. How many people were killed as a result of the American accident?
- a. 2
  - b. 20
  - c. 200
  - d. 0
- 7c. Results of the nuclear power accidents at Three Mile Island and Chernobyl were very different. What two characteristics make western nuclear plants safer than Soviet designs?
- a. more reliable coolant source and containment buildings around the reactor
  - b. government oversight and military control of the plants
  - c. better engineers and placing the plants away from population centers
  - d. smaller reactors and automatic controls
- 8a. Temperature is a measurement of the behavior of atoms. How are atoms behaving when a substance heats up?
- a. They are slowing down
  - b. They are moving and colliding more rapidly
  - c. They are escaping into the atmosphere

- 8b. What is the term used to measure how rapidly the atoms of a substance are moving and colliding?
- a. temperature
  - b. speed
  - c. torque
  - d. potential

- 8c. Name the term used to measure how rapidly the atoms of a substance are moving and colliding and give a description.

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- 9a. Which of the following is not a type of heat movement (thermodynamics)?

- a. convection
- b. conduction
- c. radiation
- d. conversion

- 9b. Identify the following descriptions as convection, conduction, or radiation

1. A result of the kinetic behavior of matter. Faster vibrating particles collide with less energetic ones and transfer some of their kinetic energy to the slower moving particle.  
\_\_\_\_\_
2. Involves the actual motion of a hot fluid from one place to another, displacing a colder fluid and making a current. This is the main way that heat is transferred in fluids.  
\_\_\_\_\_
3. The energy transmitted by electromagnetic waves. It does not need any material to transfer heat through.  
\_\_\_\_\_

- 9c. Identify the primary heat transfer mechanisms (convection, conduction, or radiation) for the following:

- a. From a heated pan to its handle \_\_\_\_\_
- b. Through the water heating in the pan \_\_\_\_\_
- c. Through empty space \_\_\_\_\_

- 10a. In which state of matter are molecules packed tightly together, forming matter that resists changes in shape and volume?

- a. solid
- b. liquid
- c. gas

- 10b. Match the following phases of matter with their molecular motion
- |            |   |
|------------|---|
| a. gases   | 1. molecules are relatively loosely packed, moving past one another |
| b. solids  | 2. molecules packed close together, vibrate in place                |
| c. liquids | 3. molecules loosely packed, moving independently, often colliding  |

10c. Describe the molecular motion of the following phases of matter:

gases \_\_\_\_\_

solids \_\_\_\_\_

liquids \_\_\_\_\_

11a. Place the phases of most matter (gas, liquid, solid) in order from coldest to warmest

\_\_\_\_\_

11b. How is the phase of most matter changed? Give one example.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

11c. Explain how a gas becomes the “fourth phase of matter” known as plasma. (hint: matter changes phase with the addition or subtraction of energy, usually heat.)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

12a. In a physical change, no new substances are produced, while in a chemical change, elements combine in new ways to produce a new substance. Is a change in phase a chemical or a physical change?

\_\_\_\_\_

12b. Why is a change in phase described as a physical and not a chemical change?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

12c. Distinguish between a physical and a chemical change

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- 13a. When energy is removed from a substance, its molecules slow down and need less room to move, so the substance \_\_\_\_\_. When heat is added to the substance, its molecules speed up and need more room, so the substance \_\_\_\_\_. Which words fill in the blanks in the above description?
- a. circulates, compresses
  - b. contracts, expands
  - c. accelerates, decelerates

- 13b. Choose the statement that describes why matter expands or contracts with temperature changes
- a. Adding heat energy to a substance makes its molecules move more quickly, needing more room, so the substance expands. Removing heat slows the molecules down, so they need less room, and the substance contracts.
  - b. Changes in temperature do not affect expansion or contraction, matter always remains in its original state.
  - c. Removing heat energy to a substance makes its molecules move more quickly, needing more room, so the substance expands. Adding heat slows the molecules down, so they need less room, and the substance contracts.
  - d. Expansion and contraction cause changes in the temperature of a substance

- 13c. Explain why matter expands or contracts with changes in temperature.

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- 14a. What substance is a special case, in that it expands when changing phase from a liquid to a solid?
- a. oxygen
  - b. water
  - c. mercury

- 14b. What substance is a special case, in that it expands when changing phase from a liquid to a solid?

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- 14c. Explain why water expands when it freezes.

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- 15a. Match the physical actions changing the phase of a sample of water with the state of the water after the change.

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|-----------------|-------------------|
| a. condensation | gas (water vapor) |
| b. evaporation  | liquid (water)    |
| c. freezing     | liquid (water)    |
| d. melting      | solid (ice)       |

- 15b. What description of the properties of phase changes in matter below is incorrect?
- Condensation is the process by which a gas or vapor changes to a liquid
  - Different amounts of energy are required to change the phase of different substances
  - Every substance has the same boiling point
  - The boiling point of water is 212°F or 0°C
- 15c. Fill in the blanks below to make each statement correct
- \_\_\_\_\_ is the process by which a gas or vapor changes to a liquid
  - Different amounts of \_\_\_\_\_ are required to change the phase of different substances
  - Every substance has its own melting and \_\_\_\_\_ point
  - The boiling point of water is 212°F or \_\_\_\_°C.
- 16a. To separate a mixture of different substances, the mixture can be heated gradually so that substances with different boiling points condense at different times and can be removed separately. This process is called:
- condensation
  - evaporation
  - distillation
- 16b. To separate a mixture of different substances, the mixture can be heated gradually so that substances with different boiling points condense at different times and can be removed separately. This process is called \_\_\_\_\_.
- 16c. Explain how a mixture of different liquids could be separated into its various ingredients. What is this process called?
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- 17a. Who was the 1911 Nobel Prize in Chemistry for the discovery of the elements radium and polonium, by the isolation of radium and the study of the nature and compounds of radium. She was also the first person to win two Nobel prizes.
- Marie Curie
  - Dr. Beverly Crusher
  - Carie Nation
- 17bc. Who was the 1911 Nobel Prize in Chemistry for the discovery of the elements radium and polonium, by the isolation of radium and the study of the nature and compounds of radium. She was also the first person to win two Nobel prizes.
- \_\_\_\_\_

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The following Colorado Model Content Standards are addressed in this assessment by the questions indicated:

Questions 15a, 15b, 15c: Standard 1h using metric units in measuring, calculating, and reporting results

Questions 10a, 10b, 10c, 11a, 11b, 11c, 12a, 12b, 12c, 13a, 13b, 13c, 14a, 14b, 14c, 15a, 15b, 15c: Standard 2.1a examining, describing, comparing, measuring, and classifying objects based on common physical and chemical properties

Questions 16a, 16b, 16c: Standard 2.1b separating mixtures of substances based on their properties

Questions 14a, 14b, 14c, 15a, 15b, 15c: Standard 2.2a measuring quantities associated with energy forms (*for example, temperature, mass, speed, distance, electrical charge, current, voltage*)

Questions 8a, 8b, 8c, 10a, 10b, 10c, 11a, 11b, 11c, 12a, 12b, 12c, 13a, 13b, 13c, 14a, 14b, 14c, 15a, 15b, 15c, 16a, 16b, 16c: Standard 2.3a identifying and classifying factors causing change within a system (*for example, force, light, heat*)

Questions 10a, 10b, 10c, 11a, 11b, 11c, 12a, 12b, 12c, 13a, 13b, 13c, 14a, 14b, 14c, 16a, 16b, 16c: Standard 2.3b identifying and predicting what will change and what will remain unchanged when matter experiences an external force or energy change (*for example, boiling a liquid; comparing the force, distance, and work involved in simple machines*)

Questions 12a, 12b, 12c, 13a, 13b, 13c, 14a, 14b, 14c: Standard 2.3d describing, measuring (*for example, temperature, mass, volume, melting point of a substance*) and calculating quantities before and after a chemical or physical change within a system (*for example, temperature change, mass change, specific heat*)

Questions 8a, 8b, 8c, 9a, 9b, 9c, 10a, 10b, 10c, 13a, 13b, 13c: Standard 2.3e describing, measuring (*for example, time, distance, mass, force*) and calculating quantities that characterize moving objects and their interactions within a system (*for example, force, velocity, acceleration, potential energy, kinetic energy*)

Questions 9a, 9b, 9c: Standard 4.2c explaining how atmospheric circulation is driven by solar heating (*for example, the transfer of energy by radiation, convection, conduction*)

Questions 14a, 14b, 14c, 15a, 15b, 15c: Standard 4.3a investigating and comparing the properties and behavior of water in its solid, liquid, and gaseous states

Questions 1a, 1b, 1c, 2a, 2b, 2c, 3a, 3b, 3c, 4a, 4b, 4c, 5a, 5b, 5c, 6a, 6b, 6c, 7a, 7b, 7c: Standard 5a investigating and describing the extent of human uses of renewable and non-renewable resources (*for example, forests, fossil fuels*)

Questions 3a, 3b, 3c, 6a, 6b, 6c, 7a, 7b, 7c: Standard 5b describing advantages and disadvantages that might accompany the introduction of a new technology

Questions 17a, 17b, 17c: Standard 6c

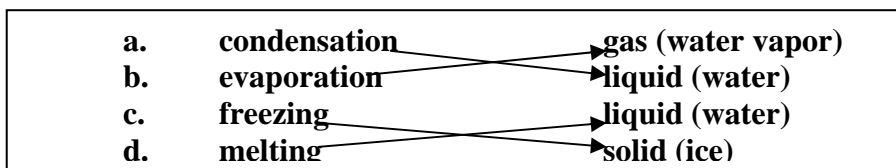
## Answer Key

- 1a. petroleum  
1b. electrical, chemical, heat, wave (light, sound), mechanical, nuclear  
1c. electrical, chemical, heat, wave, mechanical, nuclear
- 2a. Acceptable answers could include:  
-gasoline in an engine, food eaten by an athlete, water through a hydroelectric dam, an electric heater, etc.  
2b. b. Energy cannot be created or destroyed, it can only change forms.  
2c. Energy cannot be created or destroyed, it can only change forms.
- 3a. b. Not every source is always available or affordable  
3b. a2, b6, c5, d4, e3, f1  
3c. Acceptable answers could include:  
-availability of fuels, disposal issues, transportation of energy concerns, area to be supplied, nearness to water or geothermal sources, wealth of those supplied, etc.
- 4a. a. It will run out  
4b. Acceptable answers could include:  
-That there is only so much of it; it will eventually run out.  
4c. Acceptable answers could include:  
-Alternatives will become more efficient and cheaper; it will soon cost more to extract and process fuels than they are actually worth (not cost-effective)
- 5a. Answer(s) oil spills, pollution, acid rain, global warming  
5b. Answer(s) oil spills, pollution, acid rain, global warming (carbon dioxide production)  
5c. Coal: acid rain (burning coal produces sulfur dioxide), Natural Gas: pipeline/transportation accidents, Oil: oil spills and global warming.
- 6a. global warming  
6b. 4  
6c. Acceptable answers could include:  
-Nuclear fusion is the combining of light elements into heavier ones. Nuclear fission is the splitting of a heavy element into smaller, lighter elements. In both of these processes energy can be released.
- 7a. c. Chernobyl, USSR  
7b. d. 0  
7c. a. more reliable coolant source and containment buildings around the reactor
- 8a. b. They are moving and colliding more rapidly  
8b. a. temperature  
8c. temperature

- 9a. d. conversion
- 9b. 1 conduction, 2 convection, 3 radiation
- 9c. a - conduction, b - convection, c - radiation
- 10a. a. solid
- 10b. a3, b2, c1
- 10c. gases - molecules loosely packed, moving independently, often colliding  
solids - molecules packed close together, vibrate in place  
liquids - molecules are relatively loosely packed, moving past one another
- 11a. solid, liquid, gas
- 11b. Acceptable answers could include:  
-Phase changes are made by adding or removing energy, usually in the form of heat. Examples will vary, but might include boiling/freezing water, breath steaming on a cold day, molten metal or lava solidifying, etc.
- 11c. Answers will vary in completeness, but should include the general concept:  
-A gas becomes a plasma when the addition of heat or other energy causes its atoms to become ionized (to release some or all of their electrons.) The resulting electrically charged gas is said to be "ionized". When enough atoms are ionized to change the electrical properties of the gas, it is a plasma.
- 12a. Physical change
- 12b. Acceptable answers could include:  
-Because no new substance is produced
- 12c. Acceptable answers could include:  
-In a physical change, no new substances are produced, while in a chemical change, elements combine in new ways to produce a new substance.
- 13a. b. contracts, expands
- 13b. a. Adding heat energy to a substance makes its molecules move more quickly, needing more room, so the substance expands. Removing heat slows the molecules down, so they need less room, and the substance contracts.
- 13c. Acceptable answers could include:  
-Adding heat energy to a substance makes its molecules move more quickly, needing more room, so the substance expands. Removing heat slows the molecules down, so they need less room, and the substance contracts.
- 14a. b. water
- 14b. water
- 14c. Acceptable answers could include and should contain the following phrase:  
-Water expands when it freezes because of "hydrogen bonding." (Complete description might include: The hydrogen atom of an H<sub>2</sub>O molecule has a strong attraction to the unbonded electrons on other nearby H<sub>2</sub>O molecules. In ice, each oxygen atom is surrounded by 4 hydrogen atoms - 2 of its own and two from two neighboring water molecules. This forms a network structure with a lot of space between molecules. There

is more space between molecules in this network structure than there is in the liquid structure, so ice is less dense and takes up more space.)

15a.



15b. c. Every substance has the same boiling point

15c. a - Condensation, b - energy (heat), c - boiling, d - 0

16a. c. distillation

16b. distillation

16c. Acceptable answers could include:

-To separate a mixture of different substances, the mixture can be heated gradually so that substances with different boiling points condense at different times and can be removed separately. This process is called distillation.

17a. a. Marie Curie

17b. Marie Curie

17c. Marie Curie