

Answers to Unit 3 Review Questions

1. Sample graphic organizer:
Energy transformations: chemical potential energy to sound energy in fireworks, mechanical kinetic energy to electrical energy in a hydroelectric dam, radiant energy to thermal energy as an object absorbs sunlight, gravitational potential energy to mechanical kinetic energy as an object falls, light energy to electrical energy in a photovoltaic cell
Properties: cannot be created, cannot be destroyed, can be transferred, can be transformed
Uses: body functions, running machinery, moving vehicles, keeping us warm
Forms: kinetic: sound energy, thermal energy, radiant energy, potential: nuclear energy, elastic potential energy, electrical potential energy
2. Same: both are categories of energy, both obey the law of conservation of energy, both can cause change in a system

Different for kinetic energy: is the energy of motion, forms include sound energy, thermal energy, mechanical kinetic energy, electrical kinetic energy, radiant energy

Different for potential energy: is the stored energy an object has as a result of its position or condition, examples include chemical potential energy, gravitational potential energy, elastic potential energy, electrical potential energy, nuclear energy, magnetic potential energy

3. Sample answer:
Earth's temperature: conduction, convection, radiation, specific heat capacity (all affect temperature of Earth's atmosphere or hydrosphere)
Energy transformation: nuclear decay, nuclear fission, nuclear fusion, chain reaction (all involve transformation of nuclear energy)
Categories of energy: kinetic energy, potential energy (all forms of energy fall into these categories)
Properties of energy: system, surroundings, law of conservation of energy (relate to properties of energy such as energy can cause change in a system, energy cannot be created or destroyed)
4. Common answers include any three of chemical potential energy, radiant energy (light or solar energy), mechanical kinetic energy, gravitational potential energy, nuclear energy.
5. Answers can include any ways that you can observe energy indirectly, such as seeing an object when light energy interacts with matter, feeling heat or hearing sound from a chemical reaction, etc.
6. Students might identify any of the following. Examples of possible sources are given in brackets.
Kinetic energy: mechanical kinetic energy (motion of leaves in breeze), radiant energy (light from bridge), thermal energy (anything in the photo), sound energy (forest sounds), electrical kinetic energy (light on bridge)
Potential energy: chemical potential energy (cells in plants), elastic potential energy (stretched cables on bridge), gravitational potential energy (anything above a selected reference point such as the ground, including the bridge), magnetic potential energy (Earth's magnetic field)
7. Photosynthetic organisms can carry out the reverse reaction to cellular respiration by using light or solar energy to combine carbon dioxide and water to make glucose.
8. a) ATP is a molecule of adenosine triphosphate. It is used in nearly all reactions that require energy in living tissues.

BC Science Connections 10 Teaching Notes Unit 3 Assessment

b) Students might identify any two of cellular respiration, photosynthesis, or a body process such as muscle contraction, creation of new biological molecules, nervous signal conduction, and vision.

c) Answers should reflect that the role of ATP is to provide energy.

9. a) alpha decay or nuclear decay
b) an alpha particle or a helium nucleus

10. a) Some radioactive isotopes emit a beta particle (high-speed electron). In this process, a neutron in the nucleus decays into a proton and an electron. As a result, the atom now has one more proton and one fewer neutron, allowing the mass number (total number of protons and neutrons) to stay the same while the atomic number (number of protons) changes.

b) beta decay

11. a) nuclear fission

b) in a nuclear reactor

c) The products are radioactive isotopes or radioactive. Students may also answer that several neutrons are released in the products, atoms of different elements are produced, or the reaction releases a large amount of energy.

12. Nuclear reactions release much more energy than chemical reactions.

13. a) any two of carbon dioxide, water vapour, nitrous oxide, or methane

b) They warm the atmosphere so that life as we know it can survive on Earth.

c) If concentrations increase too much, they can warm the atmosphere too much, resulting in climatic change that can harm life.

14. a) Methane cracking is an emerging technology that can produce hydrogen from methane for use in fuel cells without releasing carbon dioxide.

b) Steam methane reforming is the process normally used to produce hydrogen for use in fuel cells. It releases about half the carbon dioxide of a gas-powered vehicle.

c) Steam methane reforming is more harmful to the environment because it releases carbon dioxide, a potent greenhouse gas that contributes to climate change. Climate change can harm different organisms in the environment that cannot adapt to resulting changes where they live.

15. Sample answer 1: Energy transformations have allowed us to light up the night with electric lighting, but these transformations have flooded areas in BC to build hydroelectric dams. This has flooded vast amounts of land, releasing methane that contributes to climate change as plants decay and displacing human populations, often First Peoples. If electrical energy is generated using coal, the gases produced also contribute to air pollution and climate change.

Sample answer 2: Radioactive isotopes created in nuclear reactors can be used to treat and diagnose medical conditions. However, the waste products generated by fission are also radioactive. Such radiation is harmful to all life. Fuel cells have provided the electrical energy we need to explore space. However, producing the hydrogen used in fuel cells produces carbon dioxide that contributes to climate change when it enters the atmosphere.

16. a) $E_g = mg\Delta h$

b) Graphs should show that as height from a reference point increases, so does gravitational potential energy. The graph should be linear. Height from a reference point (m) should be plotted on the x -axis and gravitational potential energy (J) should be plotted on the y -axis.

17. Sample sketch: Energy is shown to transform from electrical kinetic energy to thermal energy in an element of a stove. The thermal energy is transferred from the element to the pot and its contents.

18. Students should use an analogy a grade 7 student can relate to to help explain how cells in the retina transform light energy to enable vision. For example, they might choose a game of Pass the Secret or Telephone to use as an analogy. The rhodopsin in the rod and cone cells in the retina absorbs the light energy in the same way that first person in the game hears the message. Energy is then passed on to an electron, which becomes excited, causing one part of the rhodopsin to separate from the other. This causes a chain of

events, much like the game, that ultimately sends a signal to the brain that is interpreted as vision. Like the initial message is changed in the game, the initial energy, light energy, is transformed as vision occurs.

19. Diagrams or descriptions should reflect the following:

During evaporation, water absorbs solar energy. As its molecules begin to move faster, this energy is transformed into thermal energy. In time, evaporation occurs. Like evaporation, transpiration moves thermal energy into the atmosphere. As the water vapour rises in the atmosphere, it gains gravitational potential energy and transfers thermal energy to air molecules as they collide. As the water vapour cools and condensation occurs, forming clouds, more thermal energy is released to the atmosphere. The condensed water eventually falls as precipitation. As it falls, gravitational potential energy is transformed into mechanical kinetic energy, and into thermal energy through friction.

20. Sample answer 1: I think it is accurate to say the only truly isolated system is the universe itself because it is hard to fully isolate a system, so it does not exchange any energy with its surroundings. The universe has no surroundings, so cannot exchange energy with its surroundings.
Sample answer 2: I think it is inaccurate to say the only truly isolated system is the universe itself because we don't really know what lies beyond the universe.
21. Answers can be based on the description of batteries in the question, as well as retained prior knowledge from grade 9.

Similarities: Both batteries and fuel cells transform chemical energy into electrical energy through chemical reactions. Both are portable. Both generate an electric current. Both can be used to run loads, like a vehicle, which transforms electrical energy into other forms of energy.

Differences: Fuel cells do not store electrical potential energy like batteries do. Fuel cells carry out combustion of hydrogen while batteries carry out other chemical reactions. Fuel cells only provide water as a waste product if totally efficient, while batteries produce harmful wastes and must be recycled properly.

22. a) Students should explain that specific heat capacity is the amount of energy needed to change the temperature of 1 g of a substance by 1°C. To explain the concept to a student not taking the course, they could use an analogy that involves bringing about change using different amounts of energy. For example, it takes more energy to melt metal than ice or it takes more energy to crush a rock than a cracker.
b) Students might suggest that you could observe that coastal temperatures are milder than inland ones, it is cooler when you go in the lake or ocean than if you lie on the sand, or similar.
23. a) Students might identify the friend and the swing, or themselves, the friend, and the swing as the system. The surroundings will depend on the system that is identified and should include everything in the universe other than the system.
b) Students should recognize that energy is leaving the system that they identified in part b as the swing comes to a halt and is conserved. The energy is transformed into thermal energy and possibly sound energy due to friction and enters the surroundings.
24. A single slice of silicon could not be used to make a photovoltaic cell because two slices of silicon treated with different materials, which gives them different properties, are required for some electrons in one type of silicon to jump into the other. This creates the separation of charge that attracts the remaining electrons to one side and repels them from the other. Without this separation of charge the electrons would not move across the cell and generate a current once they absorb light energy.
25. Students should recognize that describing humanity as being made of “star stuff” refers to the fact that most of the elements in our bodies were produced during nuclear reactions in stars.
26. Answers should convey an understanding that in fission reactions involving uranium-235 in nuclear reactors a neutron splits a uranium-235 nucleus to produce radioactive isotopes and more neutrons. The additional neutrons can then split more uranium nuclei, resulting in many further reactions where neutrons

split even more uranium nuclei. When cadmium in the control rods absorbs neutrons, this reduces the number of neutrons available to split uranium nuclei, reducing the rate at which the fission reactions occur when the rods are lowered. When the rods are raised, more neutrons are available to split the uranium nuclei again, and the rate of fission increases again.

Copyright © 2018 by Nelson Education Ltd. 95

BC Science Connections 10 Teaching Notes Unit 3 Assessment

27. Sample answer: When Earth's surface absorbs light from the Sun, that radiant energy is transformed into thermal energy.
28. Solar energy maintains life on Earth by warming the surface and atmosphere, and by providing energy for photosynthesis. However, because energy is never destroyed, it is not used up in these processes. In both cases, solar energy is transformed into different forms of energy. In atmospheric and surface warming, the solar energy is transformed into thermal energy when it is absorbed by the surface and atmosphere, which results in temperatures that allow life to thrive. Ultimately, however, the matter radiates this energy as infrared radiation, which enters space. In the case of photosynthesis, solar energy is transformed into chemical energy in glucose, but when that energy is transformed into cellular respiration, some is also transformed into thermal energy. This is radiated from living things as infrared radiation as well and lost to space.
29. Answers should reflect an understanding that water molecules form hydrogen bonds with each other and that the energy it takes to break these bonds could explain why water has such a high specific heat capacity.
30. Fusion needs a high temperature to be initiated. Once it starts it can maintain this temperature itself, but

scientists still need a way to control and contain the fusion reaction at this temperature over time.

31. a) Students may describe a pizza box as a partially closed system. It is not fully closed, as matter can still escape to some degree. Evidence of this is seen in the fact that you can smell the pizza even when the lid is closed. Thus, some energy may leave the box in escaping matter. Like any closed system, thermal energy can leave the system through conduction and radiation as well, so the box does not keep the pizza very warm.
b) Students might suggest an improved pizza box design that is more like the insulated bag that the delivery person brings the pizza in. Accept any answer that attempts to create an isolated system and prevent thermal energy from leaving the system.
32. Sample answer: My cells transformed the chemical potential energy in ATP into thermal energy while I was sleeping. When I woke up, they transformed chemical potential energy into mechanical kinetic energy when I moved. The mechanical kinetic energy was transformed into gravitational potential energy as I got out of bed.
33. Accept any answers that reasonably suggest how the material could use energy transformation and/or transfer to work. One possibility is that the material could be used to build a platform for the building and transfers the mechanical kinetic energy of the shaking building to the ground. Another is that it transforms the mechanical kinetic energy of the building to another less harmful form such as thermal energy very quickly, so that it does less damage to the building.
34. a) Solar energy is absorbed by the water in the pipes and transformed into thermal energy. The thermal energy in the pipes is then transferred to the water in a pool or hot water heater.
b) Sample answer 1: I don't think it would be a good way to heat our school because the school would need a very reliable energy source to provide heat. We have a lot of rainy days here in Prince Rupert, so I don't think an active solar collector would be reliable enough, even if it were able to store a lot of thermal energy. Sample answer 2: We would need the most heat in the winter, so I don't think it would be a good way to heat our school, since there is less sunlight in winter. Also, it would be very expensive to run pipes through the whole school.

35. a) Students should suggest that it would likely leave the bulb as infrared radiation or UV radiation, or be transferred to the surrounding air as thermal energy.
b) and c) Accept any answers that are supported by a sound explanation.
36. Sample answer: No, I don't think that society would survive. Not only would we have no power for our homes, manufacturing, and transportation, but we would have no food as farming would be impossible. Actually, now that I consider it, no people could move or even be alive because chemical potential energy in cells could not be transformed into any form of energy at all. There would be no energy to carry out life functions in cells, move the body, or transport messages via nerves.
37. a) The local environment can take a long time to recover from an accident at a nuclear power plant because the radioactive isotopes released by the accident can take a long time to decay. Therefore, they would harm

Copyright © 2018 by Nelson Education Ltd. 96

BC Science Connections 10 Teaching Notes Unit 3 Assessment

the environment for a long time. Additionally, nuclear power plants are usually surrounded by terrestrial ecosystems. The radioactive isotopes remain in terrestrial ecosystems longer because they are not flushed through them as quickly as through aquatic ones.

b) Air pollutants can cause health problems such as pneumonia and bronchitis, and even heart failure. Greenhouse gases that are emitted can contribute to climate change. This can change the habitat, range, behaviour, and life processes of living things. Individuals may fail to thrive, and populations may decline. c) Sample answer: I think generation of electrical energy from fossil fuels has the greatest negative effect because there are a greater number of these plants. Also, the process contributes to climate change. Finally, the process is constantly releasing harmful emissions, while nuclear power generation mainly causes harm when there is an accident, which are few and far between if the waste is stored properly.

38. Answers will vary depending on the depth of understanding and insight students have gained in the application of the themes. The themes are connections with place, interconnectedness, transformation, renewal, and reciprocity. Encourage students to look at the concepts of energy transformation from a broad, holistic viewpoint. You may want to discuss with students what "Western science perspectives" means. What characteristics make a Western science perspective? How are they different from First Peoples perspectives?