4. It increases.
5. add energy to it
6. a machine that uses heat to do work
7. pressure
8. The fuel and air in the cylinder burn, which produces pressure inside the cylinder. The pressure causes the piston to move down.

Review
1. Answers will vary. Possible answers: A pile of playing cards and a pile of laundry are high-entropy systems. You could decrease the entropy of a pile of cards by making them into a house of cards. You could decrease the entropy of a pile of laundry by folding it neatly.
2. The universe is always moving from a more-ordered state to a less-ordered state.
3. Heat engines convert chemical energy to kinetic energy through the process of combustion.
4. Both convert chemical energy into kinetic energy in order to do work.
5. The non-useful energy output must be 150 J, because the total energy output of the heat engine has to be equal to the total energy input to the heat engine.
6. During the intake stroke, the piston moves down and air and fuel flow into the cylinder. During the compression stroke, the piston moves upward and compresses the air and fuel. During the power stroke, a spark ignites the fuel and air. They burn, producing pressure, which pushes the piston down. During the exhaust stroke, the piston moves up and pushes the waste gases out of the cylinder.

Chapter 15 Waves

SECTION 1 TYPES OF WAVES
1. zero
2. air
3. electromagnetic
4. Energy is transferred to the water.
5. They are the same.
6. kinetic, gravitational potential, elastic potential
7. They wouldn't move.
8. Vibration that decreases as energy is transferred between objects.
9. based on how the waves cause particles to move
10. up and down OR back to front
11. They are the same.
12. Student should draw an arrow pointing to the right or to the left labeled “direction wave is traveling” and arrows pointing up and down that are labeled “direction particles are moving.”
13. They move farther apart.
14. at the boundary between two mediums
15. in a circular motion or path
16. In both surface waves and transverse waves, particles move perpendicular to the direction of motion of the wave.

Review
1. Both mechanical and electromagnetic waves carry energy from place to place, and both can travel through a medium. Mechanical waves require a medium to travel through, but electromagnetic waves do not.
2. Sound waves are mechanical waves. They require a medium to travel through. There is almost no matter in outer space, so mechanical waves cannot travel through space. Light is an electromagnetic wave. Electromagnetic waves do not require a medium to travel, so they can move through outer space.
3. Transverse waves cause particles to vibrate perpendicular to the direction in which the wave is traveling. Longitudinal waves cause particles to vibrate parallel to the direction in which the wave is traveling.
4. The student recorded data about crests, but longitudinal waves do not have crests.
5. The energy in the wave is spread out over a larger area, so the amount of energy in the wave at any given point is lower.

SECTION 2 CHARACTERISTICS OF WAVES
1. They are the same.
2. the distance between two neighboring compressions or rarefactions
3. Student should label the high point of the transverse wave “crest,” the low point of the transverse wave “trough,” the compressed part of the longitudinal wave “compression,” and the spread-out part of the longitudinal wave “rarefaction.”

4. wave B

5. 3.5 s

6. Period is equal to one divided by the frequency.

7. the time it takes for one part of the wave to travel a certain distance

8. \[ v = \frac{\lambda}{T}; \]
\[ v = (15.0 \text{ m}) \div (10 \text{ s}); \]
\[ v = 1.5 \text{ m/s} \]

9. gold

10. When temperature is high, the particles in the material are moving quickly, so they bump into each other more. The energy from the wave is transferred between particles when they collide, so the more often the particles collide, the faster the wave will move through the material.

11. blue

12. gamma rays, X rays

13. bass guitar

14. Student should circle waves that are closest together.

15. If you were riding in the ambulance, the sound waves would hit your ears at the same frequency at which they were emitted. Therefore, the siren’s pitch would not seem to change.

SECTION 3 WAVE INTERACTIONS

1. It bends.

2. During reflection, a wave bounces off a surface.

3. the wavelength of the wave and the size of the barrier or opening

4. Student should label the circular wave fronts above the barrier.

5. no

6. more bent

7. the process in which two or more waves combine to form a single wave

8. 7 cm

9. They must be the same.

10. a wave that is produced when a wave interferes with its reflection

11. a single, stationary wave

12. A node is a point of complete destructive interference. An antinode is a point of complete constructive interference.

Review

1. Both types of interference occur when waves combine. In constructive interference, the combined wave has a larger amplitude than the single waves. In destructive interference, the combined wave has a smaller amplitude than the single waves.

2. Diffraction of sound waves allows you to hear sounds through an open door. The sound waves travel through the room until they reach the door. When they reach the door, the sound waves bend around the edges of the door and can travel to your ears.

3. During diffraction, waves bend as they pass a barrier or edge within a single medium. In refraction, waves bend as they pass from one medium into another.

4. The combined wave will be a crest with an amplitude of 3 cm.

5. The student should draw a waveform with a single “hump” in it.