LESSON 2

Summarize Complex Material

Use with *Student Book* pp. 84–85

SCIENCE CONTENT TOPIC: ES.c.1
SCIENCE PRACTICES: SP.1.a, SP.1.b, SP.1.c, SP.6.c, SP.7.a

1 Review the Skill

Summarizing complex material can help you better understand the important ideas presented in text and in visual elements, such as illustrations, tables, graphs, maps, and diagrams. In many cases, a visual adds key information to a written passage. When this happens, you should include information from both the text and the visual in your summary.

2 Refine the Skill

By refining the skill of summarizing complex material, you will improve your study and test-taking abilities, especially as they relate to the GED® Science Test. Study the information and model below. Then answer the questions that follow.

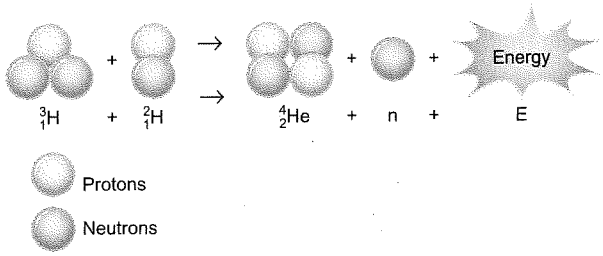
a When summarizing, first determine the main idea of the passage. Then identify the most important details. Usually these are broad, not specific, details.

NUCLEAR FUSION

Nuclear fusion is the fusing, or combining, of lighter atomic nuclei to produce heavier nuclei and energy. Fusion takes place in the sun's core. About 75 percent of the mass of the sun is hydrogen, the fuel for solar fusion. The other 25 percent is helium, the product of solar fusion. Inside the sun's core, the extremely high heat and pressure slam atomic nuclei (primarily protons) together so hard that they fuse in a multi-step process. Nuclear fusion is the opposite of nuclear fission, which creates energy by splitting atoms. The energy released by fusion, however, is greater than the energy released through fission.

b The title, labels, and caption on a visual can help you summarize it. As you study the model, look for ways that the information in it relates to the main idea of the passage.

NUCLEAR FUSION IN THE SUN



Two forms of hydrogen (H) fuse to create one helium (He) atom. The reaction releases a neutron and energy.

1. A summary of the passage might state that nuclear fusion occurs

   A. in all parts of the sun.
   B. in primarily the neutrons of hydrogen atoms.
   C. within the atoms of most gases.
   D. in the core of the sun.

2. Which statement identifies the main idea to include in a summary of the passage and model?

   A. The sun contains mostly hydrogen and helium.
   B. In fusion, the nuclei of atoms fuse to produce energy.
   C. Nuclear fusion produces heavier elements.
   D. Fusion produces more energy than fission.

TEST-TAKING TIPS

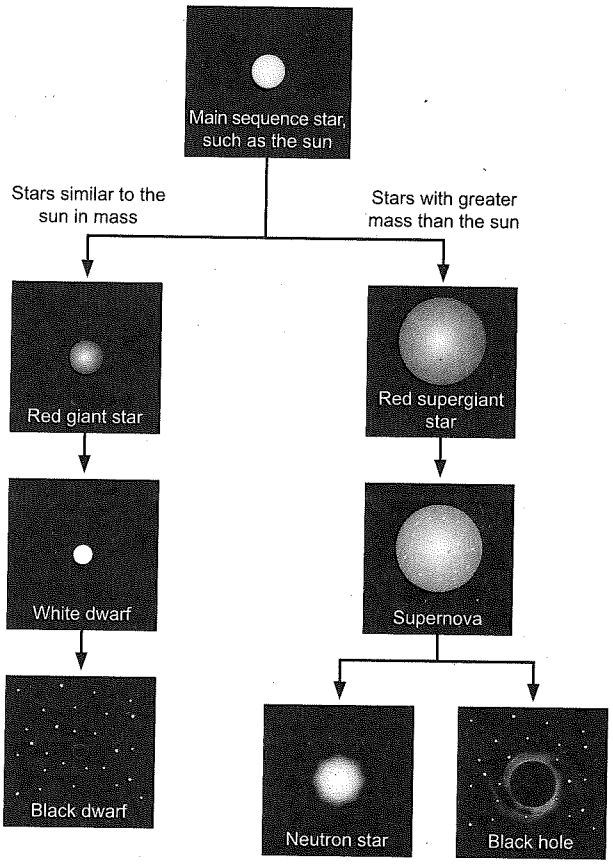
Summarizing is not the same as identifying the main idea. The main idea of a paragraph belongs in a summary. However, a good summary includes both the main idea and the most important details.

UNIT 3

3 Master the Skill

DIRECTIONS: Study the diagram and information, read each question, and choose the **best** answer.

HOW STARS DIE



Note: Sizes of stars are not to scale.

All stars are born in much the same way. However, as the diagram indicates, the way a star dies depends on its mass. Main sequence stars, such as the sun, convert hydrogen to helium through fusion. An average-sized star like the sun undergoes fusion for billions of years before its hydrogen fuel runs out. Some of the hottest and largest stars remain main sequence stars for only several million years before their supply of hydrogen is used up. Regardless of a star's temperature or mass, it eventually will run out of hydrogen fuel. At that stage, fusion of heavier elements such as helium and carbon begins. Stars with a mass similar to that of the sun expand and shrink before burning out. They become tiny, but white-hot, white dwarfs before becoming cold black dwarfs. Stars far more massive than the sun explode before collapsing into small, dark, extremely dense bodies.

3. Which detail would **best** fit in a summary of the information?

   A. Stars can fuse atoms of carbon.
   B. Black dwarfs are cold.
   C. Stars more massive than the sun explode.
   D. The sun is an average-sized star.

4. Which statement **best** summarizes the diagram and passage?

   A. Stars of the sun's mass eventually shrink and end as black dwarfs, while more massive stars explode and end as small, dark, dense bodies.
   B. When nuclear fusion begins in a star's core, the star becomes a main sequence star.
   C. The last stage of a massive star's existence is a very dense body.
   D. All stars, regardless of mass, are born in the same way.

DIRECTIONS: Read the passage and question, and choose the **best** answer.

ELEMENTS PRODUCED BY STARS

The Milky Way is a huge galaxy 120,000 light-years wide. Our sun is just one of the Milky Way's billions of stars. The galaxy's stars create helium in the fusion chambers of their cores. However, they create other elements as well, especially at the end of their life cycles. These elements include iron, magnesium, silicon, and oxygen. When a massive star explodes, the elements produced deep within the star are shot into space, where they become the building materials for new stars and planets. Such elements were part of the cloud of gas and dust from which our solar system formed billions of years ago. These elements are still abundant in the crust of Earth and other rocky planets in our solar system and are important for living things.

5. A student wrote the following summary of this passage: "The Milky Way is a huge galaxy 120,000 light-years wide. Our sun is just one of the Milky Way's billions of stars. The galaxy's stars create helium in the fusion chambers of their cores—but they create other elements as well, especially at the end of their life cycles." What is the **main** problem with this summary?

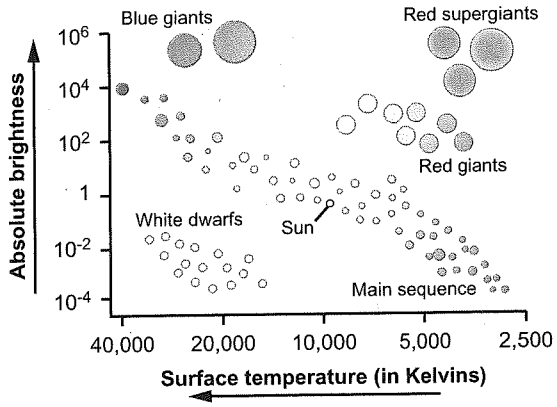
   A. It does not give details about the Milky Way.
   B. It is shorter than the passage.
   C. It uses the same wording as the passage.
   D. It does not define *galaxy*.

Spotlighted Item: SHORT ANSWER

DIRECTIONS: Read the passage, and study the diagram. Then read the question, and write your response on the lines. This task may take approximately 10 minutes to complete.

TRAITS OF STARS

The universe contains stars of different colors, temperatures, and magnitudes (brightnesses). The graph shown here is known as the Hertzsprung-Russell (H-R) diagram. It shows how color, temperature, and brightness are related in stars.



6. Examine the H-R diagram. Then use it to summarize how a star's color, temperature, and brightness are related.

DIRECTIONS: Read the passage and question, and choose the **best** answer.

DEATH OF LARGE STARS

The sun is a medium-sized star. When a star far more massive than the sun reaches the end of its life cycle, it explodes in a supernova. The explosion blasts most of the star's mass into space, but the central part of the star is left behind. Without the outward pressure from fusion in the star's core, the inward press of gravity collapses the star into an extremely dense mass that becomes either a neutron star or a black hole, depending on the star's size.

When many large stars die in a supernova, a neutron star forms. Neutron stars are formed primarily of neutrons. They are extremely tiny, dense bodies—only about 20 kilometers in diameter but with a mass almost 1.5 times that of the sun. Just one teaspoonful of material from a neutron star would weigh one billion tons.

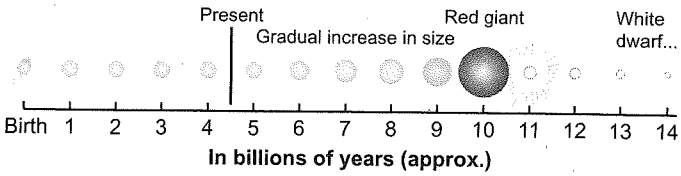
When the largest (most massive) stars collapse after a supernova, they leave behind an object with more than three times the mass of the sun. When this object collapses in on itself, it becomes a black hole—an object so tiny and with such immense density that its gravity pulls in anything around it, including its own light. Astronomers can locate black holes by detecting energy emitted by nearby objects being pulled into them. As matter is drawn into a black hole, it forms a hot disk that gives off X-rays and gamma rays that astronomers can detect.

7. Based on the passage, which statement **best** summarizes how neutron stars and black holes are similar?

   A. Neutron stars and black holes can form only before a supernova.
   B. Neutron stars and black holes are so dense that light cannot escape them.
   C. Neutron stars and black holes are made of only neutrons.
   D. Neutron stars and black holes form at the end of the life cycles of large stars.

DIRECTIONS: Study the timeline, and read the passage. Then read the question, and choose the **best** answer.

LIFE CYCLE OF THE SUN



THE SUN'S END

The sun is nearly 5 billion years old and is expected to exist for several billion years more. When the sun has used up its hydrogen fuel, fusion will cease in the core, and the core will collapse due to gravity. Pressure from the collapsing core will cause the sun to heat up while its outer layers expand, forming a giant red ball called a red giant. At this point, the sun's diameter will reach to about the orbit of Venus. Earth will be so close to the sun that life as we know it will not exist. Some scientists think that the sun will swell so much that it will engulf Earth. The sun's outer layers will gradually separate and leave the white-hot core as a white dwarf. At the very end of the sun's life, the white dwarf will cool to form a solid, dense structure called a black dwarf.

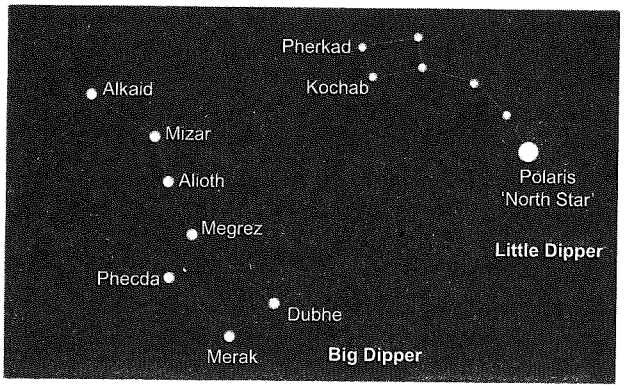
8. Which statement **best** summarizes the information in the timeline and the passage?

   A. When the sun has used all its hydrogen fuel in about 5 billion years, it will become a red giant and then end several billion years later as a black dwarf.
   B. The sun formed almost 5 billion years ago and will gradually swell during the next 5 billion to 6 billion years.
   C. Several billion years from now, there will be no life on Earth as we know it.
   D. When the sun's hydrogen has been used up, nuclear fusion in its core will stop.

3 Master the Skill

DIRECTIONS: Study the illustration and information, read each question, and choose the **best** answer.

CONSTELLATIONS



Constellations, such as the Big Dipper and Little Dipper, are patterns that people on Earth saw among the stars in the night sky in ancient times. Some were named for animals or common objects; others were named for mythological people or creatures. Although stars in constellations appear motionless, they are actually streaking around the galaxy, just like our sun. They are just too far away for us to detect their movement. Still, over tens of thousands of years, constellations do change position. The pattern of constellations that is visible to us also changes throughout the year as Earth revolves around the sun.

3. Based on the information, why do constellations appear to be in different parts of the sky at different times of the year?

   A. The constellations change shape throughout the year.
   B. Constellations exist only for a short period, and then completely new ones form.
   C. As Earth circles the sun, we see different areas of the sky.
   D. It is difficult to see constellations during summer when Earth is tilted toward the sun.

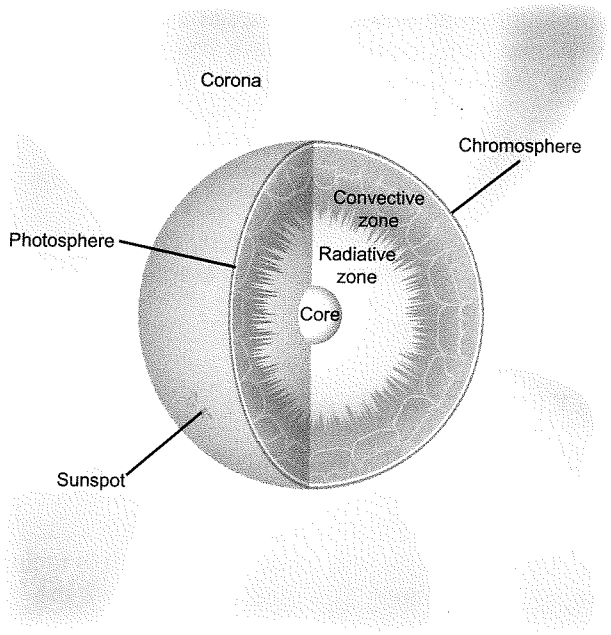
4. How will the Big Dipper **most likely** look in 100,000 years?

   A. It will no longer be recognizable as the Big Dipper.
   B. It will look very much the same as it does now.
   C. It will have the same shape but will be much larger.
   D. It will be much dimmer than it is today but will retain the same shape.

3 Apply the Skill

DIRECTIONS: Study the illustration and information, read each question, and choose the **best** answer.

CROSS-SECTION OF THE SUN



The sun is a star at the center of our solar system. At its core, the sun reaches a temperature of 27 million degrees Fahrenheit, hot enough for nuclear fusion. Fusion is a process in which atoms collide at a high speed and fuse together. In the center of the sun, hydrogen fuses to form helium and release tremendous energy—which we experience on Earth as heat and light. This energy passes from the core to the radiative zone, and then to the convective zone. From there, energy reaches the sun's surface, or photosphere. It is the photosphere that we see from Earth as a bright yellow disk. Energy escapes from the photosphere and travels to Earth at the speed of light—a journey that takes eight minutes. Above the photosphere are the thin chromosphere and corona. The chromosphere and corona are seen from Earth only during a total solar eclipse, as a bright halo around the sun's dark disk.

2. Based on the information, what would be the **best** title for the passage?

   A. Temperature of the Sun
   B. How Nuclear Fusion Works
   C. Our Solar System
   D. Structure of the Sun

3. Which statement **best** summarizes the information in the passage and illustration?

   A. Energy from the sun takes many years to reach Earth.
   B. The sun's energy is produced in its core and passes through several layers before reaching the surface and traveling to Earth.
   C. The sun uses hydrogen atoms as fuel to undergo nuclear fusion.
   D. All solar systems have a star, such as our sun, at their center.

DIRECTIONS: Read the passage. Then read each question, and choose the **best** answer.

Scientists think that stars form within the clouds of gas and dust, or nebulas, scattered within galaxies. A dense portion of a nebula can collapse due to gravity, causing the material at its center to form the hot core of a protostar. Eventually, the core becomes hot enough for nuclear fusion to occur, and the protostar becomes a main sequence star. After millions or sometimes billions of years, the star uses up its hydrogen fuel. When fusion of hydrogen stops, fusion of heavier elements begins. In time, when fusion at its core stops, the star collapses inward. Stars of average mass, such as our sun, shrink to become white dwarfs and eventually burn out. More massive stars heat up to tremendous temperatures and then explode in a fiery supernova that leaves behind a neutron star or a black hole. The remnants of exploded stars mix with surrounding gas and dust in the galaxy. This material is recycled to become new stars and planets.

4. Which point is **most** important to include in a summary of the passage?

   A. Stars are formed from huge clouds of gas and dust.
   B. Nuclear fusion inside stars uses hydrogen as its fuel.
   C. White dwarfs are stars.
   D. Our sun is a main sequence star.

5. Which title **best** summarizes this passage?

   A. Death of a Star
   B. Life Cycle of a Star
   C. Energy of a Star
   D. Birth of a Star