4. Sample answer: Elliptical galaxies usually have very bright centers and very little gas and dust. A globular cluster is a tight group of stars within a galaxy that looks like a ball and contains up to 1 million stars.
5. Looking through a telescope is like looking back in time because the light that you see through the telescope took a very long time to travel through space and reach your eye. Therefore, looking at distant galaxies reveals what early galaxies looked like.
6. The quasar is 6 billion light-years × 9.46 trillion km/light-year =5.676×10^{22} km away from Earth; The North Star is 431 light-years × 9.46 trillion km/light-year =4.08×10^{15} km away from Earth; ratio is about 6×10^{22} km: 4 3 10^{15} km = 6 million km: 4 km or 3 million km: 2

SECTION: FORMATION OF THE UNIVERSE

1. Sample answer: The study of the origin, structure, and future of the universe is called *cosmology*. The theory that the universe began with a tremendous explosion is called the *big bang theory*.
2. One way that scientists calculate the age of the universe is by measuring the distance from Earth to various galaxies. Another way to estimate the age of the universe is to calculate the ages of old, nearby stars.
3. B
4. Cosmic background radiation supports the big bang theory because measurements show that cosmic background radiation is distributed everywhere in the universe, which is what the big bang theory predicts.
5. Scientists think that the universe may continue to expand forever. Therefore, stars will die and the universe will eventually become a cold and dark place after billions of years, because the fusion process will gradually cause stars to die out.
6. 4,080,000,000,000 km
7. Sample answer: Every object in the universe is part of a larger system because the universe has a structure that is loosely repeated. For example, a cluster or group of galaxies can be made up of smaller star clusters and galaxies.
8. Scientists think that the universe will expand forever because they think that there may not be enough matter to produce the gravitational attraction needed to counteract expansion.

Chapter Review

1. a light-year
2. Open clusters
3. elliptical galaxies
4. spectrum
5. C
6. D
7. C
8. A
9. D
10. Scientists classify stars by temperature and magnitude.
11. Sample answer: The universe has a structure that is loosely repeated over and over again. Every object in the universe is part of a larger system. For example, a group of galaxies can include planetary systems, such as our solar system.
12. Sample answer: After a star forms, it enters the second and longest stage of its life cycle, known as the *main sequence*. The main sequence is the diagonal pattern on the H-R diagram where most stars lie. After the main sequence, a star can enter the third stage of its life cycle and become a red giant star. Red giants are located on the upper-right of the H-R diagram because these stars are very massive. In the final stages of a star's life cycle, a star can become a white dwarf. White dwarfs are located in the lower-left part of the H-R diagram because they are extremely hot but dim.
13. The apparent motion of stars, or how the stars appear to move, is due to Earth's rotation. The actual motion of stars is very hard to see because the stars are very distant.
14. Stars that have different temperatures have different colors. For example, blue stars are much hotter than red stars.

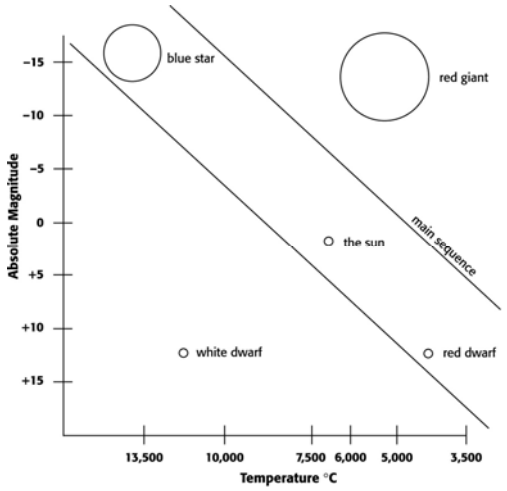
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15. Two ways that scientists calculate the age of the universe are by measuring the distance from Earth to various galaxies and by calculating the ages of old, nearby stars.
16. An answer to this exercise can be found at the end of the Teacher Edition.
17. The galaxy is most likely an elliptical galaxy because it lacks the gas and dust needed for star formation. Blue stars are young stars.
18. Sample answer: Main-sequence stars are stars that are in the second stage of their life cycle. Red giant stars are large, reddish stars that are late in their life cycle. Red supergiant stars are similar to red giant stars but are much larger. White dwarf stars are small, hot, dim stars that are the leftover centers of old stars.
19. Absolute magnitude is a physical property of the star. Apparent magnitude varies according to a star's distance and absolute magnitude.
20. According to the big bang theory, the universe began with an explosion of matter and energy. Scientists can support this theory because they have shown that all distant galaxies are moving apart from all other galaxies.
21. The star would be relatively close to Earth.
22. The galaxy is about 30 million light-years away from Earth and its speed is about 5,000 km/s.
23. The galaxy is almost 90 million light-years away from Earth.
24. The galaxy is moving at about 15,000 km/s.

Reinforcement

DIAGRAMMING THE STARS

7. The blue star, the sun, and the red dwarf star are included in the main sequence.
8. Answers may vary. Sample answer: Ithink that it is a white dwarf star.



Critical Thinking

1. Answers may vary. Sample answer: The branches might represent galaxies.
2. Answers may vary. Sample answer: The leaves could represent stars.
3. No; it is a mythical explanation of how the universe formed. It relies on metaphors and supernatural animals, and it does not use the scientific method.
4. Answers may vary. Sample answer: Yes, it does resemble the big bang theory. Like the big bang theory, this explanation states that the universe began as a single, heavy point that contained all the matter in the universe. Also like the big bang theory, this explanation states that at one point all of this material exploded outward in every direction from a central location.
5. Answers may vary. Sample answer: The big bang theory does not explain why an explosion occurred, while this explanation does.

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