

Directed Reading

Section: Structure of the Sun

- From what did people once believe the sun's energy comes?

- About how long ago did scientists discover that the sun's energy is quite different from fire?

THE SUN'S ENERGY

- What does the sun look like to the unaided eye?
 - a dazzling, brilliant ball that has no distinct features
 - a bright disc with ridges and valleys
 - a dazzling ball with seas and dark areas
 - a softly glowing sphere with flaming edges
- Why do astronomers use special filters to look at the sun?
 - The sun seems only one color otherwise.
 - No telescope can view the sun otherwise.
 - The sun's brightness can damage your eyes.
 - They view the sun only at night.

- What do scientists use to break up the sun's light into a spectrum?

- a spectrometer
- a spectrograph
- a spectra-reader
- a light graphometer

- What causes dark lines to form in the spectra of stars?

- Gases in the stars' interiors emit specific wavelengths of light.
- Gases in the stars' outer layers absorb specific wavelengths of light.
- Magnetic currents in the stars' outer layers distort wavelengths of light.
- Gases in the stars' outer layers emit specific wavelengths of light.

- What factors determine which gases produce visible spectral lines?

- the size of the star
- the elements in a star
- the type of spectrograph that is used
- the temperature of a star's outer layers

- What important factor can be determined by studying the spectrum a star?

- the amounts of elements that are not contained in the star
- the rate at which gases are released into a star's atmosphere
- the numbers of gases that are present in a star's atmosphere
- the amounts of elements that are present in a star's atmosphere

- How can scientists deduce the temperature, density, and pressure of a gas in a star's surface?

- by studying the spectrum of the star
- by studying the spectrum of nearby stars
- by studying the brightness of the star
- by calculating the size of the star

- To identify the elements in a star's atmosphere, scientists

- match the spectral lines of starlight against the spectra from known stars.
- match the spectral lines of starlight to those of Earth's elements.
- match the spectral lines of starlight against the spectra of gases in Earth's atmosphere.
- match the spectral lines of starlight to one another.

- Why does matching the spectral lines of starlight to those of Earth's elements enable scientists to identify the elements in a star's atmosphere?

- Groups of elements have the same spectral lines.
- Individual elements may have the same spectral lines.
- Each element has a unique pattern of spectral lines.
- Each group of elements has unique spectral lines.

- What element makes up about 75% of the sun's mass?

- helium
- iron
- hydrogen
- radium

- How much of the sun's total mass is composed of hydrogen and helium?

- about 75%
- about 85%
- about 90%
- about 99%

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- _____ 14. The sun's spectrum reveals that it contains
a. almost nothing besides hydrogen.
b. almost all chemical elements.
c. only hydrogen and helium.
d. hydrogen, helium, oxygen, and carbon.
- _____ 15. What atomic process combines nuclei of small atoms to form more-massive nuclei?
a. nuclear fission
b. nuclear fusion
c. nuclear half-life
d. nuclear decay
- _____ 16. Nuclei of which atoms are the primary fuel for the sun?
a. hydrogen
b. helium
c. protons
d. electrons

17. What is the common makeup of a hydrogen atom?

18. What happens inside the sun to the electrons in hydrogen atoms?

19. How many steps occur in nuclear fusion inside the sun?

20. Describe the first step of nuclear fusion.

21. What happens to the charge of one hydrogen proton?

22. What is a particle that is emitted by one proton?

23. What is the result of the first step of fusion?

24. Describe the second step of nuclear fusion.

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25. Describe the third step of nuclear fusion.

26. What is released in the fusion of two two-proton-one-neutron nuclei?

27. What particles are fused together to form a helium nucleus?

28. How often is energy released during nuclear fusion?

29. When hydrogen fusion occurs in the sun, what is always one of the final products?

30. How does the mass of a helium nucleus compare with the mass of the hydrogen nuclei that fused to form it?

31. What is converted into energy during the series of fusion reactions that form helium nuclei inside the sun?

32. What causes the sun to shine and gives the sun its high temperature?

MASS CHANGING INTO ENERGY

- _____ 33. In 1905, Albert Einstein proposed that a
a. small amount of matter yields a large amount of energy.
b. large amount of matter was equal to a large amount of energy.
c. large amount of matter yields a small amount of energy.
d. small amount of matter was equal to a small amount of energy.

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_____ **34.** At the time of Einstein's 1905 proposal, what two factors were unknown?

- a. nuclear fission and electrons
- b. energy and an atom's nucleus
- c. energy and matter
- d. nuclear fusion and the nucleus of the atom

_____ **35.** Einstein's proposal was

- a. part of his special theory of relativity.
- b. part of his general theory of physics.
- c. his basic theory about the makeup of atoms.
- d. part of his special theory of energy.

_____ **36.** What equation is part of Einstein's theory?

- a. $E=mc$
- b. $E^2=mc$
- c. $E=mc^2$
- d. $E=m^2c$

_____ **37.** In the equation $E = mc^2$, "E" represents

- a. mass, or the amount of matter.
- b. a constant.
- c. matter.
- d. energy produced.

_____ **38.** In the equation $E=mc^2$, "m" represents

- a. the total mass in the universe.
- b. the mass of one ounce of lead.
- c. mass, or the amount of matter that is changed.
- d. the amount of matter that remains.

_____ **39.** In the equation $E=mc^2$, "c" represents

- a. energy.
- b. matter.
- c. the diameter of the sun.
- d. the speed of light.

_____ **40.** What is the speed of light?

- a. 300,000 km/hr
- b. 300,000 km/s
- c. 300,000 m/hr
- d. 300,000 m/s

41. What can Einstein's equation be used to calculate?

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42. How much hydrogen is changed into helium in the sun every second?

43. What subatomic particle is given off during fusion?

44. How long does it take neutrinos that escape from the sun to reach Earth?

45. What does the study of neutrinos indicate?

THE SUN'S INTERIOR

In the space provided, write the letter of the temperature that matches the part of the sun.

_____ **46.** core

a. 3,800°C

_____ **47.** chromosphere

b. 6,000°C

_____ **48.** sunspot

c. 4,000°C to 50,000°C

_____ **49.** radiative zone

d. 1,000,000°C

_____ **50.** corona

e. 2,000,000°C

_____ **51.** photosphere

f. 2,000,000° C to 7,000,000°C

_____ **52.** convective zone

g. 15,000,000°C

_____ **53.** What has revealed what the invisible layers of the sun may be like?

- a. the solar wind
- b. neutrinos
- c. computer models
- d. the sun's corona

_____ **54.** In recent years, more detail has been learned about what is happening inside the sun by careful studies of

- a. motions in the sun's corona.
- b. motions on the sun's surface.
- c. movement of sunspots.
- d. changes in energy from the sun.

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- _____ **55.** What is the size of the sun's core?
a. 25% of 1,390 km
b. 25% of 13,900 km
c. 25% of 139,000 km
d. 25% of 1,390,000 km
- 56.** What is the sun's core made up of?

- 57.** How does the mass of the sun compare with the mass of Earth?

- 58.** What effect does the sun's large mass have on the density of the sun's core?

- 59.** Compare the nuclei of atoms on Earth and in the sun's core.

- 60.** What factors in the sun's core force nuclei close enough to fuse?

- 61.** What is the most common nuclear reaction inside the sun?

- 62.** What zone in the sun's interior surrounds the core, and what is its temperature?

- 63.** In the radiative zone, in what form does energy move outward?

- 64.** What zone surrounds the radiative zone, and what is its temperature?

- 65.** Describe how energy produced in the sun's core moves through the convective zone. Compare the movement to an example on Earth.

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- 66.** What causes the movement of gases in the convective zone?

- THE SUN'S ATMOSPHERE**
- _____ **67.** To what does the word atmosphere refer, when applied to the sun?
a. the sheath of air surrounding the sun
b. all of the gases that make up the sun
c. the uppermost region of solar gases
d. the regions of gases above the sun's core
- _____ **68.** What are the three layers of the sun's atmosphere?
a. ionosphere, troposphere, stratosphere
b. photosphere, chromosphere, convection zone
c. photosphere, chromosphere, corona
d. core, corona, photosphere
- _____ **69.** What is the innermost layer of the solar atmosphere called?
a. photosphere
b. chromosphere
c. corona
d. solar wind
- 70.** What is the sun's photosphere?

- _____ **71.** Why are we able to see the photosphere from Earth?

- _____ **72.** What are sunspots?

- _____ **73.** What layer lies above the photosphere? How did this layer get its name?

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74. How do gases move in the chromosphere?

75. Describe the upward movement of gas in the chromosphere.

76. How do spacecraft study the sun?

77. What is the outermost layer of the sun's atmosphere called?

78. Describe the size and temperature of the corona.

79. How can the corona stop most subatomic particles from escaping into space, even though it is not very dense?

80. Under what condition may the corona be visible during the day?

