

Chapter 01 - The Origin of the Ocean

True / False

1. The concept of a single world ocean emphasizes the interdependence of ocean and land, life and water, atmospheric and oceanic circulation, and natural and human-made environments.

- a. True
- b. False

ANSWER: True

REFERENCES: 1-1 Earth Is an Ocean World

LEARNING OBJECTIVES: OCEA.GARR.16.1-1-1 - Explain the concept of a single world ocean.

OTHER: Bloom's: Understand

NOTES: The Pacific and Atlantic oceans, the Mediterranean and Baltic seas, so named for our convenience, are in reality only temporary features of a single world ocean. The text refers to the ocean as a single entity, with subtly different characteristics at different locations but with very few natural partitions. Such a view emphasizes the interdependence of ocean and land, life and water, atmospheric and oceanic circulation, and natural and human-made environments.

2. The total amount of fresh water on Earth makes up only about 2.5% of all the water on the planet.

- a. True
- b. False

ANSWER: True

REFERENCES: 1-1 Earth Is an Ocean World

LEARNING OBJECTIVES: OCEA.GARR.16.1-1-2 - Describe the characteristics of our single world ocean on a human and planetary scale.

OTHER: Bloom's: Remember

NOTES: The relative amount of water in various locations on or near Earth's surface includes 97.5% salt water and 2.5% fresh water.

3. Physical oceanographers design and build oil platforms, ships, harbors, and other structures that enable us to use the ocean wisely.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-1 - Discuss the interdisciplinary nature of marine science, and distinguish among the various areas of research in the field.

OTHER: Bloom's: Remember

NOTES: Marine engineers design and build oil platforms, ships, harbors, and other structures that enable us to use the ocean wisely.

4. Although oceanographers may specialize in one particular area of study, the nature of the science is interdisciplinary, meaning that marine scientists must have a general knowledge of all areas of oceanography in order to study the system as a whole.

- a. True
- b. False

ANSWER: True

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

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LEARNING OBJECTIVES: OCEA.GARR.16.1-2-1 - Discuss the interdisciplinary nature of marine science, and distinguish among the various areas of research in the field.

OTHER: Bloom's: Understand

NOTES: Marine science draws on several disciplines, integrating the fields of geology, physics, biology, chemistry, and engineering as they apply to the ocean and its surroundings. Nearly all marine scientists specialize in one area of research, but they also must be familiar with related specialties and appreciate the linkages between them.

5. Once established, a theory is always correct and cannot be changed.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-2 - Outline the process of the scientific method, and apply it to an example.

OTHER: Bloom's: Understand

NOTES: Theories and laws in science do not arise fully formed or all at once. Scientific thought progresses as a continuous chain of questioning, testing, and matching theories to observations. A theory is strengthened if new facts support it. If not, the theory is modified or a new explanation is sought (science is thus "self-correcting"). The power of science lies in its ability to operate in reverse; that is, in the use of a theory or law to predict and anticipate new facts to be observed.

6. The condensation theory explains how the ocean on Earth was formed.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-1 - Describe the processes of galaxy, star, and planet formation in the universe, and illustrate the life cycle of a star.

OTHER: Bloom's: Remember

NOTES: The condensation theory explains the different stages of development of how stars and planets are believed to form.

7. The fusion of hydrogen atoms into helium atoms occurs near the end of a star's life.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-2 - Explain how stars form heavier atoms from hydrogen.

OTHER: Bloom's: Understand

NOTES: A protostar is the first stage in the life of a star. Nuclear fusion begins after the protostar reaches an appropriately high temperature for hydrogen atoms to begin to fuse to form helium atoms. This process marks the transition from protostar to star.

8. During the early years of Earth, lighter elements such as silicon, magnesium, and aluminum rose to the surface, forming Earth's crust.

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- a. True
- b. False

ANSWER: True

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-1 - Discuss the process of density stratification and how it contributed to the formation of Earth's young ocean.

OTHER: Bloom's: Understand

NOTES: Gravity pulled most of the iron and nickel inward to form the planet's core. The sinking iron released huge amounts of gravitational energy, which, through friction, heated Earth even more. At the same time, a slush of lighter minerals— silicon, magnesium, aluminum, and oxygen-bonded compounds—rose toward the surface, forming Earth's crust. This important process, called density stratification, lasted perhaps 100 million years.

9. Earth's moon is thought to have formed soon after the big bang similarly to how Earth formed.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-2 - Describe the events that led to the formation of Earth's moon.

OTHER: Bloom's: Remember

NOTES: Shortly after Earth's formation, a planetary body somewhat larger than Mars smashed into the young Earth and broke apart. The metallic core fell into Earth's core and joined with it, while most of the rocky mantle was ejected to form a ring of debris around Earth. The debris began condensing soon after and became our moon.

10. Earth's early atmosphere was similar to the present day atmosphere, composed mostly of oxygen and nitrogen.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-3 - Compare and contrast Earth's present and early atmospheres.

OTHER: Bloom's: Understand

NOTES: The composition of the early atmosphere was much different from the one of today. Geochemists believe it may have been rich in carbon dioxide, nitrogen, and water vapor, with traces of ammonia and methane.

11. An anoxic atmosphere was needed for life to first form on Earth.

- a. True
- b. False

ANSWER: True

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-2 - Reconstruct the conditions of early Earth that contributed to the biosynthesis of living organisms.

OTHER: Bloom's: Apply

NOTES: In the early steps in the evolution of living organisms from simple organic building blocks, the main chemical requirement seems to be the absence (or near absence) of free oxygen, a compound that can disrupt any unprotected large molecule.

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12. The fact that all life cells depend on saline water suggests that life evolved in the ocean.

- a. True
- b. False

ANSWER: True

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-1 - Assess the evidence that suggests life began in the ocean.

OTHER: Bloom's: Evaluate

NOTES: The fact that all life, from a jellyfish to a dusty desert weed, depends on saline water within its cells to dissolve and transport chemicals is certainly significant. It strongly suggests that simple, self-replicating—living—molecules arose somewhere in the early ocean. It also strongly suggests that all life on Earth is of common origin and ancestry.

13. Earth's sun will become a supernova near the end of its life cycle.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-6 What Will Be Earth's Future?

LEARNING OBJECTIVES: OCEA.GARR.16.1-6-1 - Label a timeline of Earth's history and future, and describe the events that may occur at the end of Earth's life cycle.

OTHER: Bloom's: Remember

NOTES: Our sun, like any other star, will begin to die. The sun is not massive enough to become a supernova, but after a billion-year cooling period, the re-energized sun's red-giant phase will engulf the inner planets.

14. One of the conditions necessary for a planet to have a permanent ocean of liquid water is to have a solid cold core.

- a. True
- b. False

ANSWER: False

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-1 - Describe the planetary conditions necessary for a sustained liquid ocean of water.

OTHER: Bloom's: Remember

NOTES: Consider the conditions necessary for a large, permanent ocean of liquid water to form on a planet. An ocean world must move in a nearly circular orbit around a stable star. The distance of the planet from the star must be just right to provide a temperate environment in which water is liquid. Unlike most stars, a water planet's sun must not be a double or multiple star, or the orbital year would have irregular periods of intense heat and cold. The materials that accreted to form the planet must have included both water and substances capable of forming a solid crust. The planet must be large enough that its gravity will keep the atmosphere and ocean from drifting off into space.

15. Magnetometer data has been used to determine if other planets and moons in our solar system have salty oceans.

- a. True
- b. False

ANSWER: True

REFERENCES: 1-7 Are There Other Ocean Worlds?

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LEARNING OBJECTIVES: OCEA.GARR.16.1-7-2 - Summarize the methods that have shown, or may potentially show, evidence of the existence (past and present) of water on other planets and moons in our solar system.

OTHER: Bloom's: Understand

NOTES: The spacecraft Galileo passed close to Europa—a moon of Jupiter—in early 1997. Photos sent to Earth revealed a cracked, icy crust covering what appears to be a slushy mix of ice and water. Galileo also detected a distinctive magnetic field, the signature of a salty liquid-water ocean below the ice. Ganymede, Jupiter's largest satellite, was surveyed by Galileo in May 2000; the photographs showed structures strikingly similar to those on Europa. Again, magnetometer data suggested a salty ocean beneath a moving, icy crust.

Multiple Choice

16. How much of the water on Earth is found in the ocean?

- a. 3%
- b. 67%
- c. 71%
- d. 90%
- e. 97%

ANSWER: e

REFERENCES: 1-1 Earth Is an Ocean World

LEARNING OBJECTIVES: OCEA.GARR.16.1-1-1 - Explain the concept of a single world ocean.

OTHER: Bloom's: Remember

NOTES: More than 97% of the water on or near Earth's surface is contained in the ocean.

17. Water covers approximately ____ of the surface of Earth.

- a. 25%
- b. 5%
- c. 50%
- d. 71%
- e. 95%

ANSWER: d

REFERENCES: 1-1 Earth Is an Ocean World

LEARNING OBJECTIVES: OCEA.GARR.16.1-1-2 - Describe the characteristics of our single world ocean on a human and planetary scale.

OTHER: Bloom's: Remember

NOTES: Nearly three-quarters of the planet is covered by water.

18. What is the approximate average depth of Earth's ocean?

- a. 3,600 m
- b. 12,000 m
- c. 810 m
- d. 15,500 m
- e. 1,200 m

ANSWER: a

REFERENCES: 1-1 Earth Is an Ocean World

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LEARNING OBJECTIVES: OCEA.GARR.16.1-1-2 - Describe the characteristics of our single world ocean on a human and planetary scale.

OTHER: Bloom's: Remember

NOTES: On a human scale, the ocean is impressively large. The average depth of the ocean is about 3,682 meters (12,081 feet).

19. Joann, a marine scientist, is studying the amount of dissolved iron, nitrate, and phosphate in the upper water column of the open ocean to determine if nutrients are limiting phytoplankton growth. What kind of marine scientist is she?

- a. physical oceanographer
- b. chemical oceanographer
- c. marine biologist
- d. marine geologist
- e. marine engineer

ANSWER: b

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-1 - Discuss the interdisciplinary nature of marine science, and distinguish among the various areas of research in the field.

OTHER: Bloom's: Analyze

NOTES: Chemical oceanographers study the ocean's dissolved solids and gases and their relationships to the geology and biology of the ocean as a whole.

20. A marine scientist who is testing the amount of oxygen needed by microorganisms in deep ocean sediments is conducting a(n) ____.

- a. hypothesis
- b. experiment
- c. theory
- d. scientific method
- e. marine law

ANSWER: b

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-2 - Outline the process of the scientific method, and apply it to an example.

OTHER: Bloom's: Apply

NOTES: An experiment is a test that simplifies observation in nature or in the laboratory by manipulating or controlling the conditions under which the observations are made.

21. A(n) ____ is an explanation that can be tested by additional observations and controlled experiments.

- a. question
- b. science
- c. hypothesis
- d. scientific method
- e. law

ANSWER: c

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-2 - Outline the process of the scientific method, and apply it to an example.

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OTHER: Bloom's: Remember

NOTES: Scientists start with a question—a desire to understand something they have observed or measured. They then form a tentative explanation for the observation or measurement. This explanation is often called a working hypothesis, a speculation about the natural world that can be tested and verified or disproved by further observations and controlled experiments.

22. A marine scientist who studies the movements of the seafloor at mid-ocean ridges and subduction zones is a ____.
- physical oceanographer
 - marine climatologist
 - chemical oceanographer
 - marine geologist
 - marine biologist

ANSWER: d

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-1 - Discuss the interdisciplinary nature of marine science, and distinguish among the various areas of research in the field.

OTHER: Bloom's: Analyze

NOTES: Marine geologists focus on questions such as the composition of inner Earth, the mobility of the crust, the characteristics of seafloor sediments, and the history of Earth's ocean, continents, and climate. Some of their work touches on areas of intense scientific and public concern, including earthquake prediction and the distribution of valuable resources.

23. A(n) ____ usually takes the form of a concise mathematical or verbal expression; a(n) ____ provides an explanation for the observations.
- law; theory
 - theory; law
 - hypothesis; theory
 - law; hypothesis
 - theory; hypothesis

ANSWER: a

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-2 - Outline the process of the scientific method, and apply it to an example.

OTHER: Bloom's: Understand

NOTES: Comprehensive constructs, known as laws, can also summarize experimental observations. Laws are principles explaining events in nature that have been observed to occur with unvarying uniformity under the same conditions. A law usually takes the form of a concise mathematical or verbal expression; a theory provides an explanation for the observations.

24. The water for Earth's ocean originated from ____.
- volcanic activity and other planets
 - volcanic activity and comets
 - other planets
 - the sun
 - solar nebula

ANSWER: b

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REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-1 - Describe the processes of galaxy, star, and planet formation in the universe, and illustrate the life cycle of a star.

OTHER: Bloom's: Remember

NOTES: Most of the ocean formed as water vapor trapped in Earth's outer layers escaped to the surface through volcanic activity during the planet's youth. The vapor cooled and condensed to form an ocean. Comets may have delivered additional water to the new planet's surface.

25. Which sequence correctly describes the steps in the life cycle of a star?

- a. protostar, stability, nuclear fusion, red giant, supernova
- b. supernova, red giant, nuclear fusion, stability, protostar
- c. red giant, protostar, stability, nuclear fusion, supernova
- d. protostar, nuclear fusion, stability, red giant, supernova
- e. nuclear fusion, protostar, stability, supernova, red giant

ANSWER: d

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-1 - Describe the processes of galaxy, star, and planet formation in the universe, and illustrate the life cycle of a star.

OTHER: Bloom's: Understand

NOTES: The life of a star begins when a diffuse area of a spinning nebula begins to shrink and heat up under the influence of its own weak gravity. Gradually, the cloudlike sphere flattens and condenses at the center into a knot of gases called a protostar. When the protostar reaches a temperature of about 10 million degrees Celsius, nuclear fusion begins. After fusion reactions begin, the star becomes stable—neither shrinking nor expanding, and burning its hydrogen fuel at a steady rate. This stable phase does not last forever, though. The life history and death of a star depend on its initial mass. When a medium-mass star (like our sun) begins to consume carbon and oxygen atoms, its energy output slowly rises and its body swells to a stage aptly named red giant by astronomers. The dying phase of a massive star's life begins when its core—depleted of hydrogen—collapses in on itself. This rapid compression causes the star's internal temperature to soar. When the infalling material can no longer be compressed, the energy of the inward fall is converted to a cataclysmic expansion called a supernova.

26. Planet building occurs through the process of _____, which involves the clumping of small particles into larger masses.

- a. condensation
- b. coagulation
- c. secretion
- d. accretion
- e. aggregation

ANSWER: d

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-1 - Describe the processes of galaxy, star, and planet formation in the universe, and illustrate the life cycle of a star.

OTHER: Bloom's: Understand

NOTES: New planets form in a spinning disk of dust and debris through a process known as accretion—the clumping of small particles into large masses.

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27. The process by which stars form helium atoms from hydrogen is ____.
- accretion
 - condensation
 - nuclear fusion
 - density stratification
 - compression

ANSWER: c

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-2 - Explain how stars form heavier atoms from hydrogen.

OTHER: Bloom's: Understand

NOTES: Through nuclear fusion hydrogen atoms fuse to form helium, a process that liberates even more energy. Larger stars are hotter, and their internal nuclear reactions consume hydrogen at a much faster rate. In addition, higher core temperatures permit the formation of atoms—up to the mass of iron.

28. How long ago did the big bang catalyze the beginning of the universe?
- 13.7 billion years ago
 - 1.37 billion years ago
 - 4 billion years ago
 - 40 million years ago
 - 5 million years ago

ANSWER: a

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-1 - Describe the processes of galaxy, star, and planet formation in the universe, and illustrate the life cycle of a star.

OTHER: Bloom's: Remember

NOTES: The universe apparently had a beginning. The big bang, as that event is modestly named, occurred about 13.7 billion years ago.

29. What created Earth's moon?
- The initial big bang expansion event
 - The formation of a new star
 - Ejection of rocky mantle material from Earth after a collision with a smaller planet
 - The collision of two older moons
 - Ejection of rocky mantle material following an explosive volcanic event on Earth

ANSWER: c

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-2 - Describe the events that led to the formation of Earth's moon.

OTHER: Bloom's: Understand

NOTES: Shortly after Earth's formation, a planetary body somewhat larger than Mars smashed into the young Earth and broke apart. The metallic core fell into Earth's core and joined with it, while most of the rocky mantle was ejected to form a ring of debris around Earth. The debris began condensing soon after and became our moon.

30. Through gravitational compression, Earth's layers were formed by the process of ____.
- plate tectonics

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- b. accretion
- c. density stratification
- d. subduction
- e. condensation

ANSWER: c

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-1 - Discuss the process of density stratification and how it contributed to the formation of Earth's young ocean.

OTHER: Bloom's: Understand

NOTES: Gravitational compression and heat from decaying radioactive elements accumulating deep within the newly assembled planet caused Earth to partially melt. Gravity pulled most of the iron and nickel inward to form the planet's core. The sinking iron released huge amounts of gravitational energy, which, through friction, heated Earth even more. At the same time, a slush of lighter minerals— silicon, magnesium, aluminum, and oxygen-bonded compounds— rose toward the surface, forming Earth's crust. This important process, called density stratification, lasted perhaps 100 million years.

31. How long did the process of density stratification of Earth last?

- a. 100 million years
- b. 100 thousand years
- c. 10 billion years
- d. 1 billion years
- e. 50 million years

ANSWER: a

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-1 - Discuss the process of density stratification and how it contributed to the formation of Earth's young ocean.

OTHER: Bloom's: Remember

NOTES: The density stratification of Earth lasted perhaps 100 million years.

32. Earth's early atmosphere contained high concentrations of ____.

- a. oxygen and nitrogen
- b. carbon dioxide and oxygen
- c. oxygen and methane
- d. oxygen and ammonia
- e. carbon dioxide and nitrogen

ANSWER: e

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-3 - Compare and contrast Earth's present and early atmospheres.

OTHER: Bloom's: Remember

NOTES: The composition of the early atmosphere was much different from today's. Geochemists believe it may have been rich in carbon dioxide, nitrogen, and water vapor, with traces of ammonia and methane.

33. The dependence of all living cells on ____ to survive strongly suggests that simple, living molecules originated in the ocean.

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- a. fresh water
- b. saline water
- c. carbon dioxide
- d. oxygen
- e. methane

ANSWER: b

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-1 - Assess the evidence that suggests life began in the ocean.

OTHER: Bloom's: Analyze

NOTES: The fact that all life, from a jellyfish to a dusty desert weed, depends on saline water within its cells to dissolve and transport chemicals is certainly significant. It strongly suggests that simple, self-replicating—living—molecules arose somewhere in the early ocean. It also strongly suggests that all life on Earth is of common origin and ancestry.

34. Which condition of early Earth contributed to biosynthesis?
- a. oxygen-depleted atmosphere
 - b. ozone in the upper atmosphere
 - c. oxygen in the atmosphere
 - d. extreme high temperatures
 - e. aerobic conditions

ANSWER: a

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-2 - Reconstruct the conditions of early Earth that contributed to the biosynthesis of living organisms.

OTHER: Bloom's: Apply

NOTES: A similar biosynthesis seems unlikely to occur today. Living things have changed the conditions in the ocean and atmosphere, and those changes are not consistent with any new origin of life. For one thing, green plants have filled the atmosphere with oxygen. For another, some of this oxygen (as ozone) now blocks most of the dangerous wavelengths of light from reaching the surface of the ocean. And finally, the many tiny organisms present today would gladly scavenge any large organic molecules as food.

35. What had the most influence in irreversibly changing Earth's atmosphere?
- a. Formation of carbonic acid in the ocean
 - b. Production of oxygen from photosynthesis
 - c. Chemical breakup of water vapor by sunlight
 - d. Fluctuation in the atmospheric composition
 - e. Anaerobic respiration by deep-sea organisms

ANSWER: b

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-2 - Reconstruct the conditions of early Earth that contributed to the biosynthesis of living organisms.

OTHER: Bloom's: Understand

NOTES: Living things have changed the conditions in the ocean and atmosphere, and those changes are not consistent with any new origin of life. For one thing, green plants have filled the atmosphere with oxygen. The ancestors of today's green plants produced—by

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photosynthesis— enough oxygen to oxidize minerals dissolved in the ocean and surface sediments. Oxygen began to accumulate in the atmosphere.

36. What is the age of the oldest evidence yet found with remnants of life?

- a. 1.5 billion years old
- b. 2.7 million years old
- c. 3.85 billion years old
- d. 4.2 billion years old
- e. 6 million years old

ANSWER: c

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-2 - Reconstruct the conditions of early Earth that contributed to the biosynthesis of living organisms.

OTHER: Bloom's: Remember

NOTES: Evidence of an ancient beginning has been found in the form of carbon-based residues in some of the oldest rocks on Earth, from Akilia Island near Greenland. These 3.85-billion-year-old specks of carbon bear a chemical fingerprint that many researchers feel could only have come from a living organism.

37. Which extreme environment may have favored the origin of life on Earth?

- a. polar sea ice
- b. hydrothermal vents
- c. estuarine bays
- d. dry mountain rocky outcrops
- e. rainforest sediments

ANSWER: b

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-2 - Reconstruct the conditions of early Earth that contributed to the biosynthesis of living organisms.

OTHER: Bloom's: Understand

NOTES: Weak sunlight and unstable conditions on Earth's surface may have favored the origin of life on mineral surfaces near deep-ocean hydrothermal vents.

38. The end of Earth's life cycle will occur as a result of the sun's ____ phase.

- a. supernova
- b. red giant
- c. protostar
- d. nebula
- e. accretion

ANSWER: b

REFERENCES: 1-6 What Will Be Earth's Future?

LEARNING OBJECTIVES: OCEA.GARR.16.1-6-1 - Label a timeline of Earth's history and future, and describe the events that may occur at the end of Earth's life cycle.

OTHER: Bloom's: Understand

NOTES: Our descendants may enjoy another 5 billion years of life on Earth, as we know it today. But then our sun, like any other star, will begin to die. The sun is not massive enough to become a

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supernova, but after a billion-year cooling period, the re-energized sun's red-giant phase will engulf the inner planets.

39. Which condition is necessary for a planet to have a permanent liquid ocean?

- a. low gravity
- b. double sun
- c. toxic atmosphere
- d. irregular orbits
- e. optimum distance from star

ANSWER: e

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-1 - Describe the planetary conditions necessary for a sustained liquid ocean of water.

OTHER: Bloom's: Remember

NOTES: Consider the conditions necessary for a large, permanent ocean of liquid water to form on a planet. An ocean world must move in a nearly circular orbit around a stable star. The distance of the planet from the star must be just right to provide a temperate environment in which water is liquid. Unlike most stars, a water planet's sun must not be a double or multiple star, or the orbital year would have irregular periods of intense heat and cold. The materials that accreted to form the planet must have included both water and substances capable of forming a solid crust. The planet must be large enough that its gravity will keep the atmosphere and ocean from drifting off into space.

40. The moon Europa has an icy ocean with perhaps 40 times the water as Earth. Which planetary body does Europa orbit?

- a. Titan
- b. Jupiter
- c. Saturn
- d. Ganymede
- e. Mars

ANSWER: b

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-2 - Summarize the methods that have shown, or may potentially show, evidence of the existence (past and present) of water on other planets and moons in our solar system.

OTHER: Bloom's: Remember

NOTES: Europa, a moon of Jupiter, contains an ocean with a cracked, icy crust covering what appears to be a slushy mix of ice and water. The volume of this ocean is astonishing. Though Europa is slightly smaller than our own moon, its ocean averages about 160 kilometers (100 miles) deep. The amount of water in its ocean is perhaps 40 times that of Earth's.

41. Photographs of smoothed streambed rock with surfaces eroded by water-driven pebbles from the surface of _____ provide evidence of past water flow.

- a. Europa
- b. Saturn
- c. Jupiter
- d. Mars

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e. Titan

ANSWER:

d

REFERENCES:

1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES:

OCEA.GARR.16.1-7-2 - Summarize the methods that have shown, or may potentially show, evidence of the existence (past and present) of water on other planets and moons in our solar system.

OTHER:

Bloom's: Remember

NOTES:

In September 2012, a camera aboard the Mars rover Curiosity sent photos from the surface of Mars showing clear evidence that water once flowed there. A fractured outcrop of smoothed streambed rock is seen with surfaces eroded by water-driven pebbles. Some bits of gravel show the characteristic rounded shapes that result from turbulence in stream flow.

42. High levels of ____ could indicate life on other planets.

- a. free nitrogen
- b. carbon dioxide
- c. free oxygen
- d. methane
- e. ozone

ANSWER:

c

REFERENCES:

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OTHER:

Bloom's: Understand

NOTES:

If a planet is found with lots of free oxygen, something is probably replenishing that oxygen. That "something" is probably life. The action of photosynthetic organisms (including plants) produces excess oxygen. Without photosynthesis, Earth's atmosphere would be all but oxygen-free. Life—at least on Earth—almost certainly originated in the ocean. If the atmosphere of distant planets contains significant quantities of oxygen, oceans and life might be possible.

43. What could ultimately be linked to the present absence of water on Mars?

- a. The large decrease in carbon dioxide
- b. The proximity to the sun
- c. The lack of free oxygen in the atmosphere
- d. The lack of outgassing from the interior of the planet
- e. Excess carbon dioxide

ANSWER:

a

REFERENCES:

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OTHER:

Bloom's: Understand

NOTES:

Evidence shows the past existence of water on Mars. Where is it now? Over the eons, rocks on the Martian surface absorbed the carbon dioxide, and the atmosphere grew thin and cold. The ocean disappeared, its water binding to rocks or freezing beneath the planet's surface. Mars has become much colder in the past billion years, perhaps because of the loss of

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greenhouse gases in the atmosphere.

44. Which environment on Earth could possibly mimic conditions on other planets, and, therefore, be of scientific interest?

- a. open ocean surface waters
- b. estuarine marsh ecosystems
- c. dry Arctic rock environments
- d. prairie grass ranges
- e. tropical forest regions

ANSWER: c

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-2 - Summarize the methods that have shown, or may potentially show, evidence of the existence (past and present) of water on other planets and moons in our solar system.

OTHER: Bloom's: Evaluate

NOTES: Dr. Kevin Hand discusses life in extreme environments, some of which could mimic conditions on other planets.

45. An ocean of ____ has been photographed on the surface of Titan.

- a. icy, slushy water
- b. frozen water
- c. water-smoothed rock
- d. liquid hydrocarbons
- e. liquid nitrogen

ANSWER: d

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-2 - Summarize the methods that have shown, or may potentially show, evidence of the existence (past and present) of water on other planets and moons in our solar system.

OTHER: Bloom's: Remember

NOTES: In late 2004 the spacecraft Cassini photographed what appears to be a cold liquid ocean of methane, ethane, and other hydrocarbons, complete with islands, bays, and peninsulas on the surface of Titan, Saturn's largest moon.

Matching

Match the term with the corresponding description

- a. accretion
- b. theory
- c. outgassing
- d. nebulae
- e. waves and currents

OTHER: Bloom's: Remember

46. Ocean dynamics studied by physical oceanographers

ANSWER: e

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47. A statement that explains experimental observations

ANSWER: b

48. Large, diffuse clouds of dust and gas within galaxies

ANSWER: d

49. The process by which new planets formed from rotating dust and debris

ANSWER: a

50. Volcanic venting of volatile substances

ANSWER: c

Completion

51. The _____ may be defined as the vast body of saline water that occupies the depressions of Earth's surface.

ANSWER: ocean

REFERENCES: 1-1 Earth Is an Ocean World

LEARNING OBJECTIVES: OCEA.GARR.16.1-1-1 - Explain the concept of a single world ocean.

OTHER: Bloom's: Remember

52. Earth's ocean and sea divisions, such as the Pacific and Atlantic Oceans, are but temporary features of a(n) _____ world ocean.

ANSWER: single

REFERENCES: 1-1 Earth Is an Ocean World

LEARNING OBJECTIVES: OCEA.GARR.16.1-1-2 - Describe the characteristics of our single world ocean on a human and planetary scale.

OTHER: Bloom's: Remember

53. _____ is a systematic process of asking questions about the observable world by gathering and then studying information (data).

ANSWER: Science

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-1 - Discuss the interdisciplinary nature of marine science, and distinguish among the various areas of research in the field.

OTHER: Bloom's: Remember

54. The _____ method is an orderly process by which theories are verified or rejected.

ANSWER: scientific

REFERENCES: 1-2 Marine Scientists Use the Logic of Science to Study the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-2-2 - Outline the process of the scientific method, and apply it to an example.

OTHER: Bloom's: Remember

55. A(n) _____ is a huge, rotating aggregation of stars, dust, gas, and other debris held together by gravity.

ANSWER: galaxy

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-1 - Describe the processes of galaxy, star, and planet formation in the universe, and illustrate the life cycle of a star.

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OTHER: Bloom's: Remember

56. During nuclear fusion on a protostar, _____ atoms fuse to form helium atoms.

ANSWER: hydrogen

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-2 - Explain how stars form heavier atoms from hydrogen.

OTHER: Bloom's: Remember

57. Soon after Earth's formation, gravity pulled most of the iron and nickel inward to form the planet's core in a process call density _____.

ANSWER: stratification

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-1 - Discuss the process of density stratification and how it contributed to the formation of Earth's young ocean.

OTHER: Bloom's: Remember

58. Earth's _____ was formed from an ejection of debris caused by the collision of a planetary body with Earth.

ANSWER: moon

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-2 - Describe the events that led to the formation of Earth's moon.

OTHER: Bloom's: Remember

59. The oxygen in Earth's atmosphere was formed from the process of _____.

ANSWER: photosynthesis

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-3 - Compare and contrast Earth's present and early atmospheres.

OTHER: Bloom's: Remember

60. _____ is the process by which living organisms are formed from simple organic molecules.

ANSWER: Biosynthesis

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-1 - Assess the evidence that suggests life began in the ocean.

OTHER: Bloom's: Remember

61. Life in the ocean may have originated near _____ vents.

ANSWER: hydrothermal

REFERENCES: 1-5 Life Probably Originated in the Ocean

LEARNING OBJECTIVES: OCEA.GARR.16.1-5-2 - Reconstruct the conditions of early Earth that contributed to the biosynthesis of living organisms.

OTHER: Bloom's: Remember

62. The dying of Earth's _____ will mark the end of Earth's solar system.

ANSWER: sun

REFERENCES: 1-6 What Will Be Earth's Future?

LEARNING OBJECTIVES: OCEA.GARR.16.1-6-1 - Label a timeline of Earth's history and future, and describe the events that may occur at the end of Earth's life cycle.

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OTHER: Bloom's: Remember

63. A salty, liquid-water ocean has been detected on _____, a moon of Jupiter.

ANSWER: Europa or Ganymede

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-1 - Describe the planetary conditions necessary for a sustained liquid ocean of water.

OTHER: Bloom's: Remember

64. Evidence suggests that water recently flowed on the planet _____; however, water is not detected now.

ANSWER: Mars

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-2 - Summarize the methods that have shown, or may potentially show, evidence of the existence (past and present) of water on other planets and moons in our solar system.

OTHER: Bloom's: Remember

65. The presence of _____ on a planet could be an indication of past or present forms of life.

ANSWER: oxygen

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-2 - Summarize the methods that have shown, or may potentially show, evidence of the existence (past and present) of water on other planets and moons in our solar system.

OTHER: Bloom's: Remember

Subjective Short Answer

66. Describe the processes by which Earth formed.

ANSWER: The universe began during an expansion event known as the big bang approximately 13.7 billion years ago. During its early phases, the universe was very hot, but over time cooled and expanded to form hydrogen atoms. Further cooling led to the formation of galaxies, large, rotating aggregations of stars, dust, and gas held together by gravity. Stars and planets formed according to the condensation theory and accretion.

REFERENCES: 1-3 Stars Form Seas

LEARNING OBJECTIVES: OCEA.GARR.16.1-3-1 - Describe the processes of galaxy, star, and planet formation in the universe, and illustrate the life cycle of a star.

OTHER: Bloom's: Understand

67. Explain the process of density stratification as it applies to the formation of Earth.

ANSWER: During the accretion phase in the formation of Earth, gravitational compression combined with radioactive decay caused Earth to partially melt. Gravity pulled most of the heavier elements, such as iron and nickel, inward to form the planet's core. Lighter elements, such as silicon, magnesium, and aluminum, rose toward the surface, forming Earth's crust.

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-1 - Discuss the process of density stratification and how it contributed to the formation of Earth's young ocean.

OTHER: Bloom's: Understand

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68. Identify the components of early Earth's atmosphere, and explain how it changed to that of present day.

ANSWER: Earth's early atmosphere was rich in carbon dioxide, nitrogen, and water vapor, with traces of ammonia and methane. This mixture was gradually altered by carbon dioxide dissolving in seawater, the chemical breakup of water vapor by sunlight to form ozone, and photosynthesis of green plants to form oxygen. Earth's present atmosphere is composed primarily of nitrogen and oxygen.

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-3 - Compare and contrast Earth's present and early atmospheres.

OTHER: Bloom's: Analyze

69. Briefly, describe the formation of Earth's ocean.

ANSWER: During Earth's formation, gases trapped within the planet began to vent to the surface through volcanic outgassing. As the hot vapors rose, they condensed into clouds in the cool upper atmosphere. In addition, icy comets or asteroids colliding with Earth may have contributed a portion of the accumulating water on Earth. As Earth cooled, outgassed water began to form droplets and hot rains fell to Earth for millions of years forming a deep ocean.

REFERENCES: 1-4 Earth, Ocean, and Atmosphere Accumulated in Layers Sorted by Density

LEARNING OBJECTIVES: OCEA.GARR.16.1-4-1 - Discuss the process of density stratification and how it contributed to the formation of Earth's young ocean.

OTHER: Bloom's: Remember

70. Outline the conditions necessary for a planet to maintain an ocean of liquid water permanently.

ANSWER: The conditions necessary to maintain a large, permanent liquid ocean include the following: (1) a planet that moves in a nearly circular orbit around a stable star; (2) the distance of the planet from the star must be such to provide a temperate environment in which water is liquid; (3) the planet's sun must not be a double or multiple star that provides orbital years with irregular periods of intense heat and cold; (4) materials that accreted to form the planet must have included water and substance capable of forming a solid crust; and (5) the planet must be large enough that its gravity will keep the atmosphere and ocean from drifting off into space.

REFERENCES: 1-7 Are There Other Ocean Worlds?

LEARNING OBJECTIVES: OCEA.GARR.16.1-7-1 - Describe the planetary conditions necessary for a sustained liquid ocean of water.

OTHER: Bloom's: Understand