Merritts *Environmental Geology* 2e
Chapter 2: Solid Earth Systems and Geologic Time

1. Which feature or process is found in close association with, and proximity to, subduction zones?
    a. Mid-ocean ridges
    b. Deep trenches
    c. Seafloor spreading
    d. Continental rifting

   Answer: b
   Section 1: Introduction
   Bloom's Taxonomy Level: Comprehension
   Format: Multiple Choice

2. Which event occurred when the Isthmus of Panama land bridge opened about 3 million years ago?
    a. North American placental mammals decimated the South American marsupials.
    b. North American marsupials decimated the South American placental mammals.
    c. South American marsupials decimated the North American placental mammals.
    d. There was no interaction between the different continental groups.

   Answer: a
   Section 1: Introduction
   Bloom's Taxonomy Level: Knowledge
   Format: Multiple Choice

3. Which device ultimately validated Wegener's hypothesis about continental movement over geologic time?
    a. Satellite
    b. Submarine
    c. Seismograph
    d. Survey instrument

   Answer: a
   Section 1: Introduction
   Bloom's Taxonomy Level: Knowledge
   Format: Multiple Choice

4. Which continent experienced a dramatic increase in genera after the American land bridge opened up in the Pleistocene?
    a. North America
    b. Africa
    c. Asia
    d. South America

   Answer: d
   Section 1: Introduction
   Bloom's Taxonomy Level: Analysis
   Format: Multiple Choice

5. Which term do scientists use to describe an idea that has been subjected to repeat testing, explains a multitude of phenomena, and has survived all challenges?
    a. Well tested hypothesis
    b. Unifying theory
    c. Good argument
    d. Universal insight

   Answer: b
   Section 2: An Early Conundrum and the Scientific Method
   Bloom's Taxonomy Level: Comprehension
   Format: Multiple Choice

6. Before the theory of continental movement was hypothesized, which scientific theory was used to explain the existence of identical fossils found on different continents separated by thousands of miles of ocean?
    a. All life on Earth originated in the Mediterranean and was redistributed by a great flood.
    b. Earth was covered by an unbroken land mass that eventually shrank, and the gaps were filled in by oceans.
    c. Meteorites rained down on Earth and brought the same life forms to different continents.
    d. In the beginning, there was no water and all the continents were connected with land bridges until rain filled in the oceans.

   Answer: b
   Section 2: An Early Conundrum and the Scientific Method
   Bloom's Taxonomy Level: Knowledge
   Format: Multiple Choice

7. Some people claim that since the current winter is colder than last year this constitutes justifiable evidence against the claim that global warming is occurring. Which term applies to this belief?
    a. Reality
    b. Law
    c. Theory
    d. Pseudoscience

   Answer: d
   Section 2: An Early Conundrum and the Scientific Method
   Bloom's Taxonomy Level: Comprehension
   Format: Multiple Choice

8. Which of the following would be formulated by a scientist who observes two monkeys wrestling in the jungle and believes it is related to habitat loss?
    a. Unifying theory
    b. Hypothesis
    c. Theory
    d. Scientific law

Answer: b
Section 2: An Early Conundrum and the Scientific Method
Bloom's Taxonomy Level: Comprehension
Format: Multiple Choice

9. Which term applies to the theory of plate tectonics?
    a. Unifying theory
    b. Hypothesis
    c. Theory
    d. Scientific law

Answer: a
Section 2: An Early Conundrum and the Scientific Method
Bloom's Taxonomy Level: Comprehension
Format: Multiple Choice

10. Which is the least reliable way to differentiate oceanic crust from continental crust?
    a. Color
    b. Chemical composition
    c. Density
    d. Thickness

Answer: a
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Knowledge
Format: Multiple Choice

11. Which of the following is an example of a divergent plate boundary?
    a. Andes Mountains of South America
    b. San Andreas fault, California
    c. Mid-Atlantic Ridge
    d. Hawaiian Islands

Answer: c
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Application
Format: Multiple Choice

12. Which process causes lava to form from rising mantle rocks at mid-oceanic ridges?
    a. Temperature increase
    b. Pressure reduction
    c. Magnetic reversal
    d. Seawater cooling

Answer: b
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Comprehension
Format: Multiple Choice

13. Which plate boundary feature is expressed by the San Andreas Fault?

a. Continental rift zone
b. Continental transform fault
c. Oceanic transform fault
d. Subduction zone

Answer: b
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Comprehension
Format: Multiple Choice

14. Which kind of active plate boundary is constantly making new crust?
    a. Convergent
    b. Transform fault
    c. Divergent
    d. Subduction zone

    Answer: c
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Comprehension
    Format: Multiple Choice

15. On which continent will a land-based valley soon (in geologic time) become an ocean basin due to two plates separating? Pick the location where this will happen first.
    a. North America
    b. Australia
    c. Africa
    d. Europe

    Answer: c
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Knowledge
    Format: Multiple Choice

16. In which location can you observe an active mid-oceanic ridge without the use of a submarine?
    a. California
    b. Iceland
    c. Hawaii
    d. Africa

    Answer: b
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Knowledge
    Format: Multiple Choice

17. Where should you go if you want to observe rocks recently produced by an active subduction zone?
    a. Main
    b. Alaska
    c. Hawaii

d. Colorado

Answer: b
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Application
Format: Multiple Choice

18. Which event is occurring at volcanic island arcs?
    a. Rifting
    b. Transform fault
    c. Subduction
    d. Divergence

Answer: c
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Comprehension
Format: Multiple Choice

19. Which feature is expressed by the Red Sea?
    a. Flooded continental rift
    b. Mid-oceanic ridge extension
    c. Deep ocean trench
    d. Continental-continental collision

Answer: a
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Analysis
Format: Multiple Choice

20. Which feature would generally produce normal faulting?
    a. Volcanic island arc
    b. Subduction zone
    c. Rift valley
    d. Continental-continental collision

Answer: c
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Comprehension
Format: Multiple Choice

21. Which event created the Atlantic Ocean 200 million years ago?
    a. Breakup of Pangaea
    b. Collision of North America with Africa
    c. Ocean crust subduction
    d. Chixilub meteorite impact

Answer: a
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Knowledge
Format: Multiple Choice

22. Which event created the Marianas Trench?
    a. Oceanic-oceanic convergence
    b. Continental rift
    c. Continental-continental convergence
    d. Mid-oceanic spreading center

    Answer: a
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Analysis
    Format: Multiple Choice

23. Which event generally occurs just before a continental-continental collision?
    a. Inland arc formation
    b. Subduction
    c. Normal faulting
    d. Rifting

    Answer: b
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Comprehension
    Format: Multiple Choice

24. If the current movement of plates that make up the Atlantic Ocean continues in the same direction for another 200 million years, which event will occur?
    a. The North American land mass will connect to South America.
    b. The Pacific Ocean will get smaller.
    c. Tide levels in the Atlantic Ocean will increase.
    d. Africa will collide with South America.

    Answer: b
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Synthesis
    Format: Multiple Choice

25. You are standing on the trace of a strike-slip fault and looking in the direction that the fault is trending (called the strike). You note that about 50 feet away there is a fence running perpendicular to the strike of the fault that crosses the fault trace. Recent movement on the fault has offset the fence on the left side of the fault about five feet toward you. Which kind of fault is this?
    a. Normal
    b. Reverse
    c. Right lateral
    d. Left lateral

    Answer: d
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Analysis
    Format: Multiple Choice

26. Which fault type accounts for the jagged nature of mid-oceanic ridges?

a. Transform
b. Normal
c. Thrust
d. Reverse

Answer: a
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Comprehension
Format: Multiple Choice

27. Which feature parallels a continental-oceanic convergence?
    a. Transform fault
    b. Offshore volcanic arc
    c. Inland volcanic arc
    d. Normal fault

    Answer: c
    Section 3: Plate Properties and Motions
    Bloom's Taxonomy Level: Comprehension
    Format: Multiple Choice

28. Which instrument developed during World War II to detect German U-boats led to the discovery of pole reversals?
    a. Seismometer
    b. Radio
    c. Scintillometer
    d. Magnetometer

    Answer: d
    Section 4: Piecing the Theory Together
    Bloom's Taxonomy Level: Knowledge
    Format: Multiple Choice

29. Which statement about magnetic minerals in rocks is accurate?
    a. At the North Pole, the magnetization direction will point straight down.
    b. The magnetic minerals in sedimentary rocks are not lined up with the magnetic field because they did exceed the Curie point.
    c. In igneous rocks, the magnetic minerals line up consistently with the magnetic field lines.
    d. The Curie point temperature exceeds the temperature at which lavas cool.

    Answer: a
    Section 4: Piecing the Theory Together
    Bloom's Taxonomy Level: Knowledge
    Format: Multiple Choice

30. An examination of a magnetic polarity timescale (Figure 2.14) reveals that the youngest rocks are offset. Which phenomenon accounts for this offset?
    a. Transform faulting
    b. Change in Curie point over time

c. Preferential flow of lava
d. Shift in the rift location over time

Answer: a
Section 4: Piecing the Theory Together
Bloom's Taxonomy Level: Analysis
Format: Multiple Choice

31. Which event explains the discrepancy between the magnetization direction of young lava flows versus the magnetization direction of old lava flows?
    a. Rocks re-magnetized when the poles switched.
    b. Rocks have moved long distance since they were formed.
    c. Weathering of the minerals has allowed them to re-orient.
    d. Meteorite impacts shifted the rocks from their original position.

    Answer: b
    Section 4: Piecing the Theory Together
    Bloom's Taxonomy Level: Knowledge
    Format: Multiple Choice

32. Which event confirmed Wegener's hypothesis?
    a. When North America was fit together with Eurasia, the apparent polar wander paths merged.
    b. Mid-oceanic ridges were discovered by submarines during World War II.
    c. Radiometric dating was used to date lava flows at the mid-oceanic ridges so that a magnetic polarity timescale could be constructed.
    d. It was discovered that oceanic crust is much younger than continental crust.

    Answer: a
    Section 4: Piecing the Theory Together
    Bloom's Taxonomy Level: Comprehension
    Format: Multiple Choice

33. Which insight was revealed during the construction of the magnetic polarity timescale?
    a. Magnetic polarity occurs randomly in rocks.
    b. Lava only flows in a north-south direction at mid-oceanic ridges.
    c. Lava flows of the same age yield different magnetic polarities.
    d. Lava flows of the same age yield the same magnetic polarity.

    Answer: d
    Section 4: Piecing the Theory Together
    Bloom's Taxonomy Level: Knowledge
    Format: Multiple Choice

34. Which contribution did the *Glomar Challenger* make to the theory of plate tectonics?
    a. The age of the oceanic crust gets older toward a continent.
    b. The age of the oceanic crust gets younger toward a continent.
    c. The thickness of lava flows decreases with distance from mid-oceanic ridges.
    d. The thickness of oceanic sediments decreases with distance from a mid-oceanic ridge.

Answer: a
Section 4: Piecing the Theory Together
Bloom's Taxonomy Level: Knowledge
Format: Multiple Choice

35. Which event is associated with Wadati-Benioff zones?
    a. Tornadoes
    b. Hurricanes
    c. Meteorite impacts
    d. Earthquakes

    Answer: d
    Section 4: Piecing the Theory Together
    Bloom's Taxonomy Level: Analysis
    Format: Multiple Choice

36. Which type of heat transfer results in density-driven flow?
    a. Convection
    b. Conduction
    c. Reduction
    d. Conviction

    Answer: a
    Section 5: The Driver of Plate Tectonics
    Bloom's Taxonomy Level: Comprehension
    Format: Multiple Choice

37. Which term applies to locations where heat rising up from Earth's interior is not predicted by plate tectonic theory?
    a. Poles
    b. Hot spots
    c. Rifts
    d. Oceanic ridges

    Answer: b
    Section 5: The Driver of Plate Tectonics
    Bloom's Taxonomy Level: Comprehension
    Format: Multiple Choice

38. Which conflicting evidence has been revealed by imaging of Earth's interior?
    a. It has failed to demonstrate that all hot spots reside above large reservoirs of molten rock.
    b. It has shown that only continental-based hot spots occur over zones of warm, plastic rocks.
    c. Initial studies indicate that mantle rocks are actually molten.
    d. Some European studies indicate that the outer core is not molten.

    Answer: a
    Section 5: The Driver of Plate Tectonics
    Bloom's Taxonomy Level: Knowledge

Format: Multiple Choice

39. Which determination could be made if the Hawaiian hot spot is fixed in position?
    a. Direction of circular motion of the North Pacific gyre
    b. Validity of the gravitational plate tectonic driver
    c. Thicknesses of the stratosphere since Triassic time
    d. Long-term speed and direction of the Pacific Plate

    Answer: d
    Section 5: The Driver of Plate Tectonics
    Bloom's Taxonomy Level: Comprehension
    Format: Multiple Choice

40. If the Hawaiian hot spot is migrating, what happened 41–43 million years ago?
    a. Direction of hot spot movement changed from south to southeast.
    b. Direction of hot spot movement changed from northwest to north
    c. The hot spot cooled off and disappeared.
    d. Direction of plate movement changed from south to southeast.

    Answer: a
    Section 5: The Driver of Plate Tectonics
    Bloom's Taxonomy Level: Analysis
    Format: Multiple Choice

True or False

1. Wegener's proposal that the continents were once joined together has been disproven by the theory of plate tectonics.
   Answer: False
   Section 1: Introduction
   Bloom's Taxonomy Level: Comprehension
   Format: True/False

2. The San Andreas Fault is a right lateral strike slip fault.
   Answer: True
   Section 3: Plate Properties and Motions
   Bloom's Taxonomy Level: Analysis
   Format: True/False

3. One way to decide if a belief is pseudoscience is by determining whether it can be tested and the results duplicated by others.
   Answer: True
   Section 2: An Early Conundrum and the Scientific Method
   Bloom's Taxonomy Level: Comprehension
   Format: True/False

4. The Arabian Plate was part of the African Plate until it was rifted apart and separated by the Red Sea.

Answer: True
Section 3: Plate Properties and Motions
Bloom's Taxonomy Level: Comprehension
Format: True/False

5. Japan is a volcanic arc.
   Answer: True
   Section 3: Plate Properties and Motions
   Bloom's Taxonomy Level: Application
   Format: True/False

Essay

1. Explain why science has been so successful at determining why some beliefs are justified and some are not.

   Answer: Science has become so successful at determining which beliefs are justified because it involves developing an explanation (called a hypothesis) that can be tested. Even better, the hypothesis can be tested not just by the individual who created the hypothesis, but by other scientists. This methodology allows predictions to be made that then can be used to evaluate the worthiness of the hypothesis.
   Section 2: An Early Conundrum and the Scientific Method
   Bloom's Taxonomy Level: Comprehension
   Format: Essay

2. Discuss the formation of the Appalachian Mountains and the Atlantic Ocean.

   Answer: About 300 to 400 million years ago, all the plates combined to create the supercontinent Pangaea. These continental collisions created the Appalachian Mountains. When Pangaea broke apart about 200 million years ago, the Atlantic Ocean formed.
   Section 3: Plate Properties and Motions
   Bloom's Taxonomy Level: Analysis
   Format: Essay

3. Explain the reasoning behind J. Tuzo Wilson's insights into the nature of transform fault and the implications of his insight.

   Answer: Wilson was the first person to realize that transform faults along mid-ocean ridges are evidence of seafloor spreading. As oceanic crust moves away from spreading ridges, the crust breaks into segments delineated by transform faults that are perpendicular to the ridge. Wilson noticed that the sense of motion is opposite that of a traditional strike-slip fault, implying that the segments are spreading along the ridge.
   Section 3: Plate Properties and Motions
   Bloom's Taxonomy Level: Comprehension
   Format: Essay

4. Explain the difference between magnetic mineral alignment and magnetization direction in sedimentary and igneous rocks.

   Answer: Magnetic mineral alignment occurs in sedimentary rocks as magnetic minerals become aligned parallel to Earth's magnetic field, as the sediments are in the process of lithification. Similarly, as lava cools below the Curie point (570°C) the magnetic crystals lock in the orientation of the field, but the minerals do not become aligned because the rocks cool at temperatures above 900°C.
   Section 4: Piecing the Theory Together
   Bloom's Taxonomy Level: Comprehension
   Format: Essay

5. Contrast the differences and implications between the two theories used to explain the driving force behind plate tectonics.

   Answer: The two theories are convection-driven flow versus gravity-driven flow. The convection model is fueled by heat emanating from the core that carries mantle material to the surface at hot spots and mid-oceanic ridges. The gravitational model assumes that the motion of the lithospheric plates induces flow in the underlying asthenosphere, which is in direct conflict with the convection model.
   Section 5: The Driver of Plate Tectonics
   Bloom's Taxonomy Level: Comprehension
   Format: Essay