Chapter 2— A History of Marine Science

MULTIPLE CHOICE

1. Which of the following people would probably be given the title of "first ocean scientist"?
   a. Matthew Maury
   b. Captain James Cook
   c. Christopher Columbus
   d. Wyville Thompson (of the *Challenger* expedition)

   ANS: B PTS: 1
   REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies
2. Which of the following voyages would qualify as the first 100 percent pure scientific oceanographic expedition?
   a. Columbus' 1496 trip
   b. the *Challenger* expedition
   c. Benjamin Franklin's first voyage across the Atlantic to take up his post as American Ambassador to France
   d. Captain Cook's voyage to Tahiti in the ship *Endeavour*

   ANS: B PTS: 1
   REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies
3. Longitude can be determined with the use of a(n) _____.
   a. pendulum clock
   b. echo sounders
   c. chronometer
   d. remote operated vehicle

   ANS: C PTS: 1
   REF: 2.2 Voyaging Combined With Science to Advance Ocean Studies
4. The future of oceanographic research appears to lie:
   a. with single, isolated individuals working alone.
   b. with epic voyages.
   c. with the cooperative efforts of the great private, institutional, and national oceanographic institutions.
   d. with the military agencies of the world.

   ANS: C PTS: 1
   REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology
5. Which of the following men was the first to publish a reasonably accurate chart of an ocean current, specifically the Gulf Stream?
   a. Edward Forbes
   b. John Harrison
   c. Benjamin Franklin
   d. Captain James Cook

   ANS: C PTS: 1
   REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies
6. Polynesian navigators depended on all of the following unique strategies for accurate navigation EXCEPT:
   a. the direction and characteristics of waves
   b. navigational charts made with bamboo and shells
   c. the positions of stars
   d. the chronometer

ANS: D PTS: 1
REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

7. Captain James Cook accomplished all of these tasks *EXCEPT*:
   a. first European to contact the Hawaiian Islands
   b. first to circumnavigate the world near Antarctica
   c. first European to explore the South Pacific
   d. mapped the coasts of Australia and New Zealand

   ANS: C PTS: 1
   REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

8. The word "oceanography" was first coined in association with:
   a. Cook's third voyage.
   b. the *Challenger* expedition.
   c. Columbus' fourth and final voyage.
   d. Captain James Cook's first voyage.

   ANS: B PTS: 1
   REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

9. Which of the following statements is *FALSE* regarding latitude and longitude?
   a. Longitude lines are drawn parallel to the equator while latitude lines are drawn from pole to pole.
   b. Latitude and longitude is a system of imaginary lines dividing the Earth's surface into a grid.
   c. The distance between the lines of longitude varies with latitude while the lines of latitude are always equidistant.
   d. Zero latitude is the equator and zero longitude is Greenwich, England, or the prime meridian.

   ANS: A PTS: 1
   REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

10. The first scientific expedition to use an echo sounder was:
    a. the *Challenger* expedition.
    b. the *Meteor* expedition.
    c. the United States *Exploring* expedition.
    d. the voyage of *Trieste*.

    ANS: B PTS: 1
    REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

11. A(n) ____ is a graphic representation that depicts information about the ocean and ocean features including depth.
    a. map
    b. echo sounder
    c. chart
    d. atlas

    ANS: C PTS: 1
    REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

12. The navigator in the early 1500s who was influential in charting and opening a trade route from Europe to the Orient was:
    a. Ferdinand Magellan.
    b. Captain James Cook.
    c. Christopher Columbus.
    d. Prince Henry the Navigator.

ANS: A PTS: 1
REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

13. *Glomar Challenger* is known mainly for:
    a. being the first modern scientific survey ship to circumnavigate the globe.
    b. being the first nuclear powered scientific research vessel.
    c. being owned and operated simultaneously by four governmental agencies.
    d. taking the first complete cores of deep-sea sediments.

    ANS: D PTS: 1
    REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

14. The first person to develop a picture of the large-scale wind and current systems of the Earth was:
    a. Ben Franklin.
    b. Matthew Maury.
    c. Eratosthenes of Cyrene.
    d. Wyville Thomson.

    ANS: B PTS: 1
    REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

15. Why did the Chinese abandon ocean exploration in 1433?
    a. They were too slow in developing ships that would allow them to stay at sea for long periods of time.
    b. They were distracted by the Dark Ages.
    c. They were not interested in showing the wealth or power of the Ming Dynasty to other peoples of the world.
    d. Political winds changed, and the cost of the exercise was deemed too great.

    ANS: D PTS: 1
    REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

16. Contributions by early Chinese scientists and philosophers include all of these EXCEPT:
    a. developing seagoing methods that allowed them to stay at sea for nearly four months.
    b. retrofitting their ships with multi-masts to sail more efficiently with changing winds.
    c. development of the chronometer.
    d. designing and developing rudders and watertight compartments.

    ANS: C PTS: 1
    REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

17. Which of the following statements is true about Christopher Columbus and his explorations?
    a. His goal was to discover new lands.
    b. Like many early explorers, Columbus thought the Earth was flat.
    c. One of Columbus' biggest mistakes is that he estimated the Earth to be only about half of its true size.
    d. He was the first explorer to see the mainland of North America.

    ANS: C PTS: 1
    REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

18. The importance of Matthew Maury's work included:
    a. the discovery of the Hawaiian Islands.
    b. the formulation of a working hypothesis for the formation of coral reefs.
    c. the invention of a chronometer for the determination of longitude.
    d. the charting of ocean currents that sailors used to significantly shorten their travel time.

    ANS: D PTS: 1
    REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

19. Which of the following technologies available to modern oceanographers in the last few decades has revolutionized our ability to study the ocean?

a. remote sensing via ROV's and satellites
b. shipboard SONAR
c. leadline soundings
d. the compass and chronometer

ANS: A PTS: 1
REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

20. The *Challenger* expedition (1872-1876) was a unique and historic voyage. Which of the following statements about the expedition is NOT true?
a. it is the single longest continuous oceanographic expedition ever.
b. the *Challenger* scientists developed the first reliable navigational charts to indicate current and wind patterns.
c. it led to the development of two new fields of science – marine biology and oceanography.
d. the data collected on the expedition was published in an astonishing 50 volume set that is still used today.

ANS: B PTS: 1
REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

21. Edward Forbes was an Edinburgh professor who thought that:
a. life was plentiful in the deep sea.
b. there was an easy route to the orient from Europe.
c. no life existed in the deep sea because of high pressure and no light.
d. the Pacific Ocean was much smaller than it truly is.

ANS: C PTS: 1
REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

22. Scientific contributions made by the *Challenger* expedition that influenced our understanding of marine science include all of the following *EXCEPT*:
a. the discovery of new species and life in the deep sea.
b. the discovery of the Hawaiian Islands.
c. detailed analysis of seawater samples from all over the world.
d. new information on ocean currents and the distribution of sediments.

ANS: B PTS: 1
REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

23. Polar oceanography began with:
a. Forbes.
b. Wilkes.
c. Thompson.
d. Nansen.

ANS: D PTS: 1
REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

24. The first technology to replace weighted lines for making detailed measurements of the contours of the ocean floor was:
a. echo sounders
b. satellites
c. bathyscaphes
d. submersibles

ANS: A PTS: 1
REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

25. Current technologies used in modern marine science include all of the following *Except*:
a. remotely operated vehicles.
b. chronometers.

c. echo sounders.
d. oceanographic satellites.

ANS: B PTS: 1 REF: p. 41-45

26. Information about the ocean that satellites can provide to scientists include all of the following *EXCEPT*:
a. sea surface height.
b. sea surface temperature.
c. wave height.
d. sea floor sedimentation rate.

ANS: D PTS: 1
REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

27. The scientist who charted the Gulf Stream in 1769 was:
a. Darwin
b. Forbes
c. Magellan
d. Benjamin Franklin.

ANS: D PTS: 1
REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

28. The Navy Officer who first compiled information about winds and currents was:
a. Edward Forbes.
b. Charles Darwin.
c. Matthew Maury.
d. Tim Folger

ANS: C PTS: 1
REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

29. The Portuguese explorer who first attempted to circumnavigate the world in the early 1500's was:
a. Magellan.
b. Forbes.
c. Thompson.
d. Cook.

ANS: A PTS: 1
REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

30. The invention of the compass is attributed to the:
a. Americans
b. Chinese
c. Spanish
d. British

ANS: B PTS: 1
REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

TRUE/FALSE

1. A chronometer is a timepiece that can be used to determine longitude.
ANS: T PTS: 1
REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies
2. Humanity did not spread to all the inhabitable areas of Earth until after the European voyages of discovery in the late 1400s and early 1500s.
ANS: F PTS: 1
REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

3. The first awareness of the spherical shape of the Earth developed in Europe around 1450 with the work of Henry the Navigator. During the European Age of Discovery, Henry the Navigator was the first to recognize that Earth was spherical.
   ANS: F PTS: 1
   REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration
4. The Library of Alexandria was an important gathering place for intellectuals, stored the works of scholars, and contained current information about discoveries in trade and navigation.
   ANS: T PTS: 1
   REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration
5. A cartographer makes charts and maps.
   ANS: T PTS: 1
   REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration
6. Eratosthenes was a scientist who was interested in the size of Earth and used methods of geometry to determine the circumference of our planet.
   ANS: T PTS: 1
   REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration
7. Latitude is a measurement that uses the prime meridian (Greenwich, England) as a reference point for determining the exact location of a specific point on Earth.
   ANS: F PTS: 1
   REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration
8. The Hawaiian Islands were one of the last of the Pacific Islands to be colonized by the Polynesians because it is the farthest away, some 2,000 miles from other islands.
   ANS: T PTS: 1
   REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration
9. Captain Cook was the first scientist to drift in the ice pack of the Arctic.
   ANS: F PTS: 1
   REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies
10. A compass is a navigational tool that points to magnetic north.
    ANS: T PTS: 1
    REF: 2.1 Understanding the Ocean Began with Voyaging for Trade and Exploration

ESSAY

1. Modern technologies enable scientists to acquire information about the ocean relatively rapidly. How have satellites changed the way we perceive, navigate, and study the ocean?
   ANS:

In 1958, the National Aeronautics and Space Administration (NASA) was organized to research flight within and outside of Earth's atmosphere. Though NASA's primary mandate was related to national defense, today its satellites have contributed greatly to our understanding of the ocean and ocean processes. The first oceanographic satellite, SEASAT, was launched in 1978 sending information about the ocean such as temperature, height and variation in sea surface contours. Modern satellites such as the TOPEX/Poseidon, the Jason – 3 and the AQUA are capable of sending large amount of scientific date back to Earth very quickly. The type of information that is gathered includes data about the water cycle, evaporation, temperature, chlorophyll a (phytoplankton) and dissolved organic matter at the surface of the ocean. In terms of navigation, the US Department of Defense has developed a Global Positioning System (GPS) composed of 24 satellites equipped with a computer, atomic clock and a radio transmitter. Any GPS receiver on the ground can calculate its own geographic location. Longitude and latitude are accurate with 1 meter! Overall, the use of satellites for studying the ocean has allowed scientists to see the "big picture" and watch how it changes over time - satellites can collect immense quantities of data, spanning the entire ocean, in a very short period of time! This was virtually impossible when we were limited strictly to shipboard methods. Conquering the spatial and temporal challenges of studying the ocean is one of the biggest accomplishments in oceanography to date!

PTS: 1 REF: 2.3 Contemporary Oceanography Makes Use of Modern Technologies

2. Using specific examples, describe how advances in navigation and voyaging relate to the advent of marine science.

ANS:

Early exploration of the ocean was primarily for economic and political reasons.
The Polynesians, Chinese and Europeans quickly discovered that the ocean was a vast expanse that was both wondrous and plentiful. Advances in navigation, such as the compass or the chronometer, allowed explorers to travel around the ocean with much greater efficiency. In the mid to late 1700's Captain James Cook was the first to use the knowledge the voyagers before him had compiled and applied this information to the study of the ocean. Cook was both an explorer and scientists and within 100 years of his first voyage in 1768, the first fully organized, scientific expedition was launched (Challenger expedition in 1872). Economists, traders, explorers and scientists learned very early on that an understanding of the ocean could better all of their interests. Governments quickly realized there were great profits to be had from the natural resources in the ocean and started investing in oceanographic exploration.

PTS: 1 REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

3. How are clocks used to determine longitude and why does a pendulum clock fail to produce accurate estimates of longitude at sea? Why was the invention of the chronometer so important for explorers?

ANS:

Longitude lines are imaginary lines that run from pole to pole dividing the surface of the earth into a grid. You can find longitude using a clock by: (1) determining local noon by observing the path of a shadow of a vertical shaft which is shortest at noon. (2) Set a clock and begin to travel west. At the new location, noon on the clock will no longer correspond with the shortest shadow of the shaft. (3) Determine the time between the "clock" noon and the "shaft" noon and calculate how far west (in hours) you have traveled from the starting point. (4) Since we know that the earth rotates east making 1 rotation every 24 hours, the rotation rate is 15 degrees per hour (360 degrees/24 hours= 15 degrees/hour). In summary, the more accurate the clock and the measurement of the shadow of the shaft will increase the accuracy of the longitude reading.

Pendulum clocks are useless on a moving ship because the motion of the sea alters the swing of the pendulum and therefore the time, rendering the clock useless. It was not until the advent of the chronometer that used spring mechanisms instead of a pendulum, that longitude could be determined with any degree of accuracy.

PTS: 1 REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies

4. How do echo sounders work and what kind of information can they provide about the ocean floor?

ANS:

Echo sounders changed the way scientists study the ocean floor. Echo sounders bounce sound waves off the ocean floor gathering information about depth and contour. Sound waves are emitted from a ship and travel to the ocean floor and then they are reflected back to the ship. The depth is calculated by taking the velocity of the sound waves and multiplying it by the round-trip time divided by 2 (D=V(T/2)). Initially, this technique was very popular in measuring depths but was further applied to defining ocean floor contours and features.

PTS: 1 REF: 2.3 Contemporary Oceanography Makes Use of Modern Technology

5. Describe the contributions of a famous ocean explorer or early marine scientist (such as Benjamin Franklin) to our understanding of ocean science.

ANS:

In 1769 Franklin drew a chart of the Gulf Stream. Franklin noticed that the fastest ships did not always move through the ocean at the fastest pace. Franklin's cousin Tim Folger, discovered that whalers had learned to use the Gulf Stream to their advantage by riding it on their way north from America across the Atlantic to England and avoiding it on the return. They noted the Gulf Stream was a major current running up to 3 miles per hour and could be used to cut days off their long range expeditions.

PTS: 1 REF: 2.2 Voyaging Combined with Science to Advance Ocean Studies