

Study Guide - SOL 10 - Objectives & Vocabulary

ES.10 The student will investigate and understand that **oceans** are complex, dynamic systems and are subject to long- and short-term variations. Key ideas include

Central Idea: Oceans are dynamic systems that support life, affect weather, and help moderate temperatures on the planet. Both natural occurrences and human activities can disrupt the equilibrium of the system.

a) chemical, biological, and physical changes affect the oceans;

Ocean systems are composed of interacting and interdependent elements that are subject to change in response to inputs and outflows of energy and matter.

- The ocean is a dynamic system in which many chemical, biological, and physical changes are taking place (ES.10 a).
- **Upwellings** bring cold, nutrient-rich water from the deep ocean to the surface and are areas of rich biological activity (ES.10 a).
- The **tides** are the periodic rise and fall of water level caused by the gravitational pull of the sun and moon (ES.10 a).

Algae in the oceans are an important source of atmospheric oxygen (ES.10 a).

- explain the role of oceans in the **extraction of atmospheric carbon dioxide** and the relation to the formation of carbonates (ES.10 a)
- investigate **trends of ocean temperature and pH** over time as it relates to the extraction of CO₂ and the formation of carbonates (ES.10 a)
- analyze the effects of changing ocean pH on marine organisms, **carbon sequestration**, and the production of atmospheric oxygen (ES.10 a)

b) environmental and geologic occurrences affect ocean dynamics;

Environmental and geologic occurrences may lead to changes in ocean dynamics.

- A significant amount of atmospheric CO₂ is naturally absorbed by the oceans. However, scientific evidence indicates that this amount is slowly increasing as the CO₂ levels in the atmosphere rise. Scientific observations have indicated potential negative impact on marine organisms with calcium carbonate skeletons and shells (ES.10 b).
- **Sea level** falls when glacial ice caps grow and rises when the ice caps melt (ES.10 b).
- analyze the environmental effects of oceanic disasters on the base of the food web; economics; and future productivity of the ocean environment (ES.10 b)

c) unevenly distributed heat in the oceans drives much of Earth's weather;

Systems are dynamic and change in response to inputs and outflows of energy and matter. Temperature differentials and the resulting transfer of energy within the oceans drive Earth's weather.

- The ocean is the single largest reservoir of heat at Earth's surface. The stored heat in the ocean drives much of Earth's weather and causes climate near the ocean to be milder than climate in the interior of continents (ES.10 c).
- Most **waves** on the ocean surface are generated by wind, the movement of air from high to low pressure, is caused by the uneven heating of Earth's surface by the sun (ES.10 c).
- **Convection** is the major mechanism of energy transfer in the oceans, atmosphere, and Earth's interior (ES.10 c).
- There are large **current systems** in the oceans that carry warm water toward the poles and cold water toward the equator (ES.10 c).
- describe the relationship among moving continents, the presence of ice caps, and ocean circulation over long periods of time (ES.10 c)
- relate important ocean conditions, including **El Niño, and La Nina** to weather on the continents (ES.10 c)
- analyze the role of ocean currents in the distribution of heat from the equatorial regions to the poles, and predict what changes may occur as continents move and atmospheric conditions and climate vary (ES.10 c)
- analyze water temperatures during the yearly cycle, and relate this to the formation of storms (ES.10 c)

d) features of the sea floor reflect tectonic and other geological processes; and

The cycling of energy and matter in Earth's interior occurs through the process of convection and has important consequences for ocean topography.

- The **topography of the seafloor** is at least as variable as that on the continents. Features of the seafloor that are related to plate tectonic processes include mid-ocean ridges and trenches (ES.10 d).

model the relationship between tectonic processes and the features of the sea floor (ES.10 d)

e) human actions, including economic and public policy issues, affect oceans and the coastal zone including the Chesapeake Bay.

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The oceans' resources are finite and should be utilized with care. Human activities significantly change the rates of many of Earth's surface processes and alter the biosphere.

- The oceans are an important source of food and mineral resources as well as a venue for recreation and transportation (ES.10 e).
- The oceans are environmentally and economically important. Human activities and public policy have important consequences for the oceans. The impact of human activities, such as waste disposal, construction, and agriculture, affect the water quality within watershed systems and ultimately the ocean. Pollution and overfishing can harm or deplete valuable resources (ES.10 e).

Estuaries, like the Chesapeake Bay, are areas where fresh and saltwater mix, producing variations in salinity and high biological activity. Chemical pollution and sedimentation are great threats to the well-being of estuaries and oceans (ES.10 e).

- describe different types of pollution (e.g., sediment, toxins, fertilizer, salt water intrusion) that can pollute the Chesapeake Bay throughout its entire six-state watershed (ES.10 e)
- identify the effects of human activities on the oceans (ES.10 e)
- analyze reports, media articles, and other narrative materials related to the health of oceans or a local watershed system; propose a solution and analyze cost benefits to the implementation of the solution (ES.10 e).

Lesson: Ocean in Motion
<ol style="list-style-type: none">1. Tides2. Waves3. Currents - surface and density
Lesson: Ocean/Atmosphere Interactions
<ol style="list-style-type: none">1. Algae and the atmosphere2. Carbon dioxide, oceans and pH3. Oceans, weather & climate
Lesson: Seafloor
<ol style="list-style-type: none">1. Features of the seafloor
Lesson: Chesapeake Bay and Human activities
<ol style="list-style-type: none">1. Chesapeake Bay2. Ocean issues