Principle 3: The ocean is a major influence on weather and climate.

A. The ocean moderates global weather and climate by absorbing most of the solar radiation reaching Earth.

A.1. Heat exchange between the ocean and the atmosphere drives the water cycle and oceanic and atmospheric circulation.

A.2. The ocean dominates the water cycle.

A.3. Ocean currents move heat throughout the ocean basins.

A.4. The ocean loses heat through evaporation. The lost heat is released back to the atmosphere when the evaporated water vapor condenses and forms rain. The released heat drives atmospheric circulation.

A.5. Most rain that falls on land evaporated from the tropical ocean.

A.6. The weather along coastlines is generally more moderate than inland regions because the ocean absorbs and retains heat more effectively than the land.

A.7. The heat transferred from the tropical ocean provides the energy that drives atmospheric circulation and weather, including hurricanes, cyclones, and polar storms.

A.8. Increases in sea surface temperature increase atmospheric convection, changing patterns of rainfall and drought. The most important of these changes is called El Niño.

A.9. El Niño Southern Oscillation (ENSO) is important because it changes where the rain falls in the tropics, which changes atmospheric circulation.

A.10. Short-term and seasonal changes in ocean temperature can affect rainfall and temperatures on land (i.e., weather). Long-term changes in ocean temperature can affect the climate.

A.11. Land and ocean weather maps are used to display and identify weather patterns and to help predict future patterns.

A.12. Long-term weather and oceanographic data sets contribute to climate predictions.

B. The ocean absorbs about 50% of all carbon dioxide added to the atmosphere.

B.1. The global climate is influenced by the amount of carbon dioxide in the atmosphere. The more carbon dioxide in the atmosphere, the more the climate warms.

B.2. The ocean absorbs about 50% of all carbon dioxide added to the atmosphere.

B.3. Some of the carbon dioxide absorbed by the ocean is used by phytoplankton and other photosynthetic organisms in the process of photosynthesis. About half of the world’s photosynthesis (primary production) occurs in the sunlit layers of the ocean.

B.4. Absorbing carbon dioxide can decrease the ocean’s pH, making the water more acidic. This can have consequences for many organisms in the ocean.

B.5. There have been large abrupt changes in Earth’s climate over geologic time.

B.6. Humans are changing the climate by continuing to release large amounts of carbon dioxide and methane into the atmosphere.
**Principle 4:**
The ocean makes Earth habitable.

**A.**
Originally, all oxygen in the atmosphere came from photosynthetic organisms in the ocean.

- **A.1.** Earth originally had an atmosphere containing gases toxic to most organisms; there was no life on land until oxygen became common in the atmosphere.
- **A.2.** Cyanobacteria (blue-green algae) living in the ocean generated oxygen in Earth’s atmosphere through the process of photosynthesis, over many millions of years.
- **A.3.** The oxygen produced by cyanobacteria through photosynthesis first accumulated in the ocean, and then escaped into the atmosphere, where it formed ozone that blocked much UV radiation from reaching Earth’s surface.
- **A.4.** By 550 million years ago, oxygen and ozone levels in the atmosphere were high enough that terrestrial organisms could develop and survive.
- **A.5.** Most of the oxygen consumed by organisms living on land and in the water is produced by photosynthetic organisms in the ocean.

**B.**
Life started in the ocean, and the earliest evidence of life is found in ancient ocean sediments.

- **B.1.** The fossil record of ancient life forms provides evidence for the theory of evolution and the important role that the ocean played in the evolution of life on Earth.
- **B.2.** Cyanobacteria (blue-green algae), the ancestors of all plants and algae, are among the oldest fossils currently known on Earth. These 3 billion-year-old organisms evolved in the ocean, and are found in ancient ocean sediments.
- **B.3.** The chloroplast, which plants use to make food for themselves through photosynthesis, is a remnant of cyanobacteria.
- **B.4.** The millions of different species of organisms on Earth today are related by descent from common ancestors that evolved in the ocean and continue to evolve today.

See Principle 2: B7
Principle 6
The ocean and humans are inextricably interconnected.

GRADES 6 THROUGH 8
Principle 7: The ocean is largely unexplored.


Less than 20% of the ocean is mapped, observed, and explored.

GRADES 6 THROUGH 8

Ocean Observation

Exploration leads to a better understanding of ocean systems.

A.1. There are many opportunities for ocean exploration, which can lead to scientific investigations.

A.2. Exploration leads to advances in research that will help us better understand changes over time in the climate, the biodiversity of the ocean, and the health of the ocean.

A.3. New methods and technologies are being developed to study the ocean for mineral and biological resources, and as a source of energy, power, wave power, and ocean thermal energy conversion.

A.4. New habitats and species continue to be discovered throughout the ocean.

B.4. Exploration of the ocean requires equipment and instruments that can collect data and operate in environments that are vast, have high density, high salinity, extreme temperatures, and increased pressure due to depth.

B.5. Exploration of the ocean requires collaboration and sharing of information through many different levels: local, regional, national, and international.

B.6. Young people can influence and even participate in ocean exploration by looking at the complexities of the ocean.

B.7. Special equipment has been developed to enable humans to remain below the surface of the ocean for longer periods of time and at greater depths (e.g., submarines, SCUBA gear, and human-occupied submarines).

C.4. Submersibles, Remotely Operated Vehicles (ROVs), and Autonomous Underwater Vehicles (AUVs) are being used for prolonged exploration of the ocean.

C.5. Acoustic technology, such as sonar, can be used to measure across large distances and to locate unique underwater features.

C.6. The data from these systems can be accessed over the internet, which allows for remote, real-time exploration of the ocean.