Lesson: pH Balance

In this lesson, you will be introduced to the following topics:

- Definition of weather
- Radiant energy
- Insolation
- Effects of latitude on temperature
- How Earth's rotation effects temperature and seasons
- Differences between sea breeze and land breeze
- Temperature variations between coastal areas and inland areas

Local, short-term conditions in the atmosphere, such as the humidity, temperature, and wind velocity, are called **weather**. Weather varies from place to place and from day to day in any given location. However, large geographical areas have long-term prevailing patterns of weather, called climate.

The ocean exerts a great influence on weather and climate, producing a variety of conditions, from mild sea breezes to violent hurricanes. In this chapter, you will see how interactions among the hydrosphere, lithosphere, and atmosphere produce weather and climate changes.

As you know, Earth does not have a uniform climate. It is, generally, warmest at the equator and coldest at the poles. Why does the temperature vary over the surface of the planet? The answer has to do with the rays that Earth receives from the sun-the kinds of rays, the angle at which they strike the surface, what kind of surface they strike, how they are reflected or absorbed, the time of the year (seasons), and Earth’s position in relation to the sun.

Energy from the sun, which is called **radiant energy**, travels through space as rays (also called radiation). The sun emits different kinds of radiation. Visible light is one of these forms of radiant energy.

Some radiant energy that strikes Earth’s surface is absorbed and changed into heat. The rest is either absorbed by the atmosphere or reflected back into space. The amount of solar energy that reaches any part of the planet depends on the angle at which the rays strike Earth’s surface, called the angle of **insolation**.

The amount of energy that is absorbed as heat depends on conditions in the atmosphere, physical properties of the surface the rays reach, and the angle of insolation. Solar energy is most intense at the equator because the rays are direct, that is, they strike Earth at an

angle of 90 degrees. Due to Earth's curvature and tilt on its axis, regions north and south of the equator receive the rays at an angle that is slanted relative to the surface. Slanted rays are spread out over a larger area than are direct rays (which are more concentrated), so slanted rays are less intense.

The uneven heating of Earth's surface causes the ocean's temperature to vary with latitude. The ocean is warmest at the equator. As the distance north and south of the equator increases, the temperature of the ocean's surface waters generally decreases (not counting effects of specific ocean currents).

The ocean is coldest at the poles because those areas have the lowest angle of insolation and receive the least intense solar heat which shows the sun's rays striking Earth at the start of each of the four seasons.

The axis of Earth has a tilt, or angle of inclination, of 231⁄2 degrees from the vertical in relation to the sun. In the northern hemisphere during the summer, which begins on June 21, Earth is tilted, or inclined, toward the sun. The northern oceans warm because the sun's rays strike Earth's surface directly at this time of the year, heating it most intensely.

In the winter, which begins on December 21, the northern hemisphere is tilted away from the sun, so the rays strike Earth's surface at an angle, that is, slanted. Since slanted rays deliver less intense heat, the northern oceans are colder.

(Because of Earth's tilt, summer and winter seasons are reversed in the Southern Hemisphere.) The ocean heats more slowly and retains heat longer than land does because the sun's rays can penetrate farther into water (which is transparent) than into land. The depth to which the rays travel depends on their energy. Most solar radiation is absorbed within the top 60 meters of the ocean, although some light penetrates hundreds of meters into the water.

In summary, the rays that strike Earth directly (at about 90 degrees, during the summer and at the equator) penetrate and heat the water more intensely than do rays that strike at a lower angle (slanted) during the winter and above or below the equator.

On a hot summer day, you may go to the beach to get some relief from the heat. You feel cooler as you approach the sea because a cool wind blows off the water. Often, the wind (which is a mass of moving air) is in the form of a gentle breeze, called a **sea breeze**.

The sea breeze is cool because air over the ocean is cooler than air over the adjacent land. Ocean air is cooler because water takes a longer time to heat from the sun's rays than land does. Consequently, on a summer day, the ocean releases less heat into the air above it than the land does. This cooler air moves in, as a sea breeze, from over the ocean to above the land.

The opposite occurs at night. Cooler air from the land moves seaward, producing what is called a **land breeze**.

After the sun sets, the land (and the air above it) cools (that is, loses heat) more quickly than the ocean does. As warmer air rises over the ocean, cooler air from the land moves in to take its place. Why the difference in heat loss between the two surfaces? Only the top layers of the land are heated, so the ground loses its heat quickly.

However, as mentioned above, water is heated to a greater depth than land is, so the ocean gives up its heat more slowly and retains more heat. In fact, water has a heat storage ability, or specific heat, that is about three times greater than that of land. Water's capacity to retain heat longer and lose heat more slowly provides marine organisms with a more moderate environment than that found on land, where temperatures can fluctuate more dramatically.

The fact that the land and the sea gain and lose heat at different rates helps to explain, in part, why temperatures along a coast are generally more moderate than those of inland areas.

During the summer, coastal cities are often a few degrees cooler than nearby inland cities (at the same latitude), due to the cooling effect of the ocean.

During the winter, coastal cities are often a few degrees warmer than nearby inland cities (at the same latitude), because they benefit from the warming effect of the ocean, which slowly releases heat that was absorbed from the sun.