Unit 4

***Lesson1***

Movement of water between the atmosphere, land, ocean, and living things make up the **water cycle**.

Water and snow moves downward due to gravity. Water vapor moves upward.

Water on Earth is found as a liquid, solid, or gas.

Water absorbs energy as it *melts* from solid to liquid.

Water absorbs energy as it *evaporates* from liquid to gas.

Water releases energy when it *condenses* from gas to liquid or when it *sublimates* from solid to gas.

Water releases energy as it *freezes* from liquid to solid or *deposits* from gas to solid.

Water reaches the atmosphere through evaporation, transpiration, and sublimation.

**Evaporation** occurs when liquid water changes to water vapor.

Most evaporation comes from Earth’s oceans.

**Transpiration** is the release of water vapor into the atmosphere by plants.

**Sublimation** is when solid water changes directly to water vapor without first becoming a liquid.

Sublimation can occur when dry air blows over ice or snow.

**Condensation** is the change of state from gas to liquid.

Condensation can occur as clouds, fog, or mist, or on the ground as dew.

**Precipitation** is any form of water that falls to Earth from clouds. Rain, snow, and hail are forms of precipitation. Water that flows over land and into streams and rivers is called runoff. Water seeps into the ground through infiltration. Water underground is called groundwater. Glaciers flow downhill and sometimes flow into the ocean. Winds move ocean water on the surface long distances. Cold or salty water will sink in the ocean, forming deep ocean currents that move large amounts of water. The water cycle moves energy and matter. Energy is transported by changes in state and by the movement of water from place to place. Matter is transported by the vast amounts of water that move all around the world.

***Lesson 2***

**Weather** is the condition of Earth’s atmosphere at a certain time and place. Weather conditions in the atmosphere can be recognized through direct observation. Temperature is how hot or cold something is. Thermometers are used to measure temperature. Some thermometers use the thermal expansion of a liquid to determine temperature. Electrical thermometers use the strength of an electric current to determine temperature. **Humidity** is the amount of water vapor in the air. As more water evaporates, humidity increases. **Relative humidity** is the amount of water vapor in the air compared to the amount of water vapor needed to reach saturation. Air is saturated when the rates of evaporation and condensation are equal. **Dew point** is the temperature at which more condensation than evaporation occurs. When air temperature drops below the dew point, condensation forms dew, fog, and clouds. **Precipitation** is any form of water that falls to Earth’s surface from the clouds, including rain, snow, hail, and sleet. Rain forms as water condenses. Snow forms when temperatures are low enough to turn water vapor into a solid. Hailstones are layered lumps of ice formed during severe thunderstorms. Cirrus clouds are made of ice and appear feathery or wispy. Cumulus clouds appear as heaps or piles. They form in fair weather but can produce thunderstorms. Stratus clouds form flat layers that can block out the sun and produce steady rain. **Air pressure** is the force of air molecules pushing on an area. A barometer is used to measure air pressure. Air pressure and density decrease with altitude. **Wind** is air that moves horizontally, or parallel to the ground. Over a short distance, air moves from higher pressure to lower pressure. An anemometer is used to measure wind speed. A wind vane or wind sock is used to measure wind direction. **Visibility** is a measure of the distance at which an object or light can be clearly seen. Visibility is measured by using three to four known landmarks at different distances. Air pollution or fog can cause poor visibility. Weather data can be collected at ground stations, by weather buoys, by ships, by airplanes, and by satellites.

***Lesson 3***

Weather is the short-term state of the atmosphere.

The water cycle is the continuous movement of water among the atmosphere, land, oceans, and living things.

Evaporation, condensation, and precipitation in the water cycle are also parts of weather.

An **air mass** is a large volume of air in which temperature and moisture content are nearly the same throughout.

An air mass forms when air remains over a region for many days and takes on the temperature and humidity of the land below it.

A boundary, called a **front**, forms between air masses with differing densities.

Fronts cause a change in weather as they pass.

The temperature and moisture content of the air masses that meet and how they move relative to each other determine the type of front formed.

Cold fronts form as a cold air mass pushes an existing warm air mass up.

Warm fronts form as a warm air mass slides up over a retreating cold air mass.

Stationary fronts form when a cold air mass and a warm air mass remain in one place.

Areas of different air pressure cause changes in the weather.

In a *high-pressure system*, air slowly sinks down and spreads outward.

In a *low-pressure system*, air rises and cools.

Sinking air in a high-pressure system generally produces clear skies and calm air or gentle breezes.

Rising air in a low-pressure system generally produces clouds and rain.

Winds are caused by changes in pressure, which is due to unequal heating.

Wind speed and direction are affected by local winds. Globally, there is an overall movement of surface air from the poles toward the equator.

Winds bring different air masses to a region, which affects the weather.

**Jet streams** are long-distance winds that travel above global winds for thousands of kilometers.

A jet stream affects temperatures and precipitation patterns.

The polar jet stream is more south in the winter and more north in the summer.

Each hemisphere usually has two main jet streams.

Surface currents in the ocean are caused by wind.

Energy is transferred to the atmosphere by the movement of warm and cold currents.

Hurricanes and monsoons are affected by ocean currents.

As currents flow, they warm or cool the atmosphere above, affecting local temperatures.

Coastal areas may have lower summer temperatures than inland areas because of cold-water currents.

Coastal areas may have higher winter temperatures than inland areas because of warm-water currents.

***Lesson 4***

A **thunderstorm** is an intense local storm that forms strong winds, heavy rain, lightning, thunder, and sometimes hail. Thunderstorms are a type of severe weather. Severe weather can cause property damage and sometimes death. There are three basic stages to a thunderstorm. *Stage 1* – Warm humid air rises in an updraft, creating cumulus clouds. *Stage 2* - Ice particles may form at the top of the cloud. They fall and pull cold air down, creating a downdraft and heavy rain or hail. *Stage 3* – The storm slows or ends as the downdraft prevents more warm air from rising. **Lightning** is an electric discharge that happens between positively and negatively charged areas. Electrical charges build up near the tops and bottoms of clouds as pellets of ice move up and down through the clouds. **Thunder** is the sound created by the rapid expansion of air along a lightning strike. A **hurricane** is a tropical low-pressure system with winds blowing at speeds of 119 km/h (74 mi/h) or more. Hurricanes form from thunderstorms fueled by the evaporation of warm ocean water. Winds spiral around the low-pressure center of a hurricane. High winds and tornadoes can result from hurricanes causing massive damage. A **storm surge** is a huge mass of ocean water that gets pushed onto coastal areas, causing sea level to rise several meters. Damages can take months to clean up. A **tornado** is a destructive, rotating column of air with very high wind speeds that is often visible as a funnel-shaped cloud. Horizontal winds at high altitudes can cause a thunderstorm to spin and create a tornado. *Tornado Alley* is the location in the Midwest where tornadoes are common.

Tornadoes often occur in the spring and early summer.

Winds may reach speeds of over 400 km/h.

Severe weather can cause property damage, injury, and sometimes death.

Hail, lightning, high winds, tornadoes, hurricanes, and floods are all severe weather events. Plan ahead by creating a storm supply kit that contains essential safety items.

Listen to the radio or TV for storm updates such as watches and warnings of upcoming storms.

A *watch* is given when conditions are ideal for severe weather.

A *warning* is given when severe weather has been spotted or is expected within 24 hours.

Follow flood safety rules by getting to higher ground and staying out of floodwaters.

**thunderstorms**

Seek shelter if you hear thunder. Stay away from tall buildings and trees.

Stay away from ponds, lakes, and bodies of water.

Avoid using electrical appliances, phones, and running water when indoors.

**tornados**

Go to a place without windows such as a basement, storm cellar, or closet.

Avoid areas where flying objects may cause harm.

If you are outside, lie in a ditch or low-lying area and protect your head with your arms and hands.

**hurricane**

Have a plan to leave the area and listen for storm updates.

Secure loose objects and prepare your home.

If told to evacuate, do so immediately.

Melanin in the skin can help protect against ultraviolet (UV) radiation from the sun.

Protect your skin from sunburn, even on cloudy days.

Prevent sunburn by wearing sunscreen with a sun protection factor (SPF) of 30 or more.

*Heat exhaustion* occurs when the body has been exposed to high temperatures for too long.

*Heat stroke* occurs when the body loses its ability to cool itself by sweating. It is life threatening.

Limiting outdoor activities and drinking lots of water can help prevent heat illnesses.

Heat stroke symptoms include hot, dry skin; high body temperature; rapid pulse; shallow breathing; disorientation; and loss of consciousness.

Heat stroke victims need emergency help.

***Lesson 5***

Thunderstorms can produce heavy rains in a short period of time, causing *flash floods*.

A flash flood is a sudden, local flood of great volume and short duration.

Hailstones are produced when small chunks of ice cycle through a thunderstorm cloud, gaining layers of ice in the process.

Florida has more injuries and deaths caused by lightning than any other state.

Lightning is an electric discharge that takes place in clouds or between a cloud and the ground.

Lightning can injure people, damage property, and start fires.

Winds in a thunderstorm can reach speeds of 50–160 km/h.

Downbursts of air can move toward the ground, spread out, and cause damage. These downbursts are sometimes mistaken for tornadoes.

Winds can cause severe property damage.

Tornadoes are violent spinning columns of air.

Because Florida gets so many thunderstorms, tornadoes are common.

Tornadoes can cause property damage, injury, and death.

Floods are common in Florida.

Florida is relatively flat and gets a lot of rainfall, and the rock under the soil does not let water through easily.

Floodwater can damage property, cause injury, and contaminate drinking-water supplies.

Florida also can flood from *storm surges* that push ocean water inland during hurricanes.

Hurricanes are low-pressure systems with thunderstorms and winds that circle around a central “eye.”

Hurricane season is from June 1 to November 30.

Because of its location, Florida is hit by more hurricanes than any other state.

Because of the severity of hurricanes, areas are often evacuated before they arrive.

After a hurricane, floodwaters and other hazards can cause injury, death, and property damage.

High winds can cause damages that cost billions of dollars to clean up.

The destructive power of a hurricane is related to its strength.

Category 1 hurricanes have the slowest winds at 119–153 km/h.

Category 5 hurricanes have the fastest winds at more than 250 km/h.

Cold weather in Florida can damage crops, harm the tourism industry, and be dangerous to people.

Many homes in Florida do not have adequate heating or insulation for protection from cold weather. **Sinkholes** are holes in the ground that form when a cave collapses.

In Florida, caverns form where limestone is eroded by underground water. These caves can collapse and form sinkholes.

Sinkholes can swallow cars, damage buildings, pollute water supplies, and cause injury and death.

**Wildfires** are uncontrolled fires burning in natural areas.

Wildfires increase during Florida’s periods of dry weather and drought about every three to five years.

Lightning often starts wildfires in Florida.

**Muck fires** start when dead plant and animal matter, called *muck*, ignites as a result of lightning.

Muck can be found deep under the top layer of soil.

Muck fires can burn underground, which makes the fires hard to extinguish.

When trees or grasses are dry, wildfires can spread easily.

Wildfires can cause property damage and loss of habitats for animals.

Knowing if you live in a fire-prone area, planting fire-resistant plants, and having a disaster plan can prepare you for wildfires.

***Lesson 6***

**Weather** is the condition of Earth’s atmosphere at a particular time and place.

**Climate** describes the weather conditions in an area over a long period of time.

Climate is usually determined by temperature and precipitation.

Temperature ranges are all of the temperatures in an area from the coldest extreme to the warmest extreme, and they are used to describe climate.

Precipitation patterns over time, rather than average precipitation, are used to determine climate.

Climate is directly related to the amount of energy from the sun, or *solar energy*, that an area receives.

The amount of solar energy depends on latitude.

**Latitude** is a location’s angular distance in degrees north or south from the equator.

Solar energy powers the water cycle and winds, which affect the temperature, precipitation, and other factors that determine climate.

As latitude increases, the angle of the sun’s rays becomes greater. This reduces temperatures.

Locations near the poles are cooler than locations near the equator.

The sun powers the water cycle, which causes the evaporation, condensation, and precipitation necessary to create weather.

Uneven heating of Earth’s surface by the sun causes differences in air pressure, which creates winds.

The speed, direction, temperature, and moisture content of winds affect the climate and weather.

Surface features on Earth combine to form the **topography** of an area.

**Elevation** is the height of an area above sea level.

Topography influences wind patterns in an area.

A *rain shadow* happens when warm, moist air rises over a mountain and drops its precipitation on one side, leaving the other side dry.

Air at higher elevations rises, cools, and expands, resulting in lower temperatures.

Water absorbs and releases energy as heat slower than land does.

Water can moderate temperatures of nearby land.

Locations inland from large bodies of water experience wider temperature ranges.

An *ocean current* is the movement of water in a certain direction.

**Surface currents** are ocean currents on the surface of the ocean. Cold currents cool the air in coastal areas.

Warm currents warm the air in coastal areas. Ocean currents cause the coast of Canada and Great Britain to have different climates

Earth has three major climate zones: tropical, temperate, and polar.

These different climates result from differences in topography, winds, ocean currents, and geography. Temperate climates have average temperatures below 18 °C in the coldest months and above 10 °C in the warmest months.

There are five temperate zone subclimates: marine west coast, steppe, humid continental, humid subtropical, and Mediterranean.

The polar zone is located at latitudes greater than 66.5° in both the Northern and Southern hemispheres.

Temperatures in the polar zone rarely rise above 10 °C.

The climates of the polar regions are called *polar climates*. Subclimates include the subarctic, tundra, and polar ice cap climates.

*Tropical climates* are characterized by high temperatures and are located near the equator.

Average monthly temperatures are at least 18 °C.

Subclimates include the rain forest, desert climates, and savanna climates.

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