`6th Grade Unit 3: Energy in the Earth System

*lesson 1: What is the atmosphere?*

*vocab: atmosphere, air pressure, thermosphere, mesosphere, stratosphere, troposphere,*

*ozone layer, greenhouse gases*

The atmosphere (mixture of gases that surrounds Earth):

* protects you from the sun’s radiation (light)
* maintains the temperature range needed for life
* keeps Earth warm enough for liquid water
* parts of the atmosphere are needed by living things (ex. oxygen)
* it is made of:
  + nitrogen (78%)
  + oxygen (21%)
  + other atoms (1%)
  + also dust, volcanic ash, sea salt, smoke, skin, bacteria, pollen

Water also exists in the atmosphere as water vapor, droplets, and solid water (snow and ice crystals)

in the clouds.

Air pressure- the force that air presses down on the area of a surface

* at sea level there is 1lb. of pressure for every square cm
* the farther you are from the surface the less the air pressure
* as altitude (height above ground) increases air pressure decreases

Layers of the atmosphere

Troposphere- lowest layer of the atmosphere

* temp. decreases as altitude increases
* 80% of the atmosphere’s mass
* the densest layer; b/c the other layers press down and compact the gas
* most of Earth’s carbon dioxide, pollution, water vapor, clouds, and weather are here

Stratosphere- layer between the troposphere and mesosphere

* temp. increase as altitude increases
* contains the Ozone layer where UV light gets absorbed which warms the air
* the gases in this layer are layered and don’t mix
* “strata” means layer

Mesosphere- layer between the stratosphere and the thermosphere

* temp. decreases as altitude increases
* as low as -120 °C (-184 °F)
* the top of the mesosphere is where meteoroids begin to burn up

Thermosphere- the upmost layer of the atmosphere

* temp. increases as altitude increases
* high temps. from gases that absorb high-energy radiation (light) from the sun
* temps. can be 1,500 °C but it feels cold b/c the air is so thin (low density)
* low density air means that air atoms don’t hit your skin often enough to transfer

their heat energy

Exosphere- layer above the atmosphere; where space touches the atmosphere

(diagram of atmosphere)

The atmosphere protects Earth:

* absorbing and reflecting harmful radiation (light rays)
  + ozone layer- an area in the stratosphere where ozone is concentrated
  + thickness can change based on the season, but it been decreasing steadily

over time; though to be from people’s use of certain chemicals that destroy

ozone molecules

* + the “hole” in the ozone is over the south pole
* by maintaining the right temperature
  + w/ out the atmosphere our planet would be very cold
  + the greenhouse effect is the process by which the gases in the atmo. (like water vapor,

carbon dioxide) absorb the light (radiation) from the sun

* the energy is held in Earth’s system as it is absorbed and let out of the system

when it is reflected back into space

*lesson 2: How does energy move through Earth’s system?*

*vocab: temperature, thermal energy, thermal expansion, heat, radiation, convection, conduction*

Relationship between energy and heat

* all matter is made of moving particles, atoms, they move at different speed based on

the amount of kinetic energy they have (energy of movement)

* the amount of kinetic energy is based on the matter’s temperature (the measure of kinetic

energy of the particles/atoms in a substance)

* more energy=higher temp.=atoms moving faster
* if there are more atoms (more mass) the object has more energy, even if they are the same temp.
* thermal energy- total kinetic energy of the particles
* also depends on the # of particles more particles= more energy

Thermal expansion- the increase in volume from an increase in temperature

* when atoms get hot they move faster and further apart (expand)
* when atoms get colder they move slower and closer together (contract)
* works for everything on Earth except water; its opposite
* causes a change in the density (volume compared to mass)
* when something is less dense than the air/water it’s in it floats
* when things expand they become less dense
* ex. hot air balloon floats in air b/c the hot air inside is less dense than the air around it

Heat-the energy transferred between objects that are different temperatures

* will move from one object to the next until they are the same temperature or

until they have the same amount of thermal energy

* always goes from the hotter object to the cooler one
* the hot object loses/gives off energy and the cooler one takes/gains energy

When heat gets transferred some materials get warmer faster than others (ex. air warms faster than

the water so the water in the pool is cooler than the air)

* the rate that materials heat or cool is due to a property called specific heat
  + high specific heat= a lot of energy to change it’s temp.
  + low specific heat= less energy to change the temp. the same amount
  + water has a higher specific heat than land so it takes a lot more energy

to warm up and a lot longer to cool down

The sun transfers energy to Earth by radiation (transfer of energy through electromagnetic/light waves)

* moves heat without touching
* light/electromagnetic energy travels in waves
* many types: infrared, x-ray, ultraviolet, visible, radio, microwave, gamma

When we get light (radiation) some gets scattered and some gets absorbed but a lot of it passes

through the atmosphere and hits Earth. Some of the energy get absorbed and increases the thermal

energy on Earth (warming it up). Some gets recycled in the Earth system and some gets reflected back

into space. The recycled energy gets moves around Earth through conduction and convection.

Convection- transfer of energy due to the movement of matter (happens in gas and liquid)

* water at the bottom of a pot rises to the top
* hot matter is less dense (see thermal expansion) so it floats to the top
* cool matter is more dense so it sinks to the bottom
* when matter warms/rises and cools/sinks again and again it is called convection current
* happens where temps. change (ex. warm ground and cool air or warm water near equator

meeting cool water further north, ocean currents, wind, inside the Earth moving the continents)

Conduction- transfer of energy from one object to another through direct contact

* the faster hotter particles hit the slower colder ones and transfer their energy
* happens until both are the same temp.
* the bigger the temp. difference the faster the heat transfers
* ex. cold air and warm ground, layers of different temp. air, water vapor transfers it’s energy

to the air slowing down the water atoms causing condensation

*lesson 3: What is wind?*

*vocab: wind, Coriolis effect, global wind, jet stream, local wind*

wind- movement of air caused by differences in pressure

* energy from the sun doesn’t warm Earth uniformly (evenly)
* creates hot and cold spots; cold air is more dense and hot air is less dense
* dense cold air sinking creates more pressure; hot air rising creates less pressure
* air moves from areas of high pressure to areas of low pressure

(diagram of high and low pressure areas)

The rotation of the Earth makes the winds appear to curve. Called the Coriolis Effect

* if the Earth didn’t rotate the wind would move in straight lines from low to high pressure
* more noticeable over big distances
* in the Northern hemisphere air moving north curves east, air moving south curves west

(diagram of Coriolis Effect)

Global winds- patterns of calm areas and wind systems at or near the Earth’s surface

Wind systems:

* Trade winds- between 30° and the Equator in both hemispheres
  + Coriolis effect curves them to the west
  + moved trade and people from Europe to the Americas
* Westerlies- between 30° to 60° in both hemispheres
  + Coriolis effect curves them to the east
  + carry moist winds over N. America bringing rain and snow
* Polar Easterlies- between the poles and 60° latitudes in both hemispheres
  + form from cold air sinking and moving down from the poles
  + Coriolis effect causes them to appear to move west
  + carry cold Arctic air over most of the US making snow and freezing weather

Calm areas:

* The Doldrums- area around the Equator where very little wind blows
  + in a warm low pressure area so very little air moves
  + means “dull” or “sluggish”
* The Horse Latitudes- area at about 30° latitude in both hemispheres
  + very little wind caused ships to slow
  + to save water they threw horses overboard

jet streams- narrow belts of high speed wind that blow from west to east

* move in the atmosphere between 7km and 16km
* airplanes traveling in a jet stream from west to east move faster
* airplane going against the jet stream will slow down
* 2 main ones: polar (cold air) and subtropical (warm air)
* shift up and down moving cool or warm air

local wind- movement of air over short distances

* can move in any direction
* sea and land breeze- day time cool air over water moves onto land; night cool air

moves out to the ocean

* valley and mountain breeze- day time warm air at the bottom of the valley moves up

into the mts. ; night cool mt. air moves down into the valley