

Preview of Period 15: Energy in Nature

15.1 The Earth-Sun System

How much and what kind of energy does the Earth receive from the Sun?

15.2 The Earth's Atmosphere

What is the composition of the atmosphere?

15.3 Energy Balance of the Earth

How does energy absorbed by the Earth compare to the energy emitted by the Earth?

What causes the differences in the amounts of energy striking different regions of the Earth?

What causes the seasons?

15.4 Water and Wind Cycles

What is the water cycle?

What causes local and global wind patterns?

Solar Radiation

The Sun produces 3.90×10^{26} watts of energy.

This energy is produced by **nuclear fusion**:

- ◆ In the Sun's core, protons and neutrons fuse into atoms of helium
- ◆ During fusion, photons of electromagnetic energy are given off.
- ◆ The photons travel to the surface of the Sun and are radiated into space.
- ◆ A very high activation energy is needed for nuclear fusion - the Sun's core is 16,000,000 °C. (The surface temperature of the Sun is 6,000 °C)

Energy Balance of the Earth

The total **energy influx** from the Sun (ultraviolet, visible, and near infrared radiation) must equal the total energy radiated out to prevent the Earth from heating up.

Of the total energy influx from the Sun

- ◆ **30% is reflected off of water vapor and particles in the atmosphere and never reaches the Earth,**
- ◆ **19% is absorbed by air and clouds and**
- ◆ **51% is absorbed by the surface of the Earth.**

To prevent the Earth from heating up, **all** of the energy influx must radiated away from the Earth.

Why does the Earth have Seasons?

- ◆ Seasons are caused by the tilt of the Earth's axis (23.5 degrees).
- ◆ During June, the sun shines more directly on the northern hemisphere.
- ◆ During December, the sun shines more directly on the southern hemisphere.
- ◆ Seasons are not caused by differences in the distance between the Earth and the Sun. In fact, the Earth is closest to the Sun during January.

Period 15 Summary

15.1: The electromagnetic radiation we received from the Sun results from the **fusion of protons and neutrons** in the center of the Sun.

Heated objects emit radiant energy at frequencies that depend primarily on the surface temperature of the object. The higher the surface temperature, the higher the frequencies of the spectrum.

15.2: The Earth's atmosphere consists primarily of **nitrogen and oxygen gases**.

The atmosphere is composed of three layers: the **troposphere**, which contains the Earth's life forms, the **stratosphere**, which contains the ozone layer, and the **mesosphere**.

15.3: The amount of **solar insolation** striking the Earth depends on the **season** of the year, the **latitude**, the amount of **cloud cover** and pollution that blocks incoming radiation.

Seasons are caused by the tilt of the Earth's axis (23.5 degrees).

In June, the sun shines more directly on the Northern hemisphere. In December, the sun shines more directly on the southern hemisphere.

Period 15 Summary, Continued

15.5: Solar energy drives the water cycle.

Water from oceans and lakes evaporates when radiation from Sun warms the water surface. Water vapor rises, is cooled, and condenses on dust particles, forming clouds.

When clouds become saturated, precipitation falls as rain or snow. Precipitation eventually runs back into lakes and oceans and the cycle repeats.

Solar energy contributes to winds. Heated air at the equator rises to higher latitudes. Cooler air from higher latitudes flows toward the equator. This convection mixes warm equator air with cooler high latitude air.

The spinning of the Earth (Coriolis effect**) also produces global wind patterns.**

Local wind patterns, such as ocean breezes, occur because land surfaces heat up and cool off more quickly than water surfaces, causing convection.

Period 15 Review Questions

- R.1** We experience the Sun's energy as infrared, visible, and ultraviolet radiation. How would this change if the Sun's surface temperature was hotter? If the surface temperature was cooler?
- R.2.** What is the energy balance of the earth? What could happen if this balance is upset?
- R.3.** Why does the amount of solar insolation striking the Earth change with changes in latitude?
- R.4** What causes the seasons?
- R.5** What are the advantages and disadvantages of using tidal energy? of using geothermal energy?