

Name: _____ Section: _____

Activity 15: Energy in Nature

15.1 The Earth-Sun System

1) Energy from the sun

Observe the models of the Earth, Moon, and Sun in the room.

- a) Imagine that the distance between the Earth and the Sun is represented by the length of a football field (100 yards or 91 meters). Choosing this distance to set the scale, the Sun, at one goal line, is represented by a ball 85 cm in diameter (the size of a large beach ball or exercise ball).

What would be the diameter of a model of the Earth at the opposite goal line?

What would be the diameter of a model of the Moon? _____

How far would the model of the Moon be from the model of the Earth? _____

- b) It takes radiation from the Sun about 8.3 minutes to reach the Earth. How far away is the Earth from the Sun?

2) How much energy does the Earth receive from the Sun?

- a) How many watts of energy does the Sun produce? _____
- b) Only a small fraction of this energy actually reaches the outer atmosphere of the Earth. If this energy is about 1.76×10^{17} watts, what percent is this of the total energy produced by the Sun?

- c) Where does the rest of the Sun's energy go?

- d) What is the source of the Sun's energy?

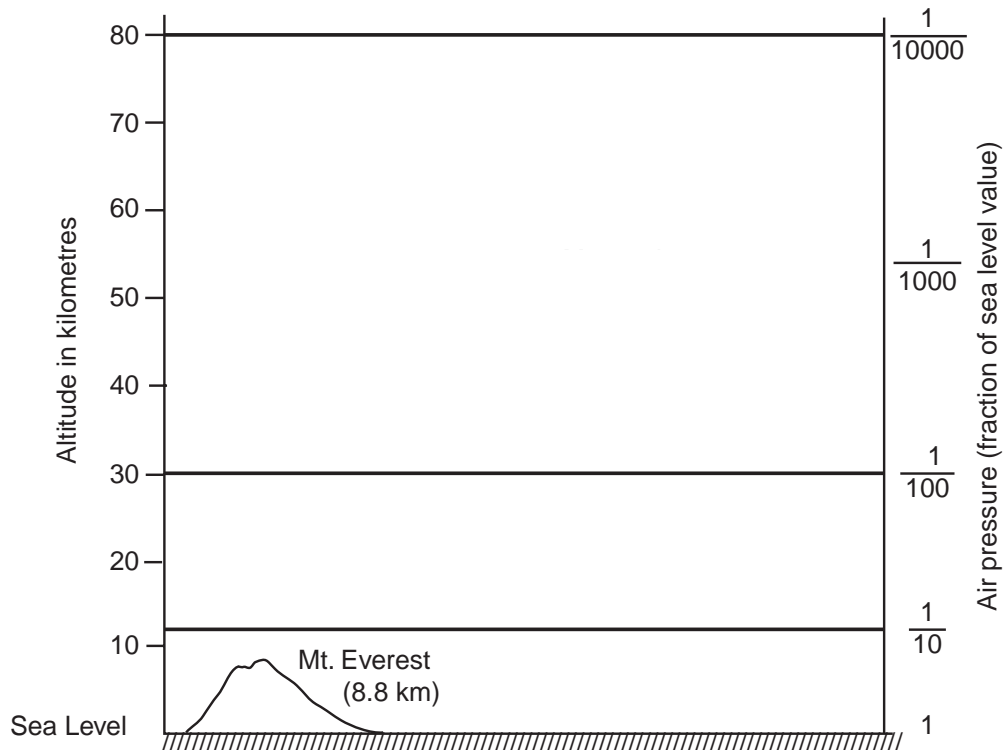
3) What form of energy is received from the Sun?

- a) What form of energy does the sun give off?

- b) We now review the spectrum of a light bulb filament at different temperatures. Look at the filament through a diffraction grating. Describe any changes you see in the spectrum as the filament glows hotter.
- c) How does the temperature of an object relate to the frequency of the energy it gives off (its electromagnetic spectrum)?

15.2 The Earth's Atmosphere

4) Atmospheric Layers



- a) On the diagram above, fill in the names of the layers of the Earth's atmosphere and the approximate percent of the Earth's air that is contained in each region. (Hint: note what fraction of the total pressure of the air is measured for each air layer.)
- b) In which atmospheric layer(s) can life exist? _____
- c) In which atmospheric layer is the Earth's ozone layer? _____

- d) Make a prediction as to how thick the atmosphere would be if the Earth were as large as the globe on your table.

Prediction: _____ **Answer:** _____

- e) What is the chemical composition of the atmosphere?

- f) Group Discussion Question: The percent of carbon dioxide in the atmosphere is very small (0.033%). Why does this small concentration make increasing the atmosphere's carbon dioxide concentrations potentially dangerous?

15.3 The Energy Balance of the Earth

5) Earth's energy balance

- a) From the energy balance diagram, what percent of the incoming solar radiation is reflected back into space?
- b) Of the solar radiation remaining, what percent reaches and is absorbed by the Earth's surface?
- c) What happens to the rest of the solar radiation that enters the Earth's atmosphere?

- d) What form of energy is absorbed by the Earth's surface?
- e) What percent of the solar radiation entering the Earth's atmosphere is radiated back into space?
- f) What form of energy is emitted by the Earth's surface?
- g) What can block the radiation from the Earth from escaping into space?
- h) Group Discussion Question: What are the consequences for the Earth if not all of the incoming radiation is radiated back into space?

15.4 How Is the Earth Illuminated by the Sun?

6) Sunlight incident on the Earth

Your instructor will explain how to use a globe and a flashlight to model the sunlight incident on different regions of the Earth.

- a) Point a flashlight light horizontally at the equator of the globe. Stand the peg board between the light and the globe about 5 cm from the globe's equator and 20 cm from the flashlight. Hold the small brown square flat along the equator.

How many dots of light on the globe fit inside the brown square? _____

- b) Keeping the pegboard the same distances from the flashlight and the globe, raise the flashlight to point it horizontally at the high northern latitudes (for example, at Alaska). Hold the brown square flat along this area.

Now how many dots of light on the globe fit inside the brown square? _____

- c) How does the amount of sunlight striking the Earth at higher latitudes compare to the sunlight striking the Equator?
- d) What effect do your findings in part c) have on the weather?
- e) Group Discussion Question: What is another reason that the higher latitudes receive less sunlight?

7) The Earth's seasons

Your instructor will discuss the causes of the Earth's seasons.

- a) Place the light bulb in the center of your table so that it shines on the equator of the globe. Move the globe around the light bulb to simulate the Earth's seasons. (Hint: The direction that the axis of the globe tilts is important.)

- b) What causes the Earth's seasons? Is the distance of the Earth from the Sun a factor?

15.5 Climate and Weather Patterns

Next, we examine two of the factors that determine the weather.

8) The Earth's water cycle

- a) Describe the components of the Earth's water cycle.

- b) What drives the water cycle?

- c) What are clouds made of?

- d) Why do clouds form?

- e) Why does moisture form on the outside of a cold can of soda? Where does the moisture come from?

