

## CHAPTER TWO

### 1) How does solar radiation arriving on Earth differ from the back radiation emitted by Earth?

Incoming solar radiation reaches Earth as shortwave radiation while radiation emitted from Earth is composed of longer wavelengths.

### 2) What kind of radiation is trapped by greenhouse gases? What is the effect on Earth's climate?

At the present time, Earth's atmosphere contains greenhouse gases that have the ability of absorbing 95% of the longwave radiation (the radiation emitted from Earth's surface). This makes it difficult for most of the heat to escape into space and makes the surface much warmer (up to 31°C) than it would be without greenhouse gases in the atmosphere.

### 3) What different and opposing roles do clouds play in the climate system?

Climate scientists are learning that cloud cover is a very important variable. On one hand, clouds contribute to heat retention by trapping outgoing longwave radiation. On the other hand, they reflect incoming shortwave radiation, which can cool the planet. This paradox differs by season and location.

### 4) How does reflection of solar radiation from Earth's surface add to the effects of uneven solar heating in creating a pole-to-equator heat imbalance?

Incoming radiation is affected by latitude. This is because solar insolation reaches Earth at a higher angle than at lower latitudes, and it concentrates the heat within a smaller area. At higher latitudes, the Sun's radiation covers a wider area simply from the curvature of Earth.

Outgoing radiation is thus affected by location as well. A smaller percent of solar radiation is absorbed at high latitudes because the radiation reaches Earth at a lower angle and more radiation is reflected back (albedo) into the atmosphere from the added factor of snow and ice.

### 5) What processes cause air to rise from Earth's surface?

Solar radiation heats the surface of Earth, convection then heats the air closest to the surface, and this air rises into the atmosphere.

### 6) What causes the monsoon circulation to reverse from summer to winter?

The summer monsoon forms from direct solar radiation at low and mid latitudes. Land heats up faster than the oceans. This rising heat over the land draws moist air in from the ocean producing an increase in precipitation over the land (in and up). The opposite extreme is the winter monsoon when there is a decrease in the Sun's radiation. The land surface now cools faster than the oceans. The cool dry air over the land sinks and travels over the oceans (down and out), shifting the winter precipitation over the water body.

7) Describe the main pathway by which heat in the atmosphere is transported toward the poles.

Strong solar radiation in the subtropics makes air masses heat up and rise. The westerly flow of air formed from the Coriolis effect moves this warm air away from the lower latitudes, bringing heat to regions that do not have as much direct solar radiation.

8) Why does rain fall on the sides of mountains in the path of winds from nearby oceans?

Low pressure cells moving from the ocean toward land have the ability of carrying a large amount of water vapor. As this air nears coastal mountain ranges, the air mass is forced to rise. The increase in elevation makes the air mass cool and leads to precipitation. This is called orographic precipitation.