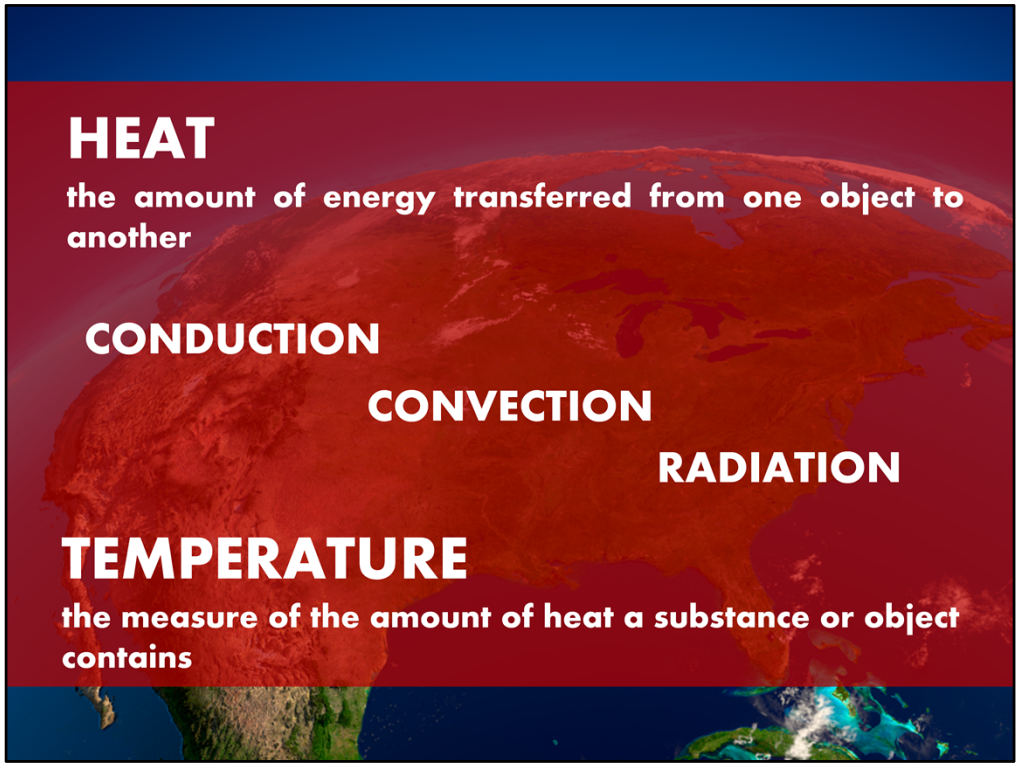
Module 11: Meteorology
Topic 7 Content: Global Warming Presentation Notes

Global Warming

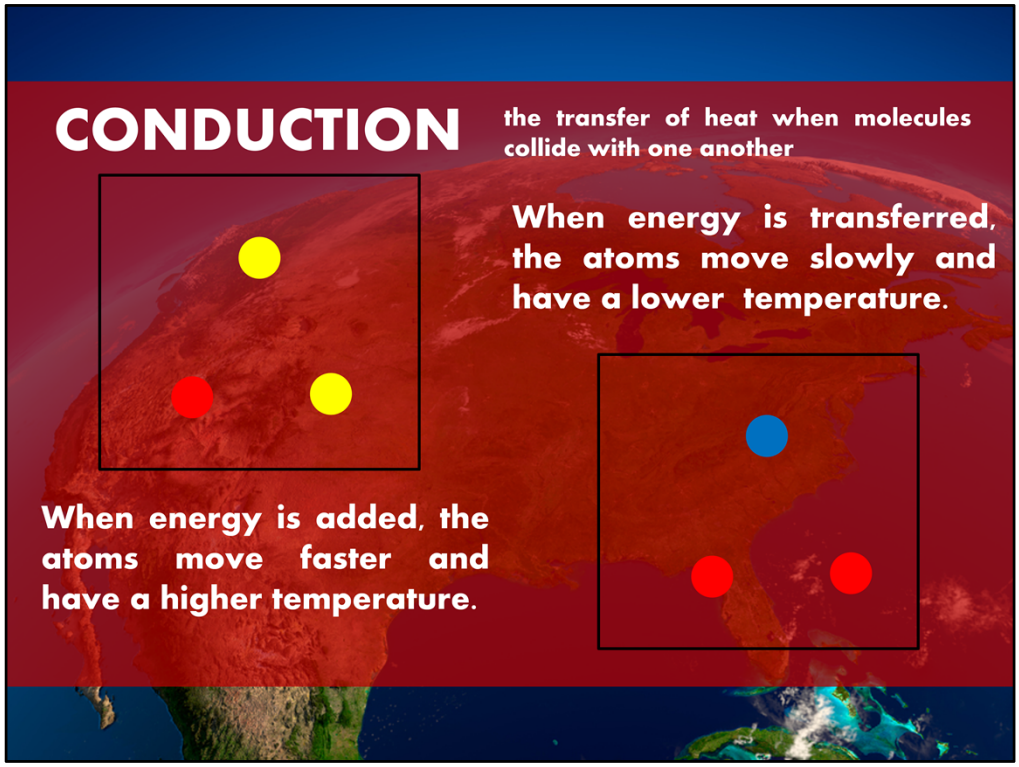
Module 11: Meteorology
Topic 7 Content: Global Warming Presentation Notes



In order to learn about global warming, you must first understand how the atmosphere is heated. Heat is different from temperature. Heat is the amount of energy transferred from one object to another. There are three ways heat is transferred in the atmosphere. Those three ways include the processes of conduction, convection, and radiation.

Temperature is the measure of the amount of heat a substance or object contains. This makes atmospheric temperature the measure of the kinetic energy, or energy of motion, of the atoms that make up the atmosphere.

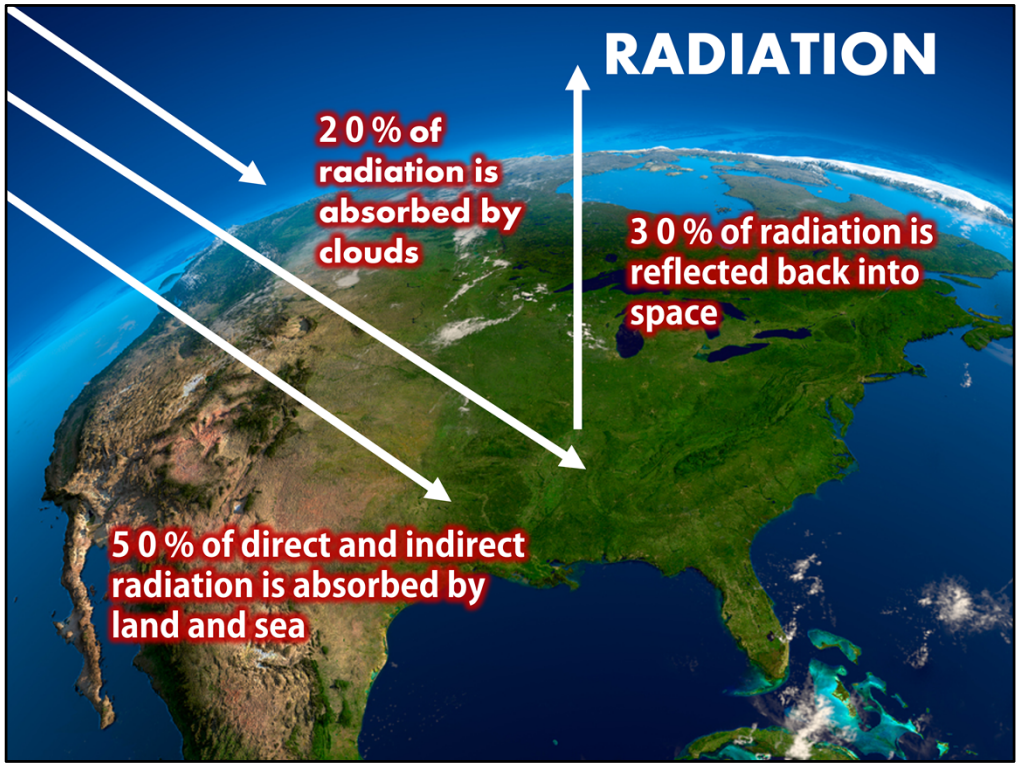
Module 11: Meteorology
Topic 7 Content: Global Warming Presentation Notes



The first way that the atmosphere is heated is through the process of conduction. Conduction is the transfer of heat when molecules collide with one another. Each of the dots that you see represent atoms that make up the atmosphere. A red dot has a high temperature, or a high amount of energy. A yellow dot has a medium temperature, or a medium amount of energy. A blue dot has a cool temperature, or a low amount of energy. As the atoms collide in the atmosphere, they transfer the energy that they contain.

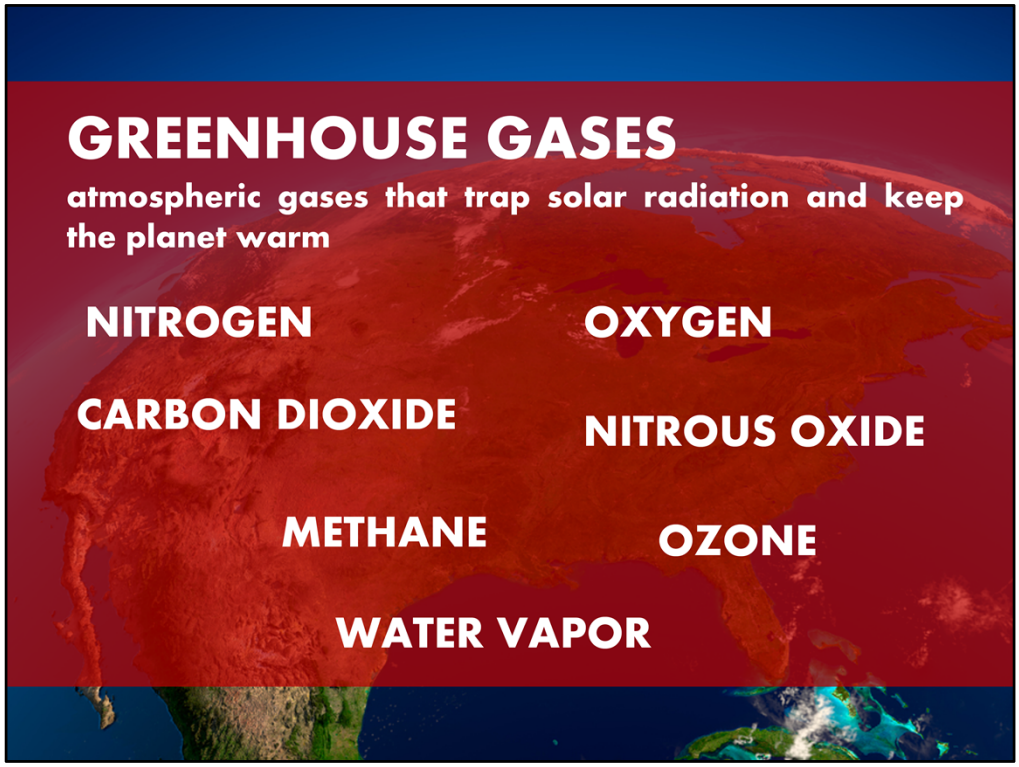
The first example shows what happens when energy is added to atoms in the air. Here, an atom with high energy will react with atoms with medium energy. As the energy is transferred, the atoms move faster and have a higher temperature. The second example shows what happens when energy is transferred to a cooler atom. In this example, the higher energy atoms lose energy and become colder. The atoms will then slow down and the temperature the atoms contain will decrease.

Convection is the transfer of heat by the flow of materials. Convection only takes place in fluid environments. In the atmosphere, as air is heated it rises and cools. Over time, this cooler air will become dense and sink back to the lower atmosphere where it is heated again.

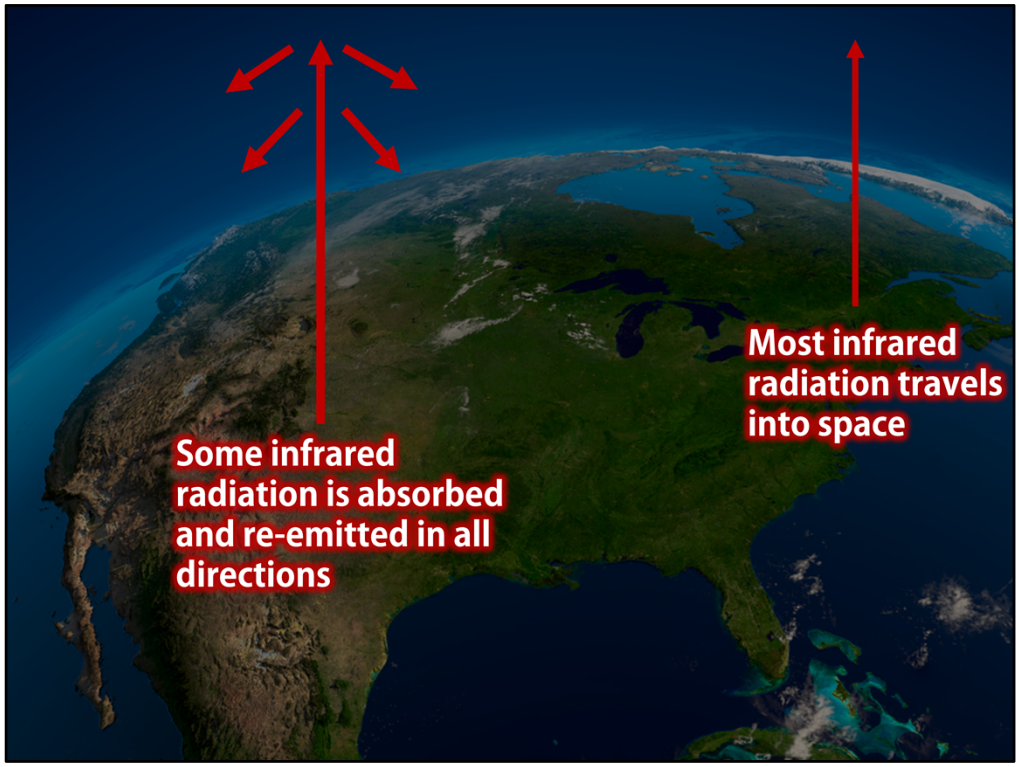


The final way the atmosphere is heated is through the process of radiation. Radiation travels out in all directions from its source. Unlike conduction and convection, radiation can travel through space. Radiation also plays a key role in global warming. When radiation strikes an object, there are three different things that can happen.

First, radiation can pass through the atmosphere and be absorbed by Earth's surface. An estimated 50% of direct and indirect radiation is absorbed by land and sea. Second, the radiation can be reflected back into space. It is estimated that 30% of radiation is reflected back into space. Some of this radiation is reflected by clouds, while the radiation can also be reflected by snow or ice covered surface. Third, radiation can also be absorbed by the clouds in the atmosphere. An estimated 20% of radiation is absorbed by the cloud cover.

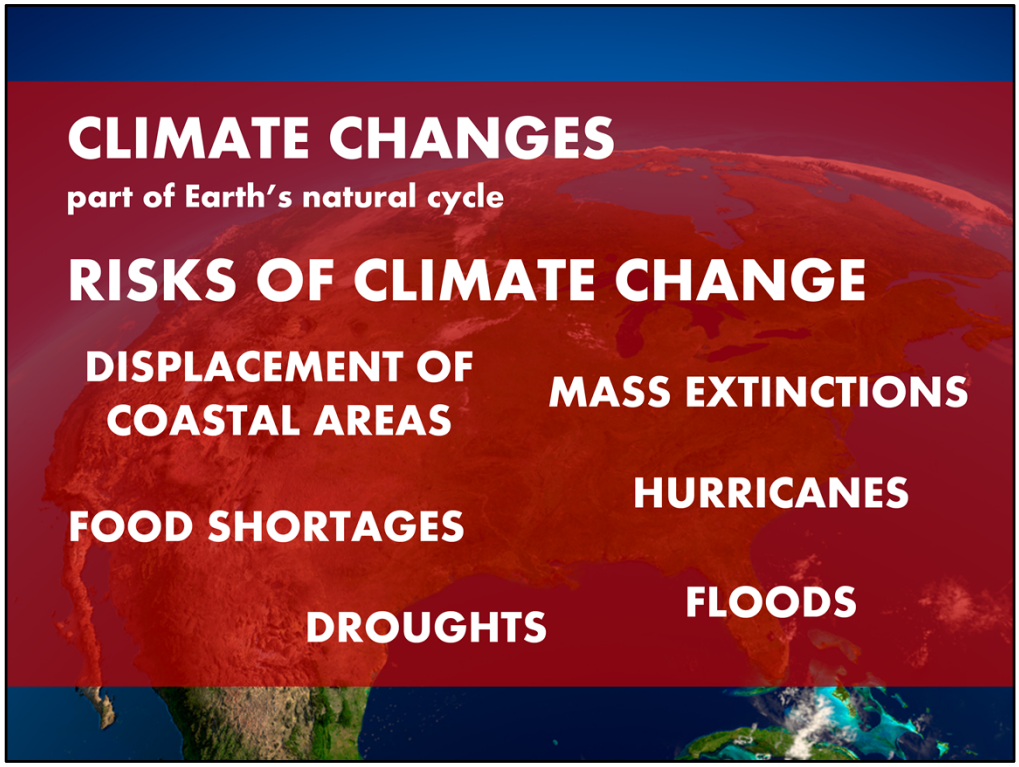


A very important process occurs when the absorbed radiation is re-emitted into the atmosphere. Certain gases in the atmosphere, called greenhouse gases, trap this radiation and keep the planet warm. This trapping of radiation by gases is called the greenhouse effect. It is a natural phenomenon, and life on Earth would likely not exist without it. The majority of the atmosphere is composed of nitrogen and oxygen, but there are several trace gases in the atmosphere as well. Some of these gases, such as carbon dioxide, methane, nitrous oxide, ozone, and water vapor, are known as greenhouse gases.



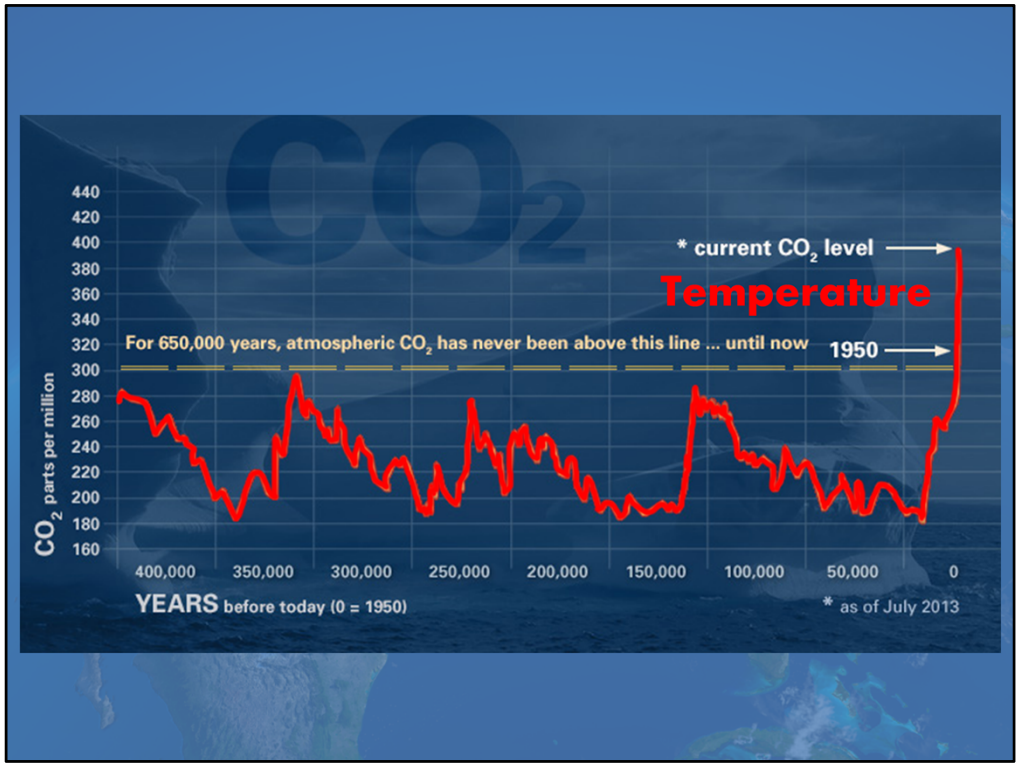
How exactly the does the greenhouse effect occur? As day turns to night, the Earth radiates heat in the form of infrared radiation. Most of this radiation passes through the atmosphere and travels into space. Some of the radiation is absorbed by greenhouse gases and re-emitted in all directions. The trapping of the infrared radiation is a very important process. This trapped heat helps keep the planet warm. Without the greenhouse gases, Earth would be a cold, uninhabitable planet.

Burning fossil fuels emits more greenhouse gases into the atmosphere. As the concentration of greenhouse gases increases, the amount of the Sun's radiation trapped in the atmosphere increases. This raises the average temperature of the Earth, causing global warming. In the 20th century, Earth's average temperature increased 0.6 °C. That may seem like a small amount, but the difference between today's global average temperature and the average temperature during an ice age is only 5 °C.



Changes in climate are indeed part of Earth's natural cycle, and sometimes these changes are extreme and abrupt. Evidence from the last few decades of scientific research and millions of years of climate records strongly indicate that the changes in climate happening now are very different from past climate changes. A warming climate poses many serious risks, such as displacement of coastal areas due to sea level rise, mass extinctions, food shortages, and an increase in the strength of severe weather such as hurricanes, droughts, and floods.

Module 11: Meteorology
Topic 7 Content: Global Warming Presentation Notes



How do scientists know that the planet is warming because of greenhouse gases? Scientists use ice core data from Antarctica to compare carbon dioxide levels and historic temperatures. The ice contains bubbles of ancient air that allows for an accurate analysis. The graph shown was produced by studying ice cores in Vostok, Antarctica. As you can see from the graph, carbon dioxide concentrations have fluctuated over time. Around 1950, the carbon dioxide levels have increased over 300 parts per million. What do you think a graph of temperature would look like? Amazingly, if you were to graph the change in temperature, the graphs would look almost identical. This data proves to scientists that, as greenhouse gases are emitted into the atmosphere, the global temperatures increase. The graph also shows that the carbon dioxide levels are at the highest levels they have ever been. This means the global average temperature of Earth is also at a high level.

The good news is that the technology and resources exist to greatly reduce the emissions of greenhouse gases from burning fossil fuels. If humans act soon to greatly reduce the global emissions of fossil fuels, scientists predict that the negative effects of climate change could be less severe.