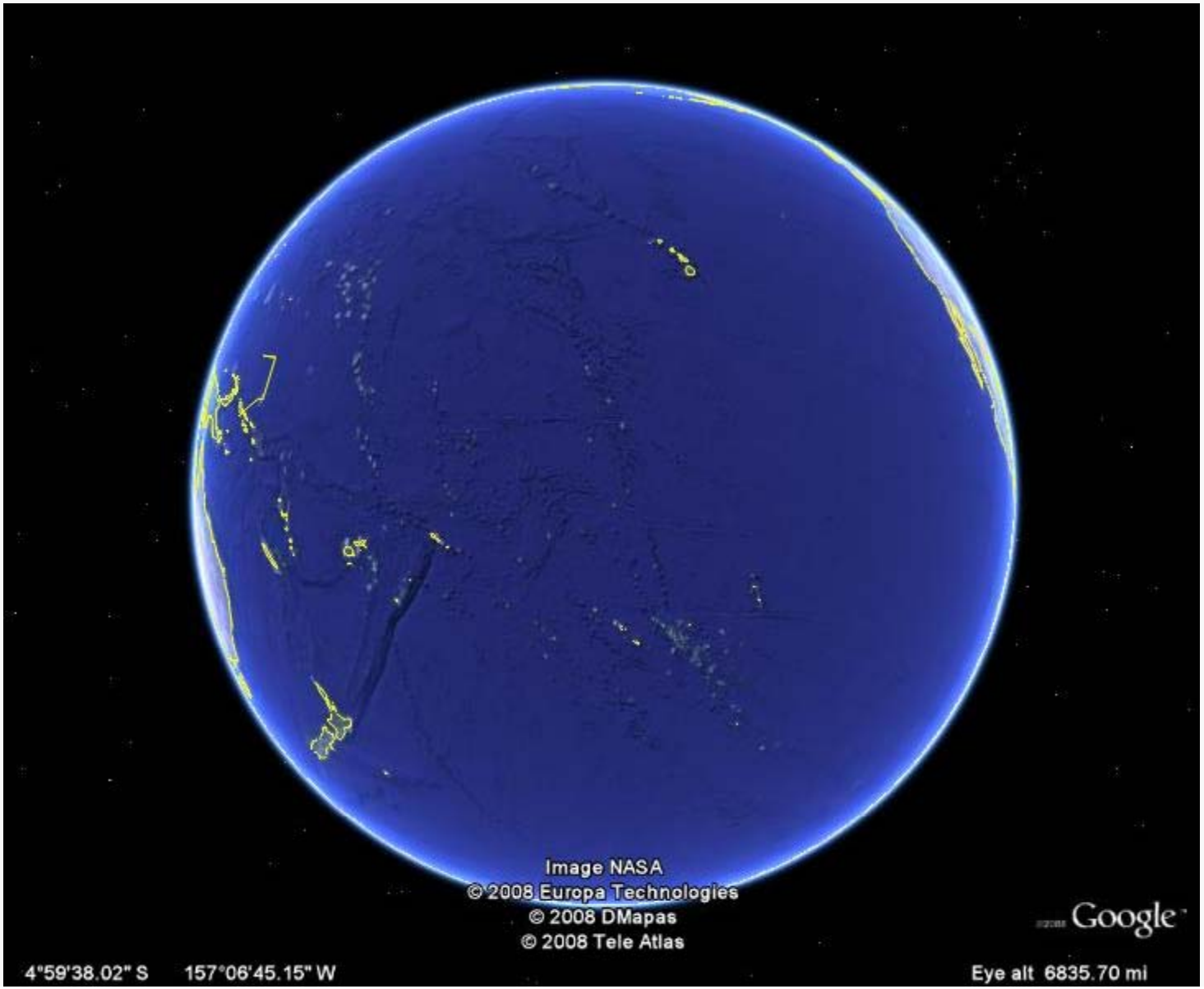
One of the Most Unique Things about the Earth Is the Abundance of Water

The Water Hemisphere



The Land Hemisphere Still Has a Lot of Water

Special Properties of Water

- Water exists in al three states at typical earth temperatures.

- Chemically it can dissolve more substances than any other, so it contains most basic (organic) components of the biosphere. Water is the universal solvent.

- Water expands in volume when it freezes, so it will break rocks apart. Also, ice will float on water acting as an insulating blanket to the layers below.

Where There Is Water, There is Life

(a)

Ice Insulates the Water Below,
So It Stays Liquid

(c)

Why Does Water Heat and Cool More Slowly than Land? Water Has More Thermal Inertia than Land?

- Specific heat of water is large.

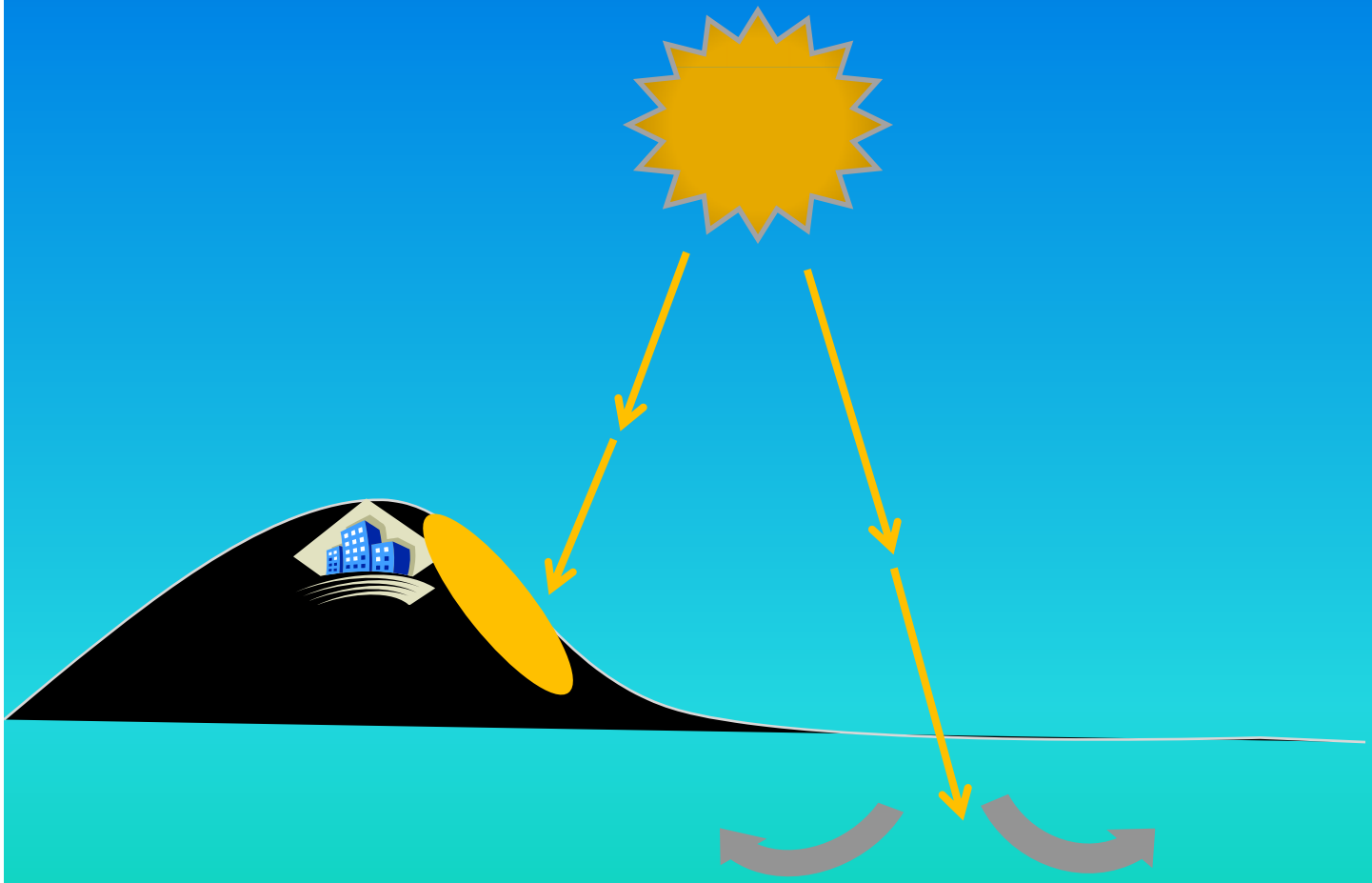
- Water mixes.

- Solar radiation penetrates water. It is transparent.

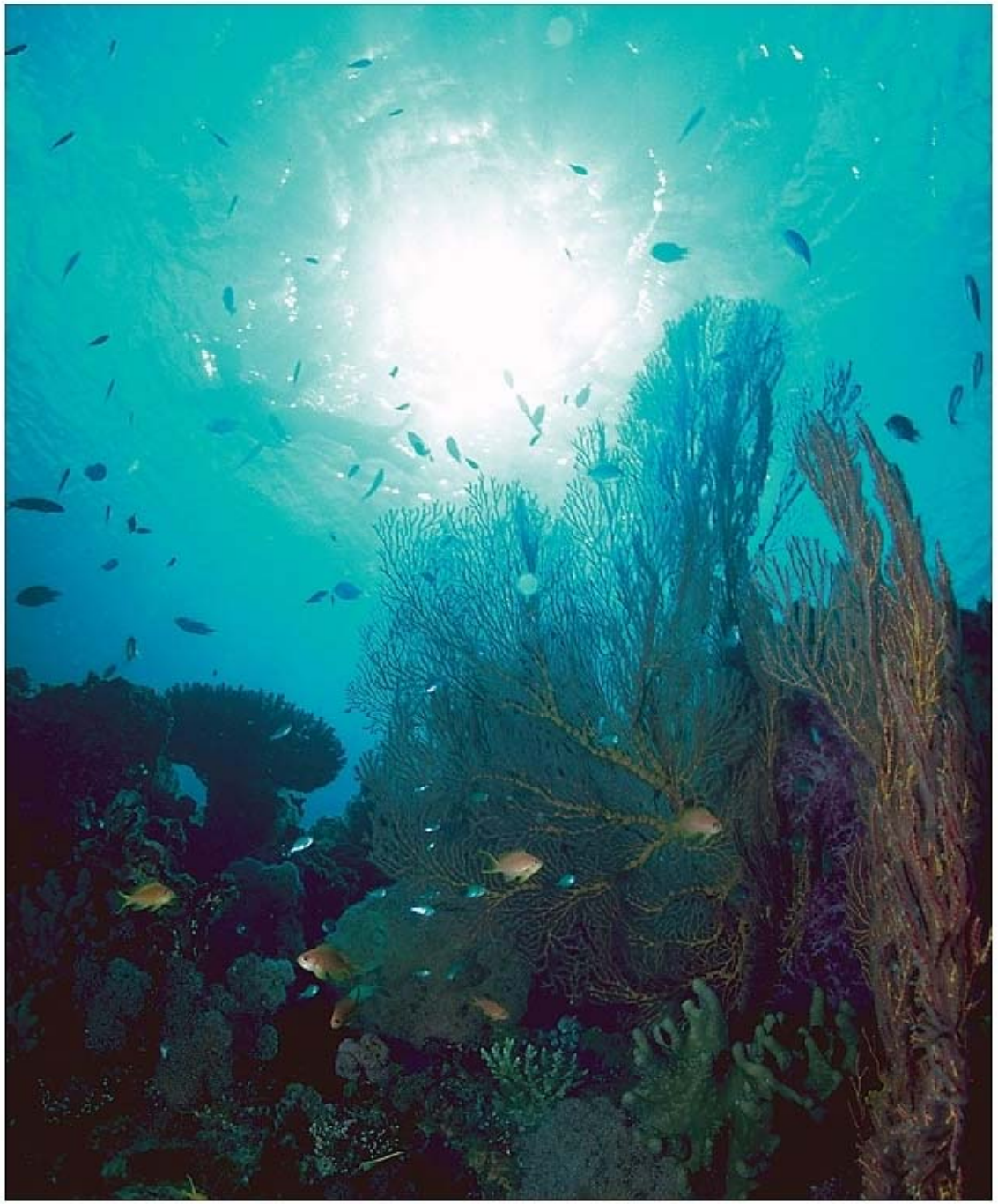
- Evaporation is cooling process. (It gains energy when moving to a more excited state, it releases energy when moving to a less excited state)

Sunlight Passes Through a Transparent Atmosphere and is absorbed by a Less Transparent Volume of Water

The Water Mixes and Distributes the Energy



Water Is Relative Transparent, So Light Penetrates to Considerable Depth. This Heats a Large Volume of Water Slowly.



Latent Heat is the energy stored or released when water changes states (phases)

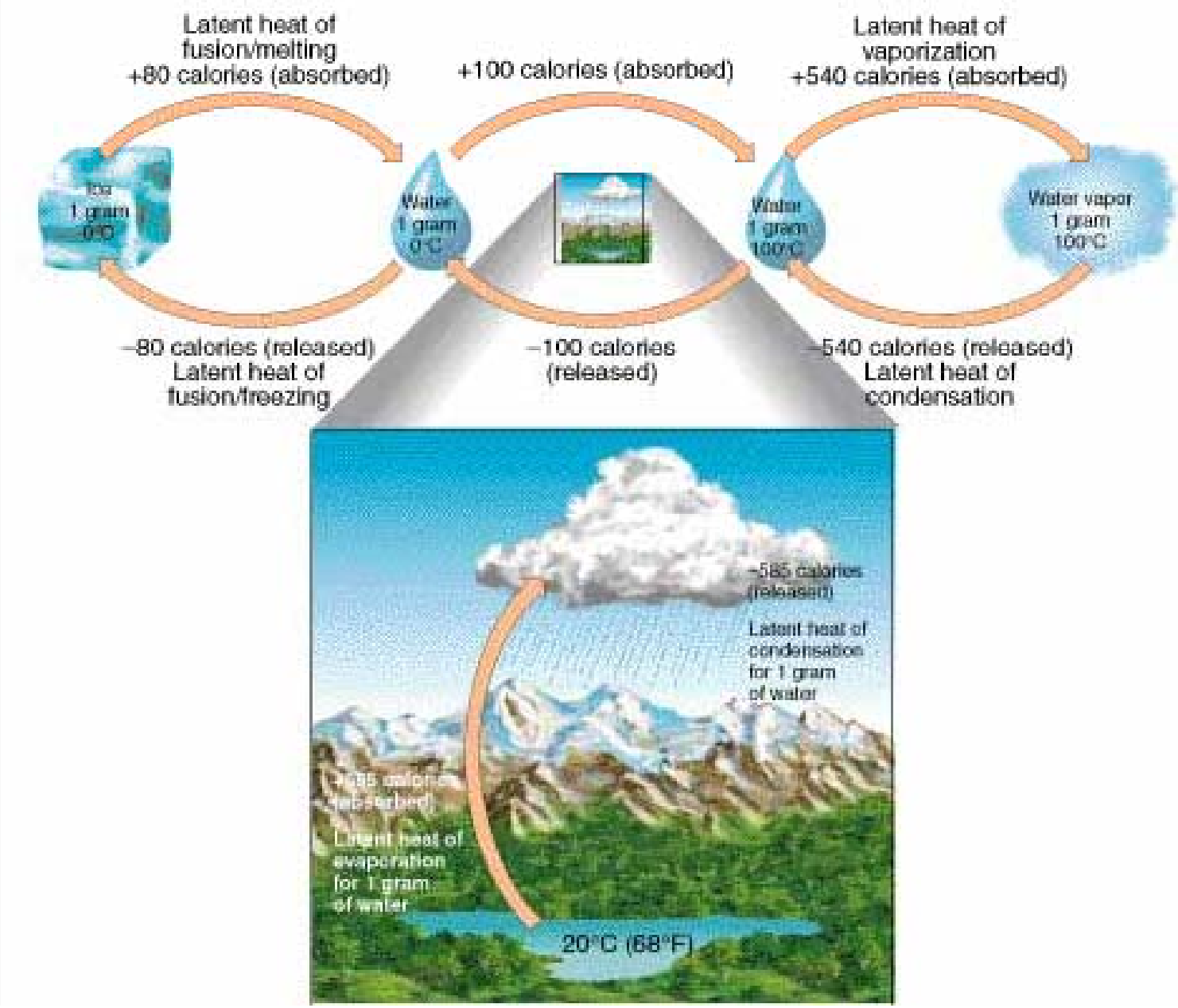


TABLE 2.1
Gases Composing Dry Air in the Lower Atmosphere (below 80 km)

Gas	% by Volume	Parts per Million
Nitrogen (N_2)	78.08	780,840.0
Oxygen (O_2)	20.95	209,460.0
Argon (Ar)	0.93	9,340.0
Carbon dioxide (CO_2)	0.03756	375.6
Neon (Ne)	0.0018	18.0
Helium (He)	0.00052	5.2
Methane (CH_4)	0.00014	1.4
Krypton (Kr)	0.00010	1.0
Nitrous oxide (N_2O)	0.00005	0.5
Hydrogen (H)	0.00005	0.5
Xenon (Xe)	0.000009	0.09
Ozone (O_3)	0.000007	0.07

Gasses in the Atmosphere (Air)

The atmosphere is composed of only a few gases.

Gas	Percentage	Importance
Nitrogen	78%	Highest concentration, transparent.
Oxygen (O_2)	21%	Biological origin. Product of life.
Ozone (O_3)	trace	Ozone layer in stratosphere absorbs sun's ultraviolet energy.
Argon	1%	Inert, does not react easily.
Water Vapor	0 – 4%	Highly variable, absorbs heat.
Carbon Dioxide	.03%	Absorbs heat, may increase 2X

Air

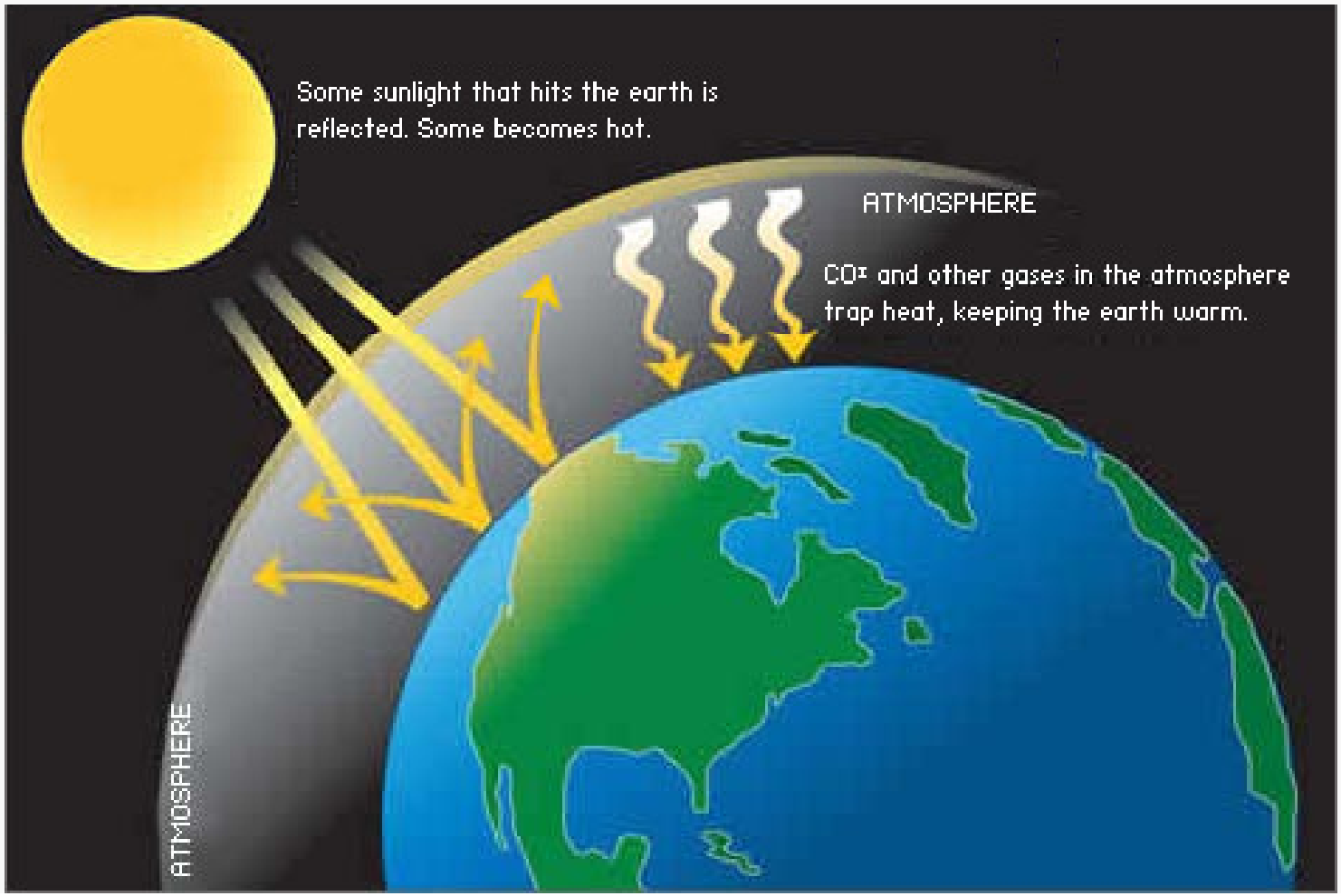
This collection of gasses is called air. The outstanding physical characteristic of air is that it is transparent, so sunlight (and other short wave energy) is transmitted through air easily and most is absorbed at the earth's surface.

The last two, water vapor and carbon dioxide, are far more important than their low concentrations suggest. They absorb or trap some of the heat escaping from the earth's surface. This warms the atmosphere and insulates the earth's surface. This process is called the green house effect. Humans are accelerating the green house effect by burning fossil fuels and adding carbon dioxide to the atmosphere.

A greenhouse has a transparent covering that lets light in but does not let heat out; so the temperature inside is higher than outside.

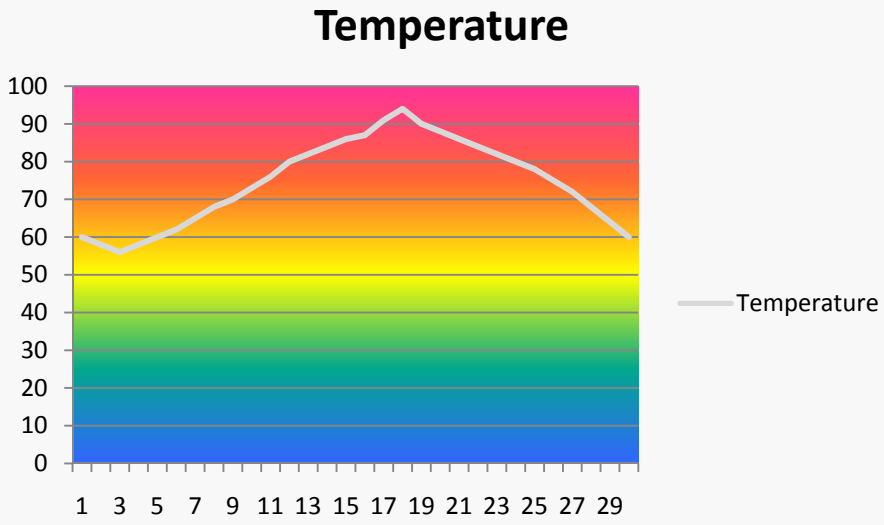
This greenhouse has a cover to filter out some of the light.

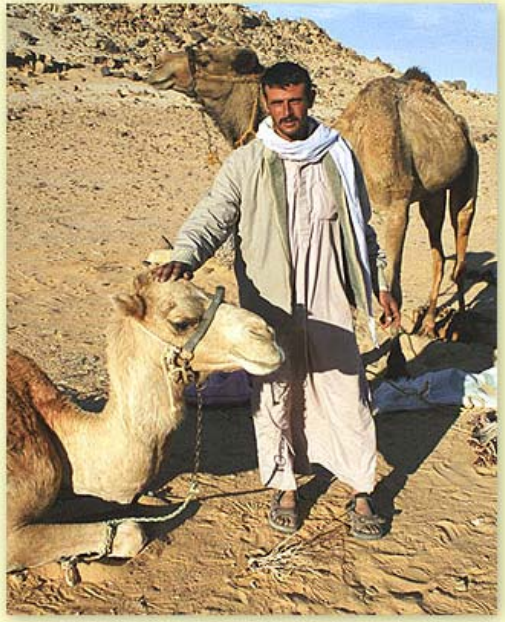
An Overly Simplistic Description of the Greenhouse Effect. Some of the escaping ground radiation is absorbed by the atmosphere and re-radiated back toward the surface. This is called counter radiation and the amount is controlled by the amount of carbon dioxide and water vapor in the air.



Water Vapor Is an Important Gas in the Atmosphere Because of Its Ability to Absorb Heat, However, It may Not Always Be Present.

The typical range of day-night temperatures is 20-23°F. However in desert environments the range can easily be 40-45°F. There is very little water vapor in desert air to absorb heat and retard the rate at which the ground cools. Therefore, heat moves through the atmosphere easily and on out to space.

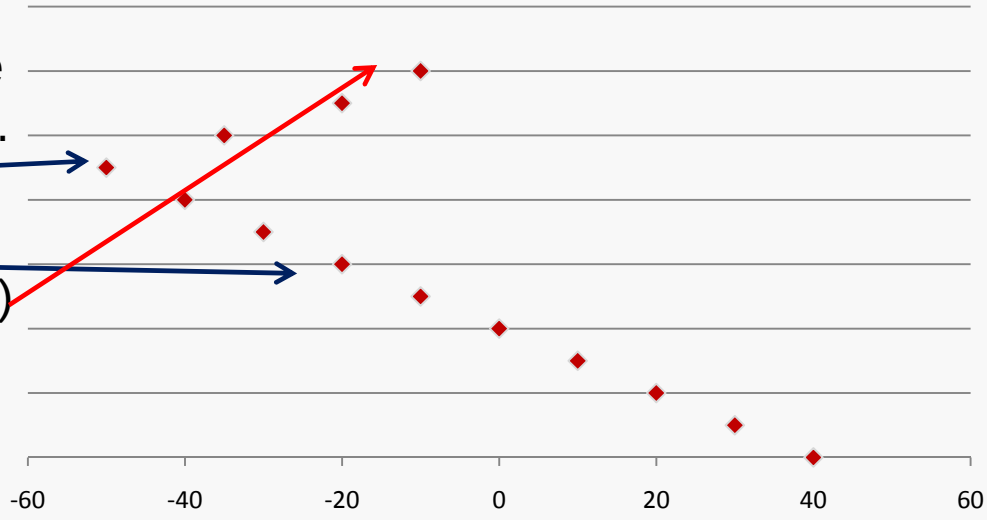




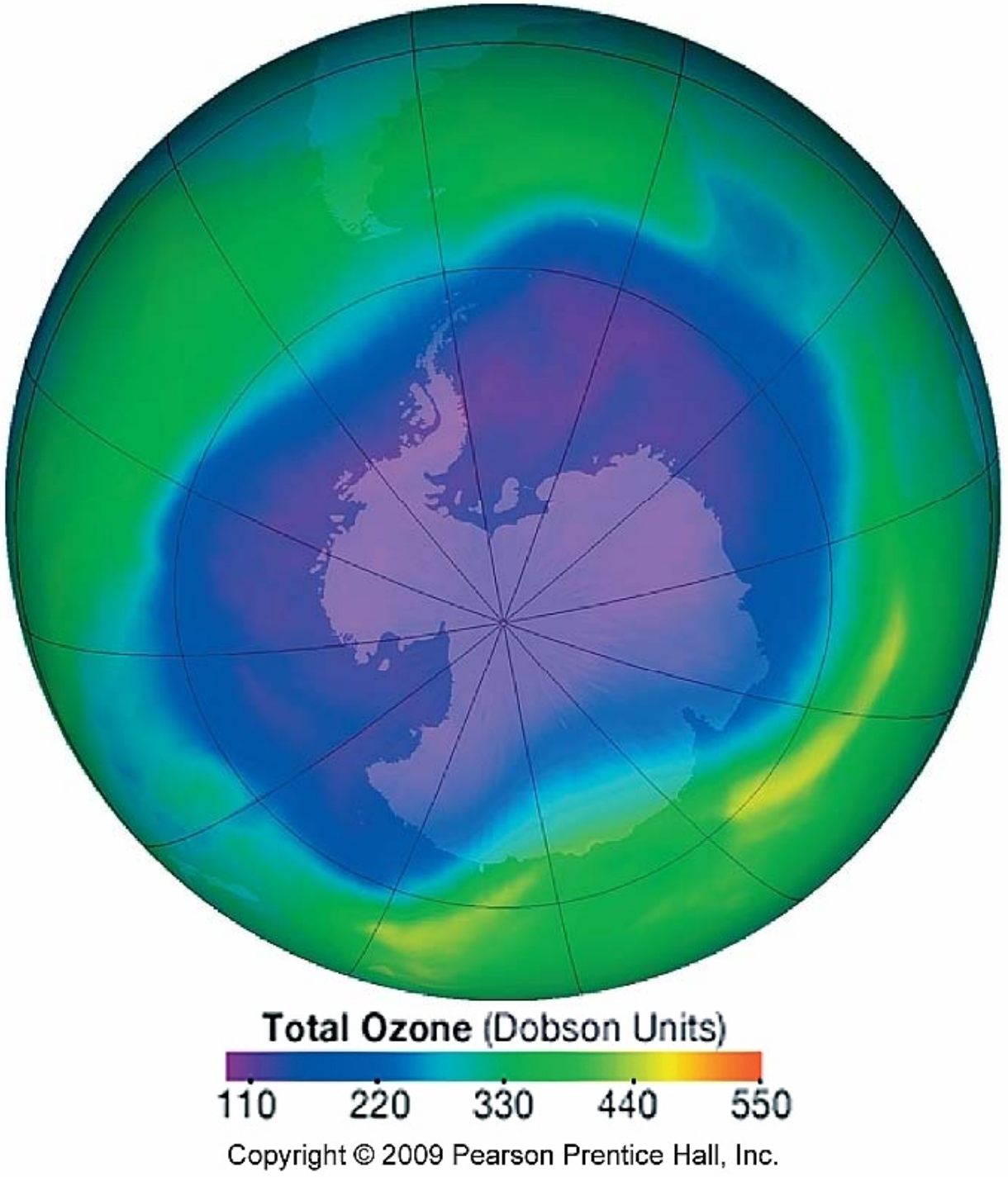
Thunderstorms Flatten Out on Top as the Rising Air Hits the Tropopause. Note What a Thin Envelope the Atmosphere Is.

The temperature of the atmosphere declines with altitude. However at some point, the temperature starts to increase. This is called the tropopause.
The troposphere, where weather occurs is below. The stratosphere (ozone layer) is above.

Temperature Compared to Altitude.



The “Hole” in the Ozone Layer in the Antarctic Showed Human Produced CFCs Gasses Really Could Float from the Surface to the Stratosphere and Enter into Chemical Reactions that Reduced the Amount of Ozone. This Allowed More Ultraviolet Energy to Reach the Surface.



Arctic Sea Ice Continues to Melt at an Alarming Rate