

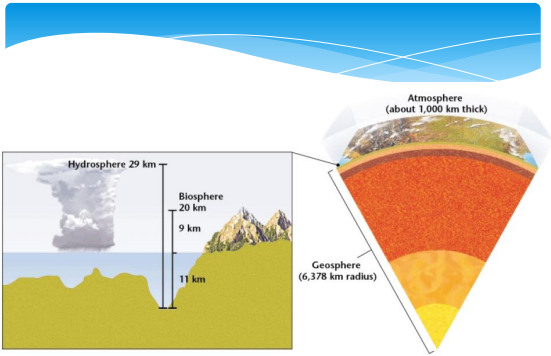
# The Atmosphere

## Composition and Structure

### The Atmosphere

- \* All energy on Earth ultimately derives from the sun
- \* Energy is intense, though, and could cook Earth
- \* Atmosphere is a thin layer of air that protects the Earth's surface from extreme temperatures and harmful sun rays

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### Atmospheric Composition

- \* Early atmosphere was much different than today
- \* Volcanoes produced nitrogen and carbon dioxide, but little oxygen
- \* More than 2 billion years ago, early organisms began producing oxygen
- \* Eventually, oxygen formed an ozone layer that protected Earth from harmful rays
- \* Green plants and diverse life forms developed

### Atmospheric Gases

- \* Nitrogen - 78%
- \* Oxygen - 21%
- \* Water Vapor - 0 to 4%
  - \* Used for clouds and precipitation
- \* Carbon Dioxide - .037%
  - \* Keeps Earth warm and is used by plants to make food
- \* Argon - .93%
- \* Traces of neon, helium, methane, krypton, xenon, hydrogen, and ozone

### The Layers

- \* Four official layers
- \* One extra, space-y layer
- \* Divided primarily by temperature

Altitude (km) / Altitude (mi)

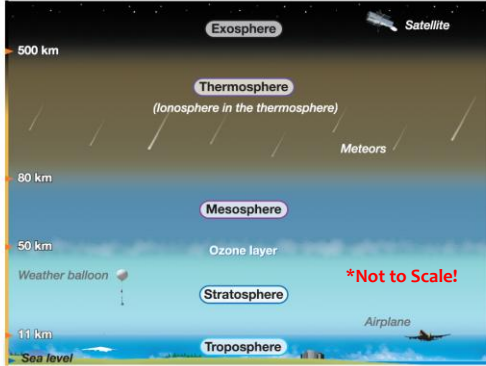
Temperature (°C) / Temperature (°F)

Layers: THERMOSPHERE, MESOSPHERE, STRATOSPHERE, TROPOSPHERE

Boundaries: Tropopause, Stratopause, Mesopause

Other features: Ozone maximum

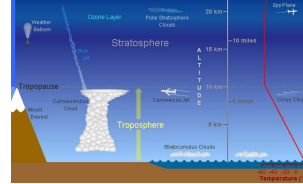
## Layers in the Atmosphere



## Troposphere

Lowest layer – extends up to 10km; contains 99% of the water vapor and 75% of the atmospheric gases

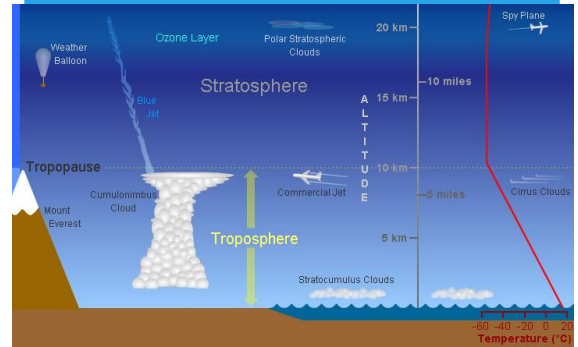
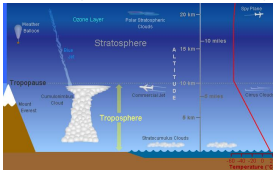
- \* Weather here
- \* Most of the layer's heat is from Earth
- \* Temperature cools about 6.5 degrees Celsius per kilometer of altitude.



## Stratosphere

Directly above troposphere, extending from 10 km to about 50 km above Earth's surface

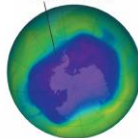
- \* Portion of the upper layer contains high levels of a gas called ozone
- \* Many jet aircraft fly in the stratosphere because it is very stable. Also, the ozone layer absorbs harmful rays from the Sun.



## The Ozone Layer

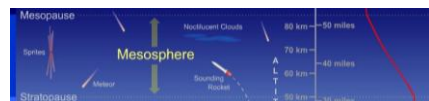
- \* About 19 km to 48 km above Earth in the stratosphere (90%) and troposphere (10%).
- \* Layer of 3-atom molecules that protects the Earth from the Sun's harmful ultraviolet radiation
- \* Life depends on the ozone layer!
- \* Pollutants called chlorofluorocarbons (CFCs) are destroying the ozone
- \* Ozone layers has a large hole over Antarctica and a smaller one over the North Pole

The largest hole in the ozone layer ever observed. (September 24, 2006)



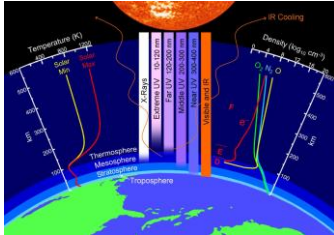
## Mesosphere

- \* Extends from the top of the stratosphere to about 85 km above Earth
- \* Coldest layer with little ozone
- \* Meteors or rock fragments burn up in the mesosphere.
- \* Small portion of Ionosphere here – layer of charged particles that influence atmospheric magnetism and radio communications



## Thermosphere

- \* Thickest atmospheric layer found between 85 km and 500 km above Earth's surface
- \* The thermosphere is a layer with auroras, known for its high temperatures.
- \* Warmed as it filters out X-rays and gamma rays from the Sun
- \* Ionosphere here, too



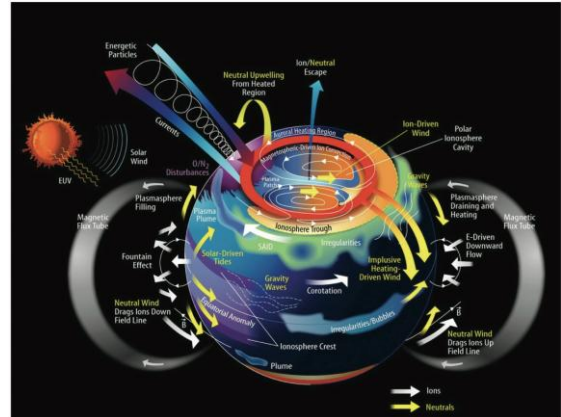
## Exosphere

- \* Where the atmosphere merges into space in the extremely thin outermost atmosphere.
- \* Upper limit of our atmosphere—some scientists debate whether or not it is properly “atmospheric” because it’s virtually empty
- \* Where space shuttle orbits, final tiny part of ionosphere



## Temperature in atmospheric layers

- \* The troposphere is warmed primarily by the Earth's surface; temperature **decreases** as altitude increases in this layer.
- \* Temperatures **increase** as altitude increases in the stratosphere, particularly in the upper portion – ozone
- \* Temperatures **decrease** with altitude in the mesosphere
- \* Thermosphere and exosphere are the first to receive Sun's rays, so they are very **hot**



## Heat

Energy that flows from an object with a higher temperature to an object with a lower temperature

- \* Heat is transferred through the atmosphere by radiation, convection, conduction
- \* Molecules move closer together, making air more dense, and air pressure increases
- \* Cold air sinks, pushing up warm air, which then cools and sinks, pushing up more warm air

