



**THE
DEVELOPMENT OF
EARTH**

WHAT WAS EARLY EARTH LIKE?

- Early Earth's surface was a molten pool of metal for a long time
- Three major factors that caused heating and melting in the early Earth's interior:

1. Collisions

- Transfer of kinetic energy into heat

2. Compression

- Compacting matter

3. Radioactivity of elements



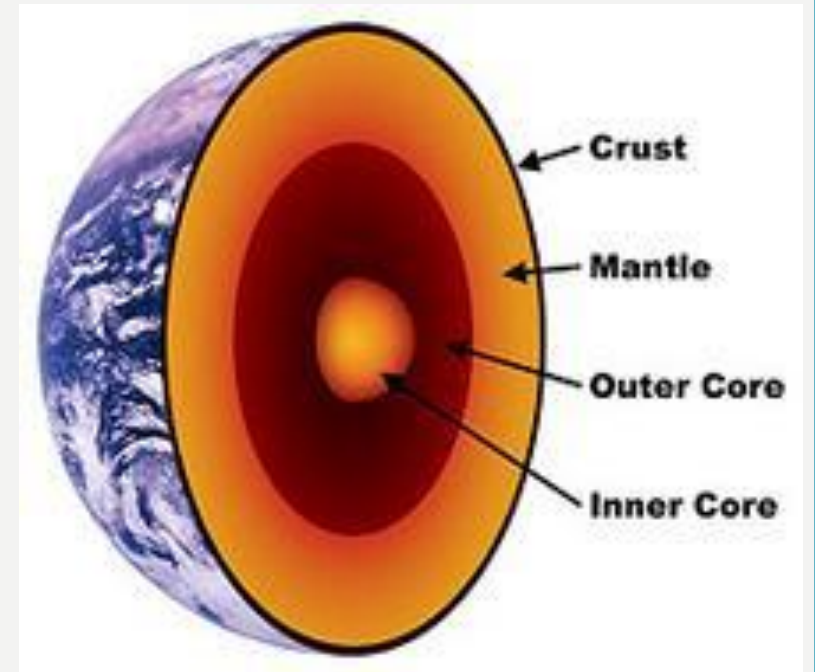
Early Molten Earth



Early Cooling Earth

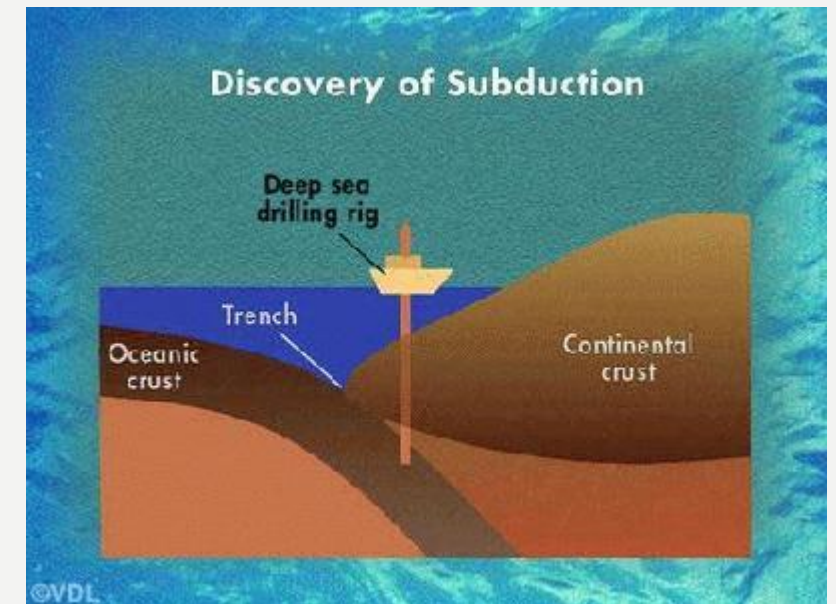
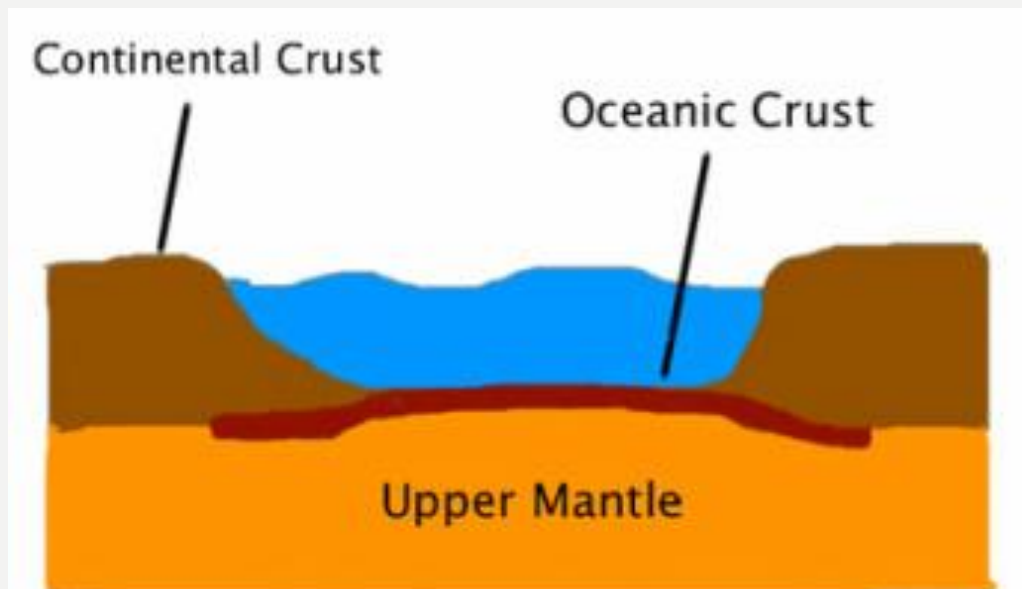
HOW DID THE EARTH'S CRUST FORM?

- Early Earth was inhospitable, the surface was a pool of molten material
- Molten material began to cool, formed early rocks
 - Formed a thin, very brittle crust
 - Similar to the cooled material from volcanoes
- Early crust melted and re-formed many times
- Two types of crust emerged
 - Continental
 - Oceanic



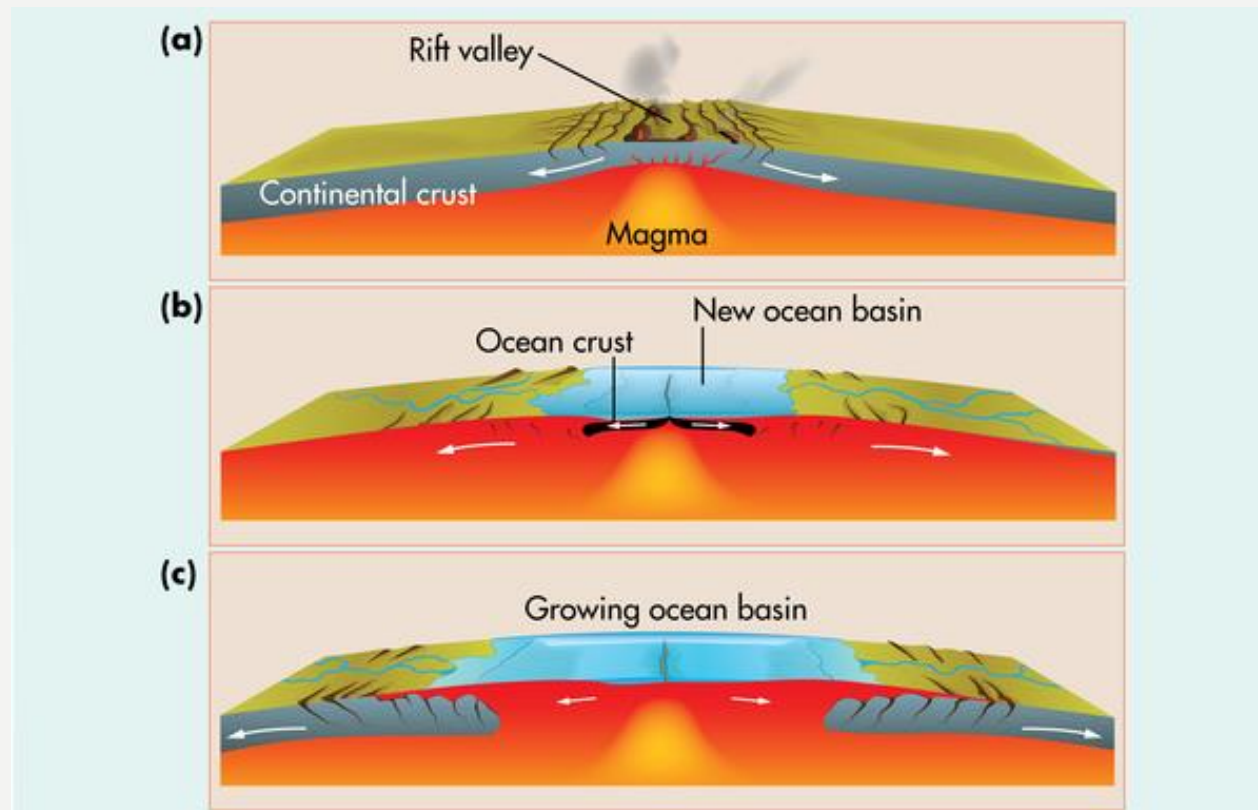
HOW DID THE EARTH'S CRUST FORM?

- **Continental Crust** – the base of all of the continents
 - Thicker, less dense than oceanic crust
- **Oceanic Crust** – portion of Earth's crust that makes up the ocean floor
 - Thinner, more dense than continental crust



HOW DID THE OCEANS FORM?

- Earth's oceans began to form when continents began to drift apart
- Molten interior rose to the surface and cooled → Oceanic Crust
- As the Earth cooled, water vapor turned into rain and eventually formed the oceans.



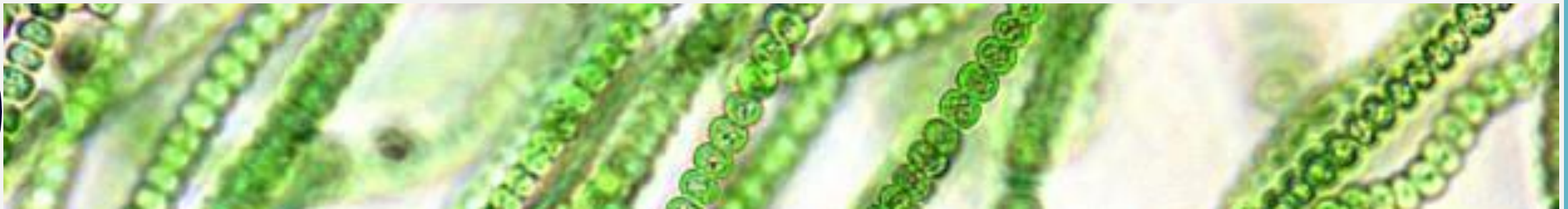
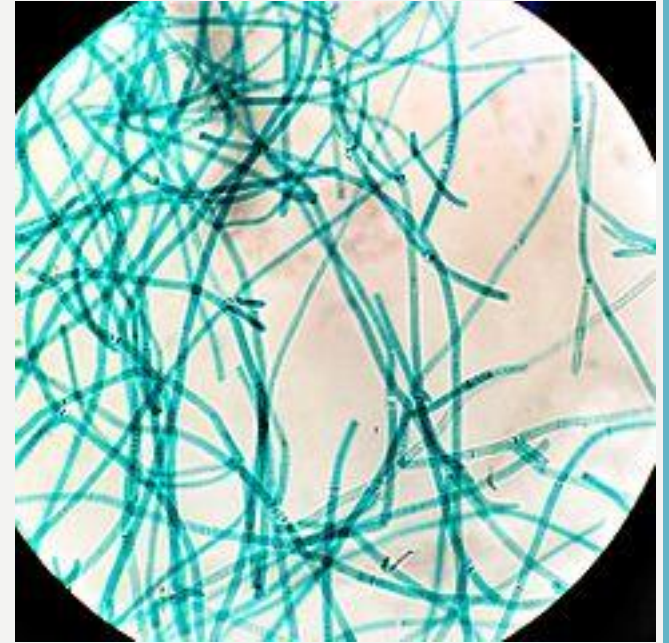
WHAT WERE EARLY EARTH'S ATMOSPHERES LIKE?

Atmosphere – gaseous layer that envelopes Earth. The density of the atmosphere decreases as you move away from the surface of the Earth.

- Earliest atmosphere, didn't stick, was mostly hydrogen and helium.
 - Too light for the planet to retain. Likely carried away by solar wind
- “First Atmosphere” developed from gases released by volcanoes.
 - Thought to be blown off by an impact with an asteroid the size of Mars 4 billion years ago
 - Material from this impact later formed the moon
 - Was mostly water vapor and carbon dioxide.
- “Second Atmosphere” developed from volcanic gases. Those that didn't break down accumulated. Sunlight broke down ammonia into nitrogen.
 - This atmosphere eventually developed into our modern atmosphere.

HOW DID WE GET OXYGEN?

- Early Earth's atmosphere had almost no free oxygen
- Earliest organisms on Earth were cyanobacteria
- These were the first photosynthetic organisms.
- Population of bacteria increased → oxygen in atmosphere increased



HOW WAS LIFE ABLE TO DEVELOP?

- At first, oxygen didn't accumulate in the atmosphere
 - Oxygen will bond to other elements if they are available
 - Other elements to bond to had to be exhausted first
- 2.5 billion years ago – little oxygen. 1% of atmosphere
- 2 billion years ago – concentration begins to increase
- 700 million years ago – concentration increased 20%



HOW WAS LIFE ABLE TO DEVELOP?

- As oxygen built up, it formed ozone (made of oxygen atoms)
- Ozone layer building up began to block harmful UV rays
- Allowed terrestrial life to survive and begin evolving

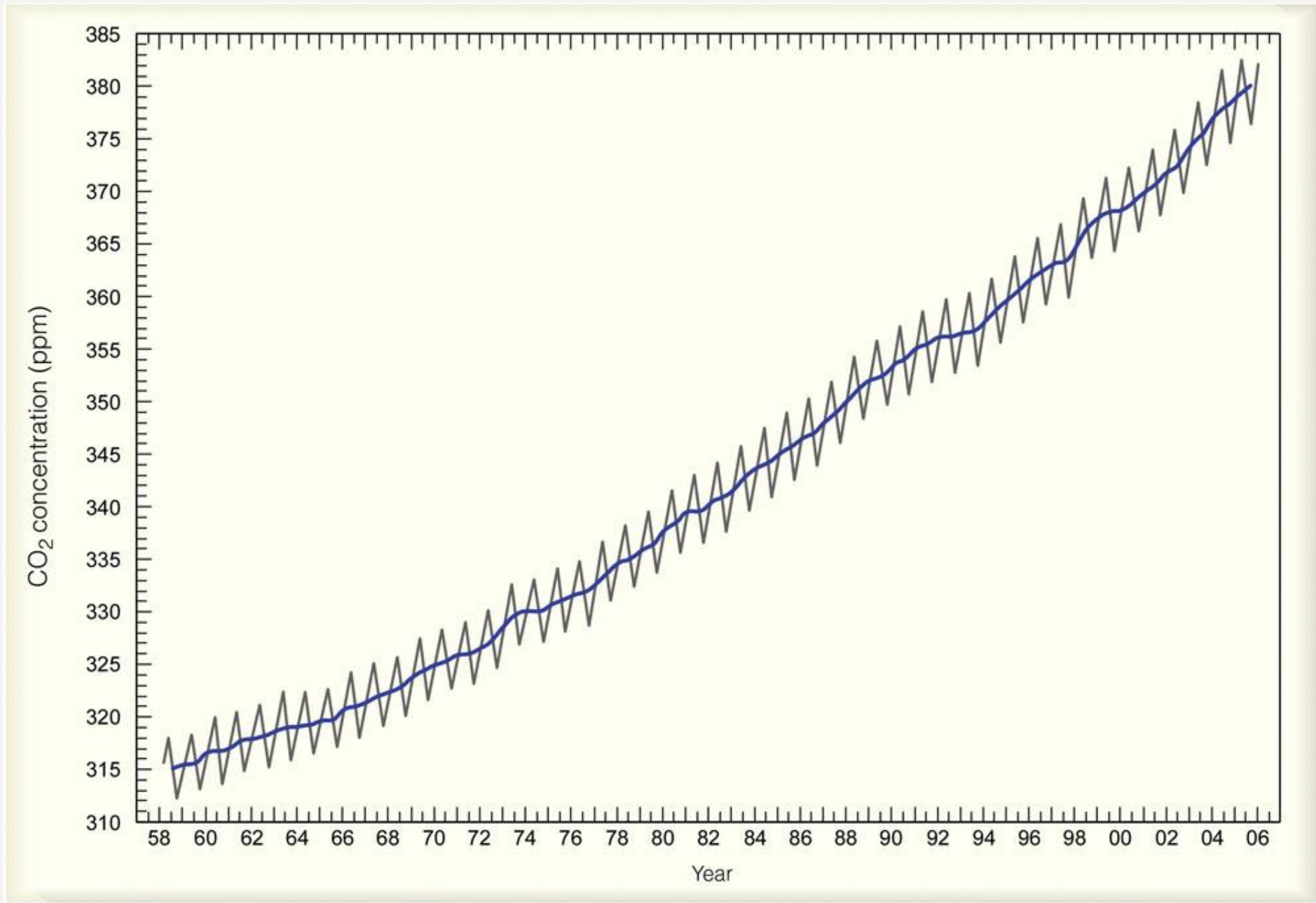


WHAT IS THE COMPOSITION OF THE MODERN ATMOSPHERE?

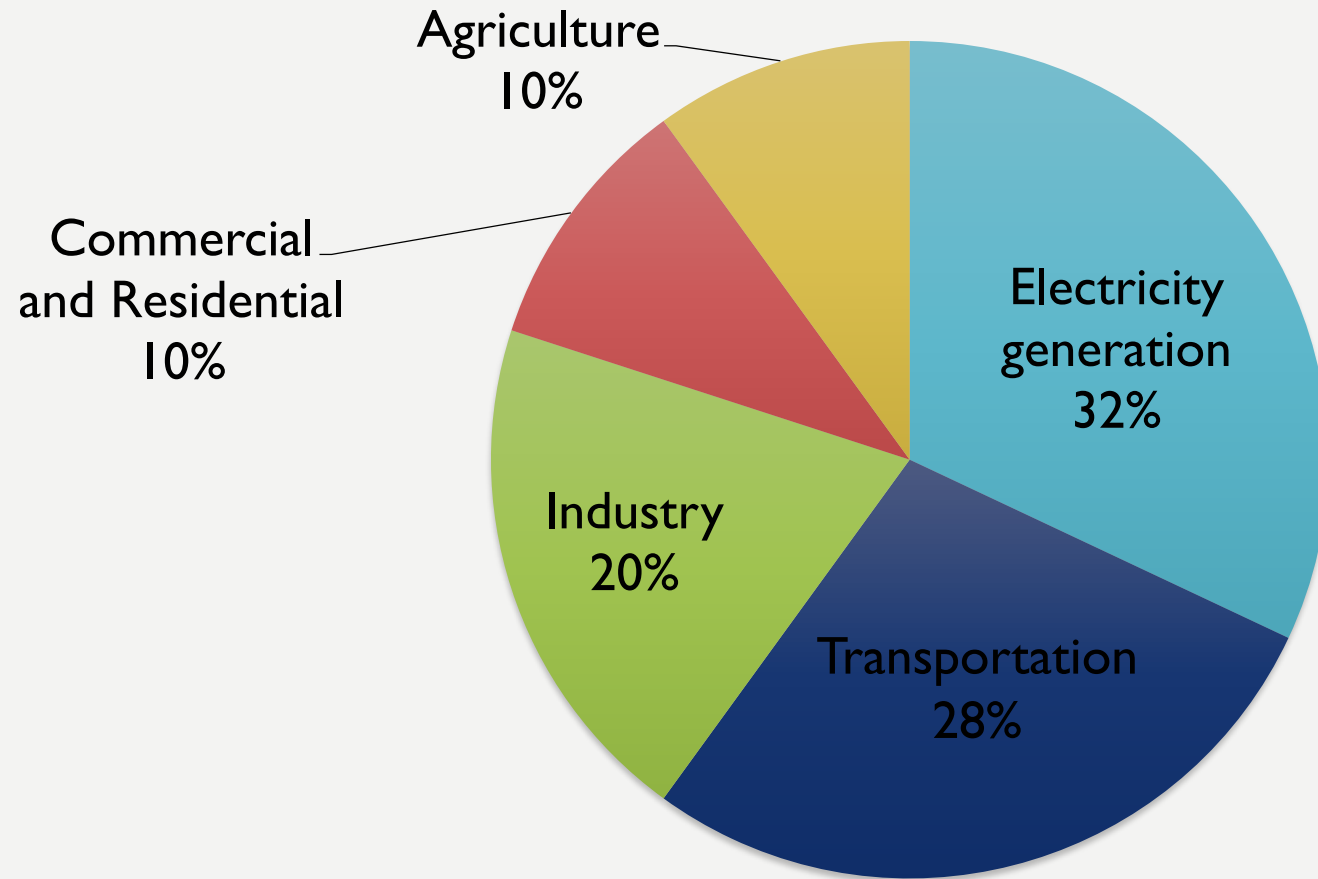
- The modern atmosphere is:
 - 78% N₂
 - 21% O₂
 - 1% Ar
- N₂ is primordial – it's been part of the atmosphere as long as there's been an atmosphere
- O₂ has been rising from none at all about 2.2 b.y.a

WHAT IS THE COMPOSITION OF THE MODERN ATMOSPHERE?

- Water Vapor: H₂O 0-4%
 - Very powerful greenhouse gas (both in vapor form and as clouds)
- Carbon dioxide
 - 390 ppm (parts per million) and counting...
 - Natural and human made sources/sinks
 - Strong greenhouse gas



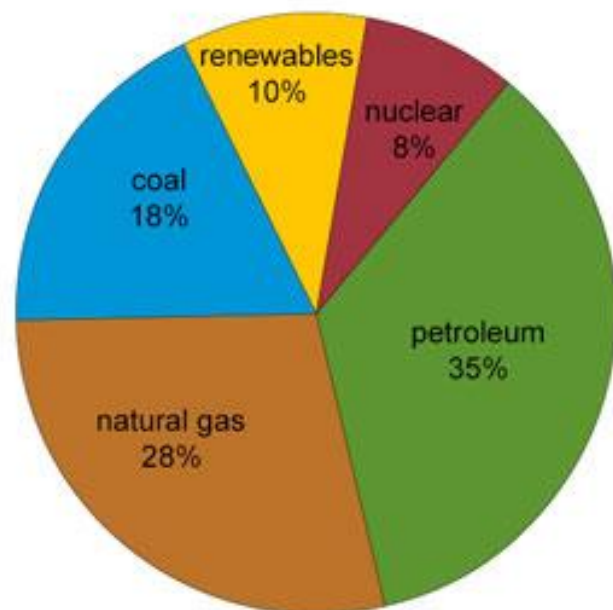
U.S. GREENHOUSE GAS EMISSIONS (BY ECONOMIC SECTOR)



U.S. ENERGY USE AND CO₂ EMISSIONS

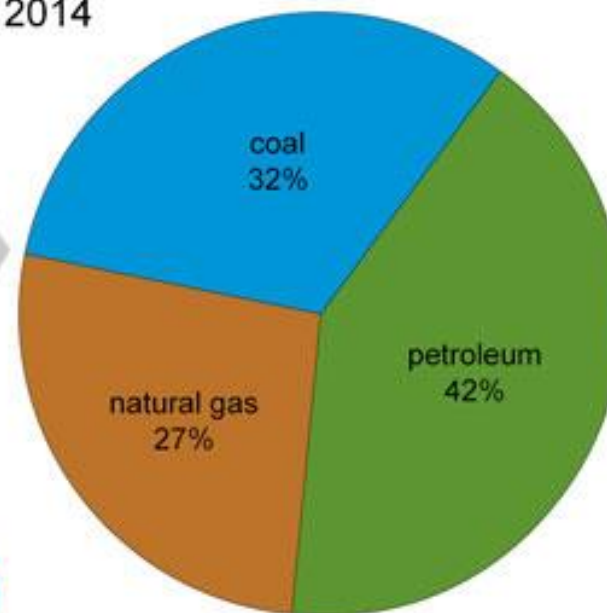
Burning petroleum products (gasoline, etc.) is the largest contributor to CO₂ emissions

U.S. energy consumption by major fuel type, 2014



Totals may not equal 100 due to independent rounding.
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 (August 2015), preliminary 2014 data

Resulting U.S. energy-related carbon dioxide emissions by major fuel type, 2014



Totals may not equal 100 due to independent rounding.
Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 12.1 (August 2015), preliminary 2014 data

