

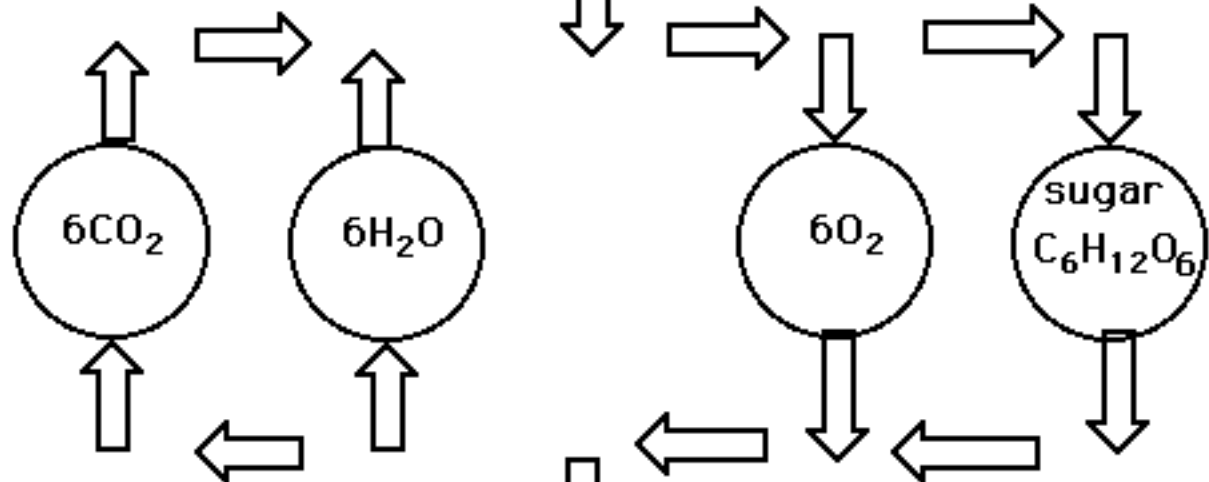
**WHAT FACTORS DETERMINE THE AMOUNT
OF CARBON DIOXIDE IN THE ATMOSPHERE?**

ROLE OF BIOLOGICAL PROCESSES:

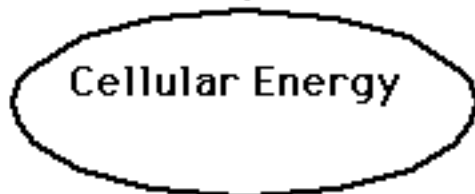
**PHOTOSYNTHESIS AND
RESPIRATION**



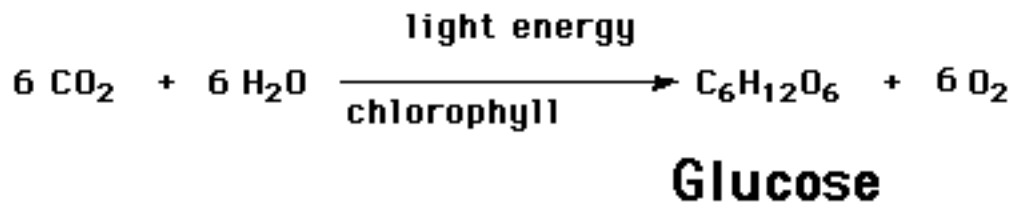
Photosynthesis



Respiration



Organisms with ability to convert light energy to chemical energy are autotrophs:

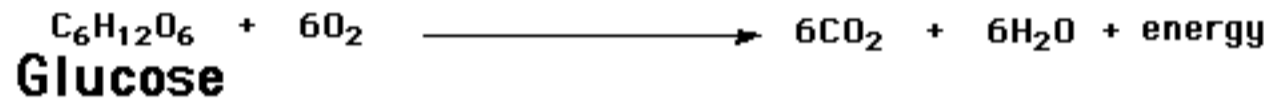


Requires 686 kcal/mol

The oxygen released is the source of the Earth's Oxygen and Ozone.

Organisms not capable of photosynthesis are heterotrophs and must consume energetic molecules and obtain energy in a process called Metabolism

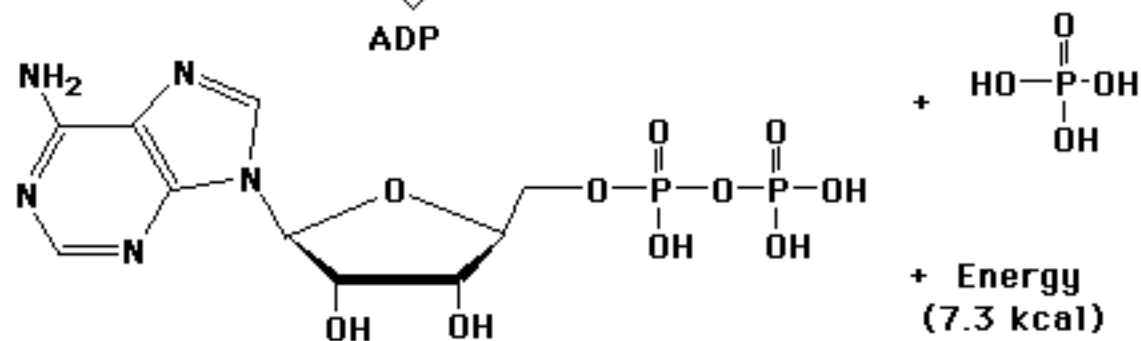
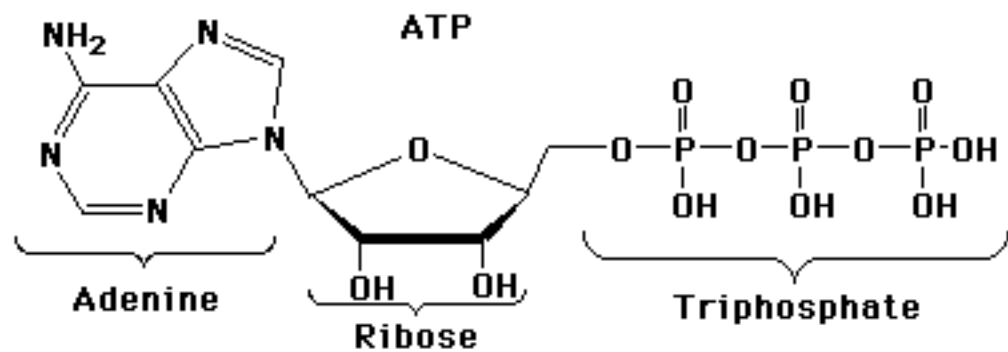
The main source of bodily energy is glucose:



Releases 686 kcal/mol

Oxygen is consumed and carbon dioxide is released.

The energy released is stored in ATP.



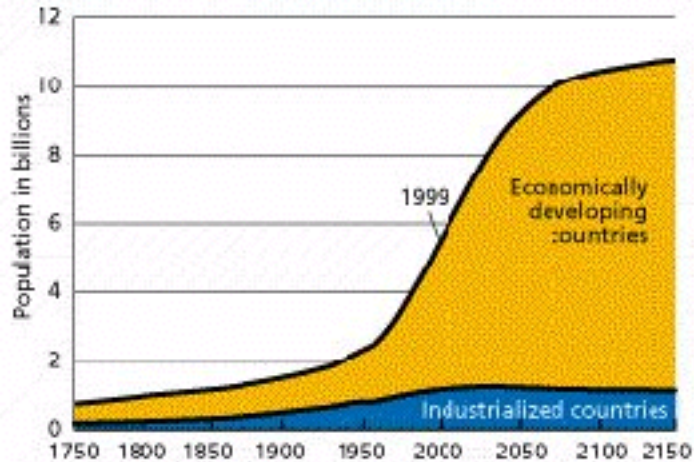
The world's population is currently growing at 76 million people per year.

Current world population - 6.2 billion

US population - 286,000

World population in 2050 - 9.1 billion

World Population Growth, 1750-2150

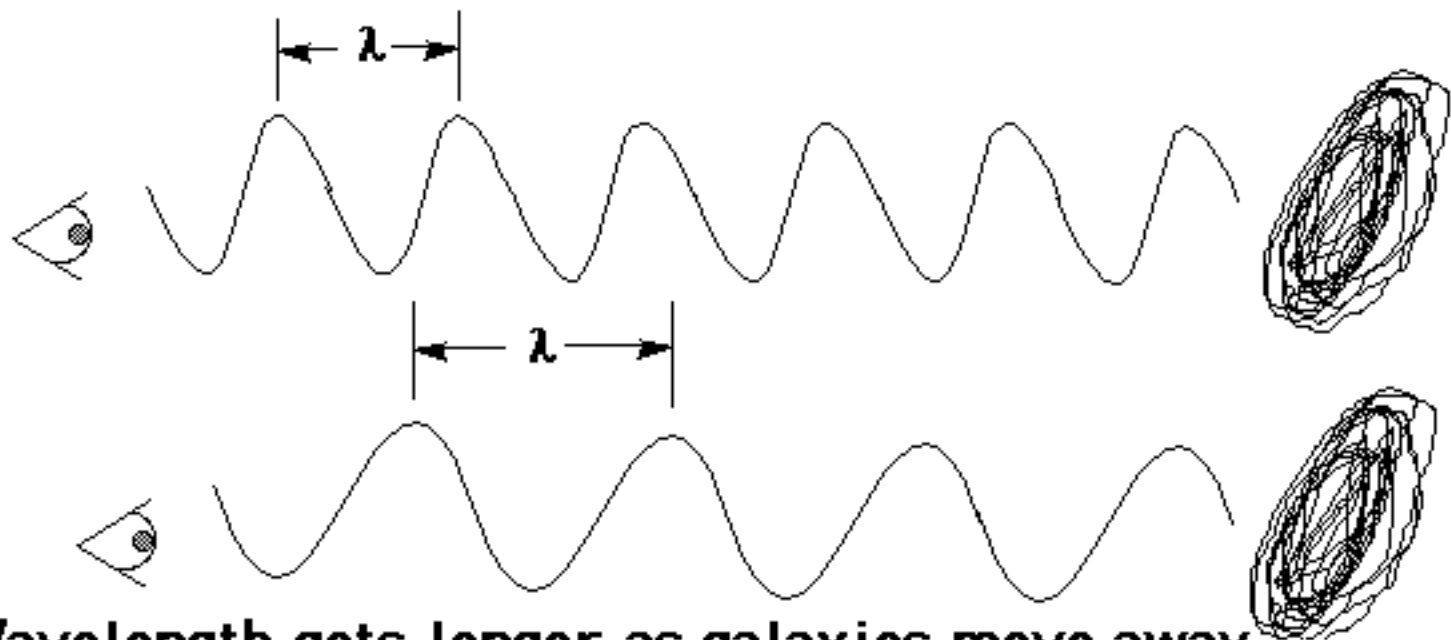


The Universe was born at a specific time in the past and has been expanding ever since

Edwin Hubble 1929 Expanding Universe

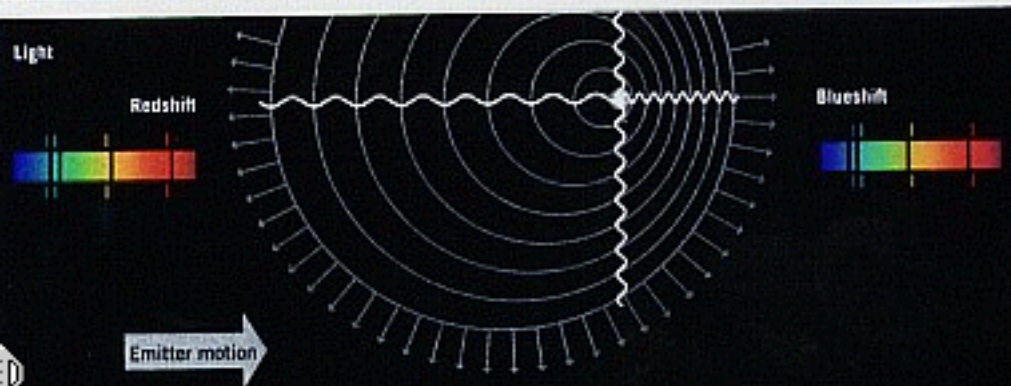
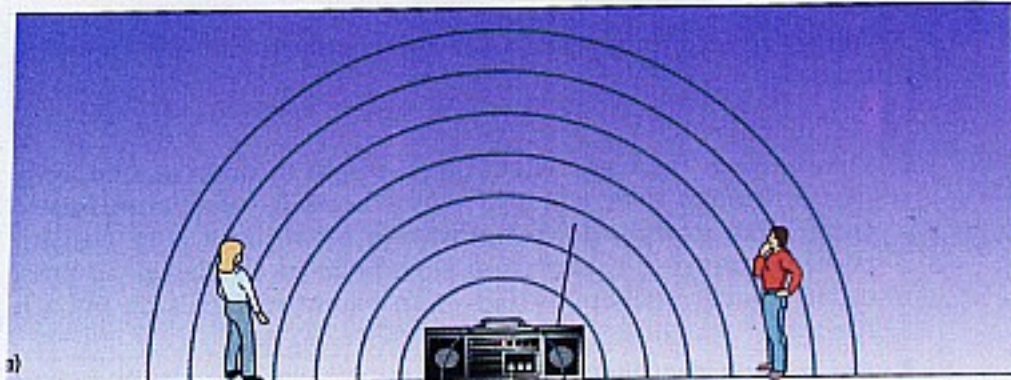
COSMOS-j

1. Light coming from far away galaxies is Red shifted



Wavelength gets longer as galaxies move away

Doppler Effect



**The red shift tells us that the universe is expanding
Called the Hubble expansion**

The Universe must have had a beginning:

Universe Cartoon

The Big Bang

About 14 Billion years ago

The Chronology of the Big Bang:

In the Beginning: All four forces of Nature united

10^{-43} sec -- Force of gravity separates

10^{-34} sec -- Quarks and electrons emerge

10^{-5} sec -- Quarks able to stick together to form
protons and neutrons

1 sec -- Electrons and positrons (matter and
antimatter) annihilate each other leaving an
excess of electrons

1 min -- Protons and neutrons stick together to form
He and Li ions

300,000 years -- The ions capture electrons to
form the first atoms

Four forces of Nature:

Force of gravity

**Strong Force – Holds protons and neutrons together
in the nucleus**

Weak Force – Associated with radioactive decay

Electromagnetic force – Electricity and magnetism

Top three reasons to believe big bang cosmology

1. **Big Bang Nucleosynthesis** - Abundance of light elements produced a hundredth of a second to a few minutes after the big bang are exactly as we predict.

2. **Cosmic Microwave Background Radiation** - discovered by Arno Penzias and Robert Wilson in 1965.

3. **Hubble Expansion** - Edwin Hubble discovered that the universe is expanding as a result of the big bang

Current Big Questions in Cosmology



Is the Universe Closed?

The question of whether the Universe will collapse in a big crunch or continue expanding forever hinges on knowing the density of the Universe.

Compress all of geologic time, starting with the origin of the Earth, into a one-year period:

Midnight, January 1 ---the origin of the Earth (4.5 billion years)

Early to mid-March---first life on Earth (3.5-3.8 billion years ago)

Early May---first photosynthesis, blue-green algae (3 billion years ago)

Mid-November---first animals with hard parts (shells) in the Cambrian (570 million years ago), first eukaryotic cells

Thanksgiving---Age of Fishes (Devonian, some 400 million years ago)---dominance by vertebrates for the first time, first land plants

About December 7---the Pennsylvanian period (about 300 million years ago)---Many areas of land consist of extensive swamps that eventually become the great Appalachian coal deposits; cockroaches common insects of the time---first eggs with shells (reptiles)

About December 11---the Permian period (about 250 million years ago)---the start of the Age of Reptiles, dominated initially by the reptiles that eventually evolved to mammals

About December 15---late Triassic period (about 200 million years ago)---first dinosaurs, turtles, crocodilians; dinosaurs become dominant land animals---mammals probably appeared here, but very insignificant at this stage

Bad Dinosaur

Dinosaur cartoon 1

Dinosaur cartoon 2

December 20---(130-140 million years ago) late Jurassic---early Cretaceous---age of dinosaurs---first snakes, birds, modern fishes (trout, bass, etc.), great expansion of flowering plants

Christmas---end of Cretaceous (65 million years ago)---extinction of dinosaurs; mammals become dominant land animals

December 31, 4 PM---earliest fossils of genus Homo (that's us) appear about here (4 million years ago)

December 31, 11:35 PM---"mitochondrial Eve" suggested to occur about here (200,000 years ago)
Modern Humans emerge

December 31, 11:58:30 PM---the entire span of "recorded" human history (ca. 12,000 years) begins here

December 31, 11:59:46 PM---the Christian era (2000 years) accounts for the last 14 seconds of our year.