Astrobiology & Life in the Universe

Why Do We Believe What We Believe?

Some Background in Physics, Chemistry, and Astronomy

Dr. R. L. Hudson (Spring, 2018)

Physics – Motion & Mathematics

Isaac Newton
1642 - 1727

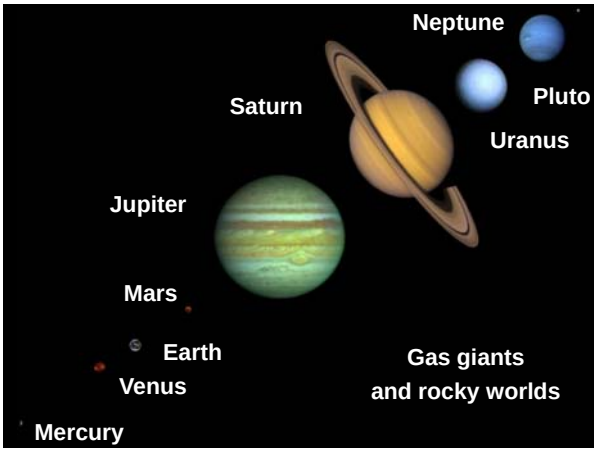
Newton's Law Of Gravity

$$F = G\frac{m_1 m_2}{r^2} \quad \Rightarrow \quad \frac{a^3}{P^2} = \frac{G}{4\pi^2}(m_1 + m_2)$$

Astronomy

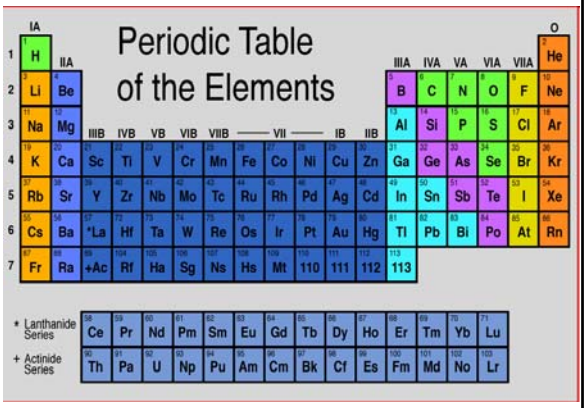
Some Residents of our Galaxy

ISM = Interstellar Medium

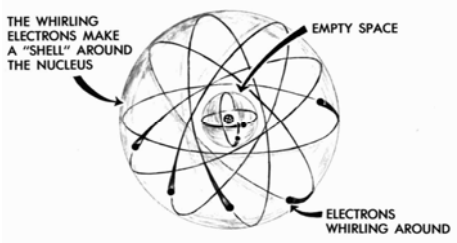


Chemistry

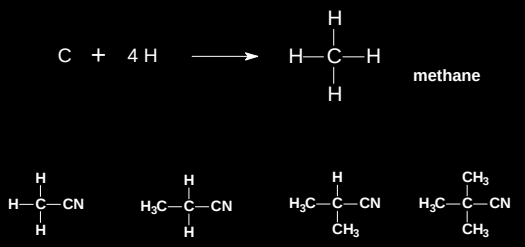
Periodic Table of the Elements



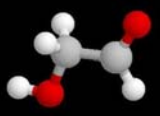
Our Atomic Picture



Atoms bond to make molecules

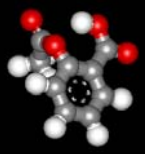


Molecules have 3-dimensional shapes

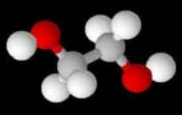


Glycolaldehyde

Aspirin



Ethylene Glycol



Learn The Terminology

Elements made of atoms, which have **symbols:**

H = hydrogen
He = helium
C = carbon
N = nitrogen
O = oxygen

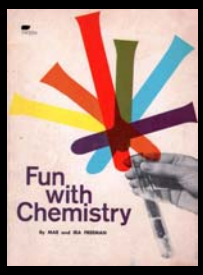
~ 118

Compounds made of molecules, which have **formulas:**

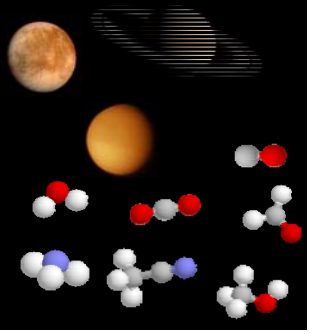
H_2O
CO_2
CH_4 = methane
NH_3 = ammonia

~ 100,000,000

February 2018



Astrochemistry



Chemistry in Space

Meteorites - Hundreds of compounds found

Planets - Dozens of compounds detected in their atmospheres and on their surfaces

Comets - Dozens of compounds detected

ISM – About 200 compounds, mostly organics, have been discovered there

How Do You Know This Stuff?

Isaac Newton (again)

Telescopes

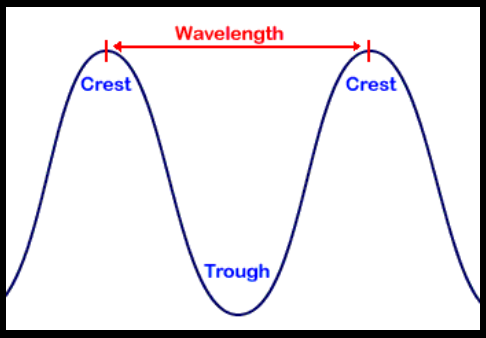
Spectroscopy

Use prisms, etc. to break-up light into wavelengths (colors)

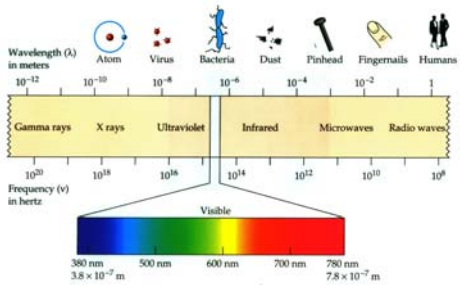
Electromagnetic Spectrum

Spectrum (sing.) Spectra (pl.)

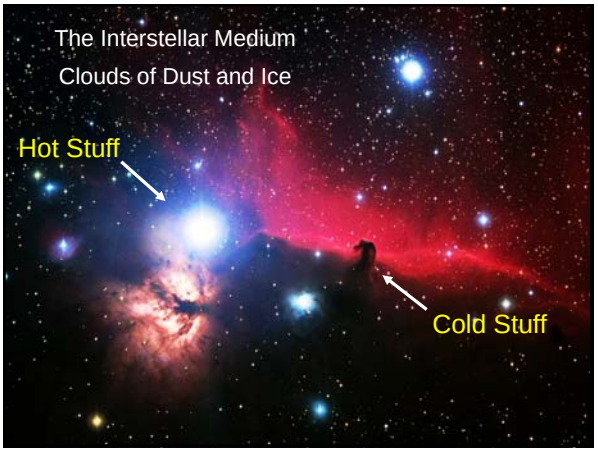
Wave Characteristics



The Electromagnetic Spectrum



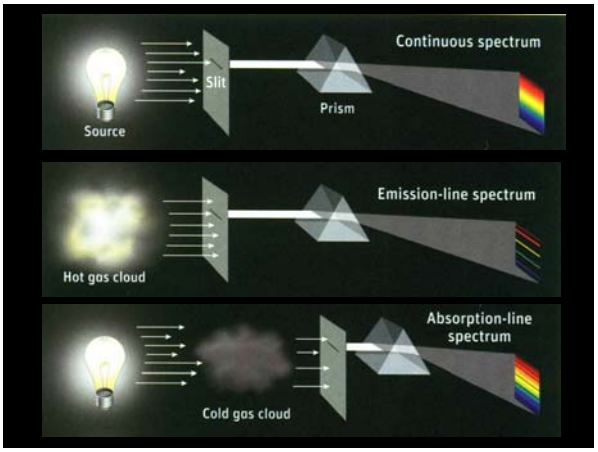
$\lambda\nu = c$ where $c = 3.00 \times 10^{10}$ cm / sec

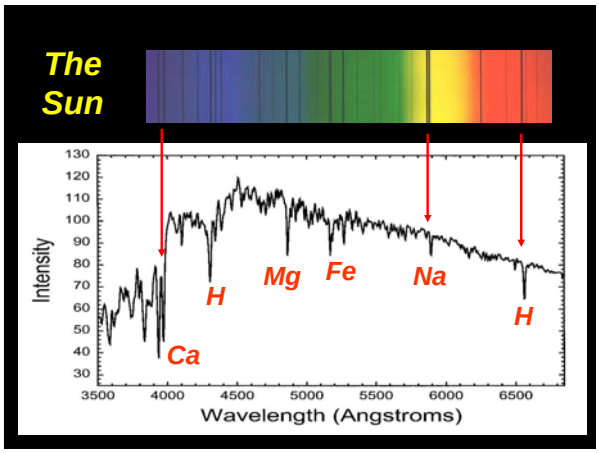


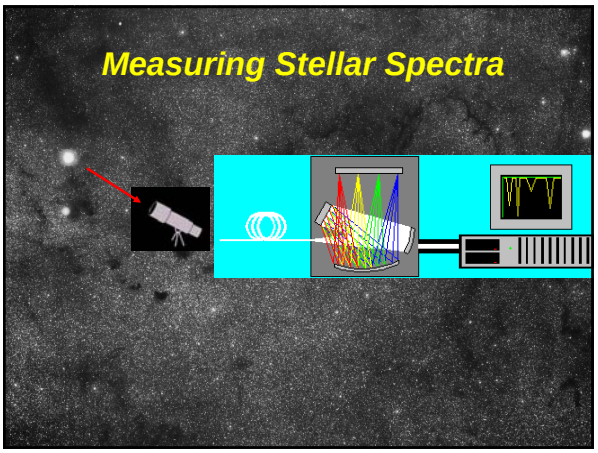
Orion Nebula

Visible light

IR light







Bottom Lines

1. Identify the lines ("peaks") of an object's spectrum and you've chemically analyzed that object.

2. Find same elements and many of the same compounds in space and on Earth.

Sources of Material

Most of the images used here are either original, from our class's textbook, or in the public domain. Material not fitting into these categories has been credited in cases where I knew the sources. The figures showing the three types of spectra are from the August, 2004 issue of *Sky & Telescope* magazine. Several images are from the Astronomy Picture of the Day web site. I will be glad to add any other credits missed.