

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



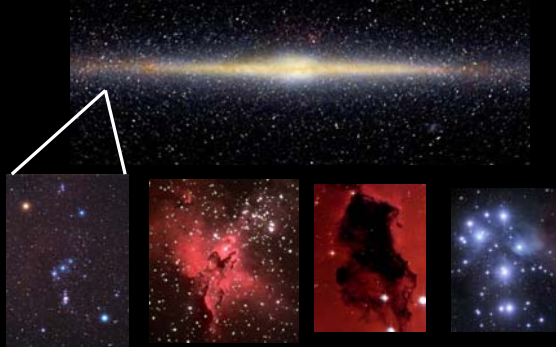
Isaac Newton
1642 - 1727

Newton's Law Of Gravity

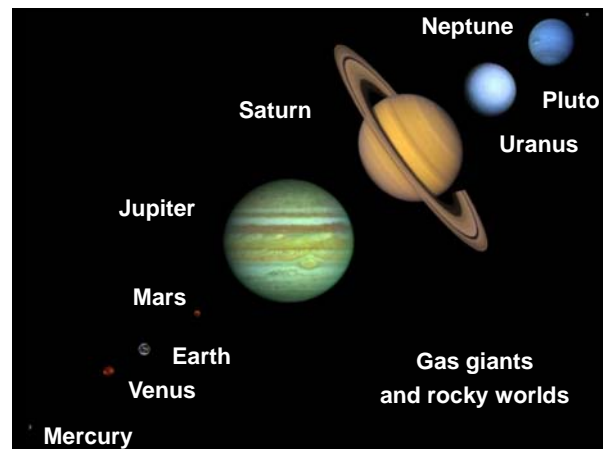
$$F = G \frac{m_1 m_2}{r^2} \quad \rightarrow \quad \frac{a^3}{P^2} = \frac{G}{4\pi^2} (m_1 + m_2)$$

Astronomy

Some Residents of our Galaxy



ISM = Interstellar Medium



Chemistry

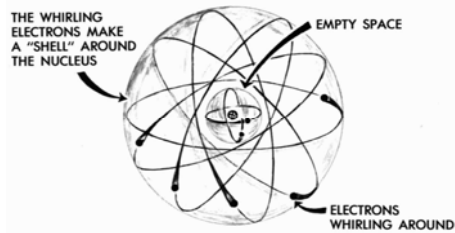


Periodic Table of the Elements

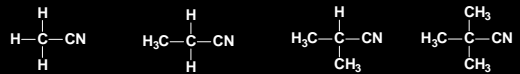
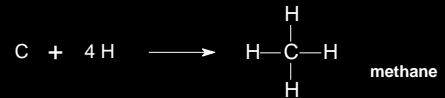
1	IA																O																			
2	IIA												IIIA		IVA		VA		VIA		VIIA		He													
3	Li		Be												B		C		N		O		F		Ne											
4	Na		Mg		IIIB		IVB		VB		VIB		VIIB		VII		IIB		Al		Si		P		S		Cl		Ar							
5	K		Ca		Sc		Ti		V		Cr		Mn		Fe		Co		Ni		Cu		Zn		Ga		Ge		As		Se		Br		Kr	
6	Rb		Sr		Y		Zr		Nb		Mo		Tc		Ru		Rh		Pd		Ag		Cd		In		Sn		Sb		Te		I		Xe	
7	Cs		Ba		*La		Hf		Ta		W		Re		Os		Ir		Pt		Au		Hg		Tl		Pb		Bi		Po		At		Rn	
8	Fr		Ra		*Ac		Rf		Ha		Sg		Ns		Hs		Mt		110		111		112		113											

* Lanthanide Series
 + Actinide Series

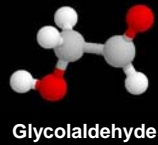
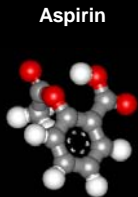
Our Atomic Picture



Atoms bond to make molecules



Molecules have 3-dimensional shapes



Learn The Terminology

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

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

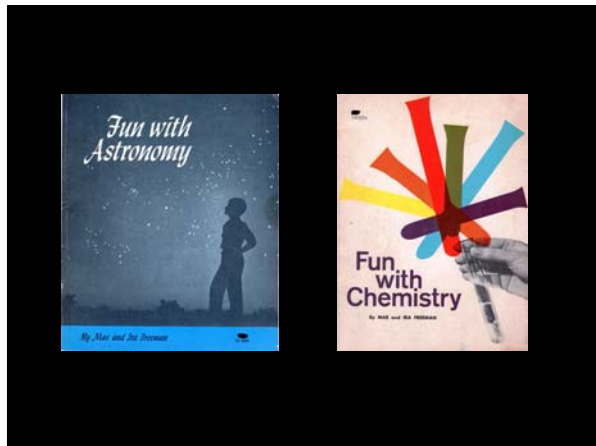
~ 118

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

H₂O
 CO₂
 CH₄ = methane
 NH₃ = ammonia

~ 100,000,000

February 2018



Chemistry in Space

Meteorites - Hundreds of compounds found

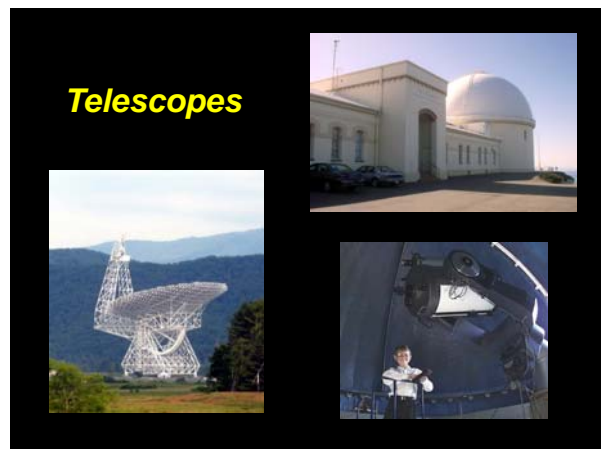
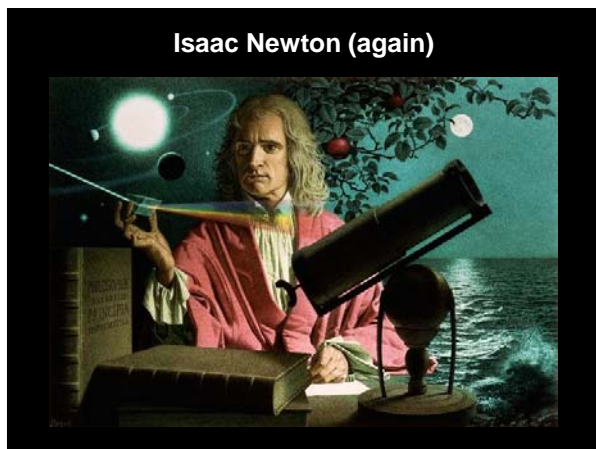
Planets - Dozens of compounds detected in their atmospheres and on their surfaces

Comets - Dozens of compounds detected

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

 Four ball-and-stick molecular models are arranged horizontally at the bottom of the slide. From left to right: a water molecule (H₂O), a carbon dioxide molecule (CO₂), a methane molecule (CH₄), and a hydrogen cyanide molecule (HCN).

How Do You Know This Stuff?



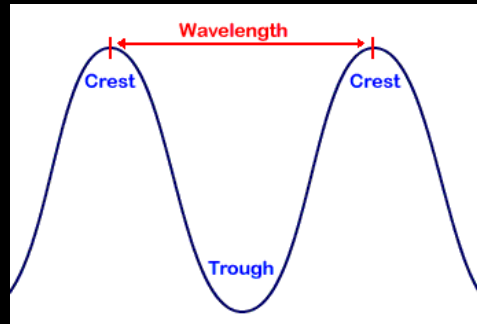
Spectroscopy

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

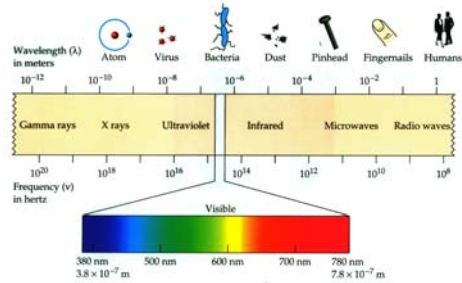
Electromagnetic
Spectrum

Spectrum (sing.)
Spectra (pl.)

Wave Characteristics



The Electromagnetic Spectrum



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

The Interstellar Medium Clouds of Dust and Ice

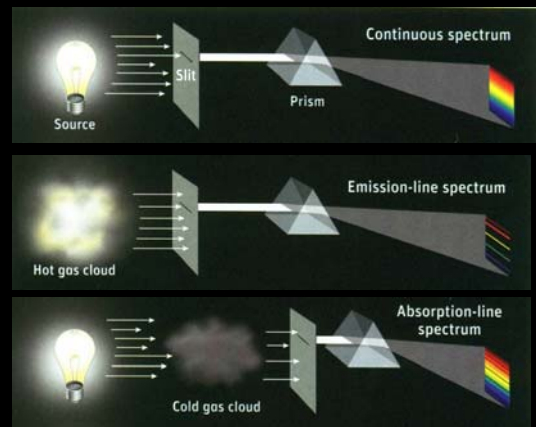


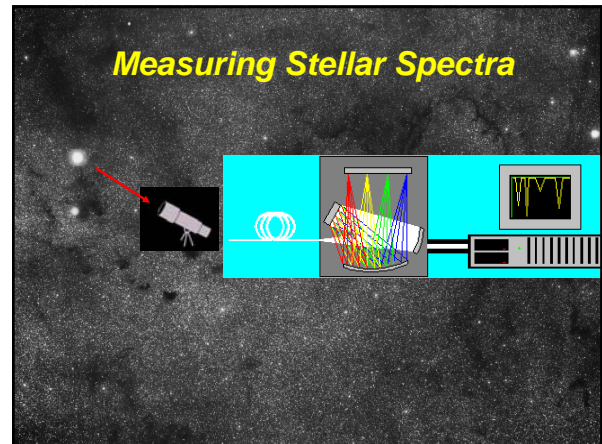
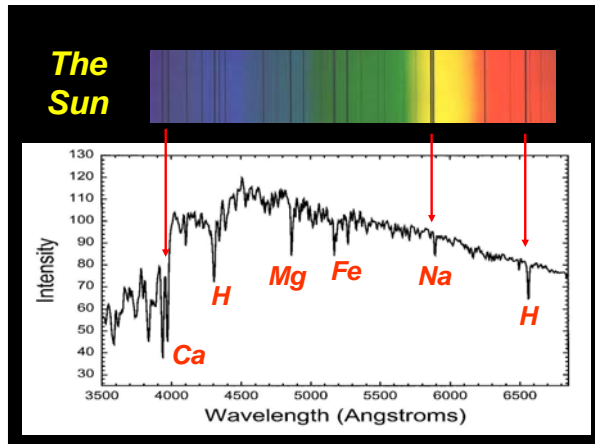
Orion Nebula

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.