

Life in the Universe - Astrobiology



Astronomy
Chemistry
Geology

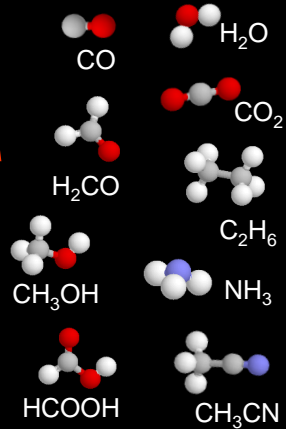
How to determine the chemical and physical nature of distant objects?

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

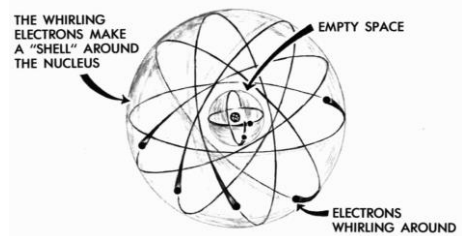
Some Residents of our Galaxy



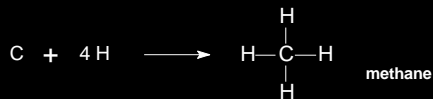
Astrochemistry



Our Atomic Picture



Atoms bond to make molecules



Learn The Terminology

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

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

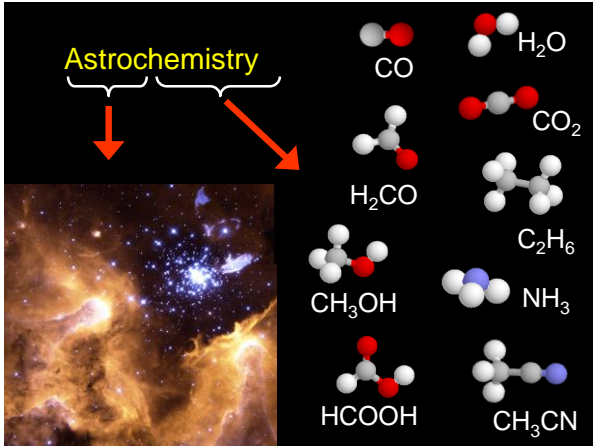
118

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

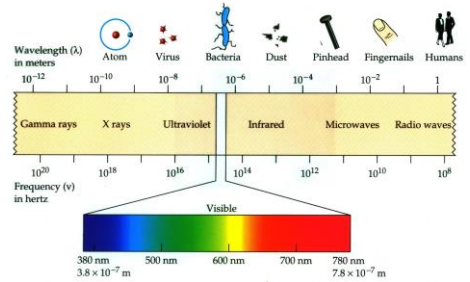
H₂O
CO₂
CH₄ = methane
NH₃ = ammonia

~ 100,000,000

February 2018

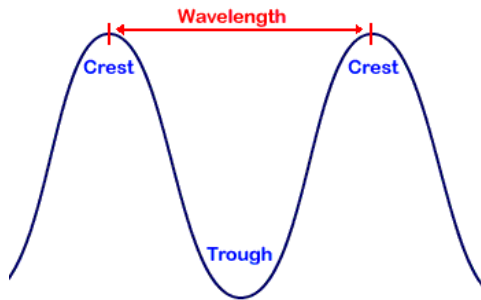


The Electromagnetic Spectrum



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

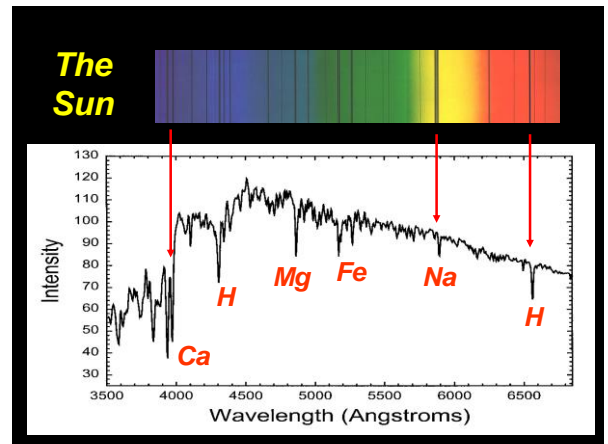
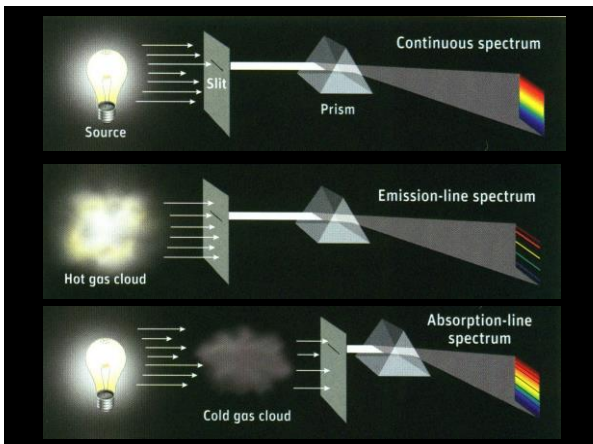
Wave Characteristics



Spectroscopy

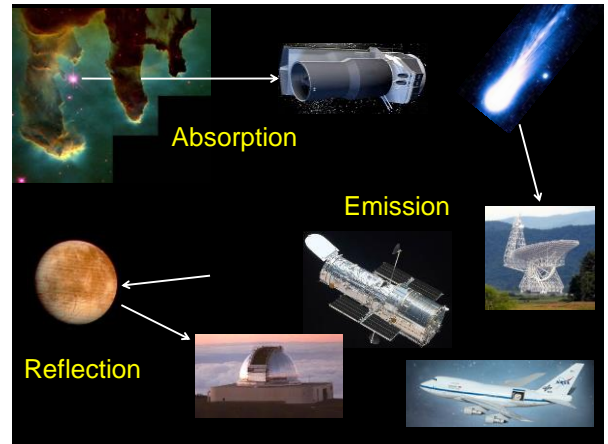
Use prisms, etc. to break-up light into wavelengths (colors).

Measure intensity (brightness) of each wavelength (color) or each frequency.

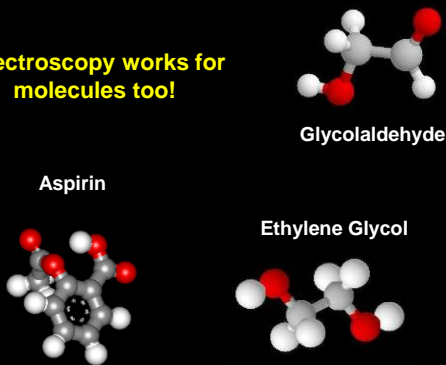


Bottom Lines

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.

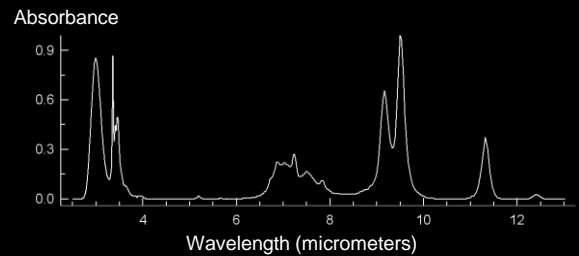


Spectroscopy works for molecules too!

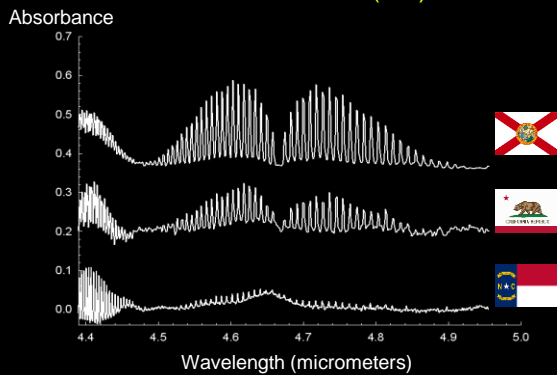


An Infrared Spectrum

Ethyl Alcohol $\text{CH}_3\text{CH}_2\text{OH}$



Carbon Monoxide (CO)



Now Apply All This Stuff

Planetary
Formation
and
Evolution



Forming Planets

Start with Dark Clouds

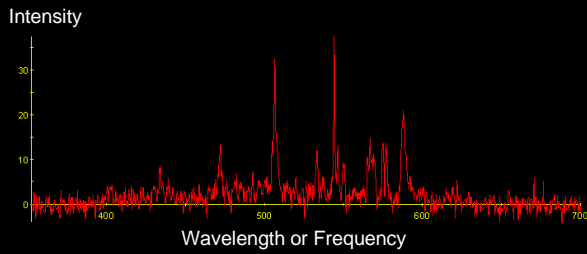


B68,
An Absorption Nebula

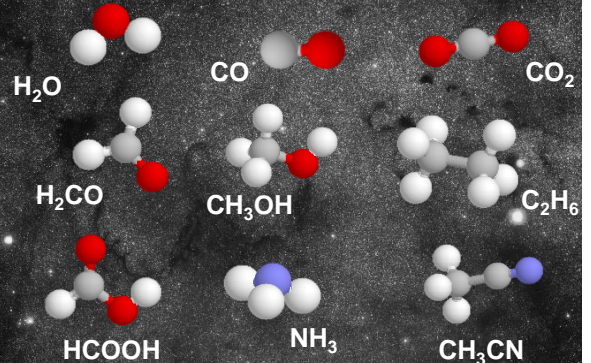
500 LY Away
(32 million AU)

~ 1 LY Across

Dark Clouds Contains Molecules!



Many Molecules Found in Them



Big Dark Clouds Gravitationally Unstable ... Collapse

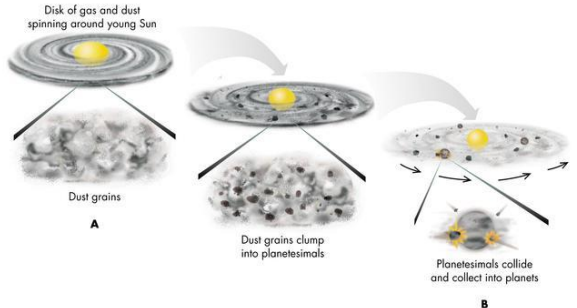


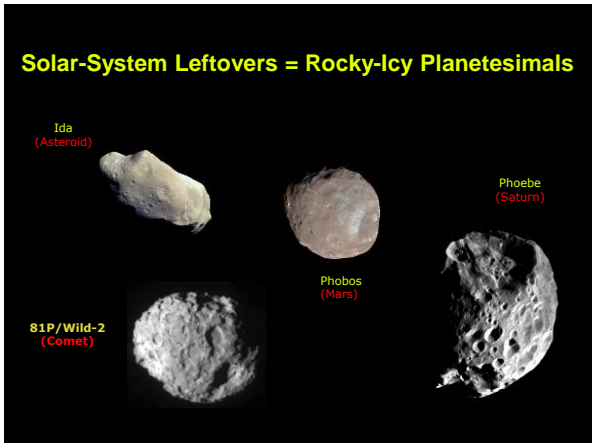
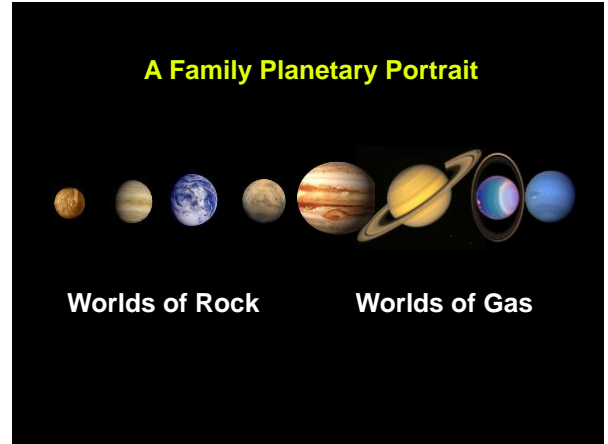
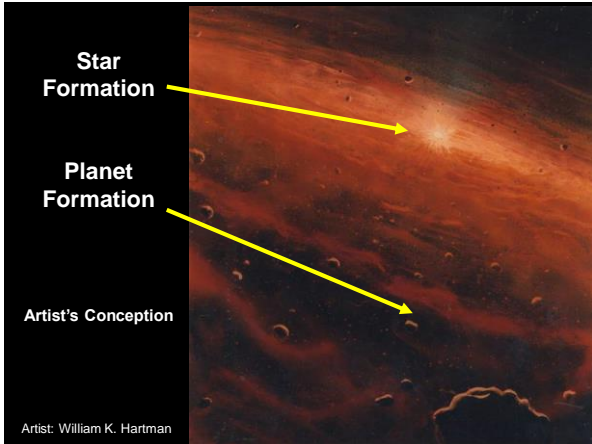
B68,
An Absorption Nebula

500 LY Away
(32 million AU)

~ 1 LY Across

Solar System Formation





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.