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

\[ F = G \frac{m_1 m_2}{r^2} \]

\[ \frac{a^2}{p^2} = \frac{G}{4 \pi^2} \left( m_1 + m_2 \right) \]

Astronomy

Some Residents of our Galaxy

ISM = Interstellar Medium

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Jupiter

Uranus

Saturn

Neptune

Pluto

Mars

Earth

Venus

Mercury

Gas giants and rocky worlds
Our Atomic Picture

Atoms bond to make molecules

C + 4 H → \( \text{CH}_4 \) methane

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

Compounds made of molecules, which have formulas:
- \( \text{H}_2\text{O} \)
- \( \text{CO}_2 \)
- \( \text{CH}_4 = \text{methane} \)
- \( \text{NH}_3 = \text{ammonia} \)

~ 118

~ 100,000,000
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)
**Spectroscopy**

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

**Electromagnetic Spectrum**

**Spectrum (sing.)**

**Spectra (pl.)**

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

**The Electromagnetic Spectrum**

- **Visible light**
- **IR light**

**The Interstellar Medium**

Clouds of Dust and Ice

- **Hot Stuff**
- **Cold Stuff**

**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.