Concepts of Science

What is Science?

1. Search for knowledge and/or understanding

2. We often achieve understanding by stating general principles or laws.

3. These principles must be testable experimentally.

"Anyone living in a house, if he is ignorant of its materials or construction, its size and kind, its position and distinguishing characteristics, is not worthy of being a guest in such a place. Similarly, he who is born and brought up in the hall of the universe, if he neglects to get to know the reason for its wonderful beauty when he reaches maturity, is unworthy of that hall and, if it should be possible, must be thrust out of it."

Adelard of Bath, 12th century, A.D.

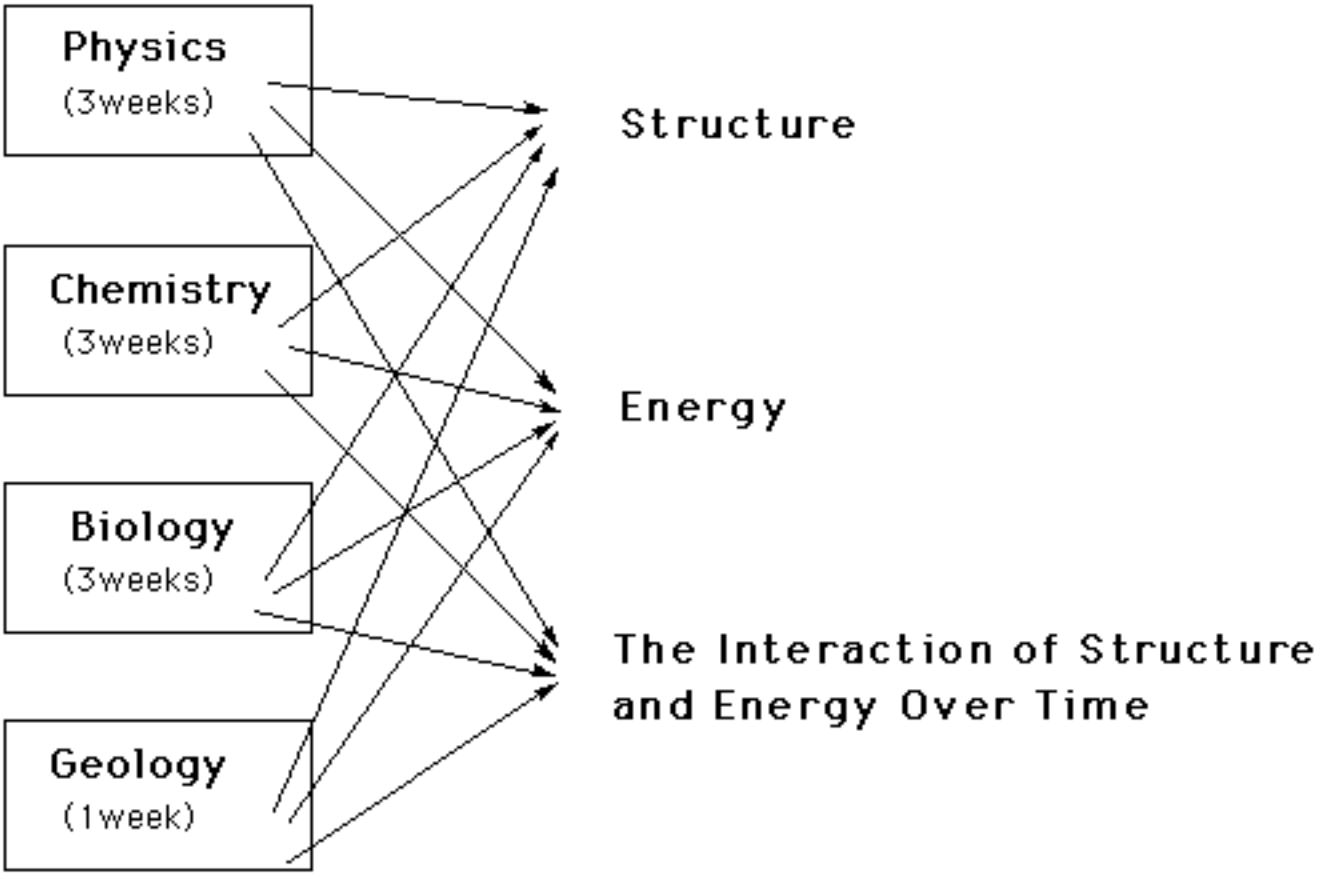
The Concepts of Science course should:

1. Be truly interdisciplinary

2. Bridge the gap between the sciences and the humanities

3. Focus on the impact of science upon everyday life

We shall take an interdisciplinary approach



Sample exam questions:

The following statement has been made: "For every mile you drive your car, 1 pound of carbon dioxide is released." In the space below, outline the computations a scientist would use to reach such a conclusion. Would this statement apply to all cars? If not, what qualifying remarks should be added to the above statement?

We have spent a great deal of time discussing various aspects of light. In the space below, write an essay in which you discuss the nature of light, its role as an energy source and some of the effects of its interaction with the earth's atmosphere.

In science, situations often arise in which two theories have been put forth to explain data or observations. The ideal way in which to choose between opposing theories is to devise an experiment which will exclude one. Write an essay in which you discuss a situation in which this has occurred and describe the definitive experiment.

Newton and Galileo were major players in the elucidation of the workings of the solar system. If you could speak to either of these men now, what are some of the things you would tell them about recent developments concerning the solar system?

We have calculated that burning 100g of methane releases 1314 kcal of energy. Many people have advocated using hydrogen as a fuel. Hydrogen has a heat of combustion of 57 kcal/mol.

a. Write the balanced equation for the combustion of H_2 to give water

b. Calculate how much energy would be released by burning 100 g of H_2

c. Which fuel (hydrogen or methane) gives off more energy per gram of fuel?

d. Aside from the energy given off, there is another reason to use H_2 as a fuel. Discuss this reason briefly.

Information often given on exams:

$$\frac{T_1^2}{R_1^3} = \frac{T_2^2}{R_2^3}$$

$$F_c = \frac{mv^2}{r}$$

$$F = G\ \frac{m_1 m_2}{r^2}\ ;\ G = 6.67 \times 10^{-11}\ \frac{Nm^2}{Kg^2}$$

$$v = \sqrt{\frac{MG}{r}}$$

Useful Information:

Meter = 39.37 inches = 1.094 yards Quart = 0.9463 liter

Yard = 0.9144 meter Pound = 0.453 kilograms

Mile = 1.609 kilometers Ounce = 28.53 gram

Inch = 2.54 centimeter

Scientific notation for very large and very small numbers

The dimensions of structures we shall talk about will range from that of the universe to the size of an individual atom. The universe is 2×10^{26} meters across while a carbon atom has a diameter of 1.5×10^{-10} meter.

Note the use of exponents; 6×10^{10} is 6 followed by 10 zeros

$$1 \times 10^{6} = 1{,}000{,}000$$

$$1 \times 10^{-6} = .000001$$

Scientific Notation

Moving decimal points:

RIGHT – SUBTRACT from exponent

$M.MM \times 10^{Y} = MM.M \times 10^{Y-1}$

$0.26 \times 10^{9} = 2.6 \times 10^{8}$

$0.75 \times 10^{-7} = 7.5 \times 10^{-8}$

LEFT – ADD to exponent

$MM.M \times 10^{y} = M.MM \times 10^{y+1}$

$92.8 \times 10^{14} = 9.28 \times 10^{15}$

$62.7 \times 10^{-11} = 6.27 \times 10^{-10}$

Scientific Notation

Multiplying: - Add exponents - $(M \times 10^{y}) \times (N \times 10^{z}) = M \times N \times 10^{y+z}$

$$(2.3 \times 10^{14}) \times (2.7 \times 10^{9}) = 6.2 \times 10^{23}$$

$$(2.6 \times 10^{4}) \times (9.7 \times 10^{-9}) = 25.2 \times 10^{-5}$$

$$= 2.5 \times 10^{-4}$$

Dividing: - Subtract exponent of denominator

$$\frac{(M \times 10^{y})}{(N \times 10^{z})} = M/N \times 10^{y-z}$$

$$\frac{(7.6 \times 10^{3})}{(2.4 \times 10^{-4})} = 3.16 \times 10^{7}$$

$$= 3.2 \times 10^{7}$$

$$\frac{(9.2 \times 10^{-9})}{(6.8 \times 10^{7})} = 1.35 \times 10^{-16}$$

$$= 1.4 \times 10^{-16}$$

The Metric System

The basic Units:

Mass - gram (g)
Volume _ liter (l)
Length _ meter (m)

The Prefixes:

nano (n) = 10^{-9} basic units
micro (μ) = 10^{-6} basic units
milli (m) = 10^{-3} basic units
centi (c) = 10^{-2} basic units
kilo (k) = 10^{3} basic units
Mega (M) = 10^{6} basic units