

3.1 Organic or Inorganic?



<http://www.sciencechannel.com/tv-shows/greatest-discoveries/videos/100-greatest-discoveries-shorts-synthesis-urea/>

The feat of imitating nature in the laboratory was a truly exciting experience—as Wöhler expressed it in his often-quoted letter to Berzelius:

"I can no longer, so to speak, hold my chemical water and must tell you that I can make urea without needing a kidney, whether of man or dog; the ammonium salt of cyanic acid is urea." Wöhler (1800-1882)

Urea is a chemical contained within our urine. It is produced as a by-product of protein metabolism in cells. The comments above refer to the synthesizing of urea. Prior to Wöhler's synthesis of urea from inorganic compounds (1828), it was thought that naturally occurring compounds from plants or animals were produced by some mysterious force which was called a *vital force*. It was believed that man would never be able to synthesize these compounds. Friedrich Wöhler, however, who had often seen the long thin crystals of urea when experimenting with waste products in urine, produced these same crystals (accidentally) upon heating ammonium cyanate. Thus, with the old vital force theory disproved, many other chemists began trying to synthesize organic compounds.

Wöhler is also well-known for his inorganic chemistry interests, having successfully extracted aluminum and beryllium from their compounds by chemical means in 1827. Among other contributions, he prepared calcium carbide and discovered various silicon compounds, demonstrating close analogies to the chemistry of carbon. He is also credited with the isolation of the elements yttrium and titanium and the discovery that some meteoric stones contain organic matter.

The terms *organic* and *inorganic* are used to distinguish between two different groups of substances. What comes to mind when you think of the words organic and inorganic?

Organic substances are considered to include all compounds of carbon except oxides of carbon, carbonates, carbides and cyanides. These exceptions, plus the substances of the remaining elements are considered to be inorganic. Three to four million organic compounds are known compared with only about 50 000 inorganic compounds.

Organic substances include those derived from living organisms as well as numerous synthetic substances.

Examples of organic materials are:

Macronutrients (lipids, proteins, carbohydrates)
Fuels
Greases and lubricating oils
Fabrics (cotton, wool, rayon, nylon, polyesters)
Wood and paper products
Antibiotics and vitamins
Dyes and pigments
Soaps and detergents
Cosmetics
Some agricultural chemicals (some fertilizers, insecticides and pesticides)
Perfumes and flavours
Some explosives
Paints, varnishes and lacquers
Plastics and elastomer

It should be mentioned that not everyone agrees where the distinction between organic and inorganic compounds should be!

One definition that was in common use: "Using or produced with fertilizers of only animal or vegetable matter." Another is the one used by scientists until about 1850, from which the first is derived: "Of or derived from living organisms." But the one we use in chemistry is this: "Carbon containing compounds." As for compounds being created synthetically in labs, not only do they have properties similar to organic compounds; they are organic compounds. In fact there is no difference whatsoever between the synthetic compound and the one extracted by living organisms.

Thus, some state the definition of organic compounds simply that:

"Organic substances contain hydrogen combined with carbon; inorganic substances don't."

While another has stated that:

"I believe that "organic" vs. "inorganic" originally stemmed from the ancient idea that compounds could be divided into two categories; those isolated from plants and animals (organic) and those extracted from minerals and ores (inorganic). Plants and animals are highly efficient chemical factories. In order to maintain their living condition, organisms must synthesize numerous carbon-based molecules. Since all the courses of carbon compounds originally came solely from living organisms, the chemistry of carbon was called organic chemistry. As a working definition, now we think of organic chemistry as primarily being the chemistry of carbon-containing compounds. Most carbon-containing compounds have one or more of the following: H, N, O, S, P. Some authors describe organic chemistry as the study of compounds that contain carbon and hydrogen. By this definition, CO₂ would be "inorganic." But I would like to stress that in fact there is no general agreement on such semantics, and I'd bet that a lot of chemists consider CO₂ to be "organic" because it contains C and O."

So, where should the distinction be? Is CO₂ organic or inorganic? Are organic compounds only ones that were once-living? It seems that people who think that CO₂ is organic are in the minority, and thus, for the purpose of Chemistry 30, we will consider CO₂ to be inorganic and go with the original distinction mentioned in the examples above. As for the synthetically created organic compounds – the majority of chemists consider these to be organic, so again, we will use this for the purposes of this course.

Did you know?

- 1.) Bones and teeth, the hard tissues in the human body, are made partly of organic and partly of inorganic material. The inorganic component mainly consists of a substance called hydroxyapatite. The simplest formula of hydroxyapatite is $\text{Ca}_5(\text{PO}_4)_3(\text{OH})$.

The outer layer of your teeth is the hardest material in your body and is called enamel. Enamel consists of approximately 92% hydroxyapatite. Enamel is a ceramic material.

Beneath the enamel, the bulk of a tooth is made of dentin. This is a composite material and contains a mixture of hydroxyapatite, collagen, water, and salts. Collagen is an organic substance.

<http://www.scribd.com/doc/240814329/Organic-or-Inorganic#scribd>

- 2.) Pearls, including freshwater pearls are delicate organic gems that are made of the natural product called calcium carbonate. This product is drawn from the lake or river by the mussel that the pearl lives in.

Your freshwater pearls were once living and growing so you will need to make sure that as with all living things they stay out of harm. The products that harm pearls most are the very things that the woman who loves pearls probably wears without a second thought. You've guessed it already - the most harmful product to a pearl is the application of perfume, hair spray and cosmetics and face creams when the owner is wearing the pearls

http://www.fashion-era.com/jewellery/jewellery_how_to_care_for_pearls.htm

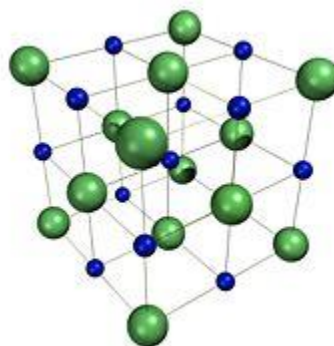
- 3.) Some organic molecules, such as amino acids have been found in interstellar space where there are no living things. (How, then could this organic molecule be produced by a *vital force*?)
- 4.) Organic Chemistry has just recently been expanded to include compounds of Silicon since Silicon is similar in behavior to Carbon (why is this???). Given that the main material in which micro-chips of the computer age have as their foundation is Silicon, isn't it fitting that the main element establishing living organisms should be merged with the main element involved in the inanimate machine world?

<http://www.scribd.com/doc/240814329/Organic-or-Inorganic#scribd>

3.1 Assignment

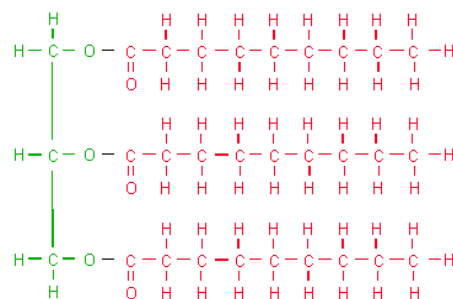
Below is a list of a variety of substances. Complete the chart that follows; an example has been provided for you. Remember that organic compounds are compounds that were either once-living or derived from something that was once living, or, they can be synthesized.

Table salt (Sodium Chloride – NaCl)



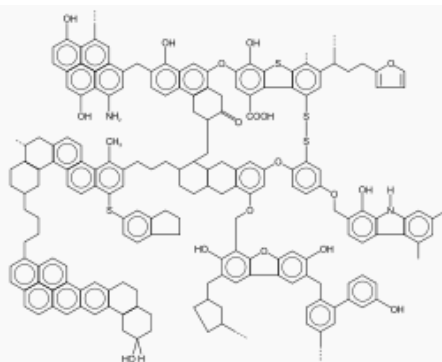
Crystal structure of NaCl

Butter (containing triglycerides)



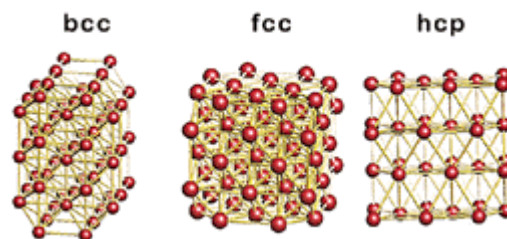
A lipid (triglyceride) molecule

Coal (made of C (60-90%), H, O and in some cases, S)



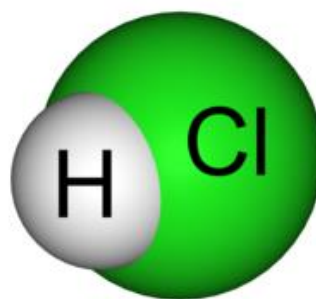
Example chemical structure of coal

Piece of iron (Fe)

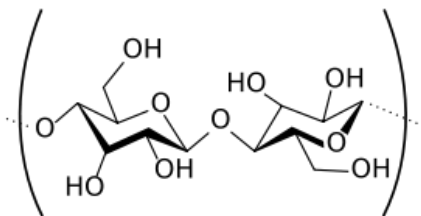


The three crystal structures of iron: body-centered cubic, face-centered cubic and hexagonal close-packed.

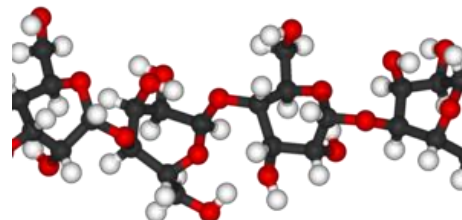
Hydrochloric acid (HCl)



Paper (containing cellulose)



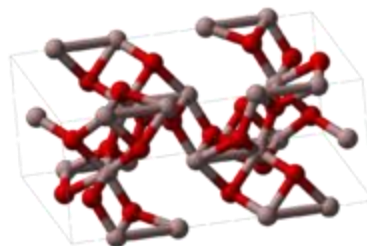
Cellulose (a linear polymer of glucose)



Ball and Stick model of cellulose

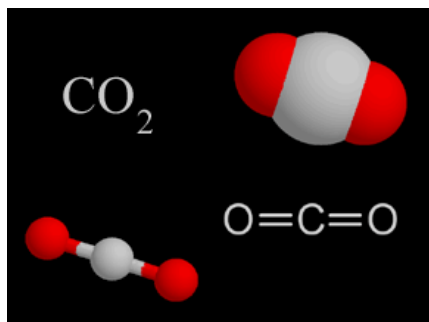
Sapphire

(from the mineral 'corundum', which is mostly pure Al_2O_3 , with some traces of iron, titanium or chromium to give the different colors)



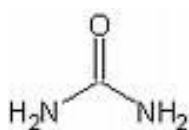
Aluminum oxide (Al_2O_3)

Carbon Dioxide (CO_2)



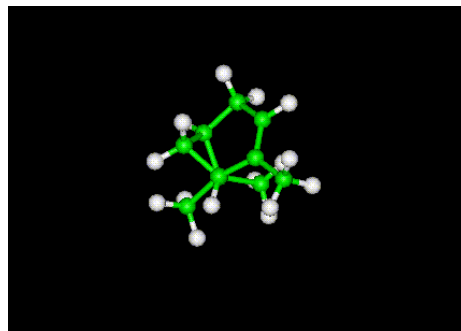
Solid CO_2 subliming

Naturally-produced Urea



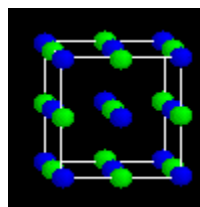
Turpentine

(a fluid composed of different types of terpenes (such as pinene) obtained by the distillation of resin obtained from trees, mainly pine trees.)

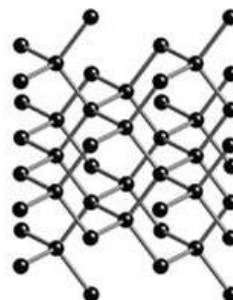


The Pinene Molecule

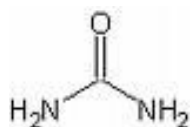
Quartz (SiO_2)



Diamond



Synthetically-produced Urea

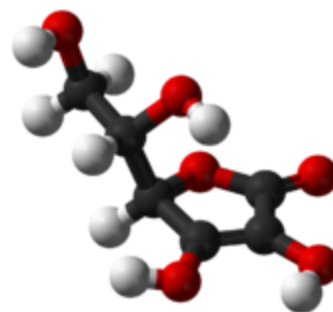
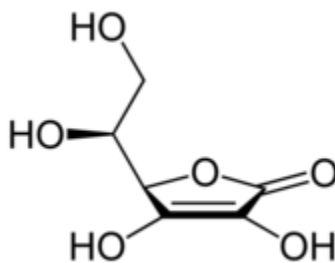


Freshwater Pearls (90% CaCO_3)

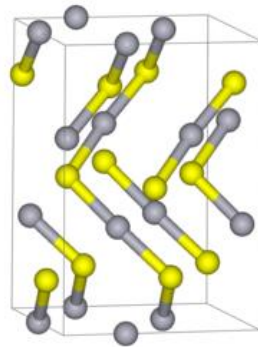
(A pearl is a hard, rounded object produced within the soft tissue (specifically the mantle) of a living shelled mollusk. Just like the shell of mollusks, a pearl is composed of **calcium carbonate** in minute crystalline form, which has been deposited in concentric layers. Its chemical composition is about 90% calcium carbonate; the rest is water and organic materials.)



Vitamin C (ascorbic acid)



Cinnabar (a mineral of mercury (II) sulfide, HgS)

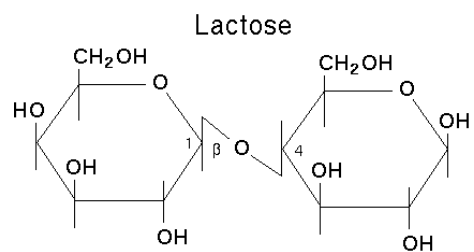


Cinnabar unit cell 3D

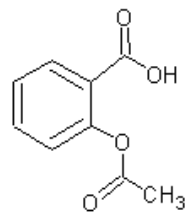
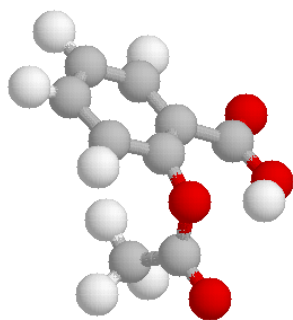
Water



Milk (containing proteins, lactose and lipids)

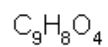


ASA (Acetylsalicylic acid)



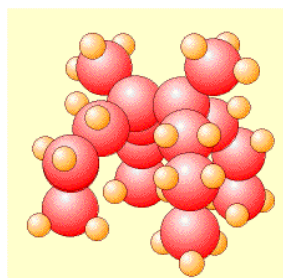
Aspirin

Acetylsalicylic Acid



Bees Wax Candle

(Hexa-decane is hardened bees wax. The discovery of the exact formula for bees wax led to the creation of all the automobile waxes, motor oils, and heavy wax base greases used in the automotive and trucking industry.)



Hexa-decane

[illegible]