

Lect 1: Chp 16: Carbon Chemistry 2pts ec

Chemistry of Living Things

Living things are a lot like laboratories... There's some serious chemistry going on inside. Your body is an incredibly complex chemical machine taking in chemicals & food, and causing countless reactions to occur every second.

_____ is the study of substances & processes occurring in all living organisms.

I'm made of what???

Only about _____ elements make up all living things.

97% of your body's mass is made of 4 elements:

- ✓ _____
- ✓ _____
- ✓ _____
- ✓ _____

Two other major elements are _____ & _____

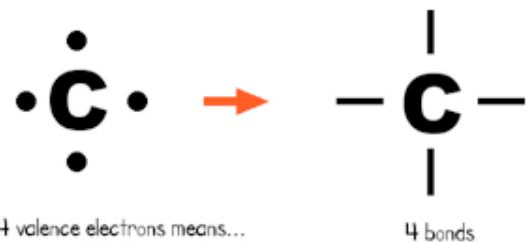
Major Compounds in the Body

- Also relies on _____ & _____
- Typically consists of _____% water. In other words, 2/3 of your body weight is water. Water is important because many of our body's chemical reactions can only occur in solutions containing water. Blood, sweat, urine... all mostly water!
- Salt is also important because of how it can separate into its two ions: Na^+ and Cl^- . Sodium ions regular the amount of water in our cells, while chlorine ions help our body digest food.

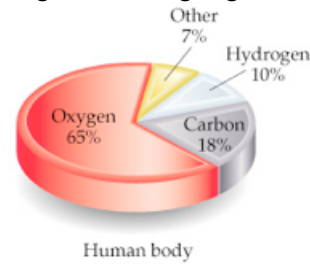
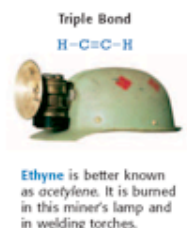
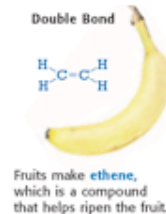
- **The most important element is...** _____ It may not be the most abundant element in living things, but it is the most important. Scientists call carbon compounds _____ compounds. Remember: Not ALL substances made of carbon are living.
- _____ & _____ are pure forms of carbon.

What makes carbon so special?

- It has a "central" role in all living organisms.
- It has _____ electrons
- It makes _____ bonds
- It bonds to itself over & over

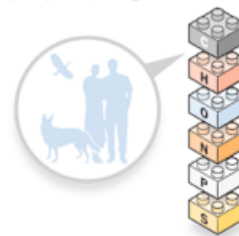


3 Types of Carbon Bonds



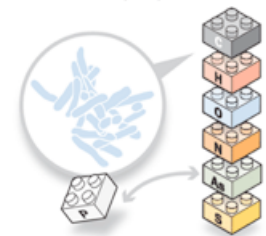
The common version

Six main chemical building blocks were thought to be necessary for life: carbon, hydrogen, oxygen, phosphorus, nitrogen and sulfur.



An alternate version

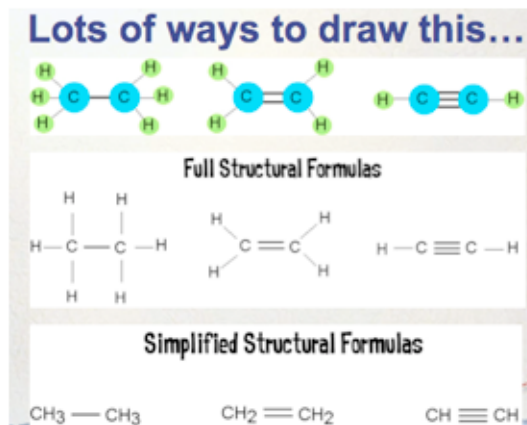
The bacteria scooped from arsenic-laden Mono Lake in California used arsenic as a building block instead of phosphorus.



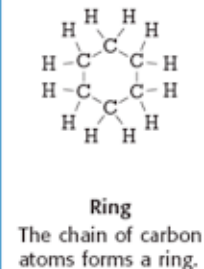
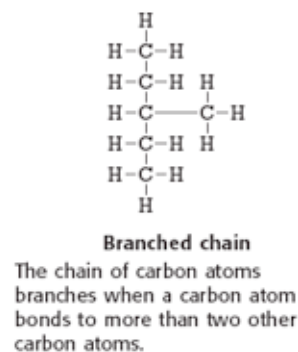
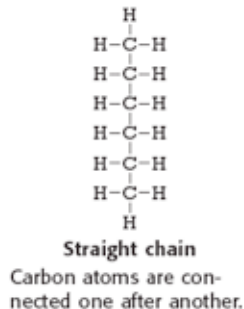
So what?

In addition to making sci-fi writers salivate, the discovery means scientists must think more broadly about what life can be made of, and by extension, where it could exist.





3 Types of Carbon Backbones

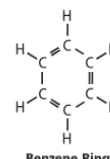


Carbon forms

One carbon chain may contain hundreds of carbon atoms. Notice how the CH_2 units repeat. A very large carbon-based molecule made of repeating units is called a polymer. Polymers can be *thousands* of atoms long.

Carbon forms

One of the most important carbon rings is benzene. Many compounds are based on Benzene. They often have very strong smells or aromas, so they are called aromatic compounds. An example of one aromatic compound is a molecule called vanillin.

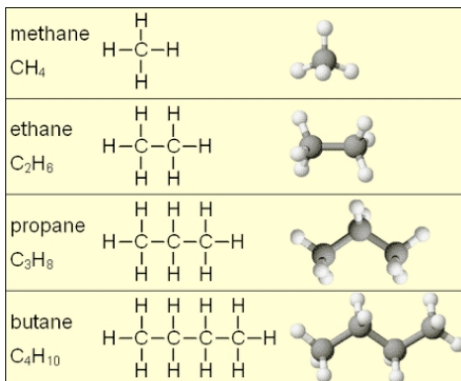


Silicon is similar to carbon. Why are there no life forms based on silicon?

Silicon is unsuitable because, although it is a valence IV element like carbon, (4 electrons to share) the Silicon - Silicon covalent bond is not strong enough for it to form long stable chains. So, it cannot form molecules of the complexity needed to make up cells like carbon can!

The alkanes make up a series of **straight chained hydrocarbons**, and are the foundation for how hydrocarbons are named. The first four members of the series are gases at room temperature and are called:

- _____ CH_4
- _____ C_2H_6
- _____ C_3H_8
- _____ C_4H_{10}



Alkanes with increasing numbers of carbon atoms have names based on the Greek word for the number of carbon atoms in the chain of each molecule. So you can get, for example, **pentane (5)**, **hexane (6)**, **heptane (7)**, **octane (8)**

Lots of carbon compounds seem to be isomers.

What is an isomer?

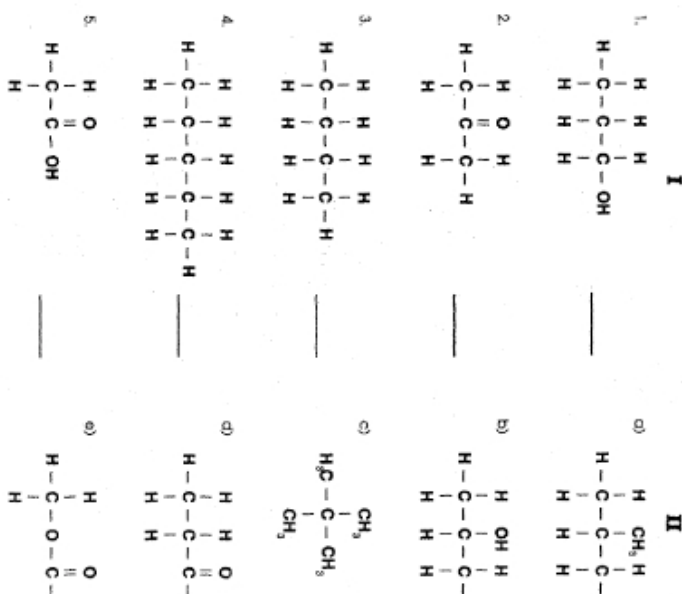
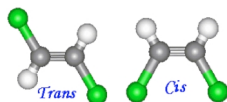
In organic chemistry, there are many examples of different compounds which have the same molecular formula as each other

But different arrangements _____

of the atoms in their molecules.

These are called _____

Isomers



ISOMERS

Some have the same chemical formula but different structural formulas. Match the structure in Column I with its isomer in Column II.

Name _____

Chemistry & Your Body

FACTS:

- You are made of about 65% _____
- You are also made of molecules consisting mostly of _____ & _____
- You are also made up of MANY different kinds of molecules, including small ones like _____ & _____ very large ones like _____ and _____

GOAL: Find out how many pounds of the major elements are in your body.

Step 1: Estimate your weight in _____ pounds. I weigh approximately _____ pounds (lbs).

Step 2: If all of the water was removed from your body, you would be made of following percentages of elements.

Element	% Found in body	% as a decimal	Amount of Element in Body (pounds)
Carbon	53%	0.53	
Oxygen	21%		
Nitrogen	9%		
Hydrogen	8%		
Calcium	4%		
Phosphorous	3%		
Sulfur & Sodium	1%		
All other elements	1%		

Step 3: Determine how many pounds of each element make up your body's mass, less water. Then, fill out the data table. To do this, convert each 5 into decimals. Then, multiply your weight by each decimal.

Example: If Bob weighs 150 lbs, he'd have 150 x 0.53, or 79.5 lbs of carbon in his body.

Elements and the Human Body

Atoms of various elements play many important roles in your body. Whether you are working out or even taking a nap, there is an incredible amount of chemistry going on inside of you.

- The combination of fluorine with calcium produces a salt with a very strong crystal structure. This provides protection for the teeth.
- Sulfur is an important part of the molecule that makes up hair and fingernails.
- Iron is the central atom in the molecule hemoglobin, hemoglobin carries oxygen in the blood.
- Chloride atoms combine with hydrogen atoms in the stomach to create hydrochloric acid. Hydrochloric acid helps digest food.
- Potassium ions play a role in the transmission of nerve impulses.
- Magnesium plays an important role in muscle contractions.
- Molecules containing phosphorus are important for energy transfer in cells. Some phosphorus is involved in almost every biochemical reaction in the body.
- Calcium makes bones and teeth hard and resistant to wear.
- Molecules containing elements of carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur make up the structure in cells and provide nourishment for the body. You will learn in this section of this course.
- Sodium ions regulate the amount of fluid in the blood.

READING VISUALS Atoms of which element play an important role in muscle contractions?

Course 11: Chemistry of Living Systems 341

Video 1. Let's review bonding & Lewis Structures

Video 2. Diamonds & Graphite

Video 3. Covalent Bonding Review

Video 4. Molecular Geometry