Organic Chemistry Notes

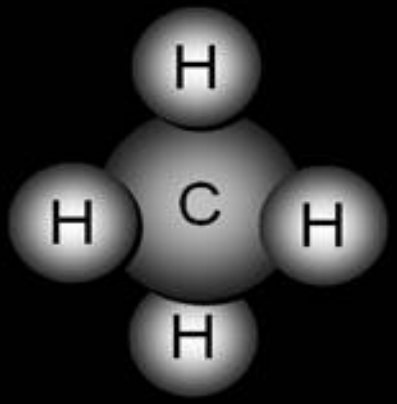
Chapter 23

WAKE UP AND SMELL THE HYDROCARBONS

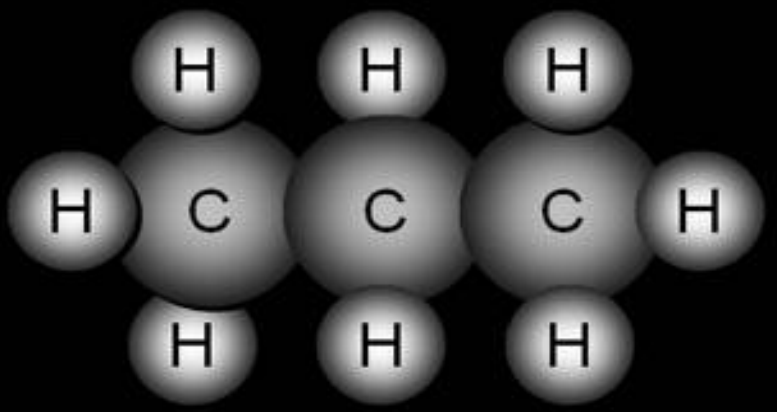
ROBOTS, ROVS, AND REALLY DEEP WATER REWRITE THE OIL RULE BOOK

What is so special about carbon?

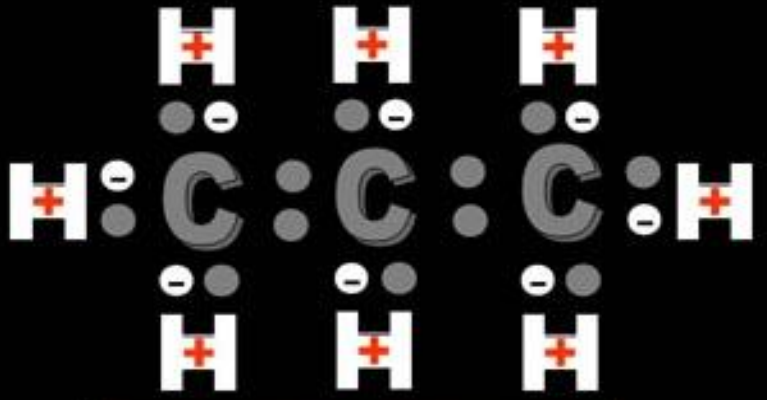
- Carbon has 4 valence electrons so carbon will always form 4 covalent bonds
- The simplest organic compound is a hydrocarbon
- Hydrocarbon consists of only carbon and hydrogen



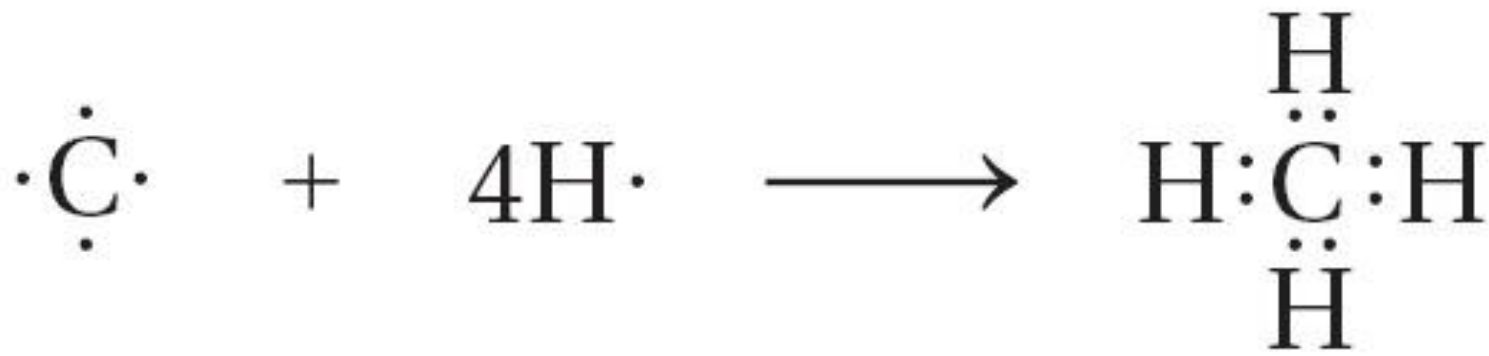
Methane
(natural gas)



Propane



The simplest alkane is: Methane



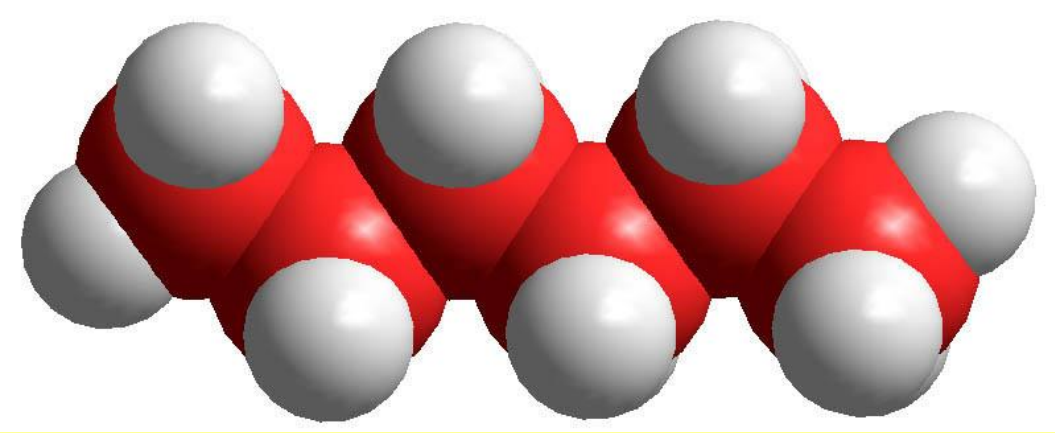
Carbon atom

Hydrogen atoms

Methane molecule

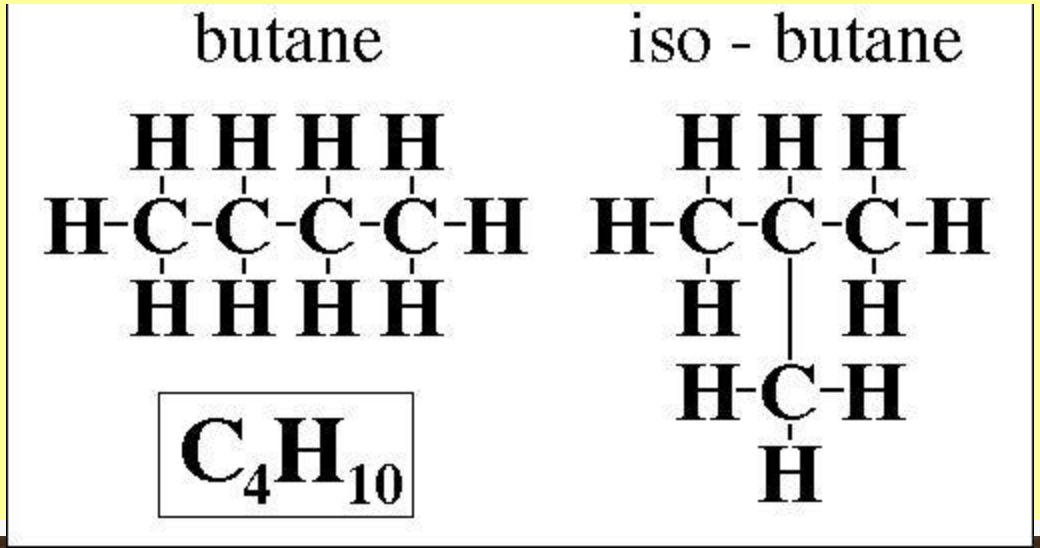
Alkane

- Single covalent bonds
- Carbon atoms form single bonds with 4 atoms
- Hydrocarbon with formula C_nH_{2n+2}
- Single chain or branched chain



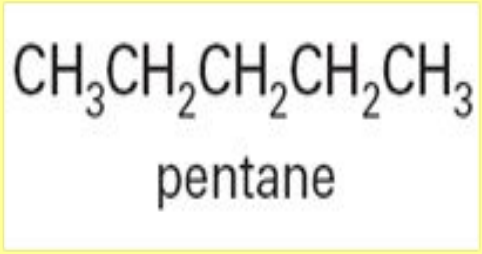
Isomers

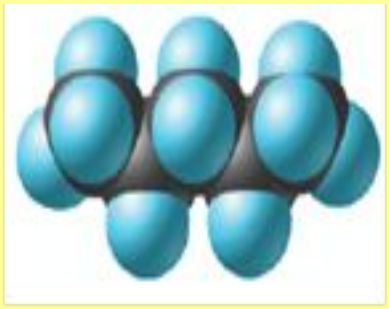
- When a compound has the same chemical formula but different molecular formulas
- Structural isomers have different physical properties (boiling point & melting point)
- Different chemical properties



Straight

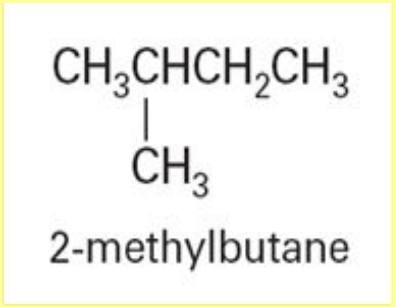
- Single chain: carbon atom linked to only 1 or 2 carbon atoms
- C_5H_{12}

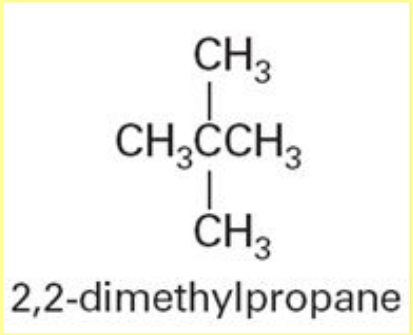


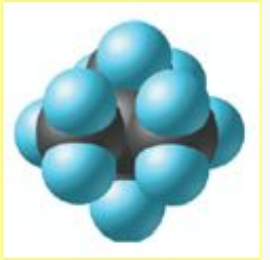


Branched

- Carbon atom linked to 2-4 carbon atoms
- C_5H_{12}



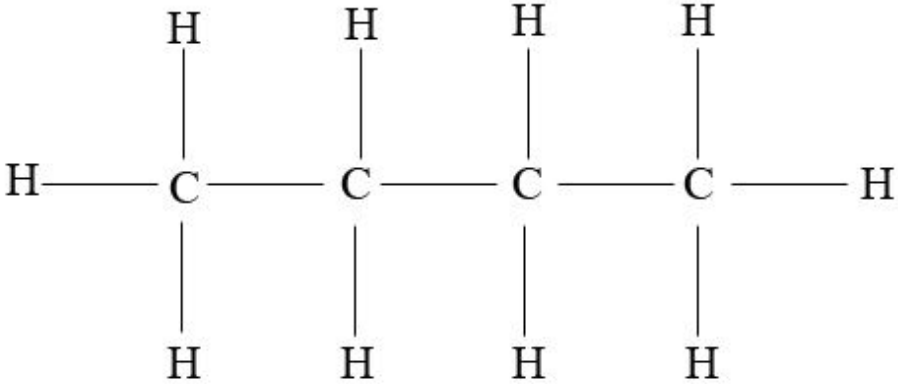




Number of Carbons	Root	Number of Carbons	Root
1	Meth	6	Hex
2	Eth	7	Hept
3	Prop	8	Oct
4	But	9	Non
5	Pent	10	Dec

Naming a Straight Chain Alkane

- Count the number of carbons, find the root for that number and add -**ane**



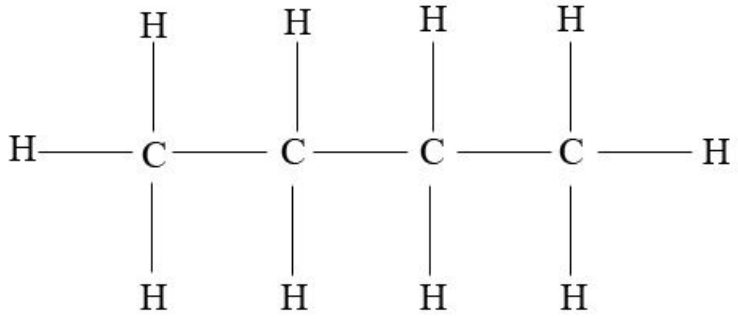
- 4 Carbons means "but"
- Add -ane
- Becomes butane

Other ways to "write" butane

Molecular Formula

C_4H_{10}

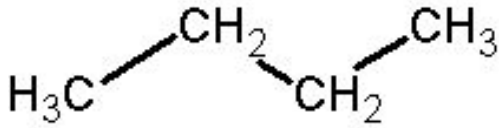
Complete Structural Formula



Carbon Skeleton

C-C-C-C

Line angle Formula



Condensed Structural Formula

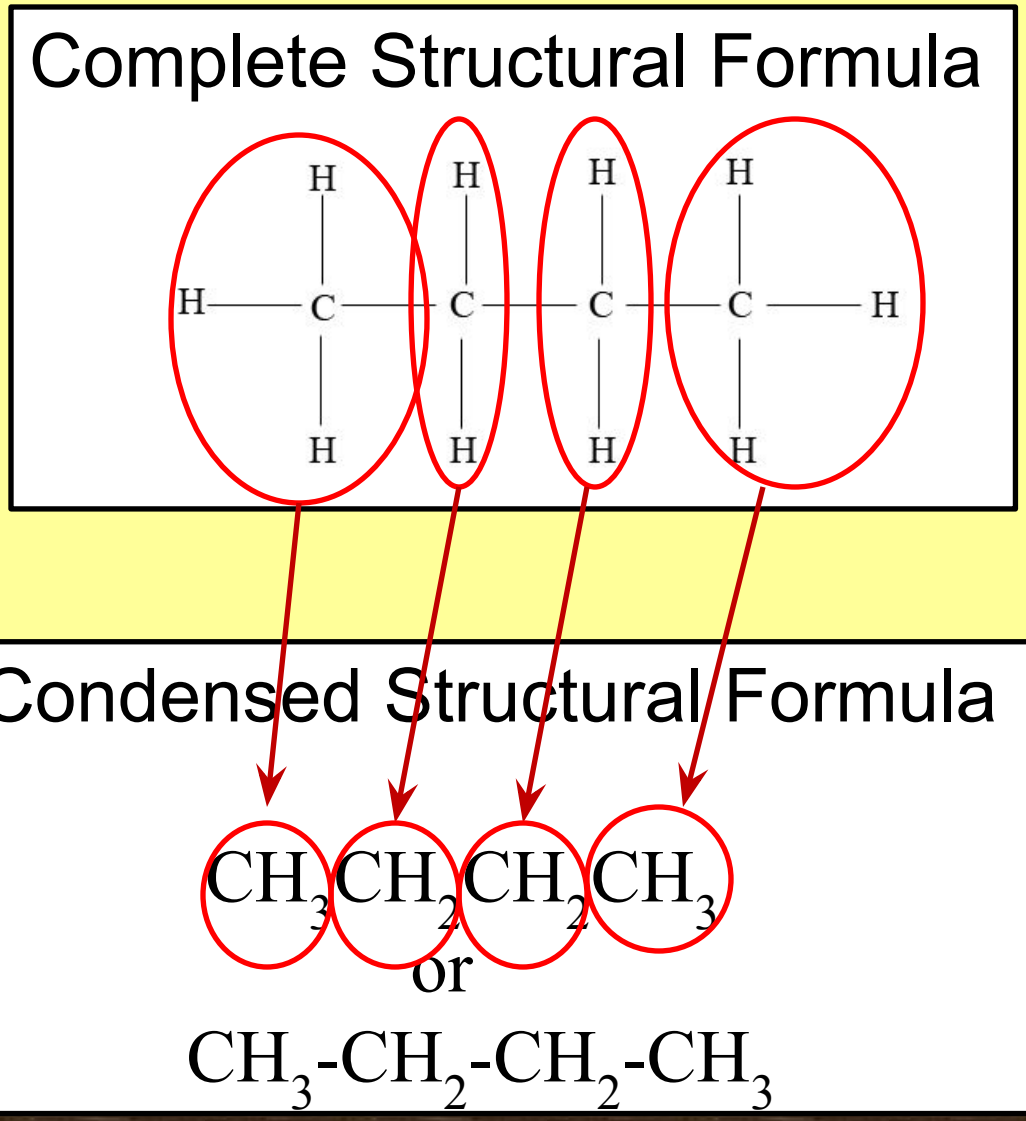
$CH_3CH_2CH_2CH_3$

or

$CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_3$

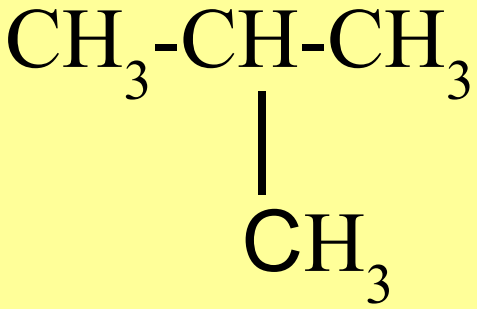
Alkyl Groups:

a carbon and its attached hydrogens



Naming a Branched chained Alkane

- Find the longest carbon chain "parent compound"
- Name parent compound as you would a straight chain
- Add other alkyl groups to name starting from end that has first alkyl group

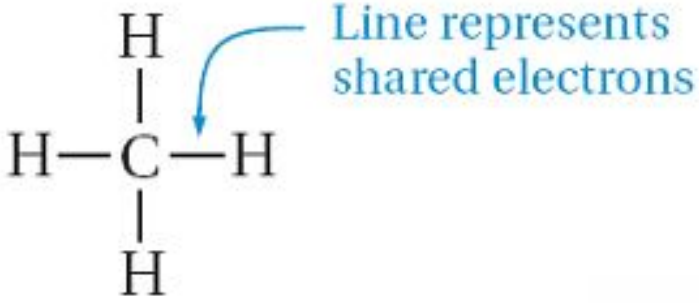


Longest chain: 3 carbons: propane
Alkyl group: methyl
Location of alkyl group: second carbon
Final name: 2-methyl propane

Do you remember?

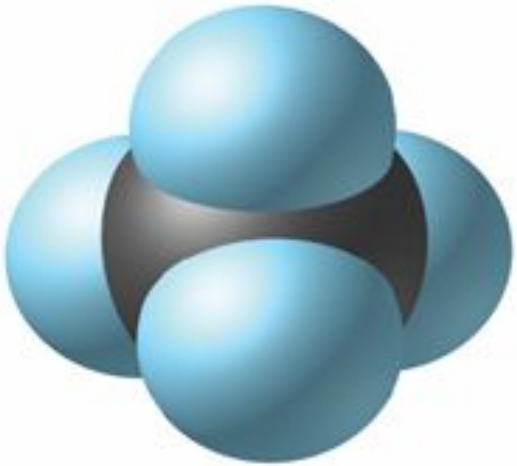
Different ways “model” a hydrocarbon

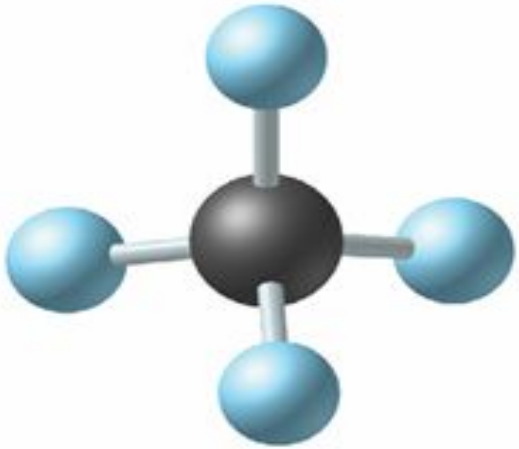
Structural formula



Methane (CH_4)

Space filling model





Ball and stick model

Saturated vs Unsaturated

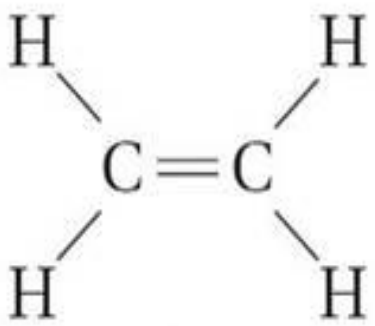
saturated compounds :

Organic compounds containing the maximum number of H atoms

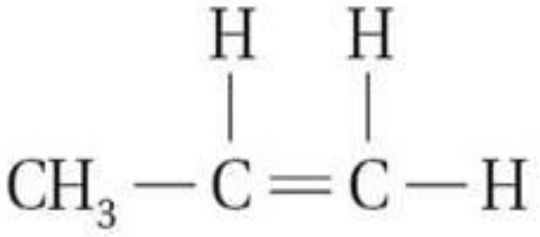
unsaturated compounds: Compounds containing double or triple carbon-carbon bonds

Alkenes

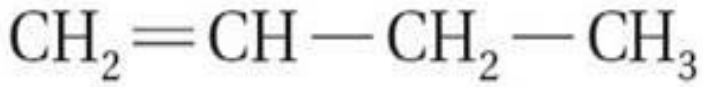
At least one double covalent bond between 2 carbon atoms



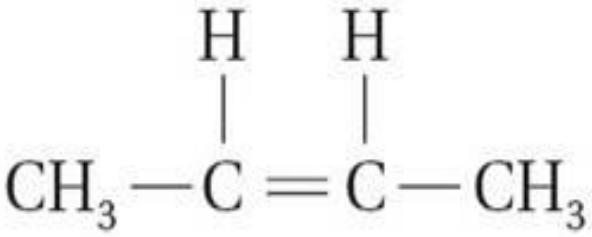
Ethene
(ethylene)



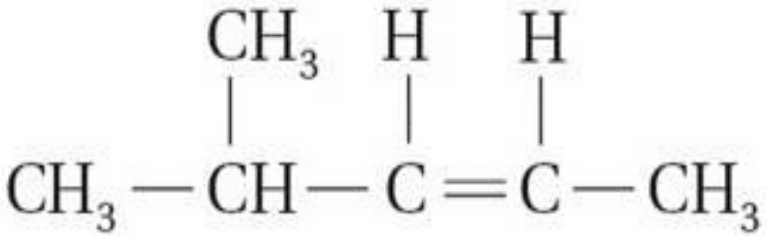
Propene
(propylene)



1-butene



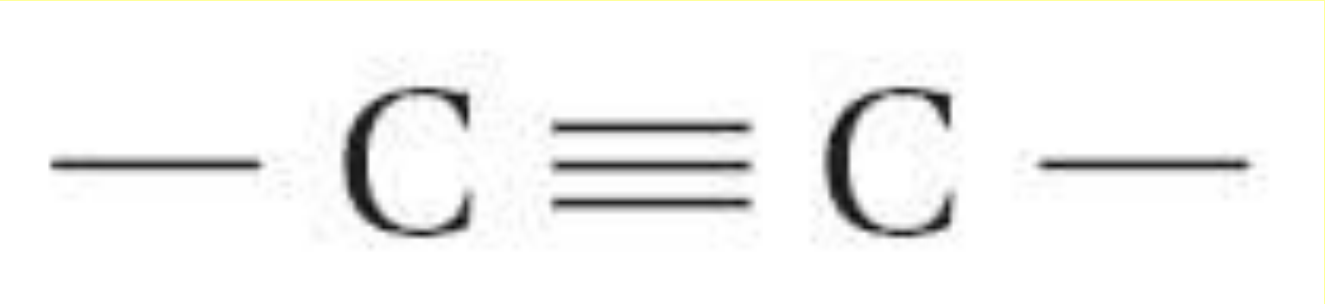
2-butene



4-methyl-2-pentene

Alkyne

- At least one triple covalent bond between 2 carbon atoms.



IUPAC Rules for Naming Hydrocarbons

1. Choose the correct ending: -ane, -ene, or –yne

2. Determine the longest carbon chain. Where a double or triple bond is present, choose the longest chain that includes this bond.
   If there is a cyclic structure present, the longest chain starts and stops within the cyclic structure.

3. Assign numbers to each C of the parent chain.
   For alkenes and alkynes the first carbon of the multiple bond should have the smallest number.
   For alkanes the first branch (or first point of difference) should have the lowest #. Carbons in a multiple bond must be numbered consecutively.

IUPAC Rules for Naming Hydrocarbons

4. Attach a prefix that corresponds to the number of carbons in the parent chain. Add cyclo- to the prefix if it is a cyclic structure.

5. Determine the correct name for each branch
(“ alkyl” groups include methyl, ethyl, propyl, etc.)

6. Attach the name of the branches alphabetically,
along with their carbon position, to the front of the parent chain name.
Separate numbers from letters with hyphens
(e.g. 4-ethyl-2-methyldecane)

7. When two or more branches are identical, use prefixes (di-, tri-, etc.) (e.g. 2,4-dimethylhexane). Numbers are separated with commas. Prefixes are ignored when determining alphabetical order. (e.g. 2,3,5-trimethyl-4-propylheptane)

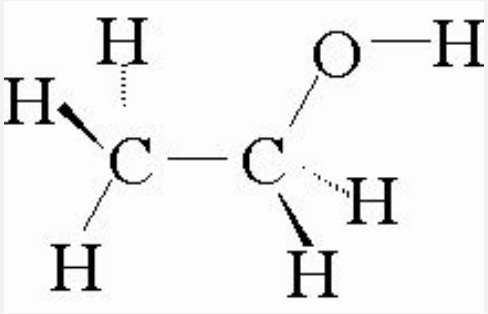
8. When identical groups are on the same carbon, repeat the number of this carbon in the name. (e.g. 2,2-dimethylhexane)

National Energy Board | Office national de l'énergie

Present in every day's life

Biofuels: Renewable Organics

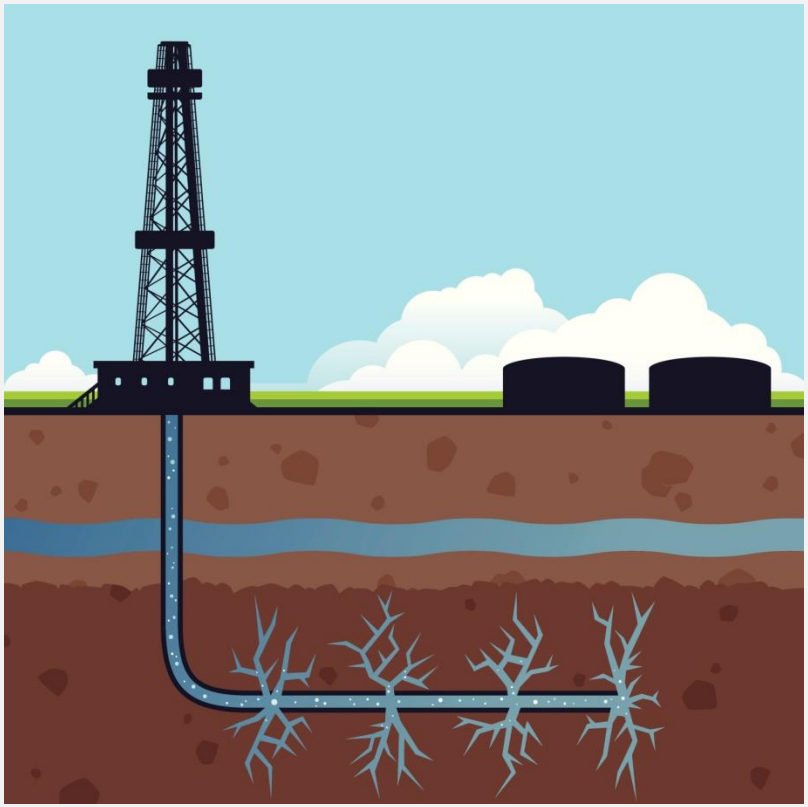
- Ethanol is a two-carbon hydrocarbon with an OH group.
- Ethanol, itself, is a clear, flammable, colorless liquid that is miscible with water, and capable of hydrogen-bonding with water molecules.
- **Bioethanol** refers to ethanol that is produced from biomass such as corn or sugar cane.



Why is this misleading?

What is FRACKING???

Hydraulic fracturing, or **“fracking”**,
Is the process of drilling and injecting fluid into the ground at a high pressure in order to fracture shale rocks to release natural gas inside.



http://www.dangersoffracking.com/

http://www.what-is-fracking.com/what-is-hydraulic-fracturing/

Typical Chemical Additives Used in Frac Water

Compound	Purpose	Common application
Acids	Helps dissolve minerals and initiate fissure in rock (pre-fracture)	Swimming pool cleaner
Sodium Chloride	Allows a delayed breakdown of the gel polymer chains	Table salt
Polyacrylamide	Minimizes the friction between fluid and pipe	Water treatment, soil conditioner
Ethylene Glycol	Prevents scale deposits in the pipe	Automotive anti-freeze, deicing agent, household cleaners
Borate Salts	Maintains fluid viscosity as temperature increases	Laundry detergent, hand soap, cosmetics
Sodium/Potassium Carbonate	Maintains effectiveness of other components, such as crosslinkers	Washing soda, detergent, soap, water softener, glass, ceramics
Glutaraldehyde	Eliminates bacteria in the water	Disinfectant, sterilization of medical and dental equipment
Guar Gum	Thickens the water to suspend the sand	Thickener in cosmetics, baked goods, ice cream, toothpaste, sauces
Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice
Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair coloring

Source: DOE, GWPC: Modern Gas Shale Development in the United States: A Primer (2009).

http://www.popularmechanics.com/science/energy/g161/top-10-myths-about-natural-gas-drilling-6386593/?slide=1

THE ONLY NUTRITIVE BEVERAGE MADE WITH **100% GENUINE** FRACKING FLUID

FRACK-O-COLA

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- Colorado Governor John Hickenlooper

Healthful, Restorative Frack-o-Cola contains Natural Sand and over 500 of the Purest Chemicals drawn straight from your local Hometown Fracking Well. This Delicious Beverage will scour your insides to leave you Clean and Fresh as an oil slick on a beautiful lake.

Frack-o-Cola will restore you to the Bloom of Health, relieving and curing all ailments from HEADACHES to BROKEN BONES. Ladies will love how it makes your SKIN RADIATE!

Studies conducted by Frack-o-Cola's own Completely Unbiased Researchers say that Frack-o-Cola will give you Advanced Mental Powers and the ability to leap High Buildings in a single bound.

REPLACE WATER IN YOUR DIET WITH FRACK-O-COLA — DRINK IT ALL DAY, EVERYDAY — FRACK-O-COLA

Consuming Fracking Fluid may cause health effects including, but not limited to, Headaches, Allergies, Asthma, Dizziness, Cancer and Death. Ingredients of Frack-o-Cola are not disclosed and the Makers of this Beverage bear no Liability for any harm that results from consuming their Product.

For more information visit foodandwaterwatch.org/frack-o-cola

Does fracking shales cause earthquakes?
If so, how are the earthquakes related to these operations?

This is usually done by hydraulic fracturing ("fracking").

Fracking causes small earthquakes, but *they are almost always too small to be a safety concern.*
In addition to natural gas, fracking fluids and formation waters *are returned to the surface*.

These wastewaters are frequently disposed of by injection into deep wells.

The injection of wastewater into the subsurface can cause *earthquakes that are large enough to be felt and may cause damage.*

USGS
United States Geological Survey
May 6, 2015

http://www.usgs.gov/faq/categories/9833/3428

You could be a hydrocarbon chemist or biofuel engineer!!