Take note while watching the following video tutorials to prepare for the "Hydrocarbons \& their Structure Activity".

Structural Formulas for Organic Molecules


Neutral Bonding Patterns for Organic Compounds
Periodic Table of the Elements


## Skeletal Line Structures

Carbon atoms can form long chains with branches. The tetrahedral electron geometry results in the carbon atoms forming a zigzag shape. Skeletal-line drawings show the carbon skeleton at the end of each line and at each corner.


Guidelines for Writing Skeletal-Line Structures
Rule 1: $\quad$ All carbon-carbon single bonds are shown as a single line
Rule 2: Double bonds are shown as two parallel lines Triple bonds are shown as three parallel lines

Rule 3: The chemical symbol of carbon, C, is omitted. The presence of a carbon atom is implied wherever two lines join and at the end of a line. A continuous carbon chain is represented as a zigzag arrangement of lines.

Rule 4: Heteroatoms are atoms other than carbon or hydrogen and must be written.
Rule 5: Hydrogen atoms must be drawn on heteroatoms and the carbons of aldehyde groups.

Note: $\quad$ Since carbon atoms ALWAYS have 4 bonds, you can determine the number of H atoms bonded to a particular carbon atom by counting the number of bonds and subtracting this value from 4.

## Practice

Lewis Structure




Condensed Structures
Because the carbon atoms form the backbone of the skeleton, it is also common to omit the bonds and only show the atoms. Double and triple bonds are often still shown.

The following three structures ALL represent the same compound:

$\mathrm{CH}_{3} \mathrm{CH}_{2} \mathrm{CH}_{2} \mathrm{CH}_{2} \mathrm{CH}_{3}$


Write the condensed structures for the 5 structural isomers of $\mathrm{C}_{6} \mathrm{H}_{14}$.






Here are " 4 different ways" to describe an organic compound:
Molecular Formula vs Lewis Structure vs Bond-Line vs Condensed

Draw these compounds the "other 3 ways" \& add the lone pair electrons.

$\left(\mathrm{CH}_{3}\right)_{2} \mathrm{CHCH}_{2} \mathrm{CHO}$


Hydrocarbons Part 2: Recognizing Isomers
Recognizing Isomers


Perspective Formulas, Sawhorses, and Newman Projections 3 different ways to show conformations


Wedge and dash


Sawhorse


Newman projection

Converting the perspective formula for 2,3-dibromobutane into a Newman Projection along the C2-C3 axis.


Draw the Newman projection for $\mathrm{CH}_{3} \mathrm{CH}\left(\mathrm{CH}_{3}\right) \mathrm{CH}\left(\mathrm{CH}_{3}\right) \mathrm{CH}_{2} \mathrm{CH}_{3}$ along the C2-C3 axis.

What are the relationships between compounds $A, B$ and $C$ ?


Structural (Constitutional) Isomers compounds with the SAME chemical formula, but DIFFERENT connectivity of atoms

Draw the 5 structural isomers with the molecular formula $\mathrm{C}_{6} \mathrm{H}_{14}$ using skeletal-line structures.

Geometric Isomers: compounds with the same connectivity between atoms, yet different spatial arrangements.

Cis \& trans isomers can NOT inter-convert. They are unique cpds.

trans-1,3-dimethylcyclohexane

trans-2-butene
mp-139C \& bp -4C

cis-1,3-dimethylcyclohexane

cis-2-butene
$\mathrm{mp}-106 \mathrm{C}$ \& bp 1C

## Cis-trans Isomers in Biochemistry

Isomerization reaction: a chemical reaction that converts one structural isomer or geometric isomer into another
The retina of the eye contains 2 types of photoreceptors: rods and cones. The rods contain a polyene known as retinal which is part of a larger protein known as rhodopsin. Light induces one of the cis- double bonds to undergo isomerization reaction to a trans double bond causing the entire molecule to change shape which initiates a nerve impulse that travels along the optic nerve to the brain resulting in a visual image.



1. a) What are the relationships between Cpd I and other Cpds II to VII identical (I), structural isomers (SI), or geometric isomers (GI)?
b) Label all geometric isomers as cis or trans.
2. Use the following compounds to answer the questions below.

A


C

D

E
a) Which compounds are structural isomers?
b) Which compounds are conformers?
3. Label the following double bonds as cis or trans if applicable.





