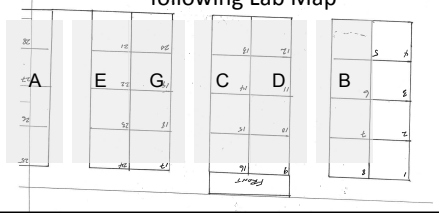
Chem 106: Lab

Week 7

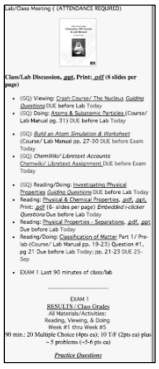
Sign in: Note the letter next to your name

Pick up graded papers

Sit in the Area Noted with that letter on the following Lab Map



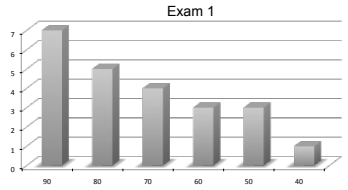
http://chemconnections.org/general/chem106/calendar-106-f17.html



Chem 106: Exam 1 Results

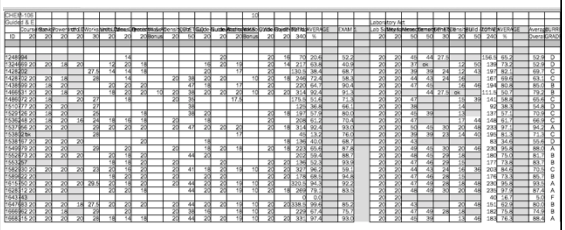
Divide raw exam score by 115 and multiply by 100 to calculate %

Class Avg. 77.4% +/- 15%



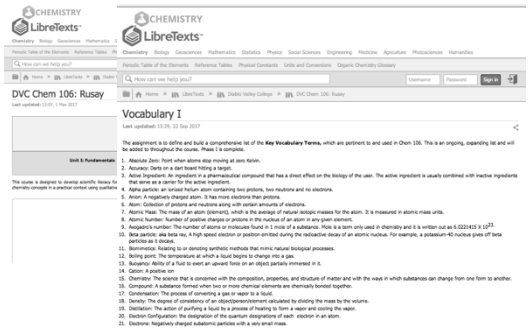
Grades

http://chemconnections.org/general/chem106/Exam1-f2017.htm



Review your grades, compile any discrepancies, and see Dr. R. to reconcile and correct incorrect entries before Exam 2, October 30th.

ChemWiki-Libretext: Vocabulary Bonuses



Chem 106: Class/ Lab #6

Week 7

After Discussion the first part of lab complete: weighing of sand & salt, and ink chromatography

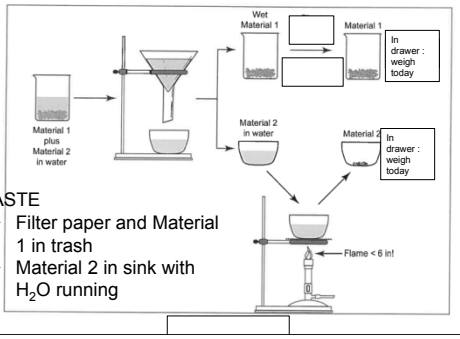
Turn in pp. 21-23 @ the end of Lab

Attach ink chromatogram

Complete TODAY

Classification of Matter

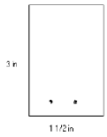
Part I: Procedural Scheme

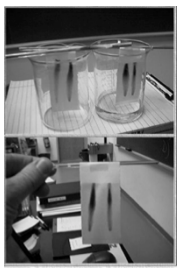


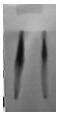
- WASTE
  - Filter paper and Material 1 in trash
  - Material 2 in sink with H_2O running

Classification of Matter

Part II – Paper Chromatography)

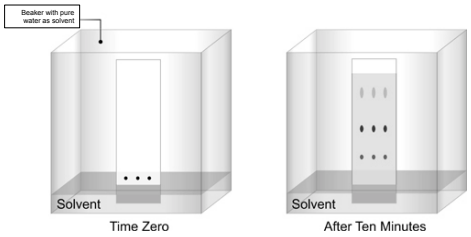






Part II – Paper Chromatography

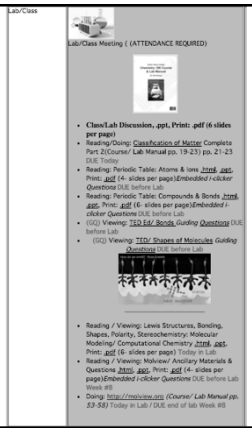
- Use water-soluble pens that are provided, DO NOT use your own pen
  - DO NOT use permanent pens/markers

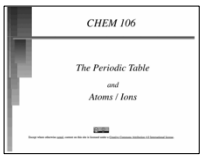


- Waste: water in sink

Experiment – Classification of Matter

- Complete Parts I & II
  Report Form pp. 21-23 Due Today: *One form for each team of lab partners.*
  - Check sig figs are correct and units included
  - Show example of calculations
  - Answer questions legibly in complete sentences.





QUESTION

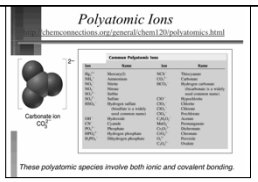
Predict the formula for the binary ionic compound formed by aluminum and oxygen.

A) Al_2O_3 ***B) Al_3O_2*** ***C) Al_2O*** ***D) AlO_2***

ANSWER

Predict the formula for the binary ionic compound formed by aluminum and oxygen.

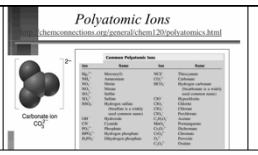
A) Al_2O_3 ***B) Al_3O_2*** ***C) Al_2O*** ***D) AlO_2***



QUESTION

Which formula containing polyatomic ions is correct?

A) $MgNO_3$ B) NH_4CO_3 C) $Na(PO_4)_3$ D) $Al_2(SO_4)_3$



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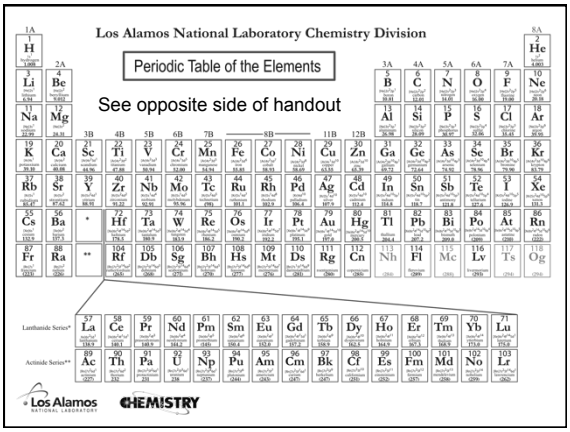


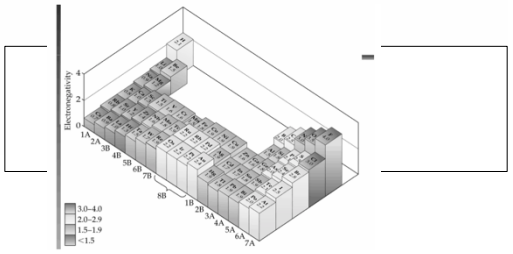
QUESTION

For the elements Rb, F, and O, the order of increasing electronegativity is:

A) Rb < F < O.
B) Rb < O < F.
C) O < F < Rb.
D) F < Rb < O.
E) none of these.

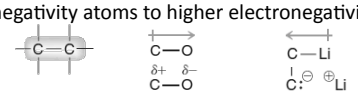
ANSWER

B) Rb < O < F.

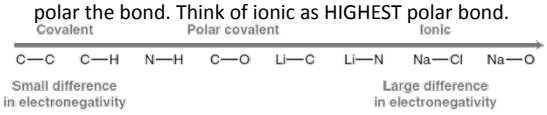


Ionic & Covalent Bonds

- Electrons tend to shift away from lower electronegativity atoms to higher electronegativity atoms.

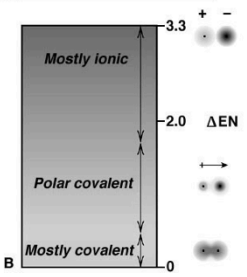


- The greater the difference in electronegativity, the more polar the bond. Think of ionic as HIGHEST polar bond.



Boundary Ranges for Classifying Ionic Character of Chemical Bonds

ΔEN	IONIC CHARACTER
>1.7	Mostly ionic
0.4-1.7	Polar covalent
<0.4	Mostly covalent
0	Nonpolar covalent



QUESTION

Atoms having greatly differing electronegativities are expected to form:

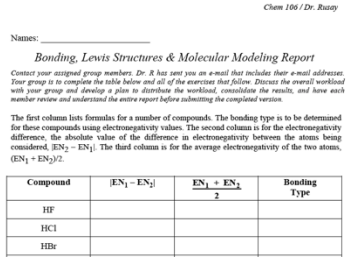
1) no bonds.
2) polar covalent bonds.
3) nonpolar covalent bonds.
4) ionic bonds.
5) covalent bonds.

ANSWER

D) ionic bonds.

If two atoms have greatly differing electronegativities the more electronegative atom will pull on the bonding electrons so strongly the electrons will transfer from one atom to the other.

(Course/ Lab Manual pp. 53-58)
Organize Today with your Moleview Group



Chem 106 / Dr. Rusay

Names: _____

Bonding, Lewis Structures & Molecular Modeling Report

Contact your assigned group members. Dr. R has sent you an e-mail that includes their e-mail addresses. Your group is to complete the table below and all of the exercises that follow. Discuss the overall workload with your group and develop a plan to distribute the workload, consolidate the results, and have each member review and understand the entire report before submitting the completed version.

The first column lists formulas for a number of compounds. The bonding type is to be determined for these compounds using electronegativity values. The second column is for the electronegativity difference, the absolute value of the difference in electronegativity between the atoms being considered, $|EN_2 - EN_1|$. The third column is for the average electronegativity of the two atoms, $(EN_1 + EN_2)/2$.

Compound	$\lvert EN_1 - EN_2 \rvert$	$\frac{EN_1 + EN_2}{2}$	Bonding Type
HF			
HCl			
HBr			

Due Next Week

Molecular Modeling
Computational Chemistry

Covalent Bonds: Lewis Structures, Shapes, Polarity, Stereochemistry

Dr. Ron Rusay

Molecular Modeling
Computational Chemistry

Shapes ⟶ Lewis Structures
Ancillaries: Polarity, Stereochemistry

Dr. Ron Rusay

https://www.youtube.com/watch?v=Jq_Ca-HKh1g

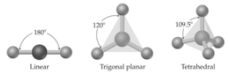
Shapes of Molecules

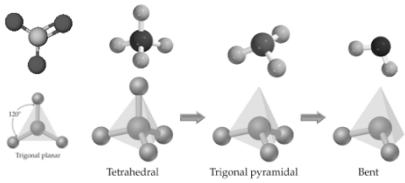
View: What is the shape of a molecule?
George Zaidan and Charles Morton

http://chemconnections.org/general/chem106/Molecular%20Shapes-Guide.html

Molecular Shapes
Molecular Models for C, H, N, O

- Fundamental repeating shapes found in every biological molecule

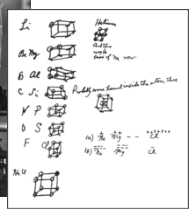




C =black
H = gray
N = blue
O = red

pink = generic atom

Professor Gilbert Newton Lewis (circa 1940)



G.N. Lewis
Photo Bancroft Library, University of California/LBNL Image Library

Footnote:
G.N. Lewis, despite his insight and contributions to chemistry, was never awarded the Nobel prize.

Notes from Lewis's notebook and his "Lewis" structure.

Valence Electrons – Lewis Dot Drawings
A Groups-Periods 2 & 3

Period	1A(1) ns^1	2A(2) ns^2	3A(13) ns^2np^1	4A(14) ns^2np^2	5A(15) ns^2np^3	6A(16) ns^2np^4	7A(17) ns^2np^5	8A(18) ns^2np^6
2	Li	Be	B	C	N	O	F	Ne
3	Na	Mg	Al	Si	P	S	Cl	Ar

Covalent Bond Numbers
(Neutral Atoms!)

one bond — H — F — Cl — Br — I —

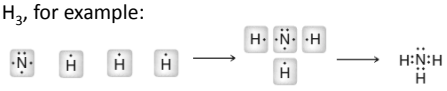
two bonds — O —

three bonds — N —

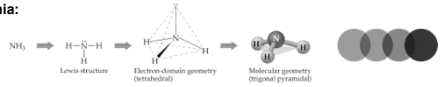
four bonds — C —

Lewis Structures ⟺ Molecular Shapes

- For simple Lewis structures:
  1. Draw the individual atoms using dots to represent the valence electrons.
  2. Put the atoms together so they share PAIRS of electrons to make complete octets.
- NH_3, for example:



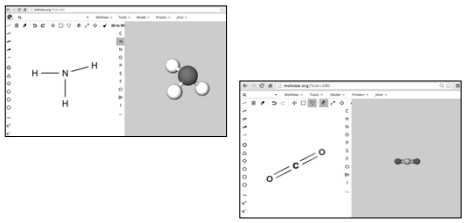
Eg. Ammonia:



http://molview.org

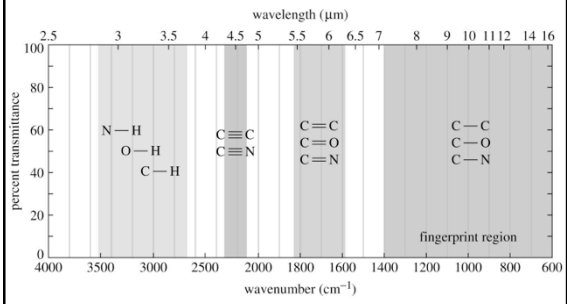
Molecular Shapes ⟺ Lewis Structures

MolView: Visual On-line Molecular Modeling

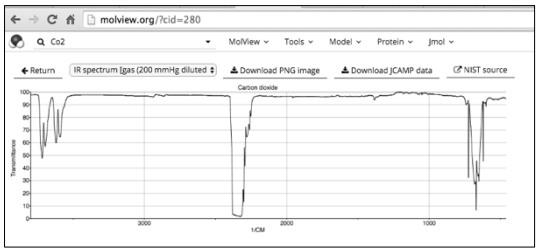


Bonding, Lewis Structures, Molecular Modeling:
Computational Experiments, Instructions, & Manual pp. 53-58

Infrared- Bond Absorbances



Infrared- Bond Absorbances



http://molview.org

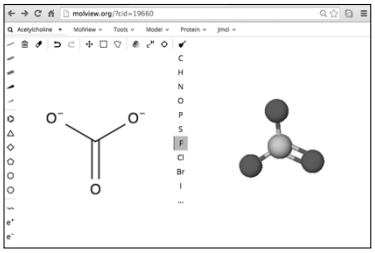
Infrared- Bond Absorbances

https://www.co2.earth/

http://molview.org

Molecular Shapes ⟺ Lewis Structures

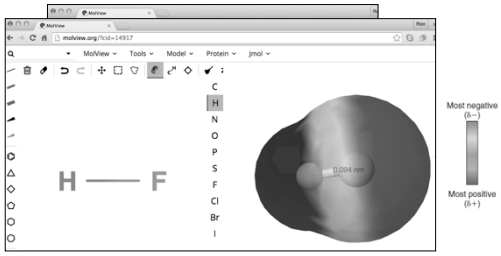
MolView: Polyatomic Ions



Bonding, Lewis Structures, Molecular Modeling:
Computational Experiments, Instructions, & Manual pp. 53-58

Computational Chemistry

Polarity: Molview (http://molview.org) Jmol

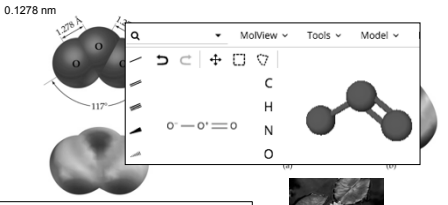


Color coded electron density distribution: red-highest, blue lowest, green balanced

NOTE: These colors may vary from model to model.

Polarity & Physical Properties

Ozone and Water



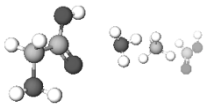
- Resultant Molecular Dipoles > 0
- Solubility: Polar molecules that dissolve or are dissolved in like molecules

- The Lotus flower
- Water & dirt repellancy: solubility?

Amino Acids

Legos of Chemical Biology

Amino acids contain carbon, hydrogen, oxygen, and nitrogen, which resemble the following shapes & structural components



•20 different amino acids are encoded by the genetic code, which is archived in DNA.

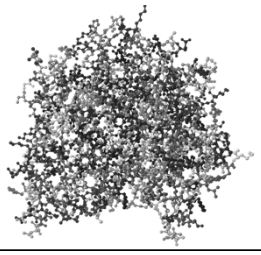
•Hundreds of amino acids link together with amide (peptide) bonds to form proteins, which are the machinery for the chemistry of life.

•There are less than 20,000 total proteins produced from humans' entire genome, each coded by a specific gene in DNA's ~3 billion genetic bases.

Proteins: Indispensible Biopolymers

Acetylcholinesterase (ACE)

ACE, an enzyme, which catalyzes a key reaction in a repetitive biochemical cycle that is crucial to neurological and physiological functions in humans…. and insects among others.

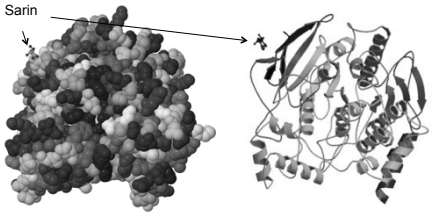


4,496 atoms;
4,404 bonds
574 amino acid residues

Proteins & Small Molecules

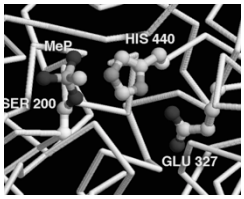
Acetylcholinesterase

Two images with Sarin, a potent nerve agent, which inhibits acetylcholinesterase, and causes convulsions and death if not antidoted with atropine.



Proteins & Small Molecules

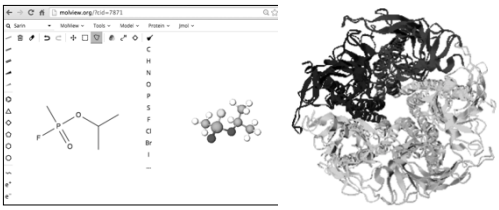
Acetylcholinesterase – Receptor - Active (Binding) Site



The ACE enzyme has a receptor, a site in the molecule defined by the 3 amino acids in the image on the right. It binds acetylcholine, which then hydrolyzes. Sarin out competes acetylcholine, binds, and the enzyme cannot work.

Proteins & Small Molecules

Acetylcholinesterase: Docking

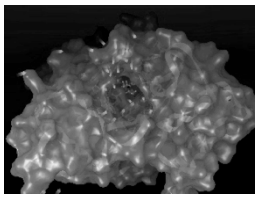


The 3 amino acids that bind acetylcholine prefers to bind Sarin, which does not unbind and the enzyme does not work.

Proteins & Small Molecules

Acetylcholinesterase-Active Site-Docking

The normal function of acetylcholinesterase is with acetylcholine. This general process is similar to the way we smell and relates to many, many physiological and pharmacological processes.



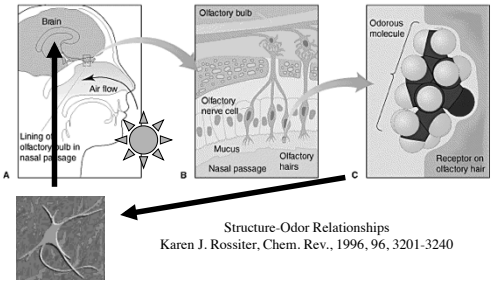
http://chemconnections.org/general/movies/richard.mpg

Molecular Modeling
Computational Chemistry

Ancillaries: Polarity, Stereochemistry
Smell ⟶ Biomimcry ⟶ Birth Defects

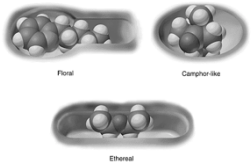
Dr. Ron Rusay

Detecting stuff we cannot see: the Sense of Smell
Models, Theories & Interactions



Structure-Odor Relationships
Karen J. Rossiter, Chem. Rev., 1996, 96, 3201-3240

Historical view of a few smell receptors.



4 October 2004

The Nobel Assembly at Karolinska Institutet has today decided to award

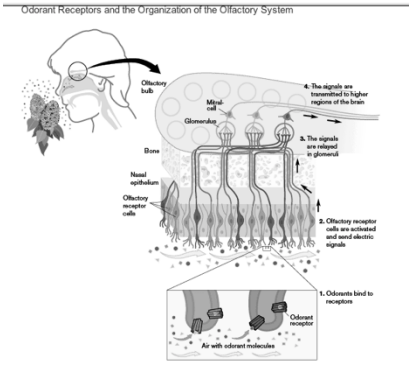
The Nobel Prize in Physiology or Medicine for 2004

jointly to

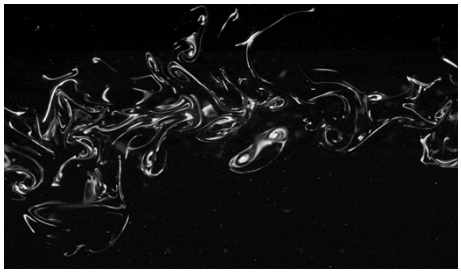
Richard Axel and **Linda B. Buck**

for their discoveries of

"odorant receptors and the organization of the olfactory system"

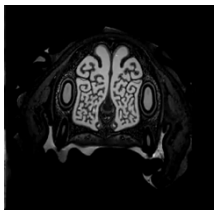


What a smell looks like



https://www.youtube.com/watch?v=58U52lDTuvk&list=PLgawtcOBBjr9I-NDoUX-HmTQr_VN465G2&index=3

Inside the extraordinary nose of a search-and-rescue dog

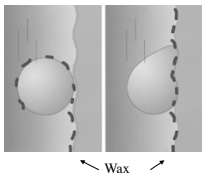


https://www.youtube.com/watch?v=FLH36ML8IEU

Dogs Can Smell Cancer - Secret Life of Dogs - BBC

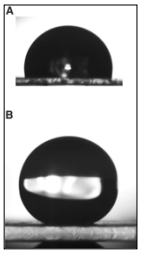
https://www.youtube.com/watch?v=e0UK6kkS0_M

The "Lotus Effect"
Biomimicry



- Water not only dissolves some dirt, but attracts and removes it like a snowball rolling downhill.
- Lotus petals have micrometer-scale roughness, resulting in water contact angles up to 170°

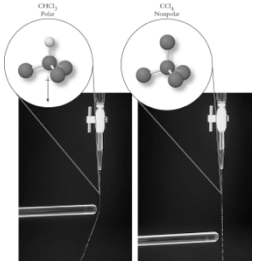
The "Lotus Effect"
Biomimicry



- Isotactic polypropylene (i-PP) melted between two glass slides and subsequent crystallization provided a smooth surface. Atomic force microscopy tests indicated that the surface had root mean square (rms) roughness of 10 nm.
- A) The water drop on the resulting surface had a contact angle of 104° ± 2
- B) the water drop on a superhydrophobic i-PP coating surface has a contact angle of 160°.

Science, 299, (2003), pp. 1377-1380, H. Yldrm Erbil, A. Levent Demirel, Yonca Avc, Olcay Mert
http://www.sciencemag.org/cgi/content/full/299/5611/1377/DC1

Polarity & Physical Properties
Chloroform (polar) vs. Carbon tetrachloride (non-)



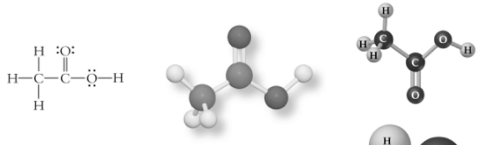
An electrically charged rod attracts a stream of chloroform but has no effect on a stream of carbon tetrachloride.

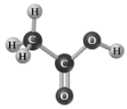
Polarity & Physical Properties
Solubility

Generally likes dissolves like:

- Polar compounds dissolve other polar compounds & ionic compounds. Eg. ethanol and water, sodium chloride and water, sugar and water
- Nonpolar compounds are soluble in other nonpolar compounds. Eg. carbon tetrachloride and oil, diesel and gasoline

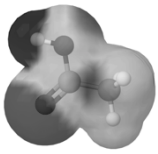
Acetic acid





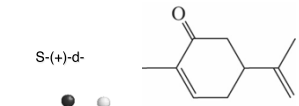
- Is acetic acid polar or non-polar?
- Will acetic acid be miscible (dissolve) in water?

Based on the Molview model?

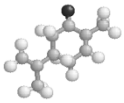


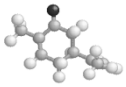
Shapes & Interactions: Mirror Images & Smell

S-(+)-d-



R-(-)-l-





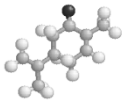
S(+)-*d*-caraway

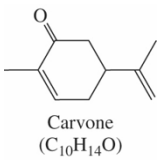
R(-)-*l*- spearmint

http://chemconnections.org/organic/chem226/Labs/Smell/ChemComm.html

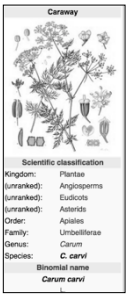
Shapes & Interactions: Mirror Images & Smell

S-(+)-d-



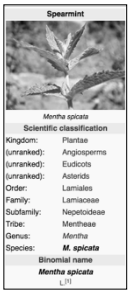


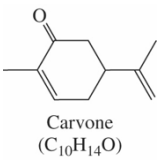
S-(+)- caraway



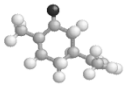
http://chemconnections.org/organic/chem226/Labs/Smell/ChemComm.html

Shapes & Interactions: Mirror Images & Smell





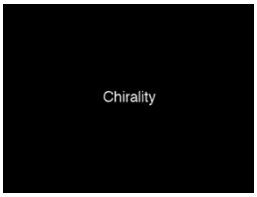
R-(-)-l-



R-(-)- spearmint

http://chemconnections.org/organic/chem226/Labs/Smell/ChemComm.html

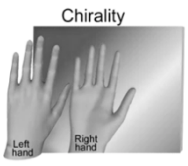
Chirality & Carbon Atoms

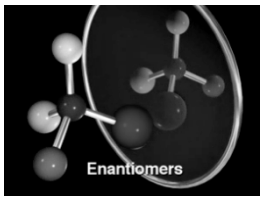


Each carbon atom with four different substituents are chiral.

http://chemconnections.org/general/movies/Chirality.mov

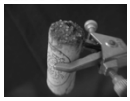
Chirality

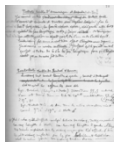




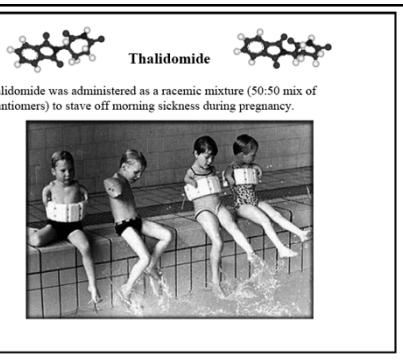
Stereoisomerism

- Enantiomers are chiral:
  i.e. They are non-superimposable mirror images.
- Most physical and chemical properties of enantiomers are identical.
- Therefore, enantiomers are very difficult to separate eg. Tartaric acid…
  Louis Pasteur:





- Enantiomers can have very different physiological effects: eg. (+) and (-) carvone, Advil (ibuprofen) …… (thalidomide)



From the late 1950s – early 1960s more than 10,000 children in 46 countries were born with deformities caused by the S-(-) enantiomer.