Organic Chemistry

- ________________________ Organic Compounds
  - compounds that contain _______________________________
  - _______________ of all compounds
  - originally associated with ___________________________________ now most are

    ____
  - Reasons for so many types:
    - Carbon can form ________ bonds to different atoms because it has _______

      valence e- and needs ________ more for stability
    - It can form ____
    - Can have a large number of __________ in one compound
    - C can form:
      - ____________________ (____ shared e-) bonds
      - ____________________ (____ shared e-) bonds
      - ____________________ (____ shared e-) bonds
  - Carbon bonds with many different elements: ____________________________________

- ______________________________ – carbon and hydrogen compounds
  - Classes
    - ___________________ – have benzene rings
    - ___________________ – all others (2 kinds: ___________________ and ___________________)
      - ___________________ (___________________)
        - all ____________ bonds
        - __________complex
        - C_nH_{2n+2} ~ where n = ____
          - methane – _________
          - ethane – _________
          - propane – _________
          - butane – _________

- pentane – ___________

- hexane – ___________

- heptane – ___________

- octane – ___________

- nonane – ___________

- decane – ___________

- ______________________ (_______________________)
  - one or more _________________ bonds
  - C_nH_{2n} ~ where n = ____
    - ethene – __________
    - propene – __________
    - butene – __________
    - pentene – __________
    - hexene – __________

- heptene –___________

- octene –___________

- nonene –___________

- decene –___________

➢ ___________________________ (_________________________)
  - _______________ bonds (one or more)
  - C_nH_{2n-2} ~ where n = ____

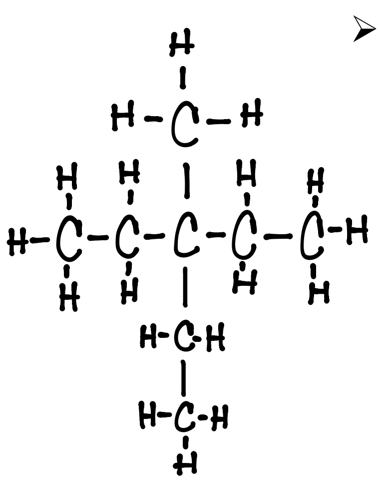
- ethyne (acetylene) – ___________
- propyne – ___________
- butyne – ___________
- pentyne – ___________
- hexyne –___________

- heptyne –__________

- octyne –__________

- nonyne –__________

- decyne –__________



- ______________________ groups
  - Groups with _____ less ______ than __________________
    - __________________ group (_____________)
    - __________________ group (_____________)
    - __________________ group (_____________)

Naming Alkanes: following the IUPAC rules

1. Name the parent hydrocarbon.
   - Identify the longest continuous chain of carbon atoms.
     - Add the suffix –*ane* to the prefix corresponding to the number of carbon atoms in the chain.
2. Number the atoms in the chain, starting at the end that is closest to an attached side group.
   - If each end has an equally close side group, start with the end that is closes to a second attached group
3. Add the names of the alkyl groups.
   - In front of the name of the parent hydrocarbon in alphabetical order.
   - Use the suffix –*yl* to show that it is a side group.
   - When there is more than one branch of the same alkyl group present, attach the appropriate numerical prefix (di-, tri-, tetra-, etc.) to the name.
     - Do this after the names have been put in alphabetical order.
4. Insert the position numbers.
   - Identify the location of each alkyl group by using the number of the carbon atom to which it is attached.
5. Punctuate the name: write the name with no spaces, with commas between numbers, and with hyphens between numbers and letters.

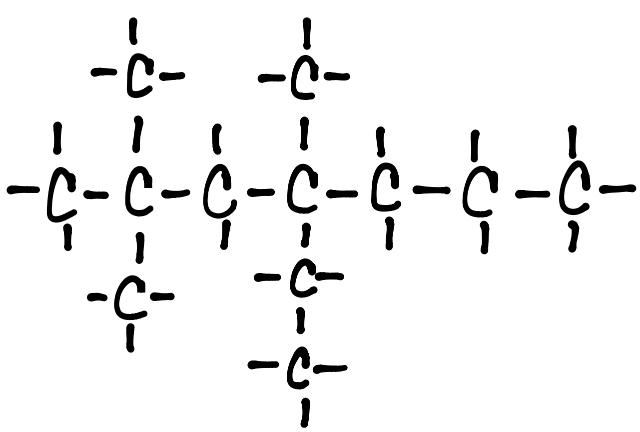
Naming Cycloalkanes: following the IUPAC rules

* Use the rules for alkane nomenclature with the following exceptions:

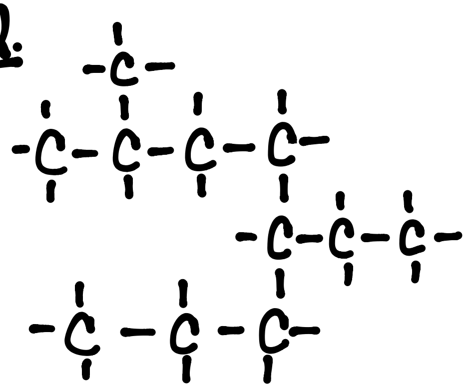
1. Name the parent hydrocarbon.
   - Count the number of carbon atoms in the ring.
   - Add the prefix *cyclo*- to the name of the corresponding straight-chain alkane.
2. Add the names of the alkyl groups.
3. Number the carbon atoms in the parent hydrocarbon.
   - If there are two or more alkyl groups attached to the ring, number the carbon atoms in the ring.
     - Assign position number one to the alkyl group that comes first in alphabetical order.
     - Then, number in the direction that gives the rest of the alkyl groups the lowest numbers possible.
4. Insert position numbers.
5. Punctuate the name.

Naming Alkanes:

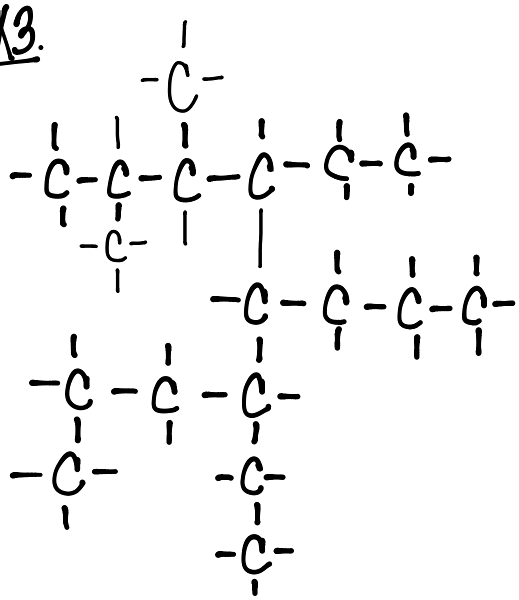
EX1. (shorthand notation)



EX2.



EX3.



Drawing Alkanes:

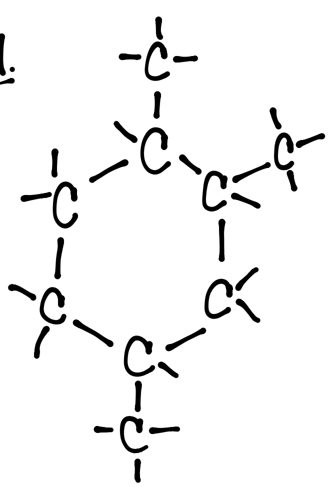
Ex 1. 3-ethyl-2-methylhexane

Ex 2. 2,2-dimethylbutane

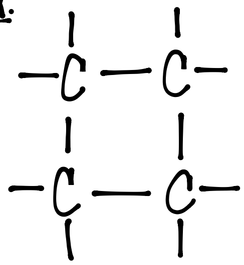
Ex 3. 4-ethyl-3,3,4,5,6-pentamethyl-5-propyloctane

Naming Cycloalkanes:

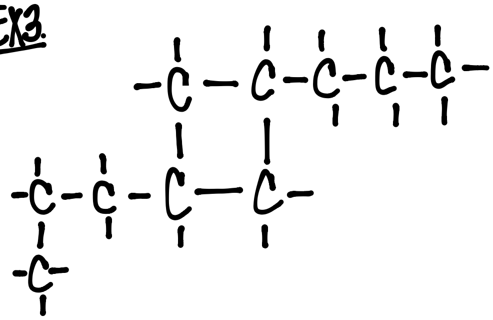
EX1.



Ex2.



Ex3.



Drawing Cycloalkanes:

Ex 1. cycloheptane

Ex 2. 1,2-dimethylcyclopropane

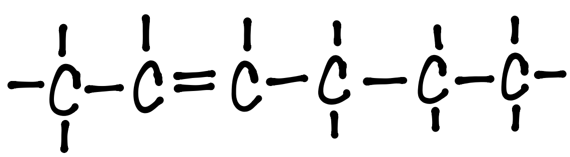
Ex 3. 1-ethyl-2,5-dimethylcycloheptane

Naming Alkenes: following the IUPAC rules

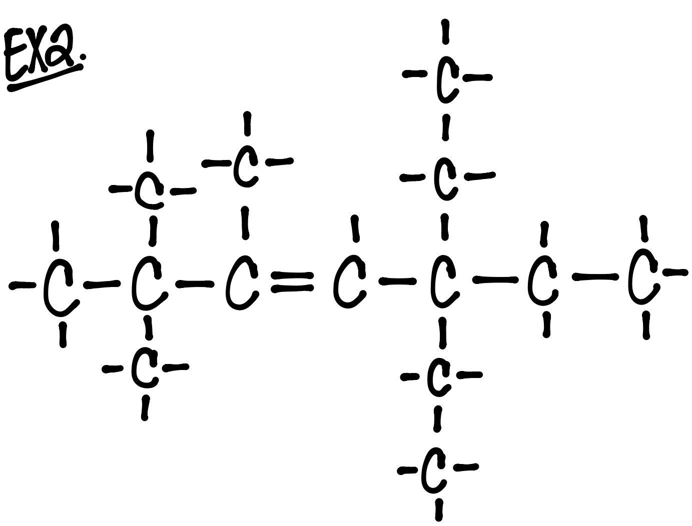
1. Name the parent hydrocarbon.
    - Identify the longest continuous chain of carbon atoms that ***contains*** the double bond.
        - Add the suffix –*ene* to the prefix corresponding to the number of carbon atoms in the chain.
        - If there is more than one double bond, modify the suffix (2 = -*adiene*, 3 = -*atriene*, etc.)
2. Number the atoms in the chain, starting at the end that is closest to a double bond.
    - If each end has an equally close double bond, start with the end that is closest to an alkyl group
3. Add the names of the alkyl groups.
    - In front of the name of the parent hydrocarbon in alphabetical order.
    - Use the suffix –*yl* to show that it is a side group.
    - When there is more than one branch of the same alkyl group present, attach the appropriate numerical prefix (di-, tri-, tetra-, etc.) to the name.
        - Do this after the names have been put in alphabetical order.
4. Insert the position numbers.
    - Identify the location of each double bond and alkyl group by using the number of the carbon atom to which it is attached.
5. Punctuate the name: write the name with no spaces, with commas between numbers, and with hyphens between numbers and letters.

Naming Alkenes:

EX1.



EX2.



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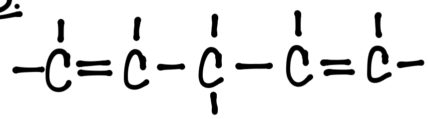


Drawing Alkenes:

Ex 1. 7-methyl-3-octene

Ex 2. 1,2-hexadiene

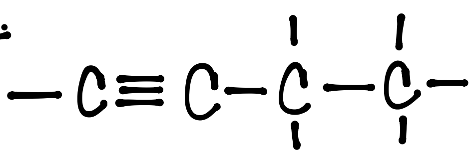
Ex 3. 4,4-dimethyl-2-pentene

Naming Alkynes: following the IUPAC rules

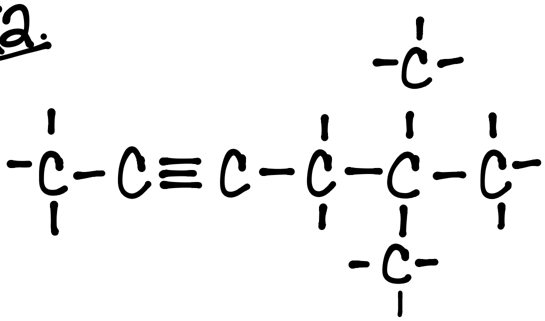
1. Name the parent hydrocarbon.
   - Identify the longest continuous chain of carbon atoms that ***contains*** the triple bond.
     - Add the suffix –*yne* to the prefix corresponding to the number of carbon atoms in the chain.
     - If there is more than one triple bond, modify the suffix (2 = -*adiyne*, 3 = -*atriyne*, etc.)
2. Number the atoms in the chain, starting at the end that is closest to a triple bond.
   - If each end has an equally close triple bond, start with the end that is closest to an alkyl group
3. Add the names of the alkyl groups.
   - In front of the name of the parent hydrocarbon in alphabetical order.
   - Use the suffix –*yl* to show that it is a side group.
   - When there is more than one branch of the same alkyl group present, attach the appropriate numerical prefix (di-, tri-, tetra-, etc.) to the name.
     - Do this after the names have been put in alphabetical order.
4. Insert the position numbers.
   - Identify the location of each triple bond and alkyl group by using the number of the carbon atom to which it is attached.
5. Punctuate the name: write the name with no spaces, with commas between numbers, and with hyphens between numbers and letters.

Naming Alkynes:

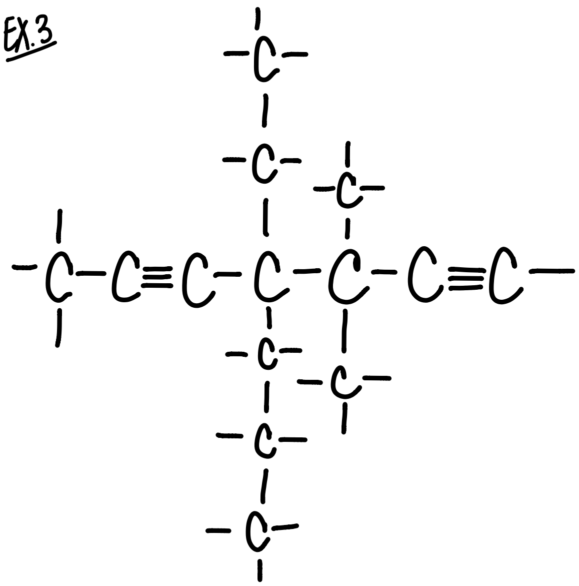
Ex1.



Ex2.



Ex.3



Drawing Alkynes:

Ex 1. 1,4,7-octatriyne

Ex 2. 5-ethyl-5-methyl-3-octyne

- ______________________________

  - Compounds that have ____, but

    ____.

    - As the number of _____________ atoms in a chemical formula ______________,

      the number of possible isomers __________________ rapidly.

  - They have similar ___________________________

  - ________________________ have increased melting and boiling points.

  - Types of Isomers:

    - ____

      - Isomers in which the atoms are bonded together in

        ____.

      - <u>Ex</u>. Butane (C_4H_{10}) & 2-methylpropane (C_4H_{10})

- ____

  - Isomers in which the ____________ of atom bonding is the __________, but the ______________________ of atoms in space is ________________.
  - <u>Ex.1:</u> 1,2-dichloroethene
  - <u>Ex.2:</u> 1,2-dichloroethane
    - In order for geometric isomers to ____________, there must be a ________________ structure in the molecule to prevent ___________________________ around a bond.

➢ Ex.3: Chloroethene

- A molecule can have a geometric isomer ________________ two carbon atoms in a ___________ structure each have two ___________________ groups attached.

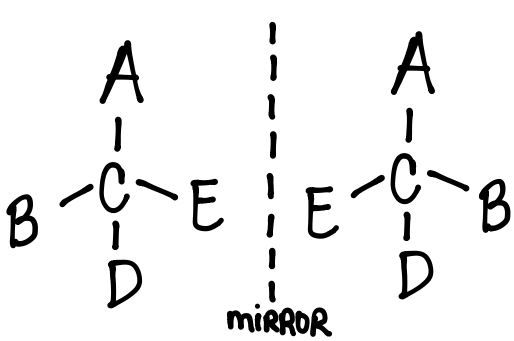
▪ ____

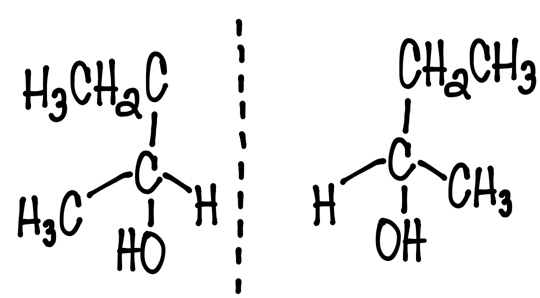
➢ Isomers that differ ______________________________ by the placement of ______________________ around ___________________ atoms in a molecule.

➢ They are ______________ images of one another and ____________________________________ on one another.

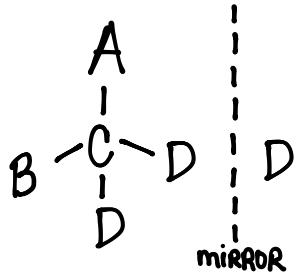
➢ Simple substances which show optical isomerism exist as two isomers known as ______________________________.

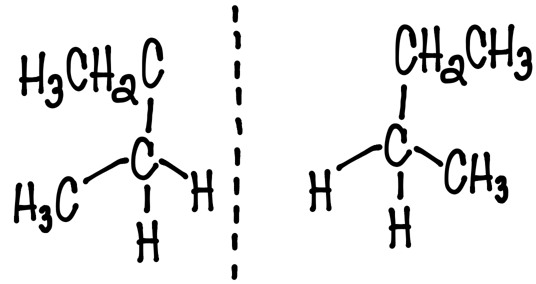
➢ Ex. Optical Isomers





- Ex. Not optical isomers

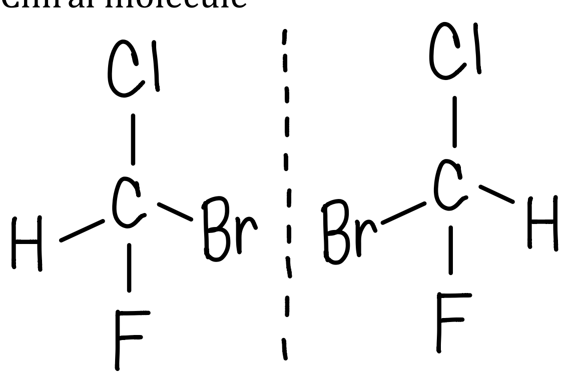




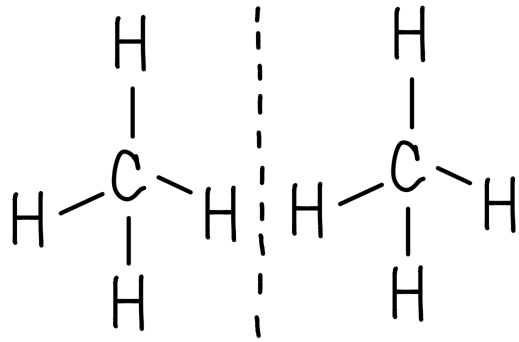
  - Optical isomers can only exist if all ________ groups attached to the ________________ carbon are ___________________.

- ____

  - A molecule is _________________ if it is not ______________________________ on its ________________ image.
  - A molecule which has ____ is described as chiral.
  - The carbon atom with the _____________ different groups attached which causes this lack of symmetry is described as a _______________ center or as an _______________________________ carbon atom.
  - Only chiral molecules have ______________ isomers.
  - Ex. Chiral molecule



- Ex. Achiral molecule



- ________________ Organic Compounds
  - ______________________ compounds – hydrocarbon containing ___________________ ring structure
    - Most have ___________
    - Benzene: __________
      - Forms a ring with ________________ bonds and _______________ bonds.
      - Shorthand notation:

- Can have attached groups:

- Benzene as an attached group is called a ______________________ group.
  - Ex. Phenylethylene (styrene)

  - Ex. 2 benzenes ~ naphthalene $C_{10}H_8$(mothballs)

- _____________________________ hydrocarbon compounds
  - ____: an atom or group of atoms that is responsible for the specific properties of an organic compound.
    - The _________________ within functional groups are often the site of chemical _______________________________.

- ______________________ is replaced with a different element
  - Results in a more ____________________ compound
- Substituted by _________________ (Cl, Br, F, I) ~ ____________________________
  - also called _____________________________
  - Ex.
  - Ex.
  - Ex.
- Substituted by _____________________
  - ___________________ ~ ________________

- Where -OH (____________________) represents the _______________

  and _____ represents the ______________ of the hydrocarbon

  - Ex. Methanol ~ CH_3OH

  - Ex. Ethanol ~ $CH_3CH_2OH \rightarrow C_2H_5OH$

  - Ex. Propanol ~ $CH_3CH_2CH_2OH \rightarrow C_3H_7OH$

➢ ___________________________________

- COOH is called a _____________________ group also known as a

  ____

- Ex. Ethanoic acid (Acetic acid) ~ CH_3COOH

- Ex. Butanoic acid ~ C_3H_7COOH

- ______________________

  - Derivatives of ______________________
  - Categorized as primary, secondary, or tertiary amines depending on the number of ______________________ atoms of the ______________________ molecule that have been ____________________.
    - ______________________ amine – ___________ H replaced
    - ______________________ amine – ___________ H replaced
    - ______________________ amine – ___________ H replaced

- Ex. Methylamine ~CH_3NH_2

- Ex. Ethylmethylamine ~$CH_3CH_2NHCH_3$

- Ex. Trimethylamine ~ $CH_3CH_3NCH_3$

Biological Compounds

- **Polymers**
  - ____

    ____

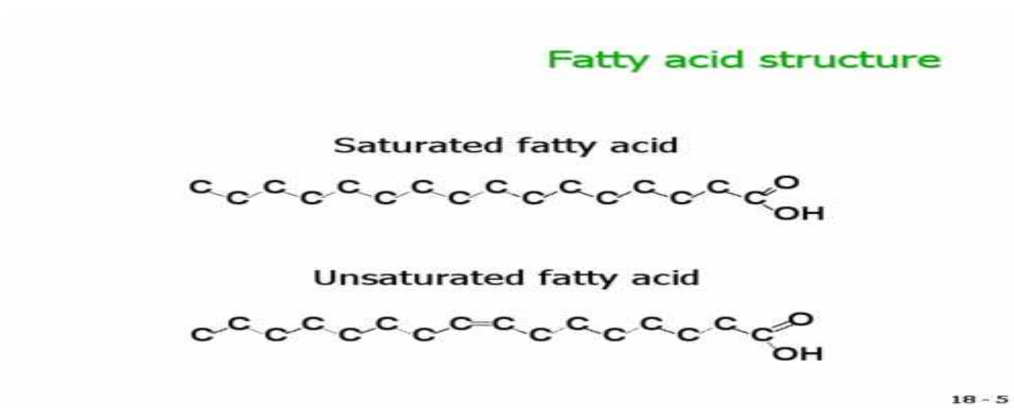
    ____.

- same molecules bonded in ____________________________
- _____________________ – smaller molecules; polymers are chains of attached monomers
- polymers are created through _____________________________ reactions (the molecules are joined through the removal of H_2O)
- polymers are broken through ______________________________reactions where H_2O is added

- **Carbohydrates (C – H – O)**
  - organic compounds with ____ ____
  - _____________________________ (simple) and __________________________ (complex)
  - _____________________________ – simplest sugars (1)
    - ex. fructose, glucose
  - ____________________________ – 2 simple sugars bonded
    - ex. sucrose → table sugar

- ______________________________ – starches → polymers of monosaccharides which may be broken down into simple sugars in digestion
  - provide the organism with a source of ____________________

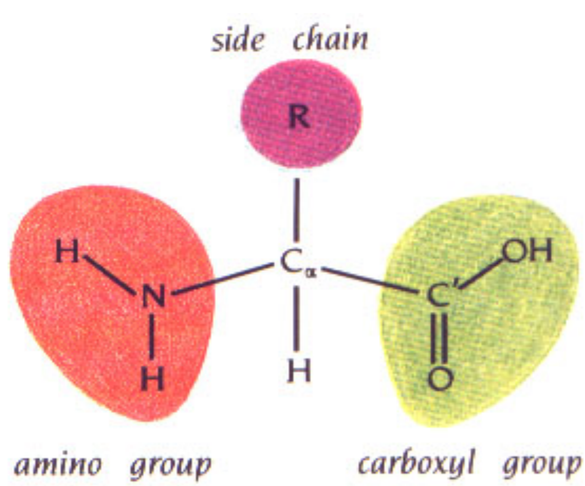
- **Lipids (C – H – O)**
  - ____
  - not very soluble in H_2O
  - less __________ than carbohydrates
  - prevalent in cell membranes due to low H_2O solubility
  - excellent energy storage
  - fatty acids → contain ____
    - ____________________________________ = single bonds
    - ____________________________________ = 1 double bond
    - ___________________________________ = several double bonds



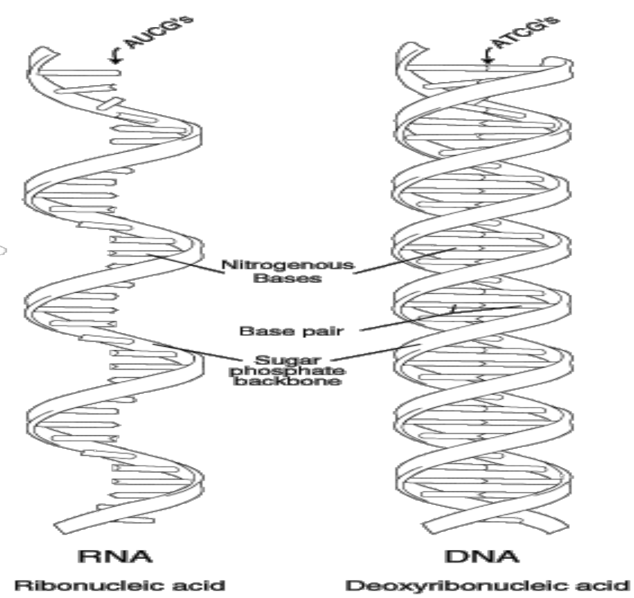
- plant lipids are ________________________________ (liquid/solid)
  - many are unsaturated but can be ____________________________________

    (add an H to make solid)
- animal lipids are fats (solid)
  - generally ____________________________

- **Proteins (C – H – O – N)**
  - polymers of _____________________________ that create muscles, tendons, hair, fingernails and _________________________
  - amino acids have a ________________ group (COOH) and an __________________ group (– NH_2)
  - ________________________________ link the amino acids together
    - these bonds form between amino and carboxyl groups from neighboring amino acids



- **Nucleic Acids (C – H – O – N)**
  - polymers of ______________________________ (sugar, phosphate and N – base)
  - DNA
    - found in __________________ of cells
    - codes for protein synthesis (genetic info)
    - __________________________________ structure
  - RNA (ribonucleic acid)
    - made from DNA instructions
    - carries the code of DNA
    - ___________________________________ structure



Exam Date: ____

- **Carbon & Hydrocarbons (Chapter 20)**
  - ✓ carbon / allotropes
  - ✓ vocab – prefixes / suffixes for naming
  - ✓ structural formulas (must be able to draw compound & name)
  - ✓ isomers – structural / geometric / optical
  - ✓ aliphatic hydrocarbons – alkanes / alkenes /alkynes
  - ✓ aromatic hydrocarbons / benzene ring

- **Other Organic Compounds (Chapter 21)**
  - ✓ functional groups
  - ✓ alkyl halides / alcohols / carboxylic acids / amines
    (functional group for each / draw compound & name)

- **Biological Compounds**