Take notes while watching the following video tutorials to prepare for the "Funct Grp Physical Properties & Intro to Acid-Base Chemistry Activity".

## Organic Functional Groups Part 5 - IMFs and H<sub>2</sub>O Solubility

Hydrophilic

Hydrophobic

H-bond donors vs H-bond acceptors

Rule of Thumb for predicting water solubility of polar organic compounds

Explain the trend in water solubility shown below.

Structure	Name	Boiling Point (°C)	Water Solubility (g/100 mL H <sub>2</sub> O)
НСНО	Formaldehyde	-21	55
CH <sub>3</sub> CHO	Acetaldehyde	21	Soluble
CH <sub>3</sub> CH <sub>2</sub> CHO	Propanal	49	16
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CHO	Butanal	76	7
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CHO	Pentanal	103	1
СНО	Benzaldehyde	178	0.3
CH <sub>3</sub> COCH <sub>3</sub>	Acetone	56	Soluble
CH <sub>3</sub> CH <sub>2</sub> COCH <sub>3</sub>	2-Butanone	80	26
CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> COCH <sub>3</sub>	2-Pentanone	102	6
	Cyclohexanone	156	2

Both THF and diethyl ether have 4 carbon atoms. THF is water soluble while diethyl ether is NOT water soluble. Explain this difference.



Predict whether you the following compounds would be soluble in oil or water.



Organic Functional Groups Part 6 – IMFs and Relative Boiling Points What is the relationship between IMFs and Boiling Points?

Relative strength of IMF's

H-bonding

Dipole-dipole

London

Tie Breakers - Other factors affecting boiling points (bp's)

Arrange the following compounds in order of decreasing bp.



## What is the relationship between cpds A – D above?

Which compound has the **highest** boiling point?

A)CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH

B) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>OH

C) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CHO

D) CH<sub>3</sub>COCH<sub>3</sub>

E) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>

Arrange the compounds above in order of decreasing boiling point.

Organic Functional Groups Part 7 - Combustion Reactions

Combustion Reactions: any reaction in which an organic compound reacts completely with oxygen to produce carbon dioxide and water.

Our cells burn sugars and fats as source of energy.

 $C_6H_{12}O_{6(aq)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(g)} + energy$ 

Balancing Combustion Reactions – a strategy Step 1

Step 2

Step 3

Step 4

 $C_6H_{14}$  +  $O_2 \rightarrow CO_2$  +  $H_2O$ 

 $C_5H_{10} + O_2 \rightarrow CO_2 + H_2O$ 

Organic Functional Groups Part 8 Carboxylic Acids: Acid-Base Chemistry & Its Effects on H<sub>2</sub>O Solubility

Carboxylic acids can lose a proton to form Carboxylate ions.

Why is H<sup>+</sup> often referred to as a proton?

To name the carboxylate ions, replace the 'ic acid' with 'ate'.

Draw the skeletal line structures and name the resulting carboxylates for the compounds below.

Compound	Carboxylic Acid	Carboxylate w/ Name
Pyruvic acid	О О       H <sub>3</sub> C—С—С—ОН	
Lactic acid	ОНО │	

Carboxylates can form H<sub>2</sub>O soluble salts with Na<sup>+</sup> and K<sup>+</sup> ions. Draw the skeletal line structure for potassium propanoate. Some interesting and useful Carboxylic Acids & the power of charge Draw the skeletal line structure for stearic acid  $(CH_3(CH_2)_{16}CO_2H)$ .

Would you expect this acid to be water soluble? Why?

Draw the skeletal line structure for sodium stearate.

Would you expect this carboxylate salt to be water soluble? Why?

Soaps are  $H_2O$  soluble carboxylate salts



Soap scum is formed by  $H_2O$  insoluble carboxylate salts.



Hard water: water with Ca2+, Mg2+, and Fe2+ / Fe3+

Organic Functional Groups Part 9 Amines – Acid Base Chemistry & its Effects on H<sub>2</sub>O Solubility

Amines are proton acceptors. Amines are weak bases.

Salts of amines

Useful for storing drugs and other biologically active amines

Why?

- less prone to decomposition
- minimize or reduces fish odor
- soluble in water (syrup & injectables)



Predict the products for the following reactions.

a)  $CH_3NH_{2(1)} + H_2O_{(1)} \rightleftharpoons$ 





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