

## Descriptions of Scale

Macroscale vs. Microscale

Chemistry & Molecular Biology bridge these worlds

<http://htwins.net/scale2/>

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## What is food made of?

Organic vs. Inorganic

Organic = “from life”, contains C-H bonds

Inorganic = no C-H bonds

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## What is food made of?

Water

Inorganic components

*Salts, minerals*

“Small” Organic Molecules

*Vitamins, metabolites*

Macromolecules

*Lipids, proteins, carbohydrates*



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## Water

H<sub>2</sub>O!

Very small, simple

Essential to all life on Earth

*Search for Extraterrestrial Life*

Most food is mostly water



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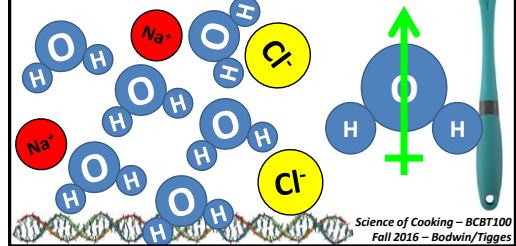
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## Why is water liquid?

Water molecules are bent → polar  
Polar molecules stick together



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### Water Content of Foods

Food	Water Content (%)
<b>Meat</b>	
Pork, raw, composite of lean cuts	53-60
Beef, raw, retail cuts	50-70
Chicken, raw meat without skin	74
Fish, muscle proteins	65-81
<b>Fruits</b>	
Berries, cherries, pears	80-85
Apples, peaches, oranges, grapefruit	85-90
Rhubarb, strawberries, tomatoes	90-95
<b>Vegetables</b>	
Peas (green)	74-80
Beets, broccoli, carrots, potatoes	80-90
Asparagus, beans, cabbage, cauliflower, lettuce	90-95

Source: <http://class.fst.ohio-state.edu/fst605/605%20pdf/Water.pdf>

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### Water in Foods

Water content of some foods

Food	Water content (%)
Beef	50 to 70
Chicken meat	74
Fish	65 to 81
Pears	80 to 85
Apples, peaches, oranges	85 to 90
Tomatoes, strawberries	90 to 95
Avocado, banana	74 to 80
Carrot, potato	80 to 90
Lettuce, lentils	90 to 95
Honey	20
Jam	28
Flour, rice	12
Milk powder	4

Source: <http://www.aqaqa.com/en/doc/water-in-food>

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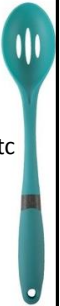

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### Inorganic Components

“Salts” – charged particles  
Sodium chloride → Na<sup>+</sup> and Cl<sup>-</sup>

Other trace minerals  
Iron, potassium, calcium, magnesium, etc

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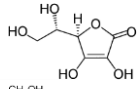
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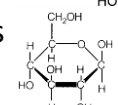
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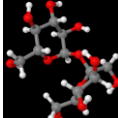
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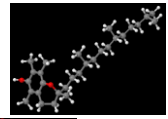

## "Small" Organic Molecules

"Organic" = containing C and H

Vitamins 

Sugars 

Others 

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## BIG Food Molecules

Lipids

Proteins

Carbohydrates

DNA/RNA



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## Lipids

Fats


Long chains of (mostly) C and H

Lipids are non-polar

Don't mix w/water = "hydrophobic"

"like dissolves like"

Molecule animations: <http://www.biotopics.co.uk/JmolApplet/contentstable.html>  
Fatty acids Jmol: [http://www.mpcfaculty.net/mark\\_bishop/Bishop\\_Jmol\\_fatty\\_acids\\_triglyceride.htm](http://www.mpcfaculty.net/mark_bishop/Bishop_Jmol_fatty_acids_triglyceride.htm)



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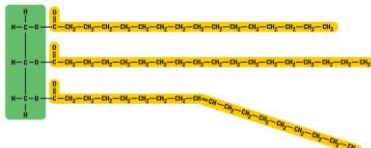

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### Fatty Acids/Triglycerides

Vinegar = 2 carbons  
Water soluble

Stearic acid = 18 carbons  
NOT water soluble

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### Types of Fats

Saturated vs. Unsaturated

Mono- vs Polyunsaturated  
"Hydrogenated"

"Omega-3"



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### Macromolecules

Polymers –  
poly="many", meros="parts"  
Different "parts" result in  
different function/properties



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# Amino Acids

Amino group      Central Carbon      Carboxyl group  
 Side group  
 Carboxyl group  
 Amino group  
 Side chain - varies

Leucine (hydrophobic)      Serine (hydrophilic)

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# Proteins

Polymers made of amino acids

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# Proteins

Shape depends upon properties of side chains interacting with water

Shape = Function

20 "letters", many "words"

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## 4 Levels of Protein Structure

Primary – aa order

Secondary – near aa interactions

Tertiary – long range in 1 protein

Quaternary – clusters of proteins

***Denaturing disturbs structure***



Protein structure: [http://en.wikipedia.org/wiki/File:Main\\_protein\\_structure\\_levels\\_en.svg](http://en.wikipedia.org/wiki/File:Main_protein_structure_levels_en.svg)



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