Class 1

Welcome to Bio375: Biochemistry

Prerequisites: Bio110 and one year of Organic Chemistry lecture + lab (with merit grade)

Course Introduction

Please take the time to read (and refer to throughout the semester) the detailed document posted on Moodle

Quick round of Introductions

- Please share preferred name and pronouns
- Class year and major
- Anything else you would like us to know about you

What comes to mind when you hear the term “Biochemistry”?

What and how we will learn in Bio375

- Structure and function of proteins, carbohydrates and lipids; enzyme kinetics; central metabolic pathways.
- Lecture, primary literature discussion, laboratory experimentation.
- Writing-attentive class (several lab reports).

Learning goals for Bio375

- Apply fundamentals learned in class to solve new problems
- Think critically and analytically about scientific data
- Appreciate benefits of working collaboratively
- Communicate effectively (oral and written)

How to **achieve** goals – practice makes perfect!

- Attend class regularly and take notes
- Study regularly and consistently (textbook, review in-class notes within a couple of days)
- Attend office hours regularly (don't wait until right before exam)
- Try to work on homework problems on your own and tackle additional problems in assigned (or other) textbook
- Be organized (don't wait until last minute)
- Ask questions, share ideas

Biochemistry Moodle Page

BIOLOGY 375: Biochemistry
Fall 2026 Lecture Syllabus
(subject to change)

Readings refer to *Lehninger Principles of Biochemistry*, Sixth edition, Freeman.
PDFs of text book chapters, supplementary readings, homeworks, slides, etc. posted on Moodle.

Date	Lecture topic	Readings
Tu, 9/1	1. Course introduction, water	Course information Lecture syllabus Ch. 2:47-58
Th, 9/3	2. pH & buffers ***Problem set 1: pH and buffers (due 9/10)***	Ch. 2:58-69
Tu, 9/8	3. Amino acids: structure & chemistry	Ch. 3:75-89
Th, 9/10	4. The peptide bond & covalent structure of proteins ***Problem set 2: amino acids (due 9/17)***	Ch.4:115-143
Tu, 9/15	5. Thermodynamics & kinetics of protein folding	Ch. 4:143-151
Th, 9/17	6. Protein structure & function: myoglobin & hemoglobin I	Ch. 5:157-174
Tu, 9/22	7. Protein structure & function: myoglobin & hemoglobin II ***Problem set 3: hemoglobin (due 9/29)***	Ch. 5:157-174
Th, 9/24	8. ***Paper 1 – A silent polymorphism in the MDR1 gene changes substrate specificity***	Posted on Moodle
Tu, 9/29	9. Protein function: enzymes	Ch. 6:189-200; 214-218
Th, 10/1	10. Enzyme kinetics ***Exam 1 (classes 1-8) - available at Collier Library from noon Th, 10/1 through noon W, 10/7***	Ch. 6:200-213

Assignments

All work submitted for a grade **must** be your own (incl. lab reports) – no collaboration with each other or AI.

Total points for the semester = 400 (100%)

- Three exams (non-cumulative) worth 70 points each (52.5%)

- Eight homeworks worth 10 points each (17.5%)

(one HW with lowest score dropped)

- Presentation of primary literature worth 20 points (5%)

Please review schedules/commitments before we meet for lab next week – when you will sign up for the paper you would like to present.

- Participation worth 20 points (5%)
  - Contribute to discussions in class, attend office hours

- Four lab reports worth 80 points total (20%)

Lab

- Wednesdays, 1:10-4 pm in Park 126 (NO LAB THIS WEEK)
- We will go over lab policies and expectations NEXT week (Sept 9) – please read assigned material before hand

BIO 375: Biochemistry
Fall 2026 Lab Syllabus
(subject to change)
Lab manuals posted on Moodle

Date	LAB EXERCISE
Sept. 2	**NO LAB**
Sept. 9	• Getting to know each other and our lab space (read lab policies) • Pipet Olympics (read appendices 1 and 2) • Learning how to write scientific papers • Introduction to Blood Cells Lab (please read introduction in posted manual)
Sept. 16	• Blood Cells Lab, Part I: Extract proteins
Sept. 23	• Viewing protein structures in 3D – myoglobin (please download PyMol on your laptop and bring to lab)
Sept. 30	• Blood Cells Lab, Part II: Protein assays
Oct. 7	• Blood Cells Lab, Part III: SDS-PAGE analysis • Introduction to Enzyme Kinetics Lab (please read introduction in posted manual) ***(Blood Cells lab report due Wed, 10/21)***
Oct. 14	**FALL BREAK – NO LAB**

Scheduling office hours

- Two scheduled times per week (M-F between 9:30 am - 4:30 pm)
- Indicate preference on survey

Did I forget anything important?
Questions? Comments? Suggestions?

Please fill out survey and return to Dr. C.

What are the four types of **macromolecules** that constitute all cells?

What is a **peptide bond**, and how is it formed?

Proteins have polarity:
what are the two ends of a protein called?

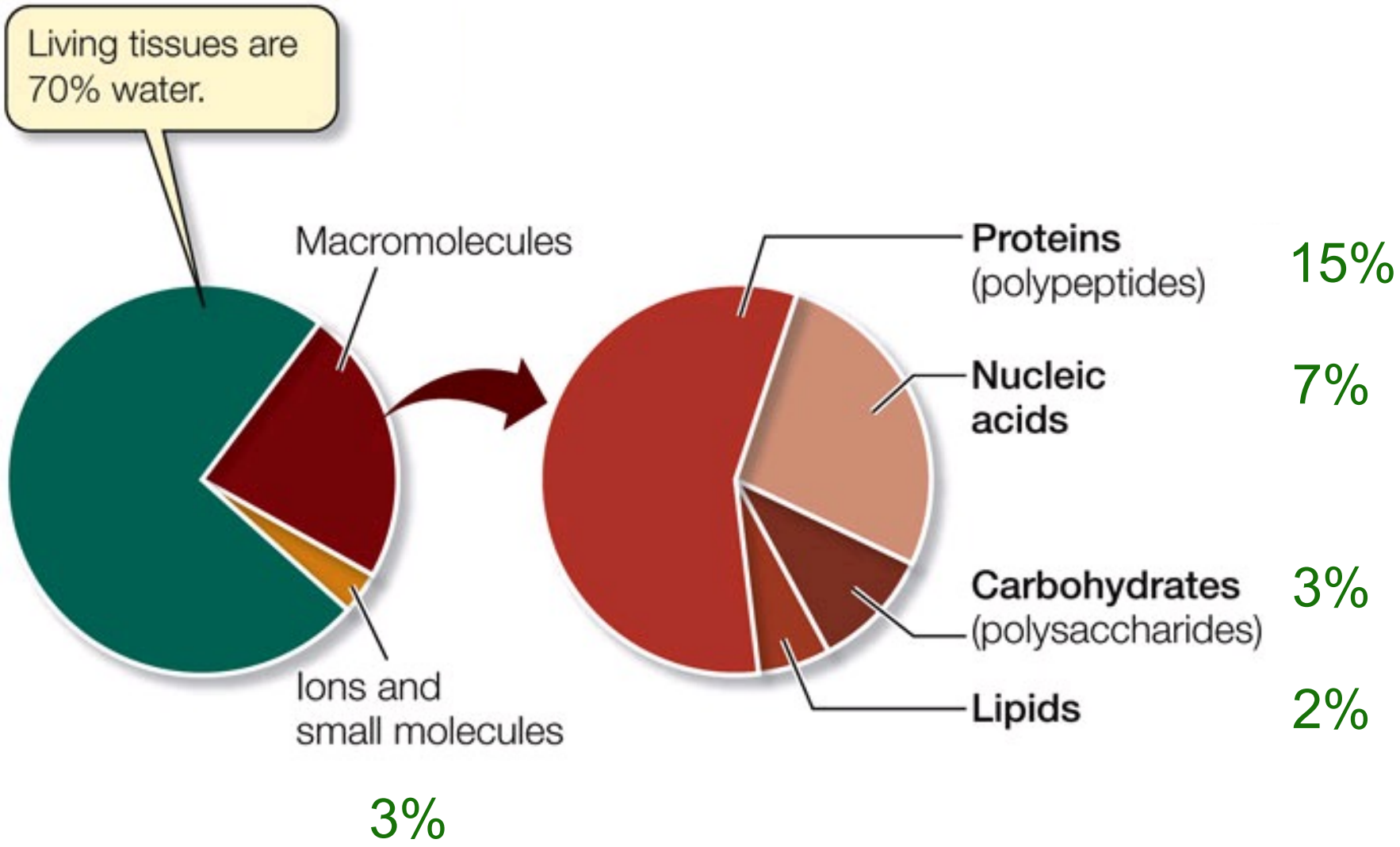
Energy transformations (metabolism) in living organisms are governed by laws of thermodynamics.

What are the two laws of thermodynamics?

What constitutes ~70% of the weight of a typical cell?

Water
(Ch. 2, pp. 47-58)

Molecular components of a typical cell



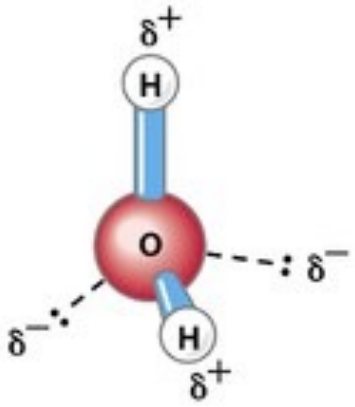
Water - the ideal biological solvent

- Low freezing point and high boiling point
- High heat capacity (1 cal/g/°C)
- High heat of vaporization (540 cal/g)
- High density (denser than ice)

TABLE 2–1 Melting Point, Boiling Point, and Heat of Vaporization of Some Common Solvents

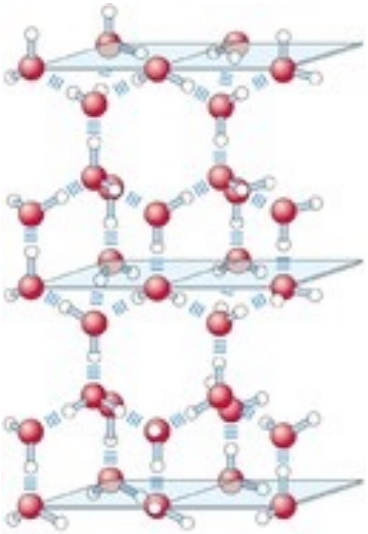
	Melting point (°C)	Boiling point (°C)	Heat of vaporization (J/g)*
Water	0	100	2,260
Methanol (CH_3OH)	−98	65	1,100
Ethanol (CH_3CH_2OH)	−117	78	854
Propanol ($CH_3CH_2CH_2OH$)	−127	97	687
Butanol ($CH_3(CH_2)_2CH_2OH$)	−90	117	590
Acetone (CH_3COCH_3)	−95	56	523
Hexane ($CH_3(CH_2)_4CH_3$)	−98	69	423
Benzene (C_6H_6)	6	80	394
Butane ($CH_3(CH_2)_2CH_3$)	−135	−0.5	381
Chloroform ($CHCl_3$)	−63	61	247

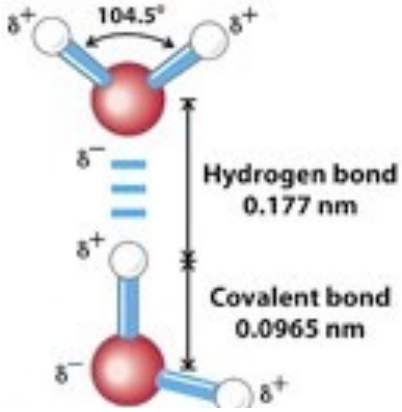
Water is dipolar: allows extensive hydrogen bonding interactions



- Water is a permanent dipole

- Water molecules cohere via H-bonds. One water molecule H-bonded to four neighbors.





- Bond dissociation energies:
  H bond = 23 kJ/mol (weak)
  OH covalent bond = 470 kJ/mol (strong)

Figures 2-1 & 2-2

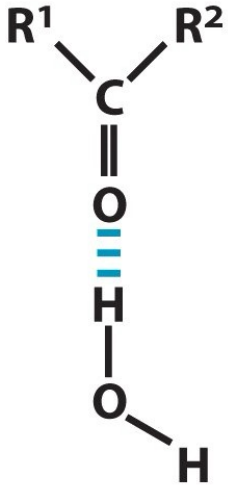
Water also H-bonds with other polar molecules

Between the hydroxyl group of an alcohol and water

Alcohol = H-donor

Water = H-acceptor

Between the carbonyl group of a ketone and water



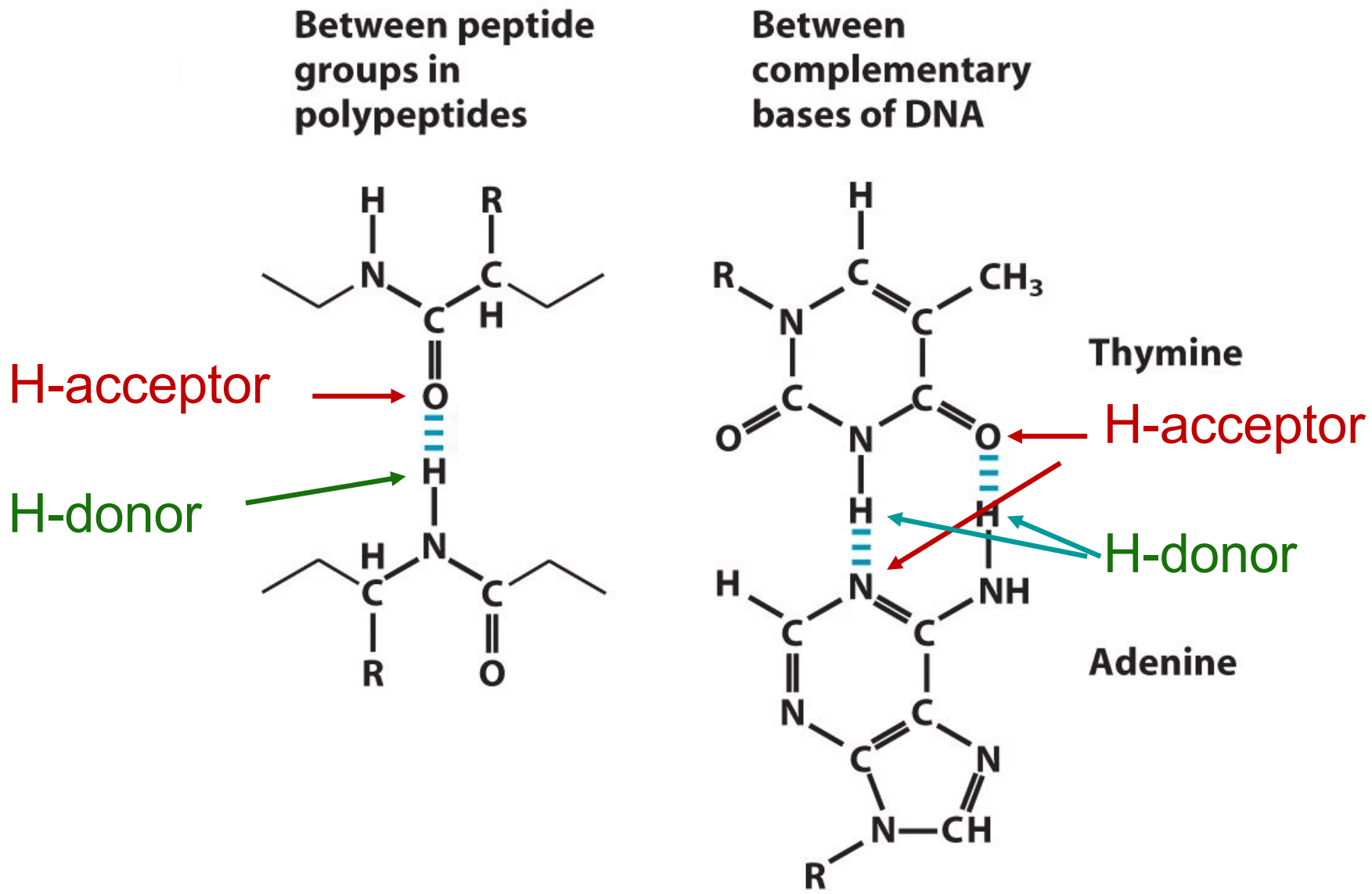
Ketone = H-acceptor

Water = H-donor

H-bonds can form between any electronegative atom and an H atom that is covalently bonded to another electronegative atom.

In biology, **O and N** are the most important acceptors.

H-bonding does NOT have to involve water



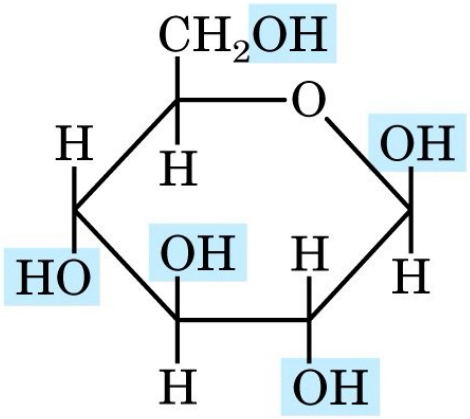
H-bonds are very important in biology!

Water as a solvent

Hydrophilic

Polar

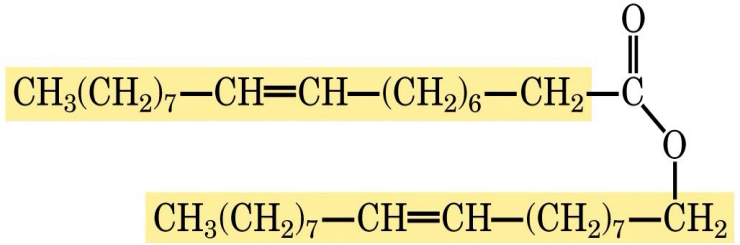
Glucose



Hydrophobic

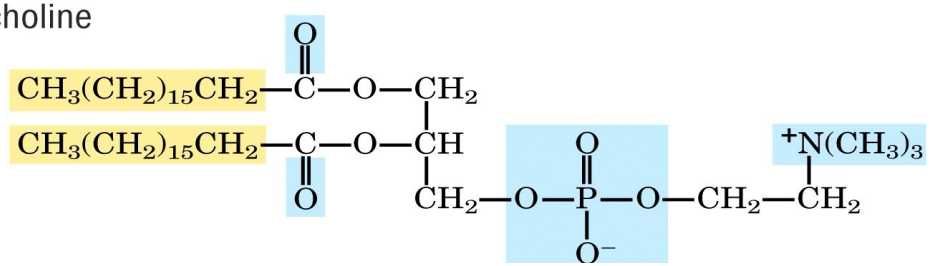
Nonpolar

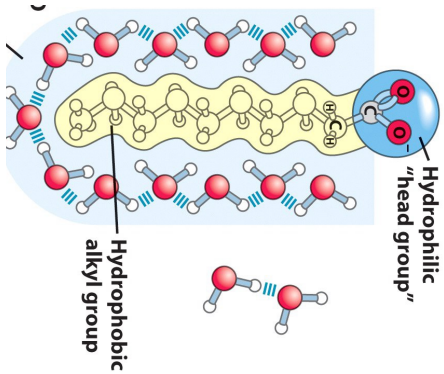
Typical wax



Amphipathic

Phosphatidylcholine



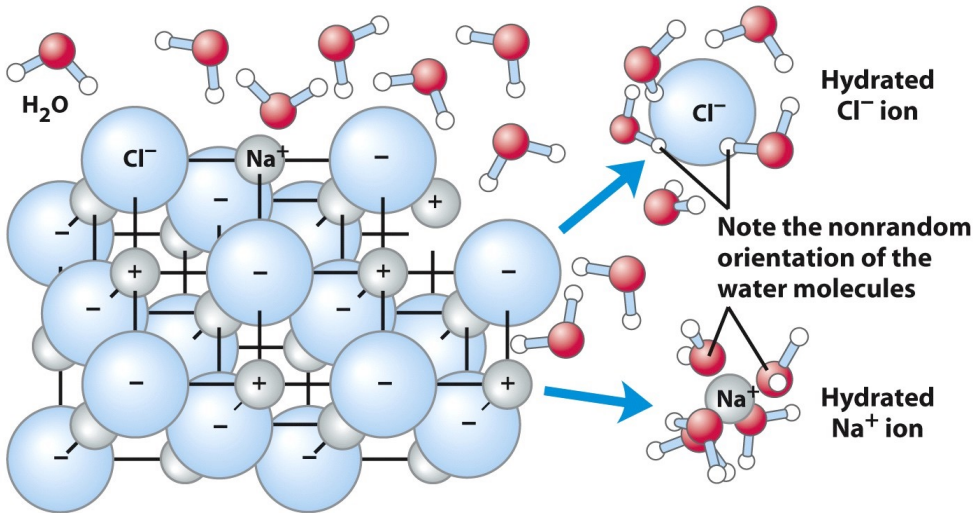


Water has a high dielectric constant

Dielectric constant (ε): solvent's ability to shield attractive forces between oppositely charged ions

$$F = \frac{Q1Q2}{r^2 \varepsilon} \qquad \text{(Coulomb's law)}$$

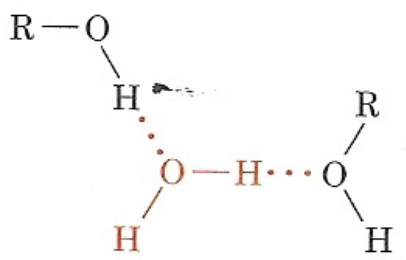
ε for air = 1; ε for water = 80; ε for benzene = 5



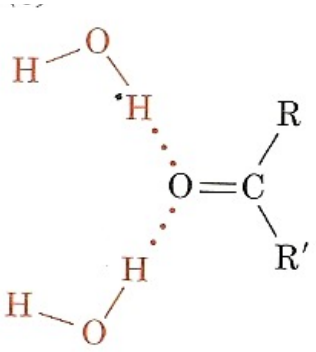
Solubility of polar molecules

- Polar (uncharged) molecules are soluble in water for the same reason as ionic molecules (shielding by hydration).

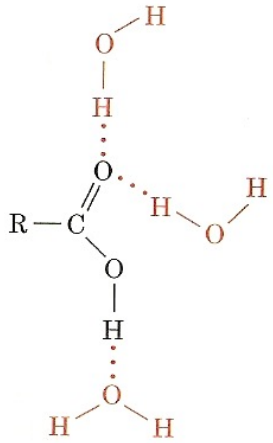
- Solubility enhanced with functional groups that H-bond with water:



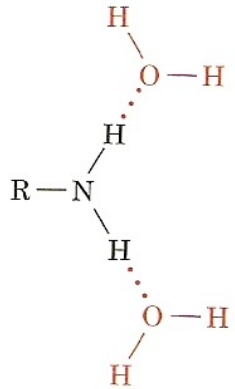
Hydroxyl



Carbonyl

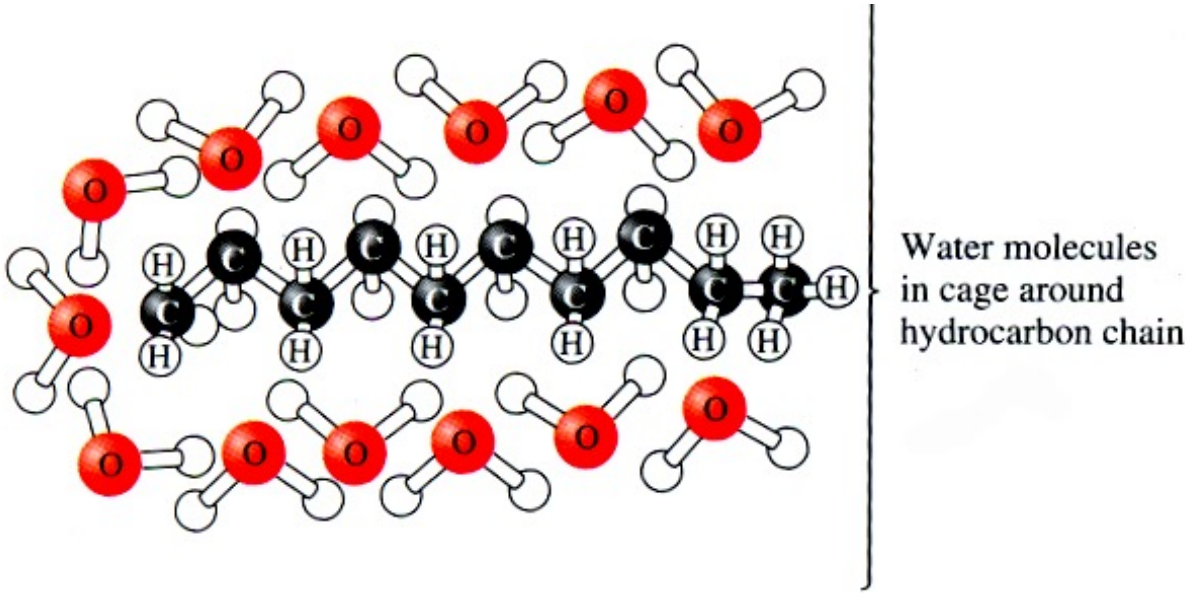


Carboxyl



Amino

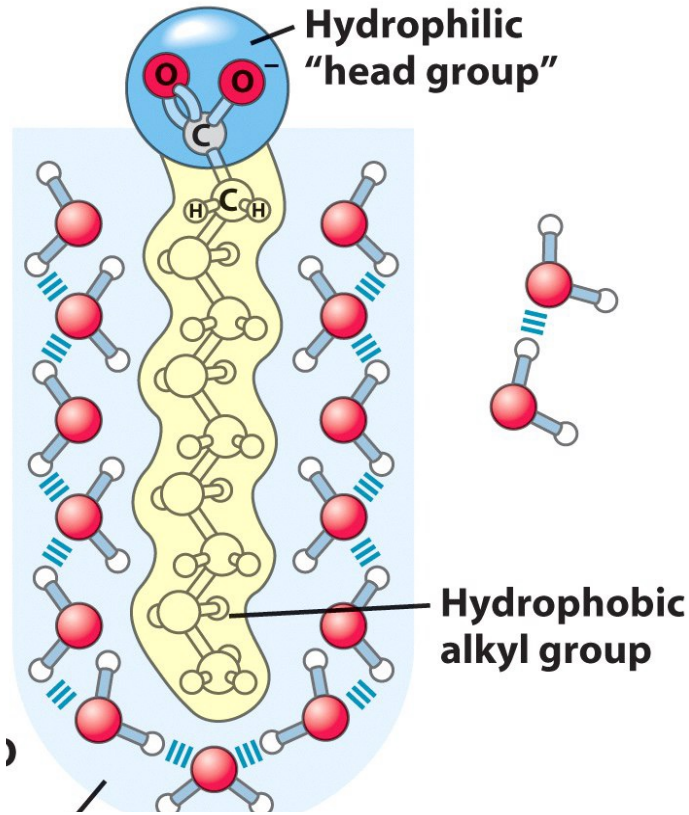
Nonpolar molecules are poorly soluble in water



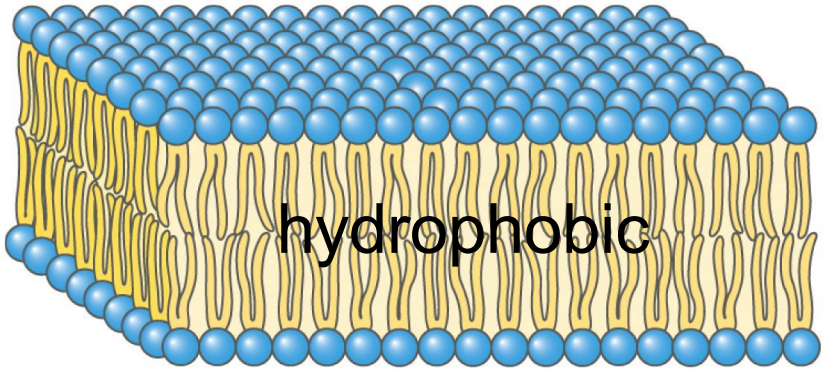
Hydrophobic interactions stabilize nonpolar molecules and are important in determining their structure.

Amphipathic molecules

Phospholipid



hydrophilic



hydrophilic

Membrane formation