#1: Fundamental Concepts

BIOCHEM2280

What are Biomolecules?

- Biomolecules are molecules produced by living organisms
  - They can exist as '**monomers**' or single units:

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  - They can also exist as '**polymers**' or multiple monomers combined:

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- Biomolecules can be put together or broken apart in chemical reactions which involve changes of energy
- In biochemistry, these energy changes are represented by **Gibbs Free Energy (G)**
  - At its core, Gibbs Free Energy represents the energy in a system which is available to do work
- Gibbs Free Energy is closely related to 2 other concepts:
  - **Enthalpy (H)** = The total heat content of a system (Measured in joules; J)
  - **Entropy (S)** = The degree of disorder or randomness in a system (Measured in joules per Kelvin; J/K)
- In the context of our body and the reactions which occur to sustain life, it is useful to calculate the change in free energy, or **ΔG**, using the reaction:

$$\Delta G = \Delta H - T\Delta S$$

Where:

- **ΔG** = Change in free energy
- **ΔH** = Change in enthalpy
- **T** = Temperature in Kelvins
- **ΔS** = Change in entropy

- This equation is particularly useful in determining the *spontaneity* of a reaction
  - **Spontaneity** simply refers to whether a reaction can occur with or without any external energy (ex. heat)
  - Broadly, the 3 classes of reactions you will classify using ΔG are *spontaneous, non-spontaneous, and equilibrium*
- A **spontaneous (exergonic)** reaction is a reaction which can occur without the addition of any external energy.
  - Spontaneous reactions will favour proceeding in the forward direction
  - A reaction is spontaneous when its ΔG is less than 0

$$\Delta G < 0; \text{ Spontaneous}$$

- An **equilibrium** reaction is a reaction which occurs in both the forward and reverse directions
  - A reaction is in equilibrium when its ΔG is equal to 0

$$\Delta G = 0; \text{ Equilibrium}$$

- A **non-spontaneous (endergonic)** reaction is a reaction which requires the addition of external energy to proceed
  - Non-spontaneous reactions will favour proceeding in the reverse direction
  - A reaction is non-spontaneous when its ΔG is greater than 0

$$\Delta G > 0; \text{ Non-spontaneous}$$

Biomolecules

Monomer	Polymer
 Amino Acid	 Protein
 Monosaccharide	 Polysaccharide
 Nucleotide	 Nucleic Acid
 Lipid	Does not polymerize but can aggregate to form structures such as biological membranes

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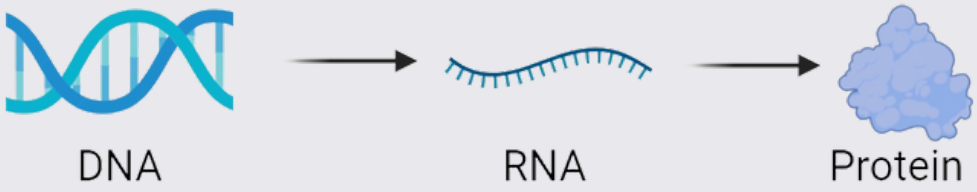
THE CENTRAL DOGMA



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- **DNA** is the cellular storage of information and makes up our genotype
- **RNA** can be used to perform cellular functions or further translated into proteins
- **Proteins** (and some RNA) are the 'action' molecules of the cell and make up our phenotype

♡ LETTER TO THE STUDENT

Dear Student,

Thank you for opening this Biochemistry 2280A guidebook. This resource has been created by the Education Team at WebStraw. The Education Team consists of students that have previously taken and/or are currently taking Biochemistry 2280A.

Created by students for other students, this resource aims to provide a comprehensive view of material taught within this course. Our goal is to help students develop, solidify, and refine their understanding of course content. Our resource is also open access meaning there are no financial or legal barriers to students who wish to access and use our resource.

To maximize the benefits of this resource, we recommend that you read carefully through the topics, focusing on *bolded terminology, compound structures, and diagrams.* Although this resource ideally will cover all testable content as of the 2024-2025 academic year, we cannot guarantee this and strongly encourage you to cross-reference with class material and notes.

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This resource is supplementary to your course content and is not meant to (1) replace any of the resources provided to you by your instructor nor is it meant to (2) be used as a tool to learn the course material from scratch. We assume that students who use this resource will have a basic understanding of the course content. This resource does not contain everything you need to know for your evaluations. Please refer to the course material provided by your instructors if there are any discrepancies between our resource and your course content.

We appreciate you using our resource! Best of luck on your exams :)

-The WebStraw team

♡ Note to Instructors: If this resource has been created for your course and you would like to collaborate with us, please email us at team@webstraw.org

Note: Marvin was used for drawing, displaying and characterizing chemical structures, substructures and reactions, Marvin 24.4.1, Chemaxon (https://www.chemaxon.com)

biochem 2280.

a handmade guide

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