

Updated: 2 October 2019 [Print version](#)

CEE 370 Environmental Engineering Principles

Lecture #12
Environmental Biology I:
Biochemical Fundamentals

[Reading: Mihelcic & Zimmerman, Chapter 5](#)

David Reckhow CEE 370 L#12 1

Why study microorganisms

- Biodegradation!
 - They are the engines of our wastewater treatment system
 - They are often used to purify drinking water
 - They account for natural attenuation of pollutants
- They may interfere in treatment systems
- Indicators of environmental degradation
- Some are disease causing agents
- Future biotechnology
 - Can we harness and engineer their biochemical engines?
 - Molecular biology
 - Genomics
 - Proteomics

David Reckhow CEE 370 L#12 2

What is the next lowest category below "Phylum"

- A. Kingdom
- B. Discipline
- C. Domain
- D. Class
- E. Order

The diagram illustrates the taxonomic hierarchy for an American black bear (*Ursus americanus*). It is structured as a funnel with eight levels, each containing representative icons. From top to bottom, the levels are: Species (one bear), Genus (two bears), Family (three bears), Order (four bears), Class (five bears), Phylum (six bears), Kingdom (seven bears), and Domain (eight bears). Labels on the left side of the funnel indicate the taxonomic rank for each level: Ursus (Genus), Ursidae (Family), Carnivora (Order), Mammalia (Class), Chordata (Phylum), Animalia (Kingdom), and Eukarya (Domain). The top of the funnel is labeled with the taxonomic ranks: Species, Genus, Family, Order, Class, Phylum, Kingdom, and Domain.


David Reckhow
CEE 370 L#12
Eukarya 3

phylogeny

- Domains
 - Archae
 - Bacteria
 - Eucaryotes – nucleus, organelles
- Kingdoms of Eucaryotes
 - Protists, Fungi, Plants, Animals
- Other: KPCOFGS

} Procaryotes


David Reckhow
CEE 370 L#12
4



Environmental Microbiology

- Types of Microorganisms
 - Bacteria
 - Viruses
 - Protozoa
 - Rotifers
 - Fungi
- Metabolism
- Microbial Disease
- Microbial Growth

David Reckhow CEE 370 L#12 5



Biochemical Molecules

- Carbohydrates: polysaccharides & sugars
 - Sources of energy, structural components, markers for identification & communication
- Nucleic Acids
 - Transmit information across generations – the blueprint, code for protein synthesis
- Proteins & amino acids
 - Site of reactions, transport, storage, structure, defense
- Lipids
 - Storage of energy, membrane functions

David Reckhow CEE 370 L#12 6

Carbohydrates

- Polyhydroxy aldehydes and ketones
 - Empirical formula: CH_2O
- Monomer: sugars
 - Linear chain and ring forms
 - example: glucose

$$\begin{array}{c}
 \text{O} \\
 \parallel \\
 \text{H}-\text{C}-\text{H} \\
 | \\
 \text{H}-\text{C}-\text{OH} \\
 | \\
 \text{HO}-\text{C}-\text{H} \\
 | \\
 \text{H}-\text{C}-\text{OH} \\
 | \\
 \text{H}-\text{C}-\text{OH} \\
 | \\
 \text{CH}_2\text{OH}
 \end{array}$$

David Reckhow
CEE 370 L#12
7

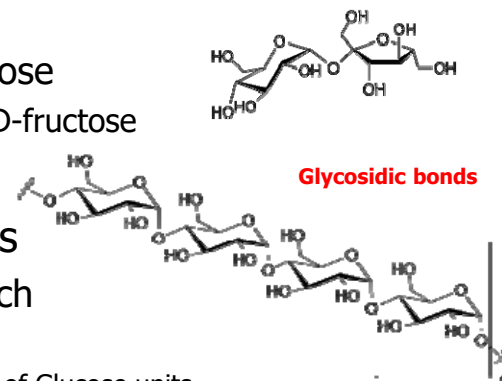
Types of sugars

- Position of carbonyl
 - Terminal: aldehyde – an aldose
 - Mid-chain: ketone – a ketose
- Number of carbons
 - Three – triose
 - Five – pentose
 - Six - hexose

David Reckhow
CEE 370 L#12
8

Polymeric carbohydrates

- Disaccharides
 - Example: sucrose
 - D-glucose + D-fructose
- Polysaccharides
 - Example: Starch
 - Amylose unit
 - Linear array of Glucose units

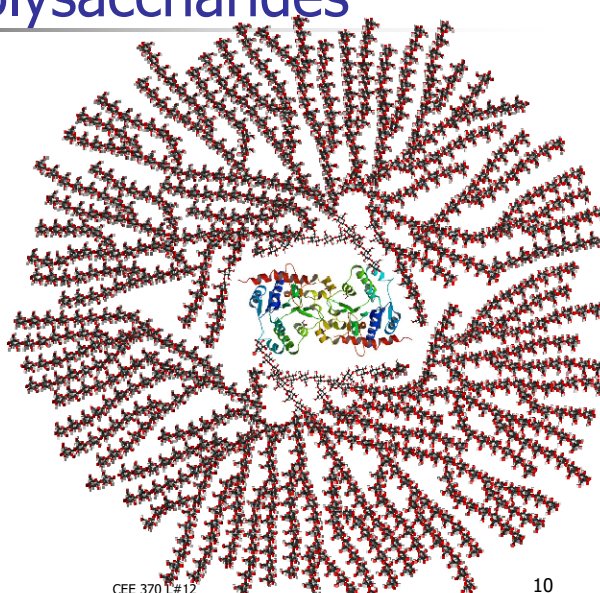


Glycosidic bonds

David Reckhow CEE 370 L#12 9

Large polysaccharides

- Glycogen
 - Long-term storage in animals & fungi
 - Core protein surrounded by glucose chains



David Reckhow CEE 370 L#12 10

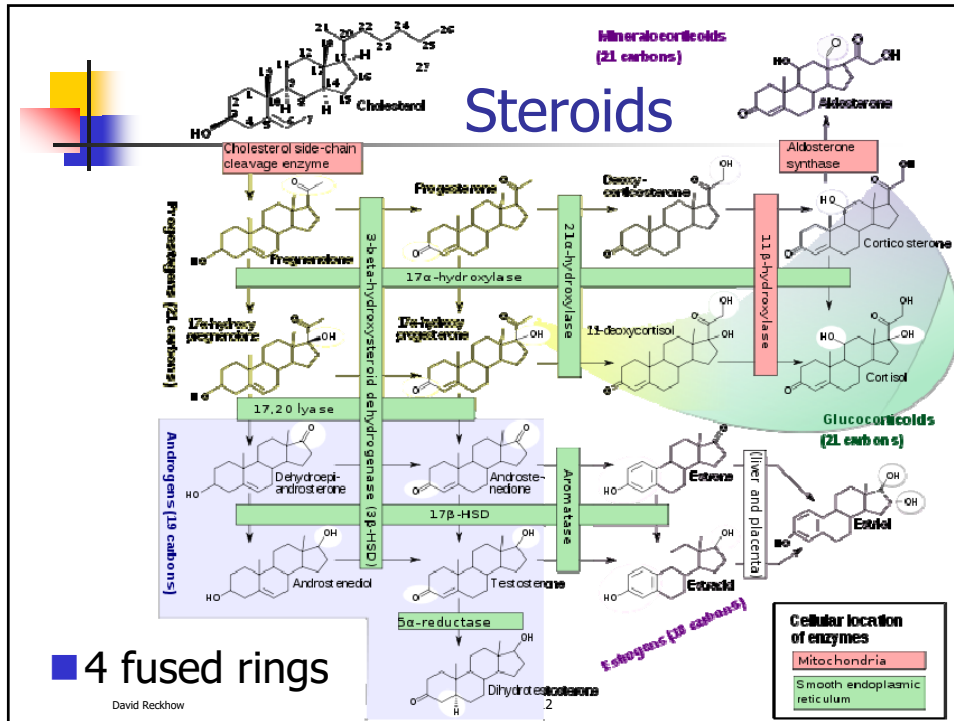
Lipids I

- Hydrophobic – not very soluble in water
- Fats
 - Glycerol + fatty acids bound by ester linkages

Formation of a fat

Lipids II

- Phospholipids
- Major components of cell membranes
- Composed of a glycerol, 2 fatty acids and a phosphate group




Others

- Very important and will be discussed in lecture on genetics (#10)
 - Proteins, amino acids
 - Bases, Nucleic acids, DNA, RNA

David Reckhow

CEE 370 L#12

14



- To next lecture

David Reckhow CEE 370 L#12 15