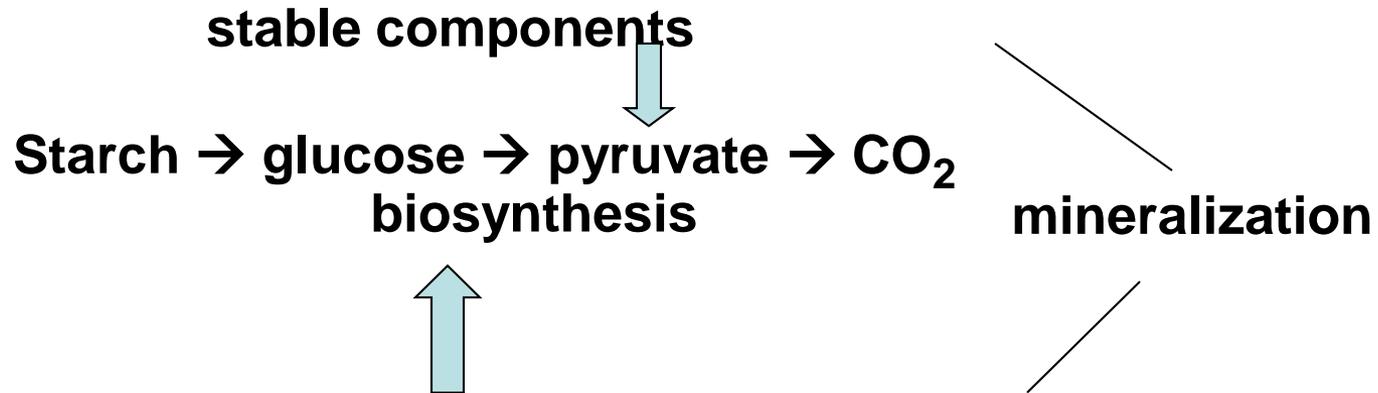


Biodegradation/

Prof . Dr. Idham Ali Abed / collage of Agriculture / University of Anbar

--- breakdown of complex organic molecules into the simplest,

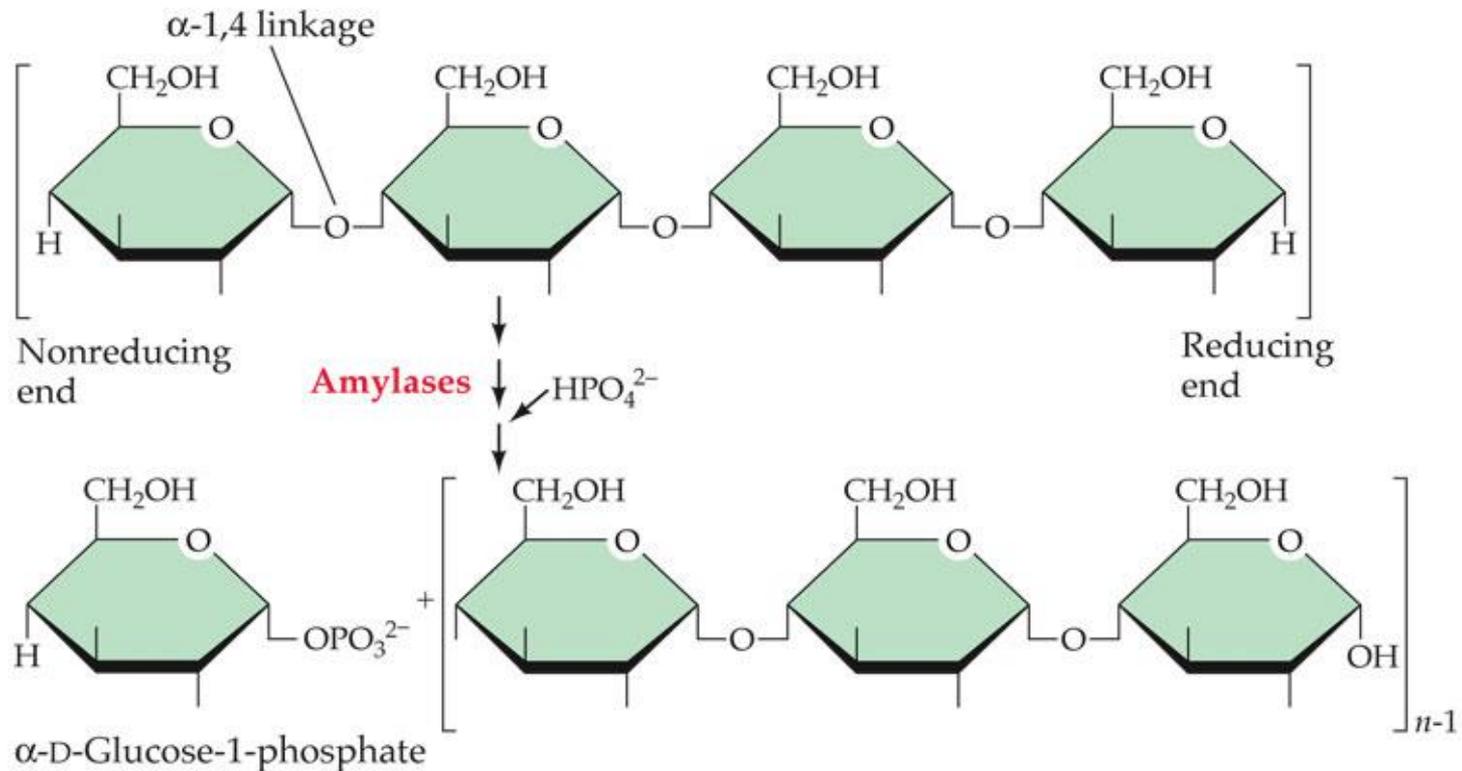


Protein → amino acids → CO₂ + NO₃⁻ + SO₄⁻

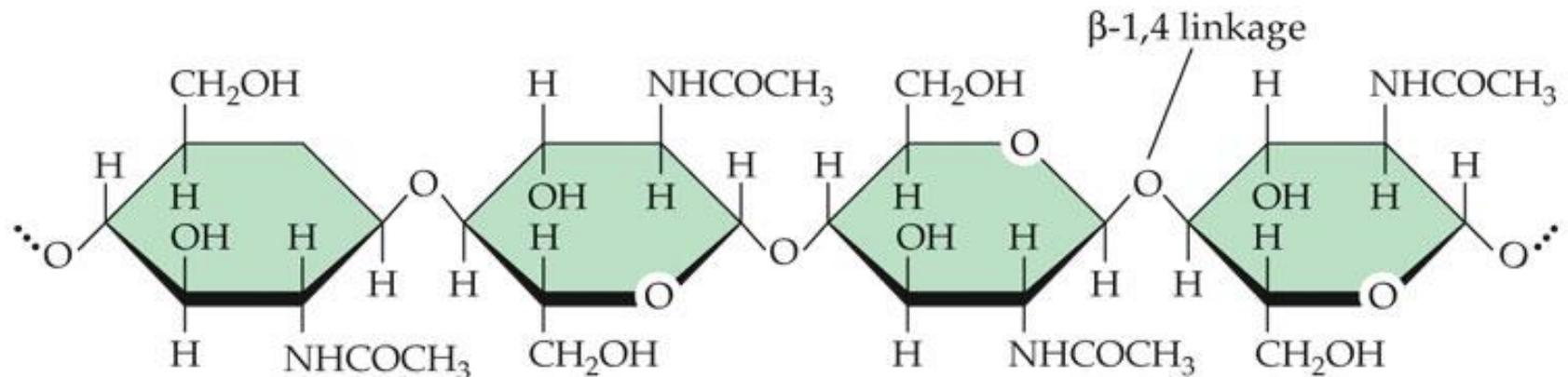
Lipid → fatty acids → acetyl-CoA → TCA cycle or
biosynthesis

Complex Sugars

Starch & Glycogen: polymers of glucose connected by α -glycosidic linkages, easily broken down

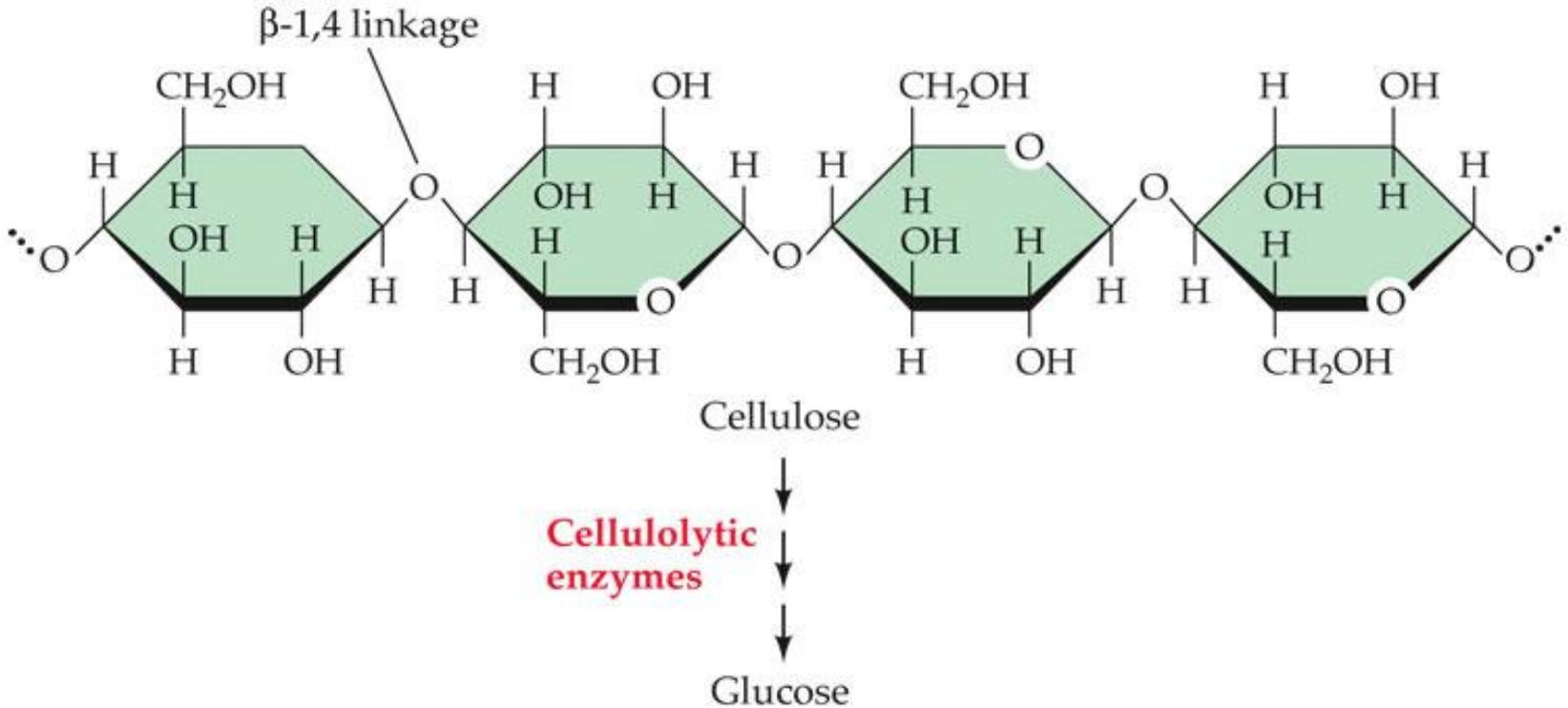


Chitin: A polymer of N-acetylated sugars connected by β -1,4 glycosidic bonds. Found in some bacteria, fungi, and insects. Some bacteria can utilize chitin as sole C&N source.



Chitin

Cellulose: a polymer of glucose connected by β -1,4 glycosidic bonds



More Fun with Cellulose:

--- cellulose has always been important to human society

A.) construction

B.) paper products

--- in coming years cellulose may also become much more Important to the US as an energy source.

A.) electricity production (currently in use and expanding)

B.) ethanol production (still in development phase)

1.) hemicellulose extraction

2.) cellulose to fermentable sugars

--- Will ethanol answer our liquid fuel needs in the US?

No. It can help, but only if we can get cellulosic ethanol to be economically viable.

Currently: ca. 4 billion gallons of ethanol/ yr. (95% from corn starches)

limit of corn sugar fermentation → probably about 7-8 b ga.

“waste” cellulose converted to sugars → 30-50 b. ga.

Lignin: A polymer with random linkages caused by the free radical condensation of three phenolic compounds

--- really no way to enzymatically attack lignin, a nearly infinite number of enzymes would be needed

--- lignin degradation occurs in the same way it is formed, by random free radical attack via peroxidases produced by some bacteria and fungi

--- woody plants use lignin as a means of defending and supporting cellulose fibers, lignin degradation is a slow process

--- lignin removal is an economically important subject for two reasons:

1.) lignin must be removed from pulp for white paper

2.) lignin removal produces large volumes of acid waste containing PAH's

Biodegradation of other compounds

--- there is considerable interest in using the wide ranging chemical degradative abilities of bacteria to break down man-made materials, to keep them from accumulating in the environment.

---bacterial bioremediation is most useful for subsurface materials and groundwater contamination.

compounds of interest:

Benzene

PCB's (PolyChlorinated Biphenols)

PAH's (PolyAromatic Hydrocarbons)

Insecticides & Herbicides

Heavy Metals (those that can be reduced to insoluble forms, not mercury)

Two options for finding bacteria for bioremediation:

- A.) Look in the environment, particularly around known sites of contamination (bacteria evolve rapidly!)
- B.) Genetic engineering

Not so Sexy (but Vital) Bioremediation

- Wastewater treatment makes heavy use of bacteria to break down human sewage
- Anaerobic digesters are now available that generate electricity from waste decomposition!