How Sweet It Is: Disaccharides & More

May 22, 2013

- The Ruff degradation (as it relates to Fischer's proof).
- Let's not forget about the periodate oxidative cleavage rxn.
- Sucrose and the sweetness receptor. Raffinose and farts.
- Starch, Glycogen, and Maltose.
- Chitin and Cellulose: Structure and related issues.

Announcements

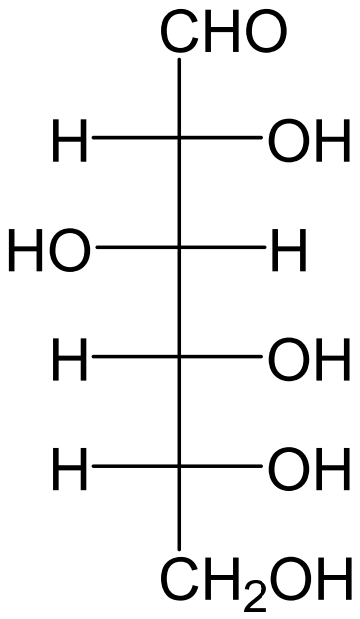
Quiz 3 will be returned after class today. Average = 22.3/30, Std. Dev. = 5.7, High = 35/30.

Quiz 4 is scheduled for Friday, May 31. The focus of this quiz will be carbohydrates (Chapter 24). The 'think deeply' topic (10 pts) will be *Structures of the Monosaccharides* (Loudon, pages 1173-1182). The only structures you need to remember are D-glyceraldehyde and D-glucose. The remainder of the quiz will consist of suggested Chapter 24 problems (10 pts), problems of our own design (10 pts), and the usual series of bonus questions (5 pts).

TA Office Hours: Mon 7-8 pm: Rob Craig - 302 Schlinger (x4056); Tue 3-4 pm: Kelly Kim - 302 Schlinger (x4047); Tue 7-8 pm: Corey Reeves (CANCELLED THIS WEEK—but Evan will offer a second OH from 10-11 pm in Fleming on Tuesday)- 302 Schlinger (x4056); Wed 5-6 pm: Adam Boynton - 139 Noyes (x3202); Wed 8-9 pm: Ben Suslick (UTA) - Lloyd Lounge; Thu 8-9 pm: Evan Zhao (UTA) - Fleming Lounge; Thu 9-10 pm: Crystal Chu - 202 Schlinger (x3634); Sun 3-4 pm: Chung Wan Lee - 302 Schlinger (x4056).

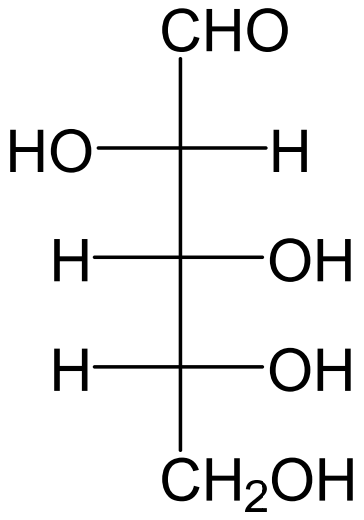
Suggested Problems for Chapter 24: 24.39(a,c,e,g), 24.40, 24.42, 24.45, 24.46, 24.50, 24.54, 24.57, 24.60.

Ruff Degradation:



Glucose

1. Br_2/H_2O
2. $H_2O_2/Fe_2(SO_4)$



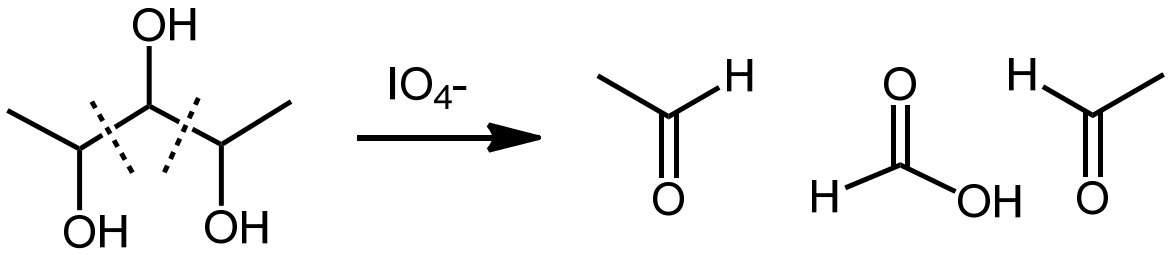
+ CO_2

Arabinose

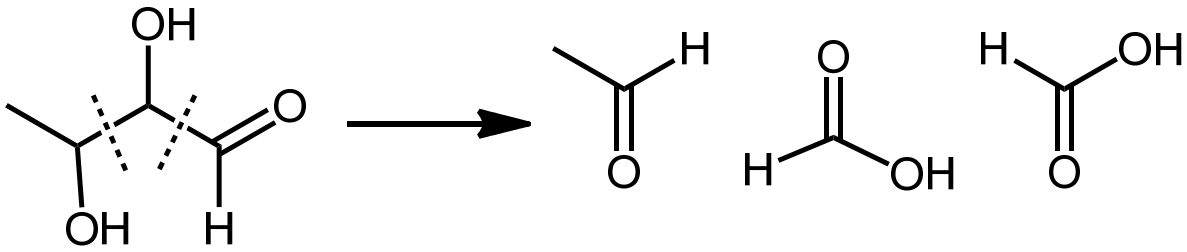
McGruff the crime dog

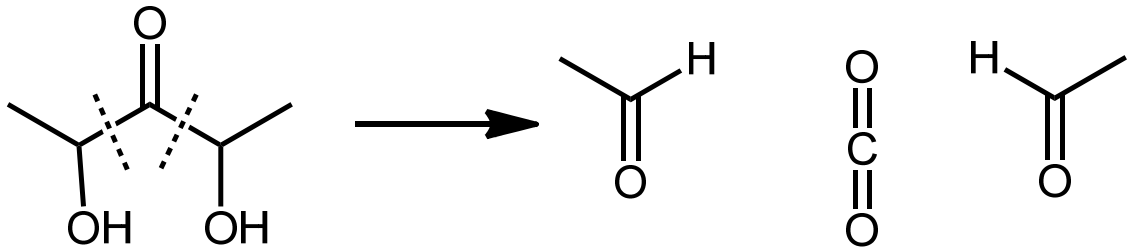
Periodate Cleavage Products

1.



2.





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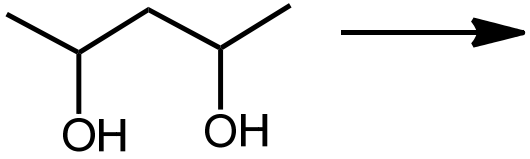
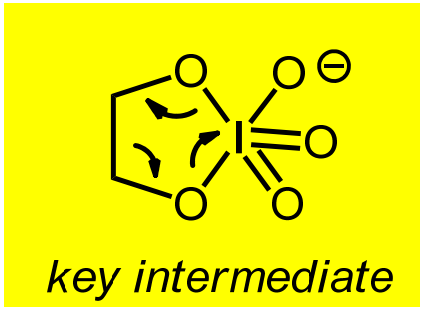
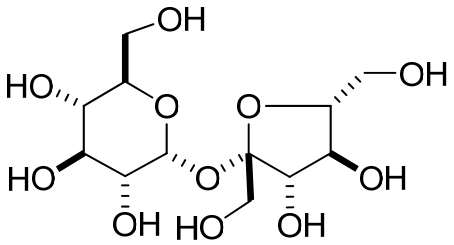


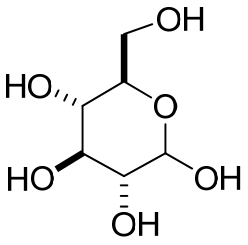
NR



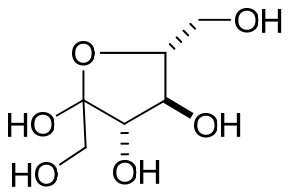
The Current Theory of Sweetness…



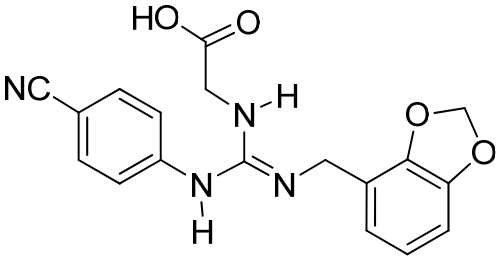
Sucrose
sweetness = 1.0



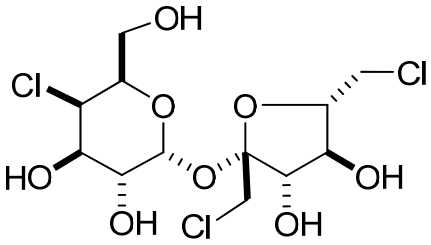
Glucose
sweetness = 0.75



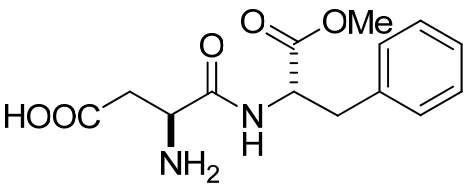
Fructose
sweetness = 1.75



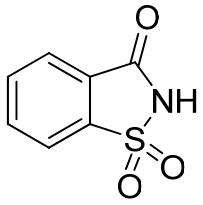
Lugduname
sweetness = ca. 225,000



Splenda (Sucralose)
sweetness = 600
Heat- and pH-stable
cooking OK



Aspartame
sweetness = 250



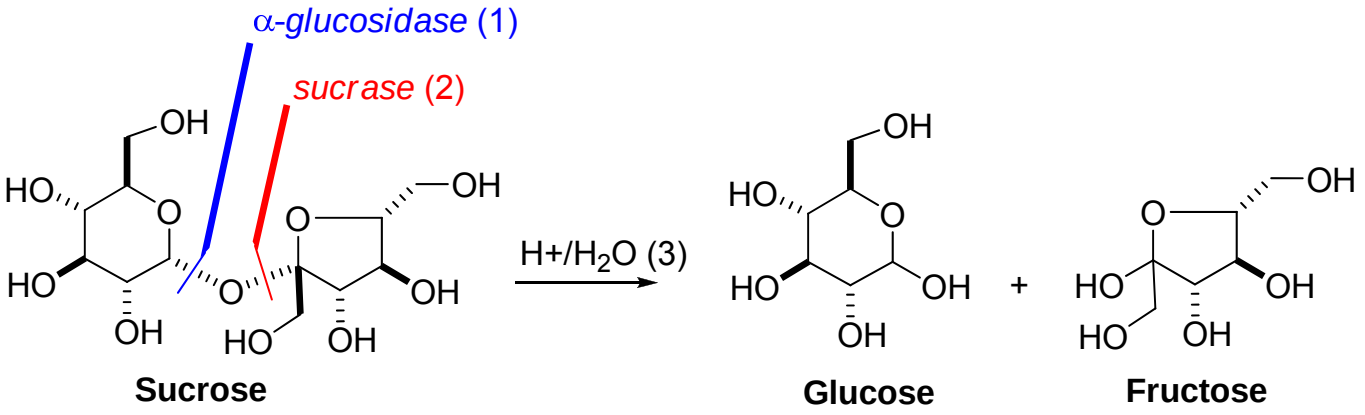
Saccharin
sweetness = 510

Equal is a mixture of Aspartame, Glucose, and Maltodextrin.

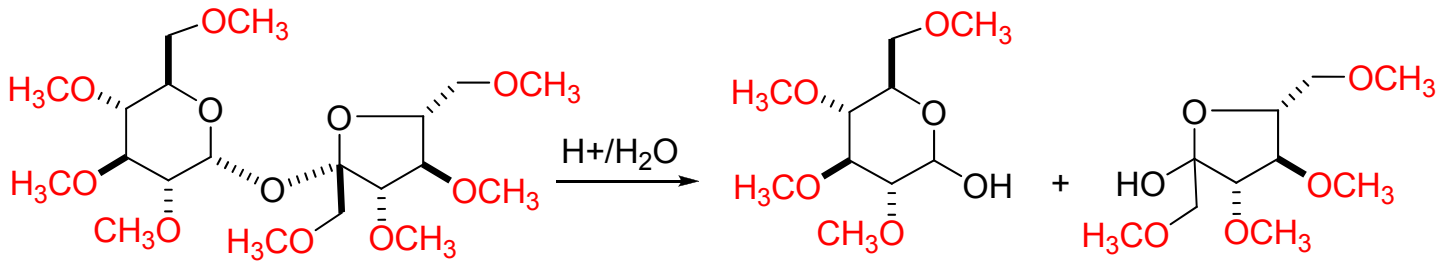
involves multipoint (8 total) interactions between substrate and receptor.

Splenda: "Made from sugar so it tastes like sugar" (ad campaign & lawsuit)

Establishing the Structure of Sucrose

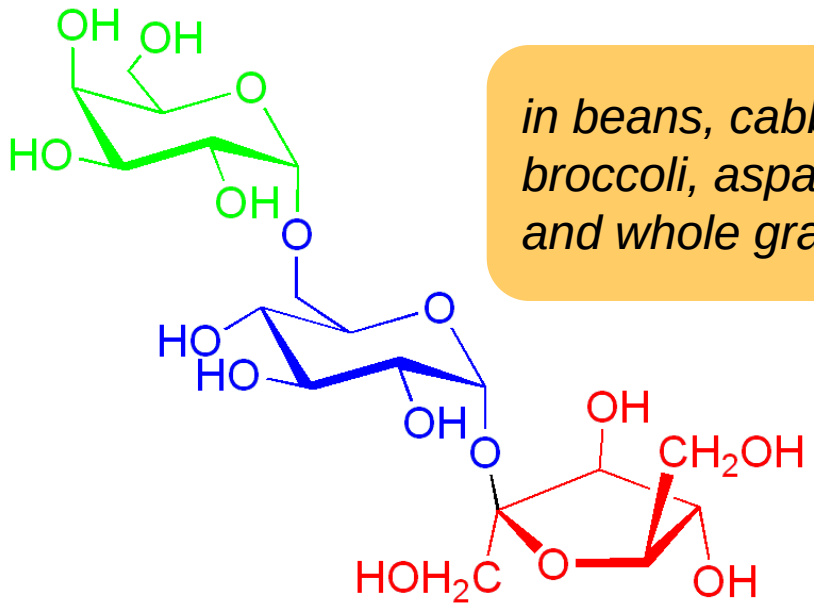


negative Tollen's, Benedict's, Fehlings: Sucrose is a non-reducing sugar.



(1) Indicates an α-linked glucoside.
(2) Indicates a β-linked furanoside.
(3) Indicates glucose & fructose are components.
(4) Methylation experiments further reveal pyranoside & furanoside elements.

Raffinose



in beans, cabbage, brussels sprouts, broccoli, asparagus, other vegetables, and whole grains.

α-D-galactopyranosyl-α-D-glucopyranosyl-β-D-fructofuranose

- Humans, pigs, and poultry lack α-galactosidase.
- Bacterial fermentation to CO_2, CH_4, and H_2 occurs in lower intestine.

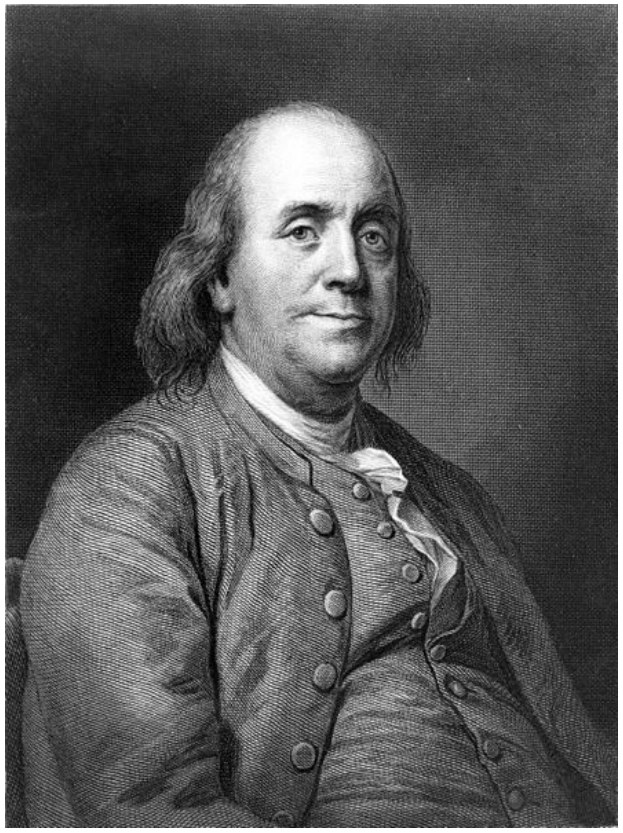
H/T: Prof. Barney Grubbs

www.beano.net

Fart Proudly

Ben Franklin to a colleague, ca. 1781

"Permit me then humbly to propose one of that sort [a research prize] for your consideration, and through you, if you approve it, for the serious Enquiry of learned Physicians, Chemists, &c. of this enlightened Age.

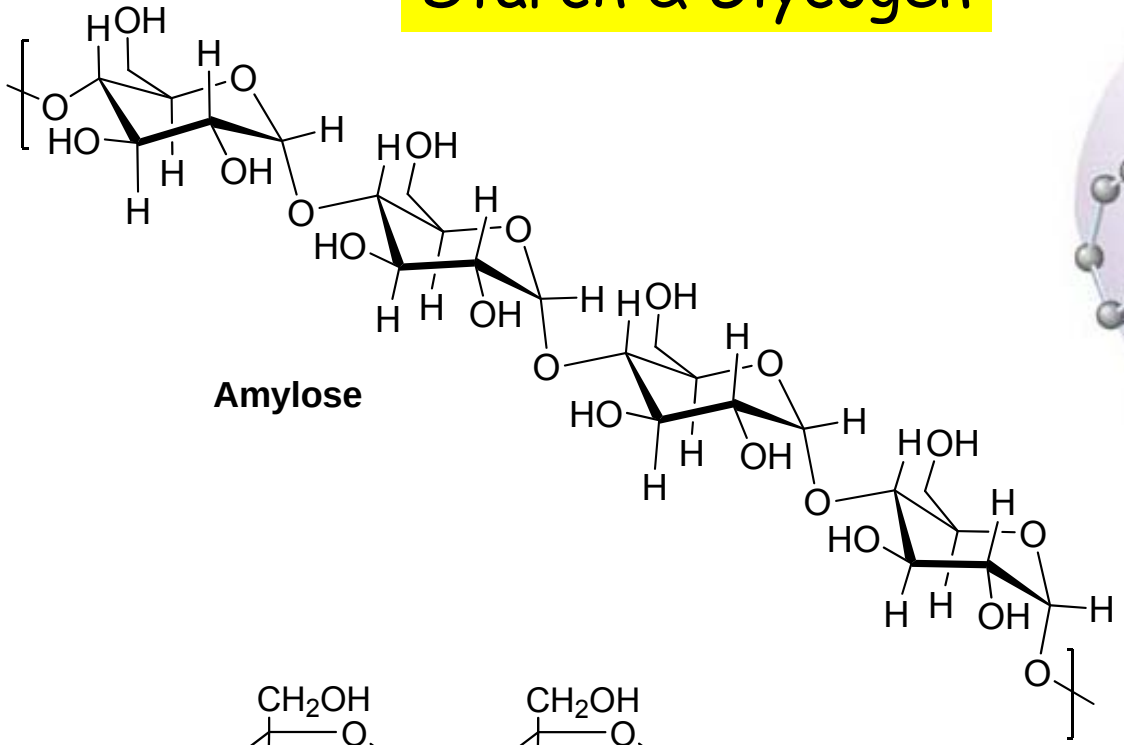


It is universally well known, that in digesting our common food, there is created or produced in the bowels of human creatures, a great quantity of wind. That the permitting this air to escape and mix with the atmosphere, is usually offensive to the company, from the fetid smell that accompanies it."

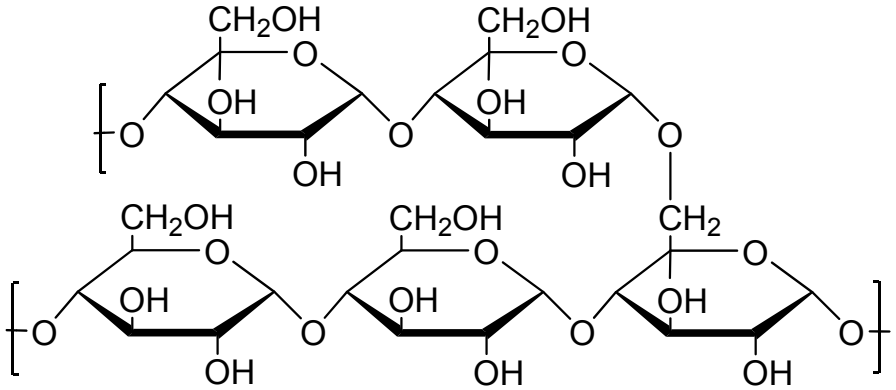
Scientists, he felt, should develop a drug to render farts "not only inoffensive, but agreeable as perfumes."

http://en.wikipedia.org/wiki/Fart_Proudly

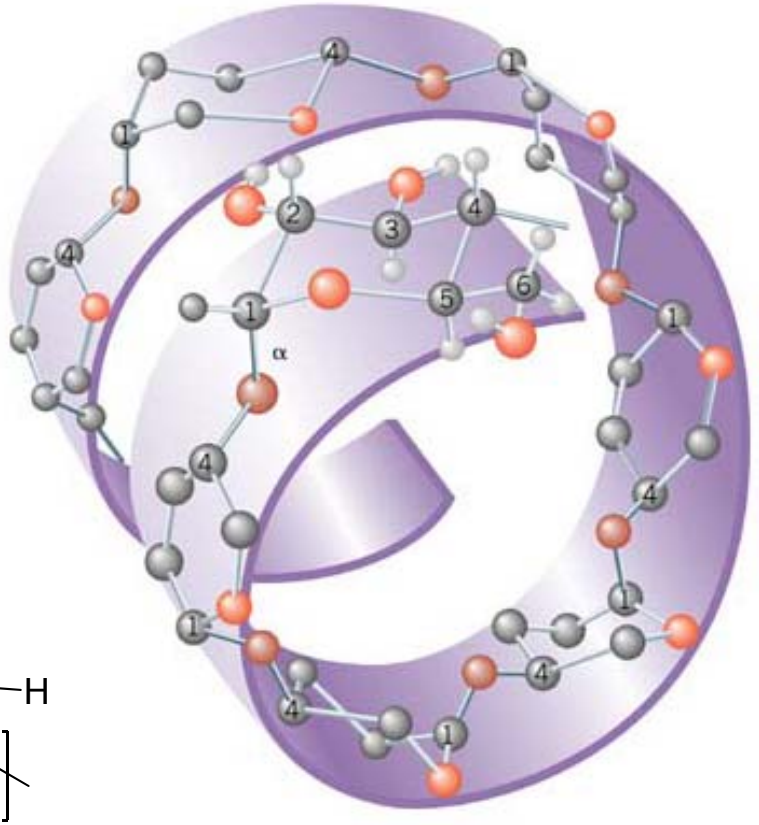
Starch & Glycogen



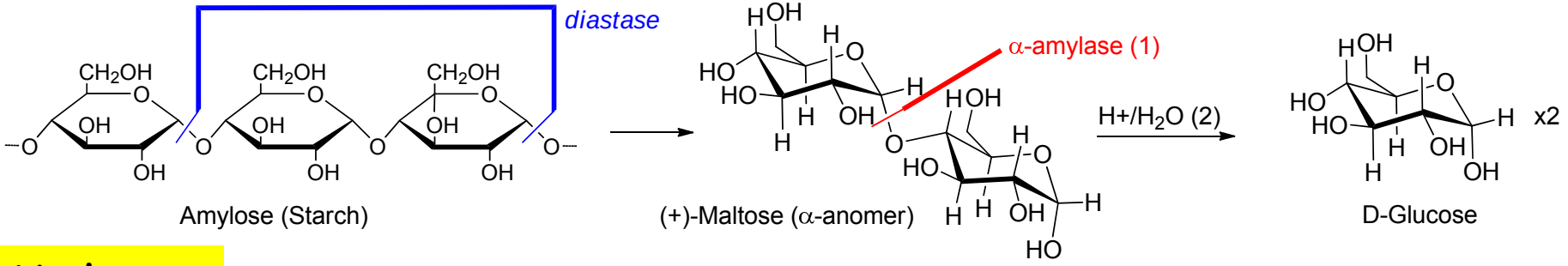
Amylose



Amylopectin

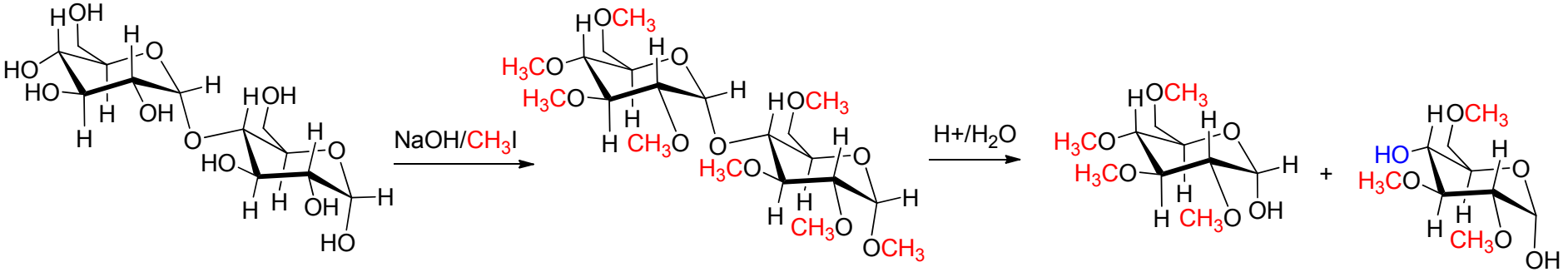


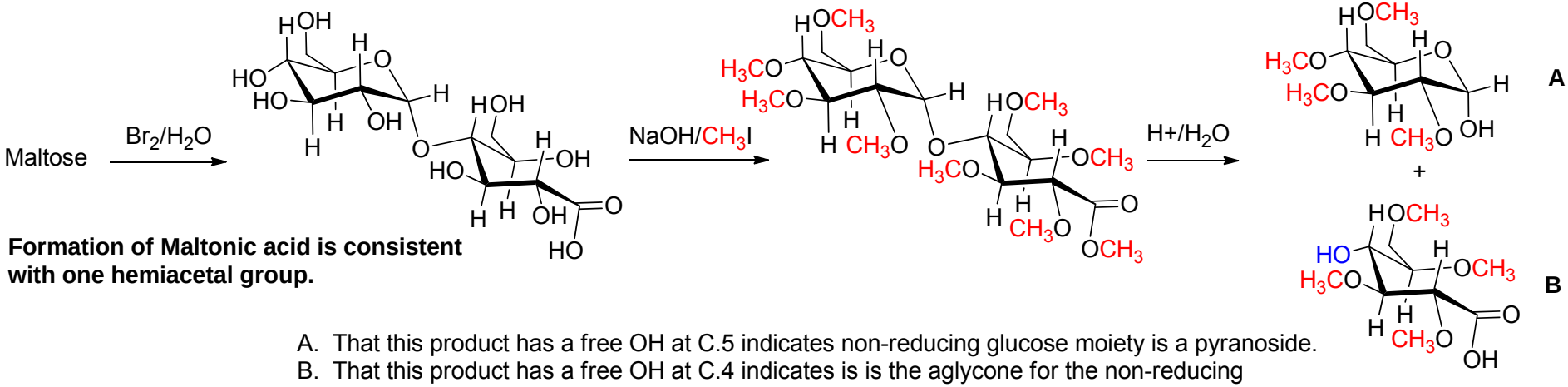
- Starch is 70% amylopectin, 30% amylose.
- Glycogen is the starch equivalent in animals.



Maltose

Positive Benedict's (Cu) and Tollen's (Ag) tests, a reducing sugar.

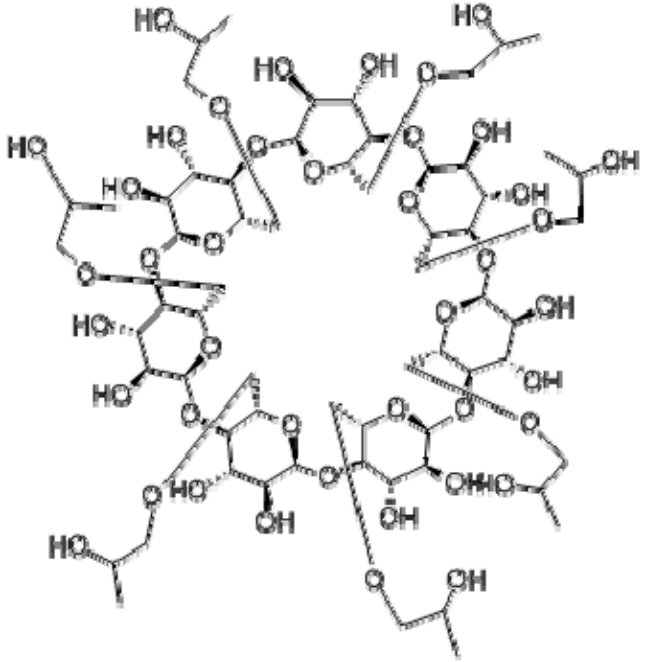


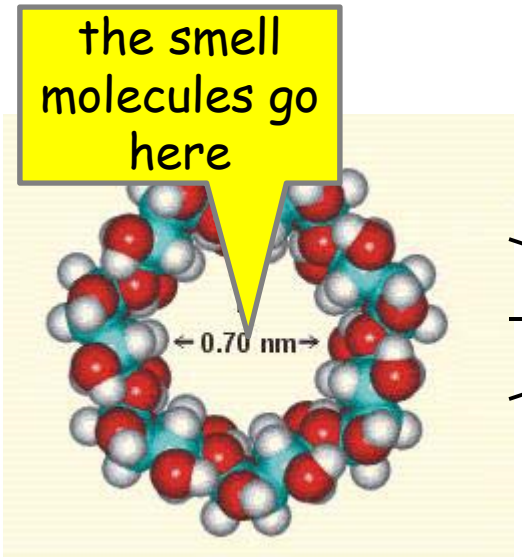


Formation of Maltonic acid is consistent with one hemiacetal group.

A. That this product has a free OH at C.5 indicates non-reducing glucose moiety is a pyranoside.
B. That this product has a free OH at C.4 indicates is is the aglycone for the non-reducing glucose.

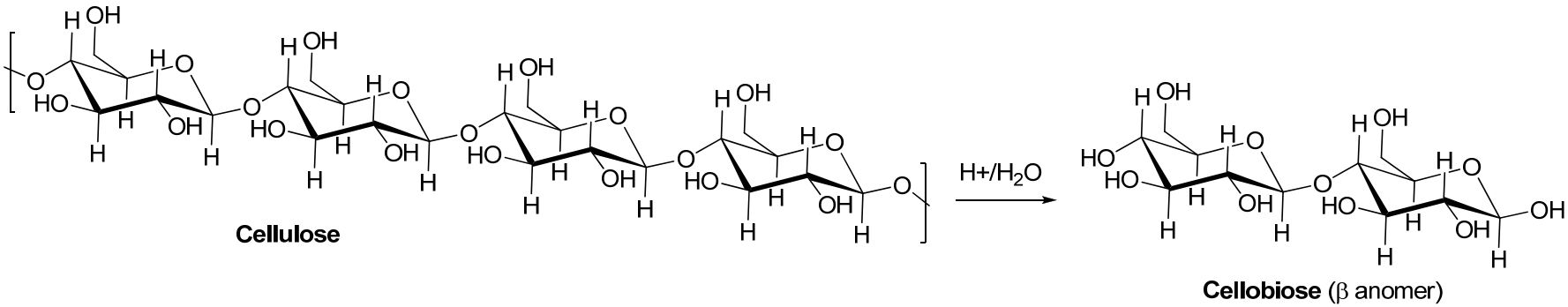
A Functionalized Cyclodextrin is the Active Ingredient in Febreze (eliminates odors)



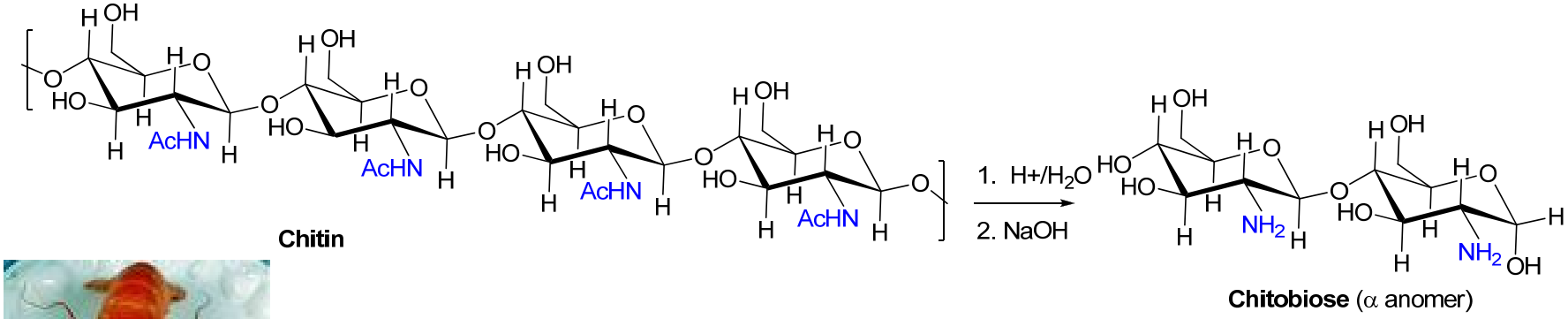


hydroxypropyl-β-cyclodextrin

Cellulose and Chitin are Structurally Similar

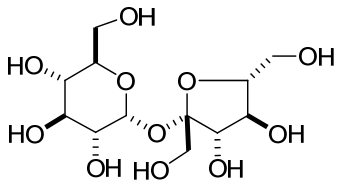


- The most abundant organic molecule on the planet.

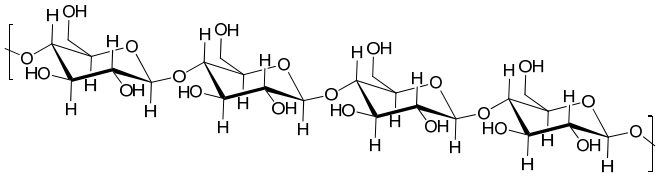


- Forms the exoskeleton of arthropods, cell walls of fungi, beaks of octupus and squid.

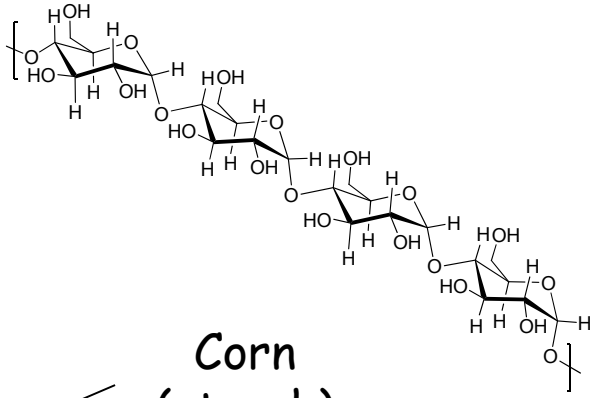
Ethanol Production from Renewable Resources



Sugar Cane
(sucrose)



Switchgrass
(cellulose)



Corn
(starch)

665 gal/acre

1000 gal/acre

400 gal/acre

ethanol

Ethanol heat of combustion = -1371 kJ/mol, octane = -5430 kJ/mol.