

## Activity 22: Monosaccharides

### *Learning Objectives*

Part 1     *Distinguish between D- and L-enantiomers*

*Distinguish enantiomer, epimer, and diastereomer*

*Convert a wedge-dash projection into a Fischer projection for carbohydrates*

Part 2     *Distinguish between primary ( $1^\circ$ ), secondary ( $2^\circ$ ), and tertiary ( $3^\circ$ ) alcohols*

*Recognize the functional groups aldehyde, ketone, and alcohol*

*Characterize monosaccharides as aldoses versus ketoses and by carbon number (ex., pentose)*

Part 3     *Draw the ring (hemiacetal) form of an aldohexose monosaccharide*

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**Estimated Completion Time**     90 Minutes

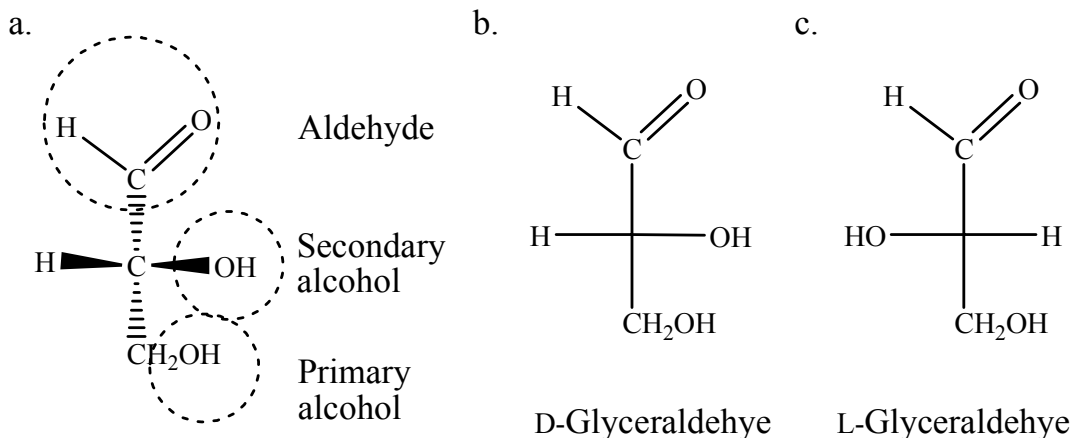
### **Instructor Information**

Depending on the nature of your students, they may need to be led through Part 3, numbers 2–5. By the time question 6 is reached, the group should be able to draw the mannose anomer.

## ANSWERS TO QUESTIONS

### Part 1. Distinguishing D- and L-Stereoisomers

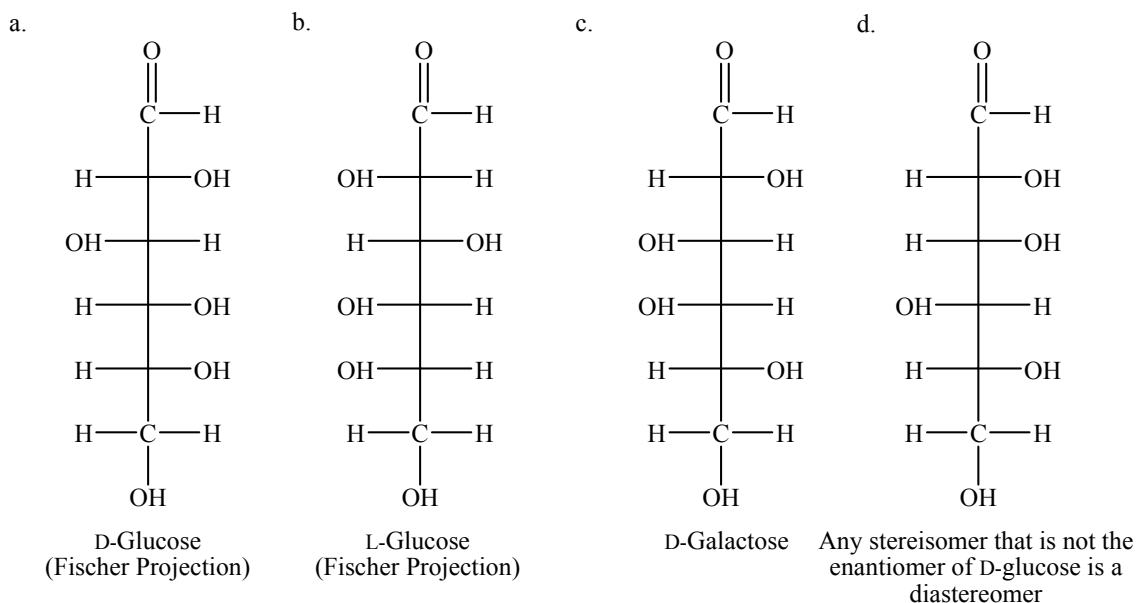
1.



2.  $C_3H_6O_3$ . Yes, glyceraldehyde is a carbohydrate. It has the general molecular formula for a carbohydrate.

3. The *ald-* prefix of aldose implies that an aldehyde functional group is present, and the *-ose* suffix implies the carbohydrate family.

4.



5.  $2^4=16$  stereoisomers
6. I. D-isomer      II. L-isomer

## Part 2. Monosaccharide Structure

### Distinguishing Alcohols

1. All the molecules shown contain an OH group.
2. Students should arrive at their own method for distinguishing alcohols. If they ask themselves, “How many carbons are bonded to the carbon bonded to the OH,” they will arrive at the correct answer.

3.

Functional Group	Molecule Letters(s)
Primary alcohol	<b>A, D, E</b>
Secondary alcohol	<b>B, F</b>
Tertiary alcohol	<b>C, H</b>
Phenol	<b>G</b>

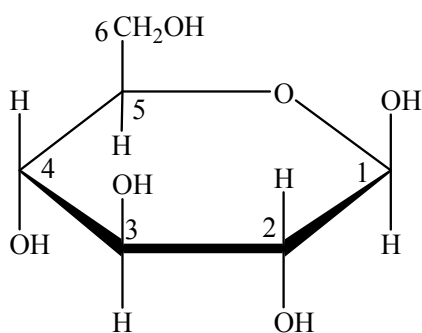
4. Carbons 2–5 contain secondary alcohols, and carbon 6 contains a primary alcohol.

### Monosaccharide Characteristics

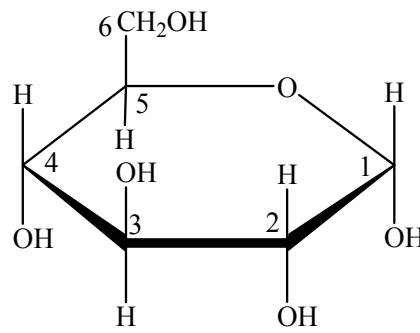
5. Both aldehyde and ketone functional groups contain a carbonyl, C=O. The aldehyde functional group has a carbon and a hydrogen bonded directly to the carbonyl; the ketone group has two separate carbons bonded to the carbonyl.
6. Glucose and galactose contain the aldehyde functional group, and fructose contains a ketone.
7. Aldopentose
8. Enantiomers
9. a. II. Epimers      b. I. Structural isomers      c. IV. Diastereomers  
d. V. Not related

### Part 3. Drawing $\alpha$ - and $\beta$ -Anomers (Ring Formation)

- Aldehyde at C1. ( $\delta^+$ ) C=O ( $\delta^-$ )
- a. 6                      b. 5                      c. 1
- Either anomer is correct for this exploration

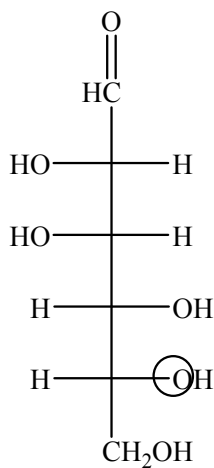


$\beta$ -anomer

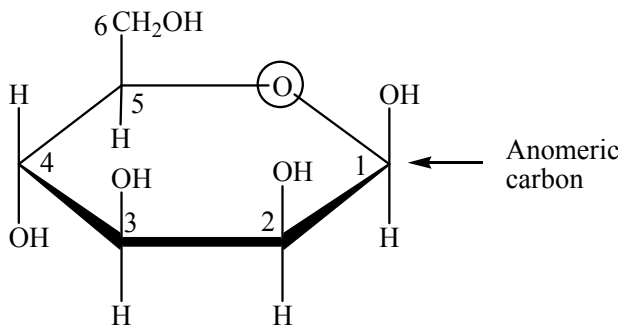


$\alpha$ -anomer

- Either answer (top or bottom) can be correct based on student drawing for question 3.
  - Either answer ( $\alpha$  or  $\beta$ ) can be correct. If OH is on top,  $\beta$ ; if OH is on bottom,  $\alpha$ .
- If the —OH of C1 is on the bottom of the ring relative to carbon 6 (opposite side of ring), the  $\alpha$ -anomer is formed. If the —OH of C1 is on the top of the ring (the same side of ring), the  $\beta$ -anomer is formed.
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D-Mannose

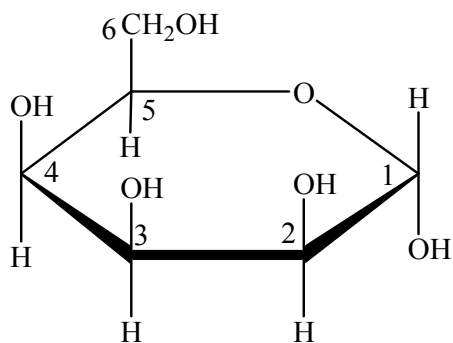


$\beta$ -D-Mannose

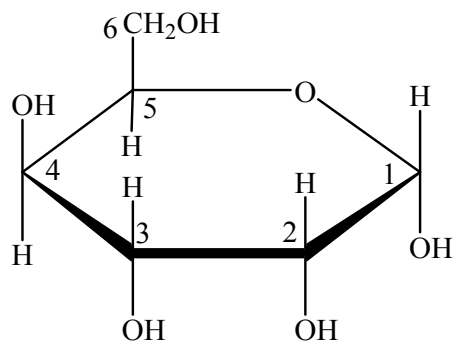
## Activity 22: Skill Development - Drawing $\alpha$ - and $\beta$ -Anomers

1.

a.

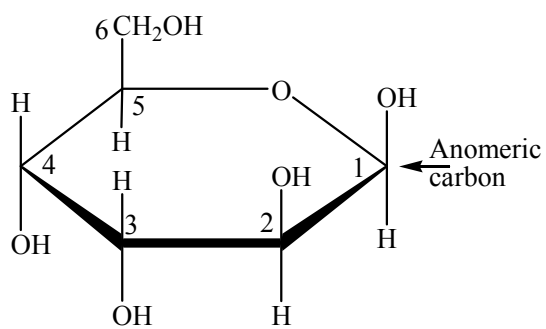


b.



2.

a.



b.

