

An Introduction to Carbohydrates

What is a **carbohydrate**? Why are carbohydrates important?

Draw the structures (*without* stereochemistry, for now) of the following carbohydrates. Where are each of these carbohydrates found in nature?

glucose (2,3,4,5,6-pentahydroxyhexanal)

fructose (1,3,4,5,6-pentahydroxyhexan-2-one)

2-deoxyribose (3,4,5-trihydroxypentanal)

These *monosaccharides* usually exist as a more stable *cyclic hemiacetal*. What are the cyclic hemiacetal forms of glucose and fructose? (Both form 6-membered rings.)

Stereochemistry of Carbohydrates

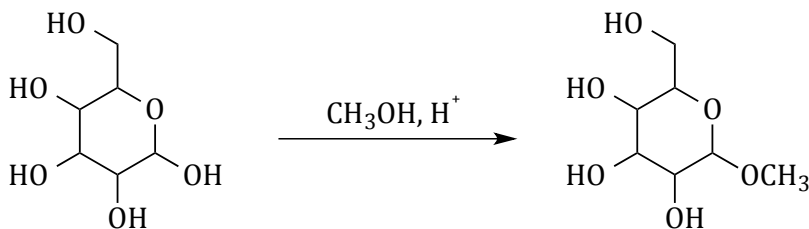
Let's figure out the stereochemistry of D-glucose by using the following facts:

1. The terminal carbon (#5) has the *R*-configuration.
2. In the 6-membered ring form, all of the substituents are *equatorial*.

The stereochemistry of carbohydrates is often shown using a **Fischer projection**.
Draw a Fischer projection that shows the correct stereochemistry of glucose.

Acetals, Disaccharides, & Polysaccharides

Glucose will react with an alcohol to form an acetal. Provide a mechanism:



What if the alcohol is, in fact, merely the –OH group from *another* monosaccharide?

The Anomeric Effect

Consider the methyl acetal of glucose. There are two possible diastereomers of this compound at the acetal carbon. Draw these two structures. Which would you predict to be more stable?

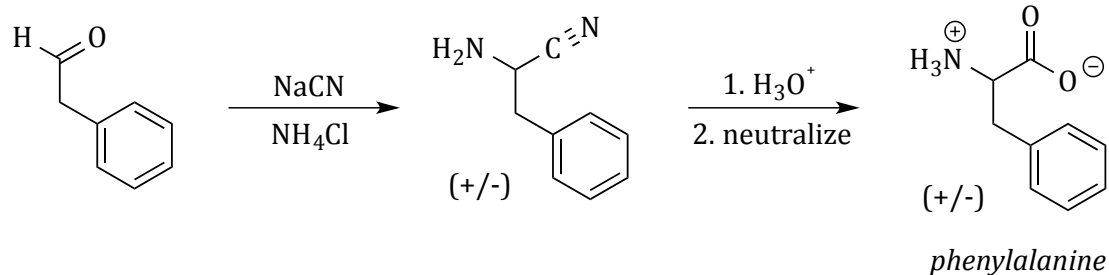
It turns out that the most stable conformation actually has the –OMe group in an *axial* position. Why is this conformation more stable?

What are some other manifestations of this **anomeric effect**?

Amino Acids: Structure & Synthesis

Draw the structures of some **amino acids**. What is the pK_a of each of the functional groups in an amino acid? In what form will these amino acids be found at pH = 7?

The following procedure, known as the **Strecker synthesis**, is one way to synthesize an amino acid. Provide a curved-arrow mechanism.

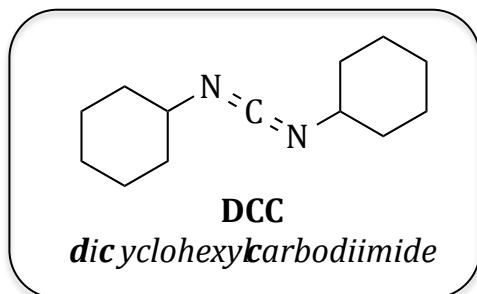
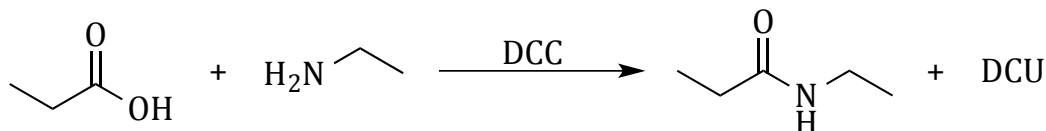


The Structure of Peptides:

The peptide bond

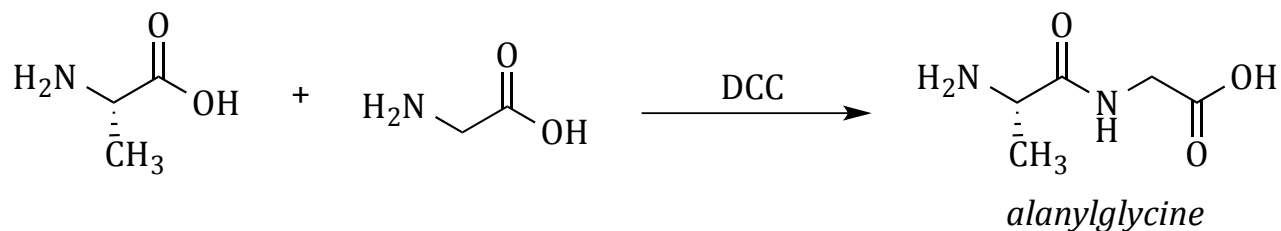
What is a **peptide**? What is a **protein**? What are their roles in biology?

We can form a peptide bond by using the **amide coupling reagent** known as DCC. Provide a curved-arrow mechanism.



Synthesis of Peptides: Protecting Groups

Why can't we use DCC to synthesize the following dipeptide?



How can we synthesize that dipeptide using **protecting groups**?

Synthesis of Peptides: Solid-Phase Synthesis

Today, nearly all chemical synthesis of peptides is performed using *solid-phase synthesis*. Show how you can use solid-phase synthesis to synthesize alanylglycine.

Even machines can do
solid-phase synthesis!



Reading: Section 26.6