Glucose is phosphorylated by ATP to form a sugar phosphate. The negative charge of the phosphate prevents passage of the sugar phosphate through the plasma membrane, trapping glucose inside the cell.

A readily reversible rearrangement of the chemical structure (isomerization) moves the carbonyl oxygen from carbon 1 to carbon 2, forming a ketose from an aldose sugar. (See Panel 2–3, pp. 70–71.)

The new hydroxyl group on carbon 1 is phosphorylated by ATP, in preparation for the formation of two three-carbon sugar phosphates. The entry of sugars into glycolysis is controlled at this step, through regulation of the enzyme phosphofructokinase.

The six-carbon sugar is cleaved to produce two three-carbon molecules. Only the glyceraldehyde 3-phosphate can proceed immediately through glycolysis.

The other product of step 4, dihydroxyacetone phosphate, is isomerized to form glyceraldehyde 3-phosphate.
The two molecules of glyceraldehyde 3-phosphate are oxidized. The energy-generation phase of glycolysis begins, as NADH and a new high-energy anhydride linkage to phosphate are formed (see Figure 13–5).

Step 6: The transfer to ADP of the high-energy phosphate group that was generated in step 6 forms ATP.

Step 7: The remaining phosphate ester linkage in 3-phosphoglycerate, which has a relatively low free energy of hydrolysis, is moved from carbon 3 to carbon 2 to form 2-phosphoglycerate.

Step 8: The removal of water from 2-phosphoglycerate creates a high-energy enol phosphate linkage.

Step 9: The transfer to ADP of the high-energy phosphate group that was generated in step 9 forms ATP, completing glycolysis.

Step 10: The net result of glycolysis is two molecules of pyruvate, two molecules of ATP, and two molecules of NADH.

In addition to the pyruvate, the net products are two molecules of ATP and two molecules of NADH.