- The branches grow by further additions of 1→4 glucosyl units and further branching

- New branch must be at least four residues away from the pre-existing one

- Branching is important because:

- It increases solubility of glycogen

- Creates a number of terminal residues, the sites of action of glycogen phosphorylase and synthase. Thus branching increases the rate of glycogen synthesis and degradation

Phosphorylase

- Regulated by factors that signal the energy status of the cell and reversible phosphorylation which is responsive to hormones such as epinephrine, insulin, and glucagon

-unlike *glycogen synthase* the active form is phosphorylated and the inactive is dephosphorylated

Phosphorylase a (active form) is phosphorylated. It is inactivated by the removal of a phosphate by *protein phosphatase-1* to form *phosphorylase b*

Reactivation requires rephosphorylation catalyzed by *phosphorylase kinase*

-epinephrine and norepinephrine can mediate stimulation of glycogenolysis.

- This involves cAMP-independent mobilization of Ca^{2+} from mitochondria into the cytosol followed by the stimulation of a *Ca^{2+}/calmodulin–sensitive phosphorylase kinase*

-Vasopressin, oxytocin, angiotensin II acting through Ca^{2+} or the phosphatidylinositol bisphosphate pathway

Summary

- Glycogen breakdown requires the interplay of several enzymes
- Phosphorylase is regulated by allosteric interactions and reversible phosphorylation

- Epinephrine and glucagon signal the need for glycogen breakdown

- Glycogen is synthesized and degraded by different pathways
- Glycogen breakdown and synthesis are reciprocally regulated