

Regulation of Glycogen Metabolism

Presentation by:

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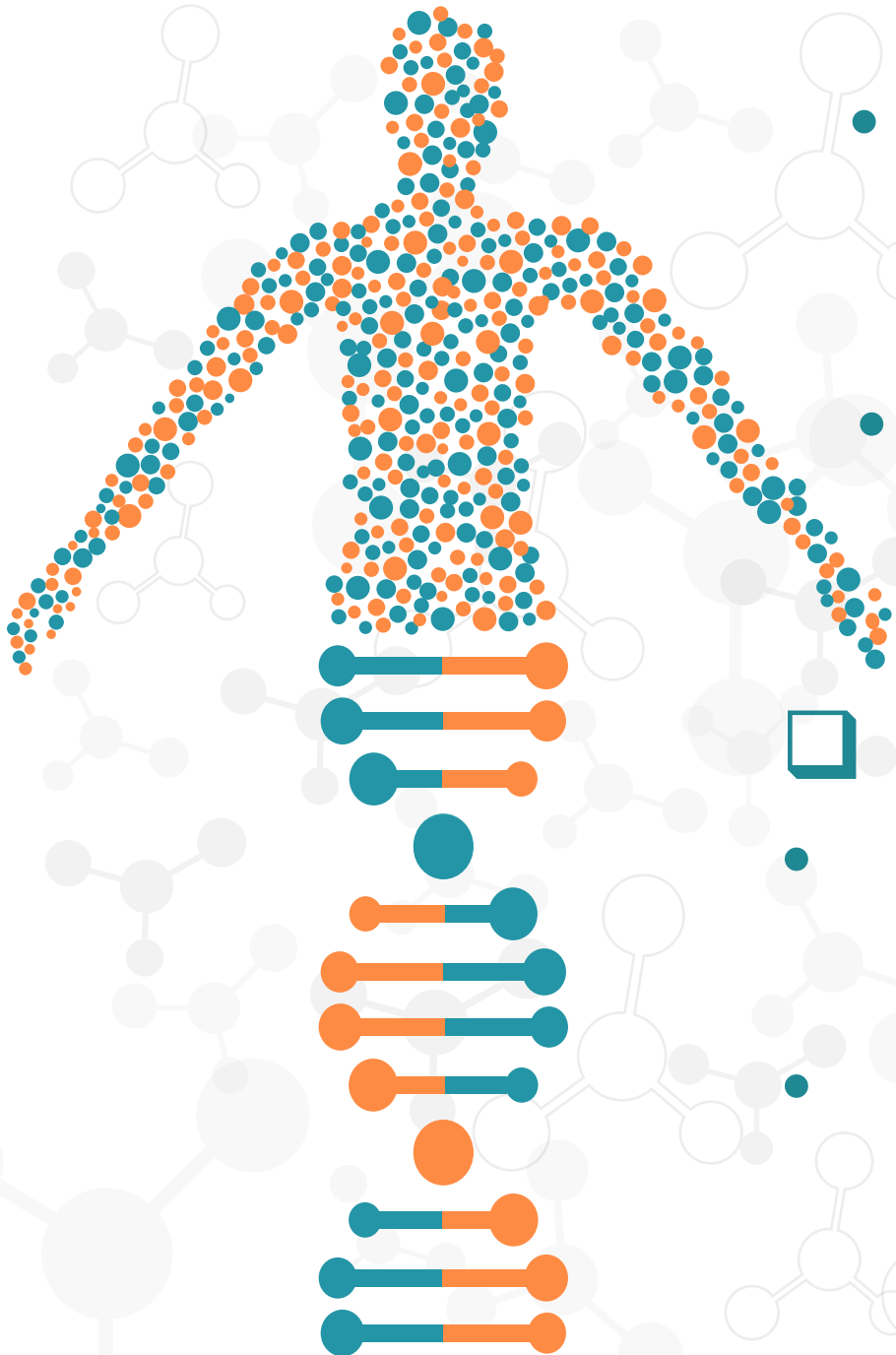


Objective :

1. Regulation of glycogen synthesis (Glycogenesis).
2. Degradation (Glycogenolysis).



Regulation of Glycogen Synthesis and Degradation



- **Importance of maintaining blood glucose levels.**

- **Glycogen storage form in liver and muscle.**

- In liver:**

- **Glycogen synthesis during periods well fed state.**

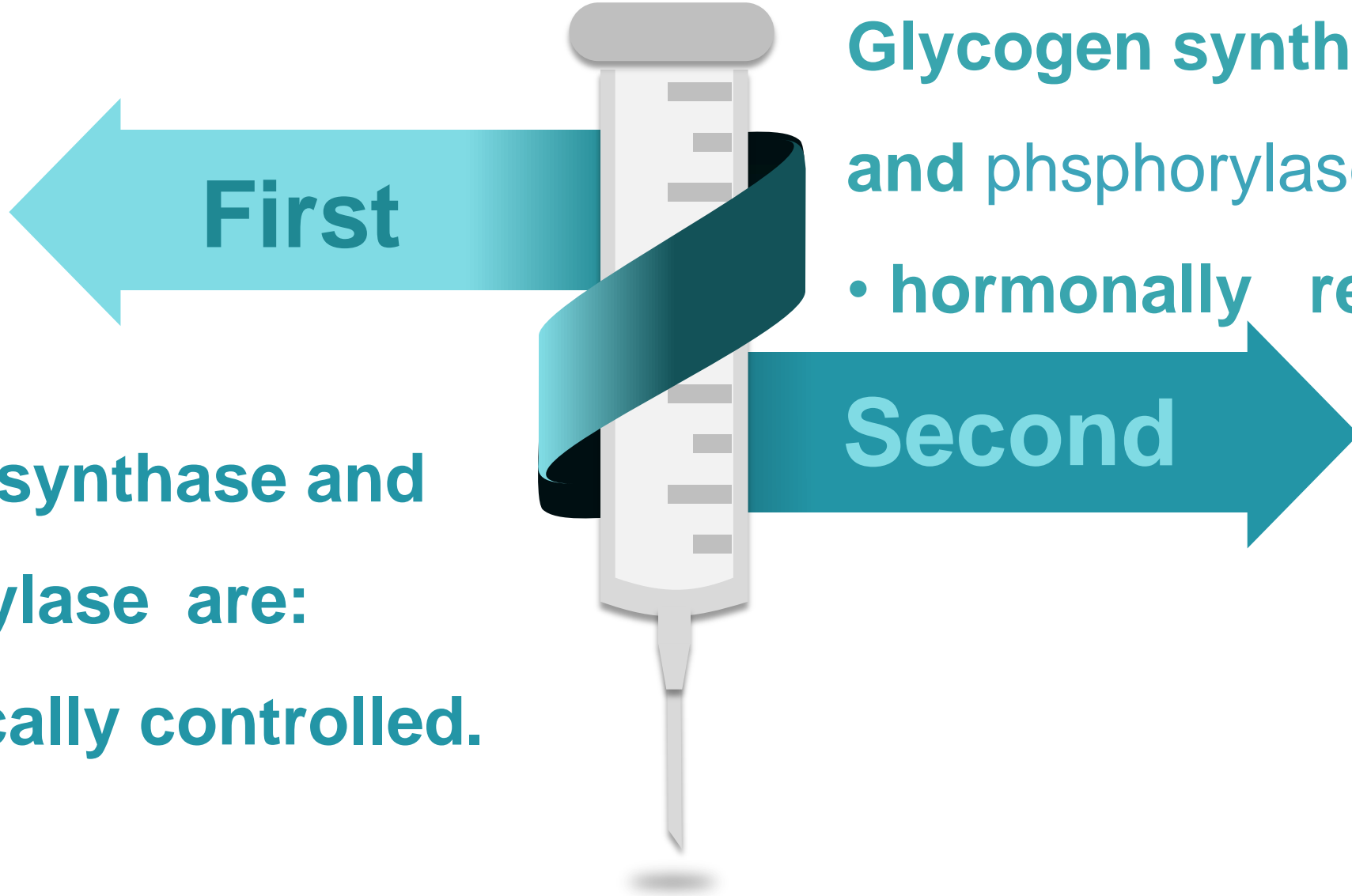
- **Glycogen degradation during periods of fasting.**



□ In skeletal muscle:

- **Glycogen degradation occurs during active exercise.**
- **Synthesis begins as soon as the muscle is at rest.**

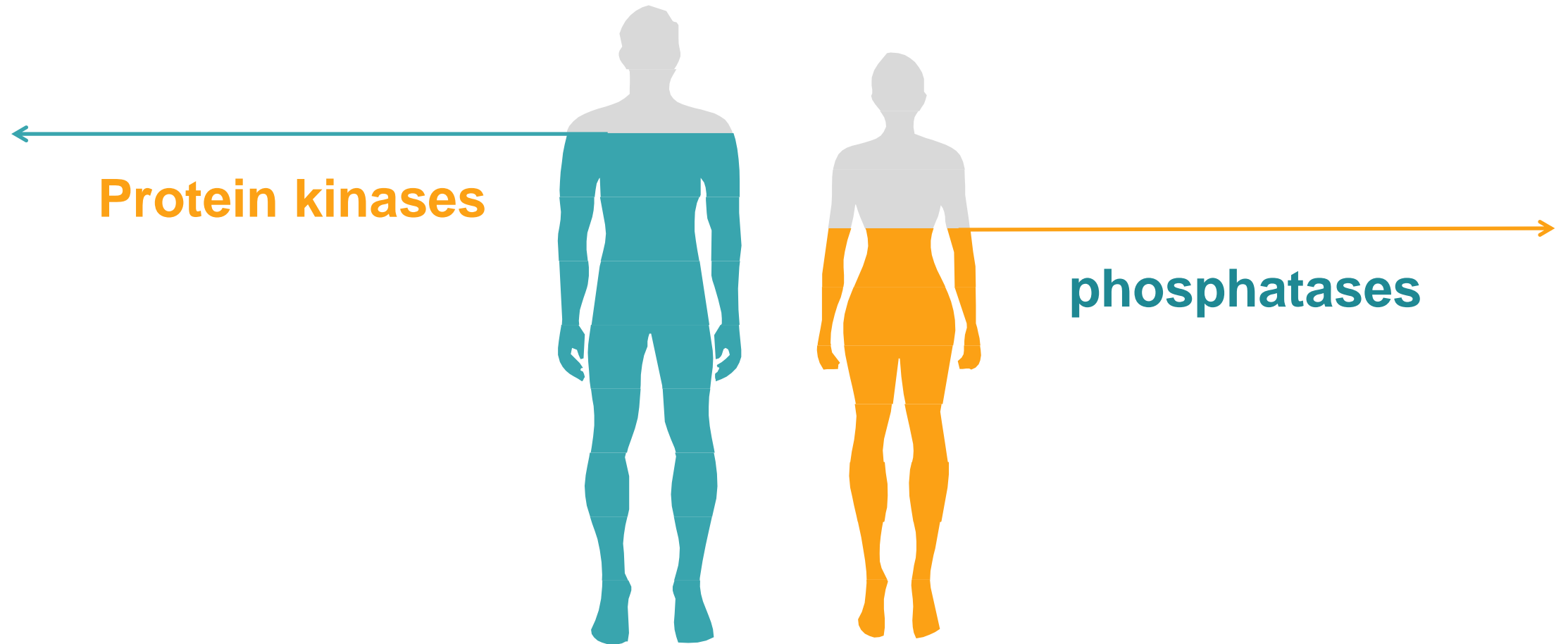
Regulation of glycogen synthesis and degradation is accomplished on two levels :



Glycogen synthesis and phosphorylase are:
• hormonally regulated.

Glycogen synthase and phosphorylase are:
• allosterically controlled.

The regulation of glycogen synthesis and degradation is extremely complex, involving many enzymes.



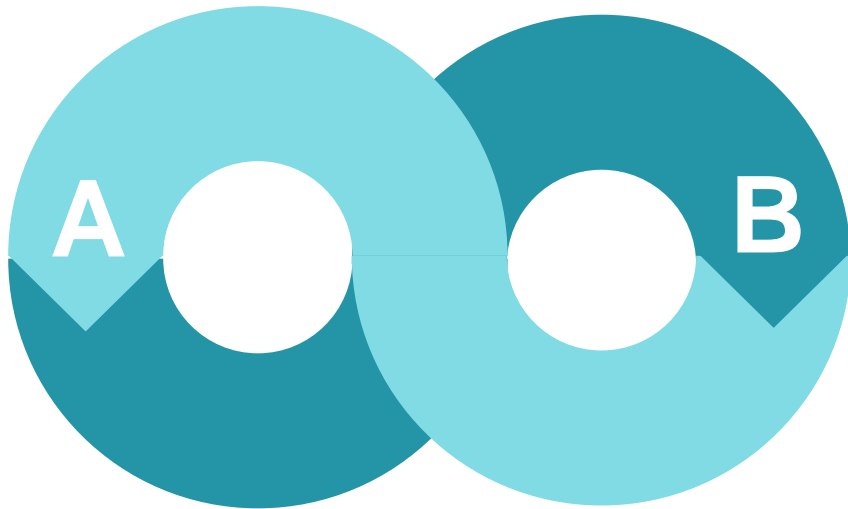


Regulation of Glycogenesis

Regulation of Glycogenesis

A. Covalent modification:

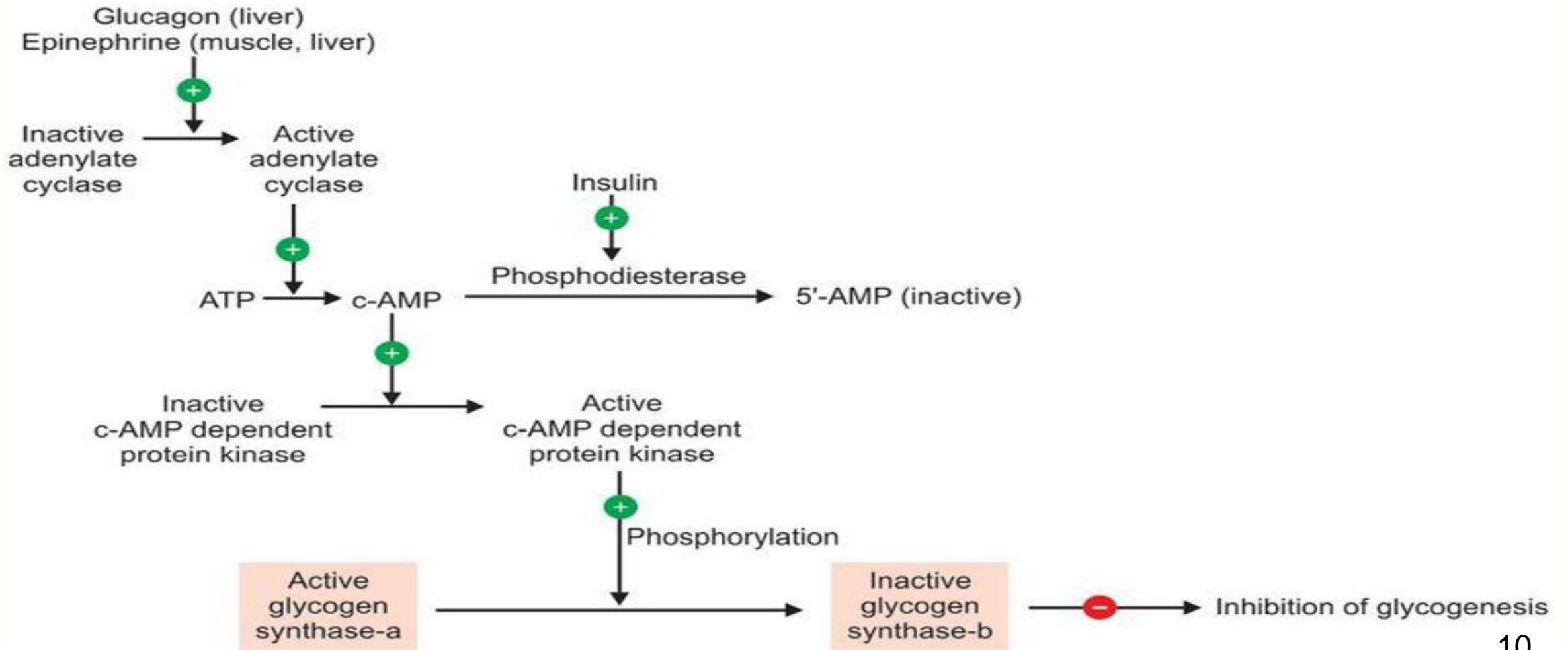
- **Glycogen synthase is the key enzyme .**



It is present in two form:

- **Glycogen synthase a (active form) which is dephosphorylated.**
- **Glycogen synthase b (inactive form) which is phosphorylated.**

Hormonal regulation of glycogenesis



Regulation of Glycogenesis

B. Induction and repression of the key enzyme:

- In well fed state: induce insulin synthesis for the key enzyme(induction) so, glycogenesis is stimulated.
- In fasting: decrease insulin leading to decrease synthesis of the key enzyme (repression) and hence glycogenesis is inhibited.

Regulation of Glycogenesis

C. Allosteric regulation

Glycogen synthase is:

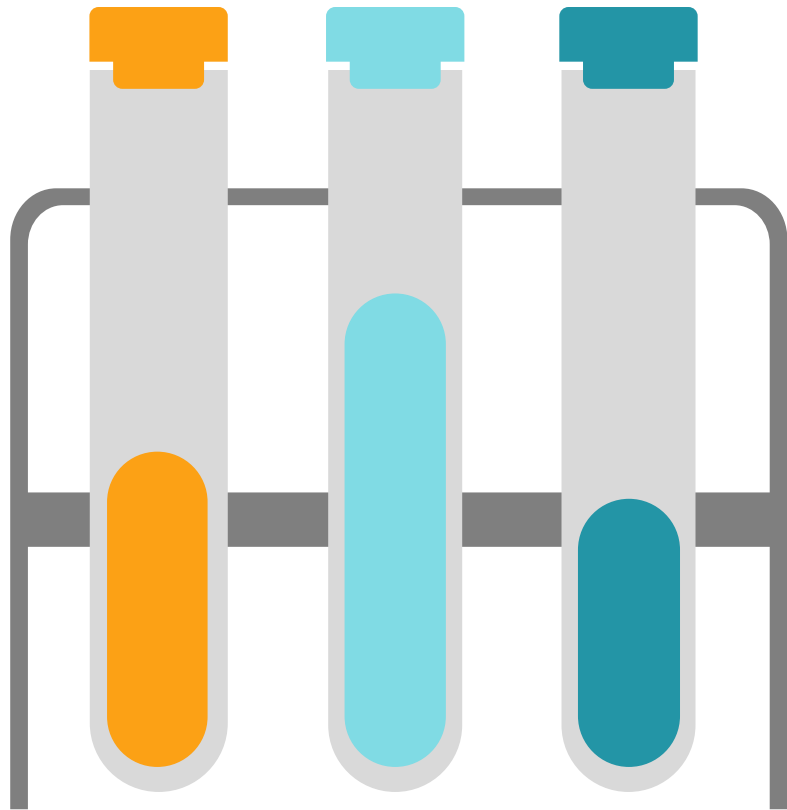
- **allosterically activated by glucose-6-P.**
- **allosterically inhibited by glycogen molecule.**



Regulation of Glycogenolysis

Regulation of Glycogenolysis:

- Phosphorylase is the key enzyme



A Covalent modification:

It is present in two form:

- Phosphorylase “a” which is phosphorylated active form.
- Phosphorylase “b” which is dephosphorylated in active form.

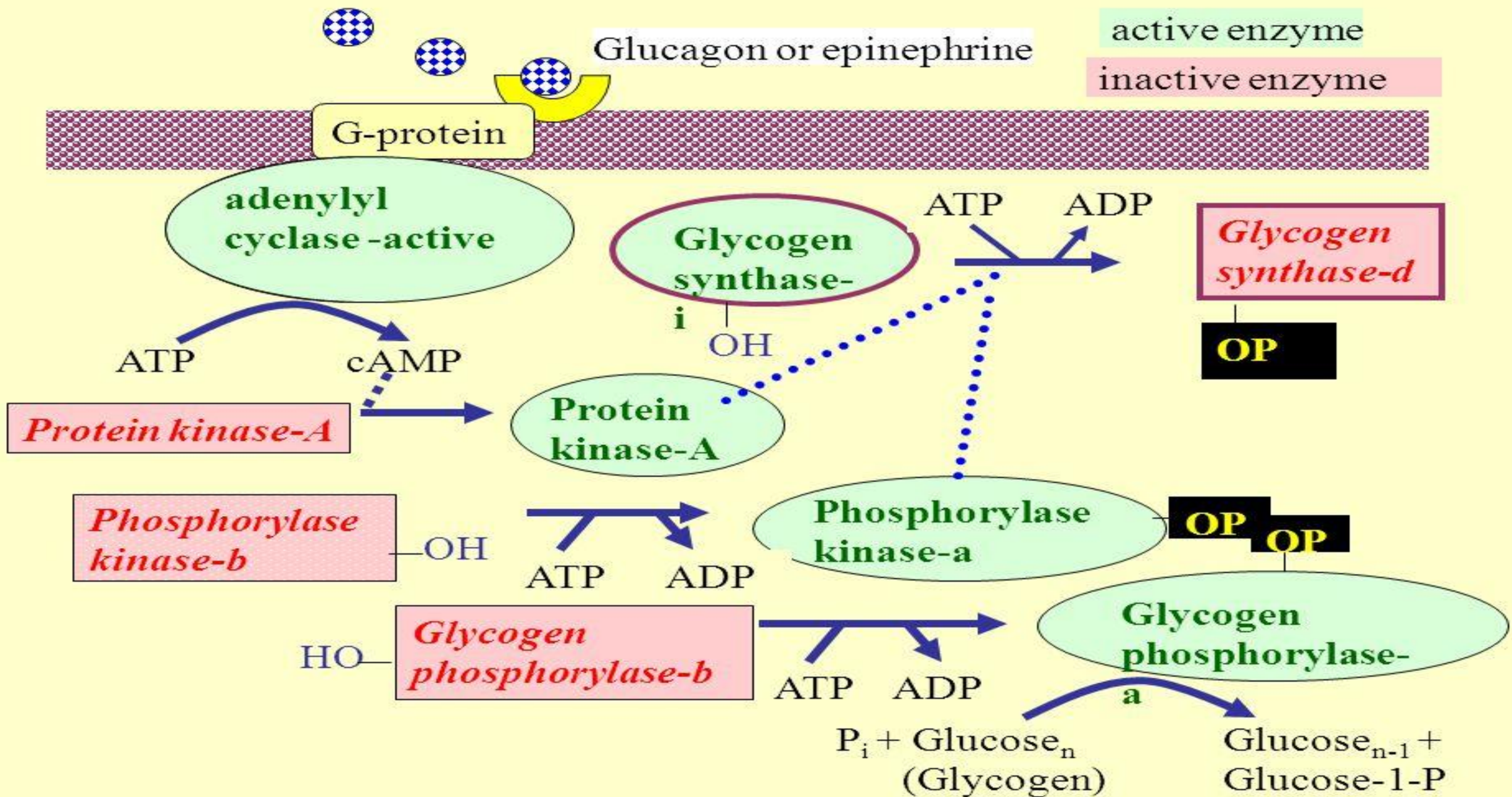


Figure 1. Cascade for the control of glycogenolysis and glycogenesis

Regulation of Glycogenolysis:

- Phosphorylase is the key enzyme.



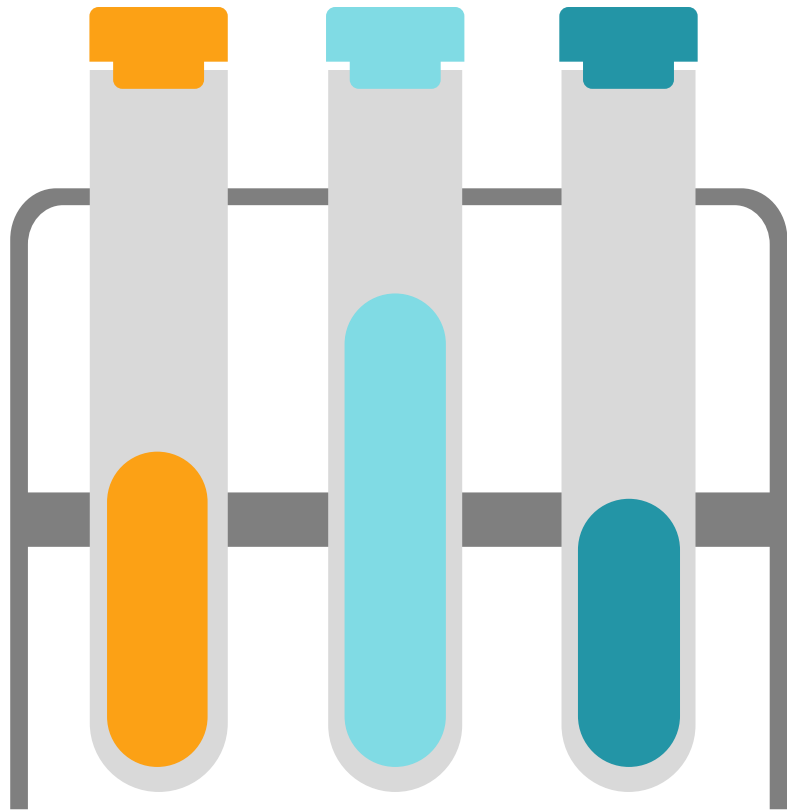
B Induction and repression of the key enzyme.

In well fed state : induce insulin which leads to decrease synthesis of key enzyme (repression) so glycogenolysis is inhibited.

Fasting decrease insulin which increase synthesis of key enzyme (induction) so glycogenolysis is stimulated.

Regulation of Glycogenolysis:

- Phosphorylase is the key enzyme



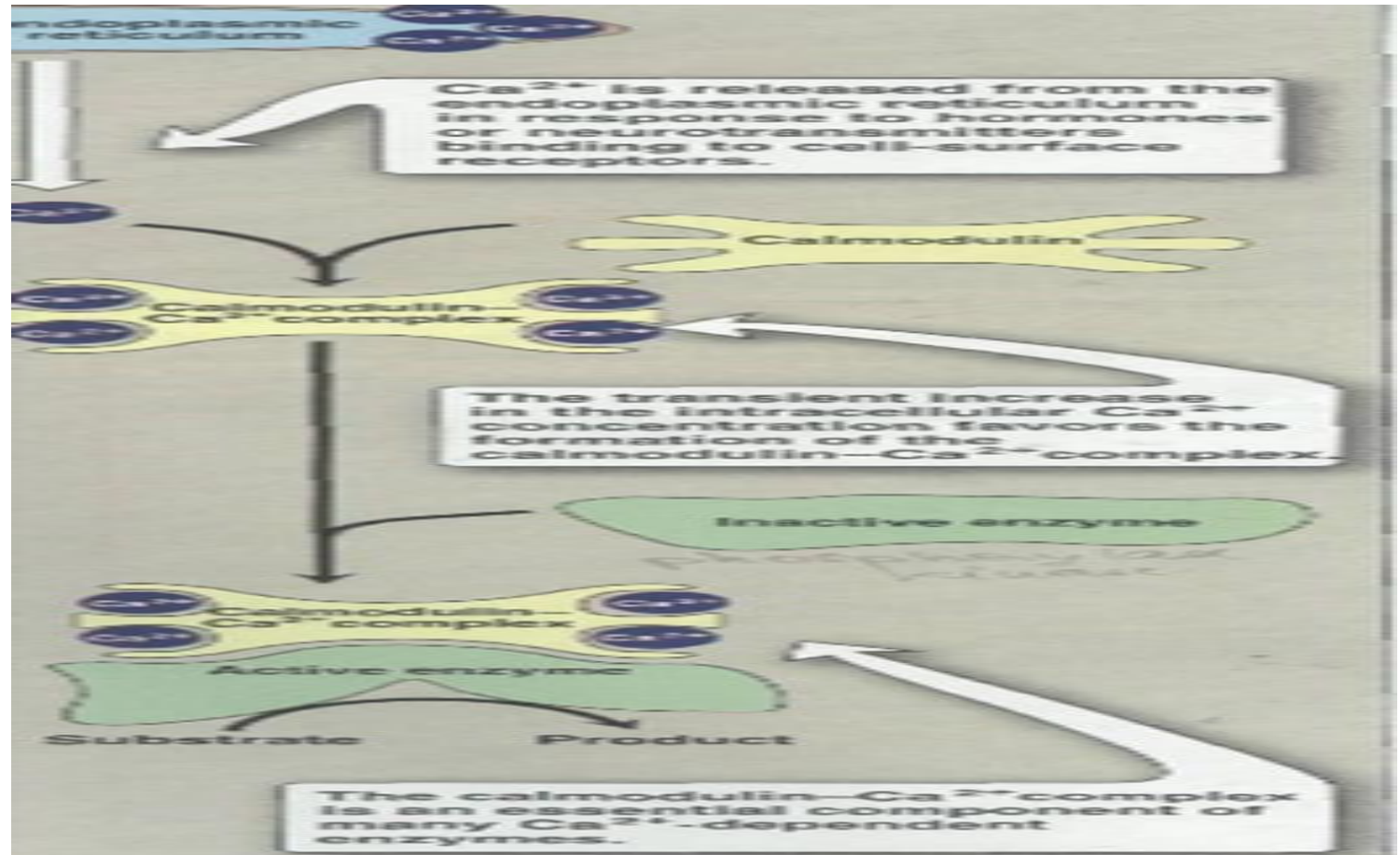
Ⓒ Allosteric regulation:

Muscle phosphorylase is:

- Allosterically activated by AMP which is increased during muscular exercise.
- Allosterically inhibited by ATP and G-6-P

Activation of glycogen degradation in muscle

- Increase AMP.
- Calcium calmodulin.



Summary

A

Glycogen metabolism is carefully regulated so that sufficient glucose is available for the body 's energy needs.

B

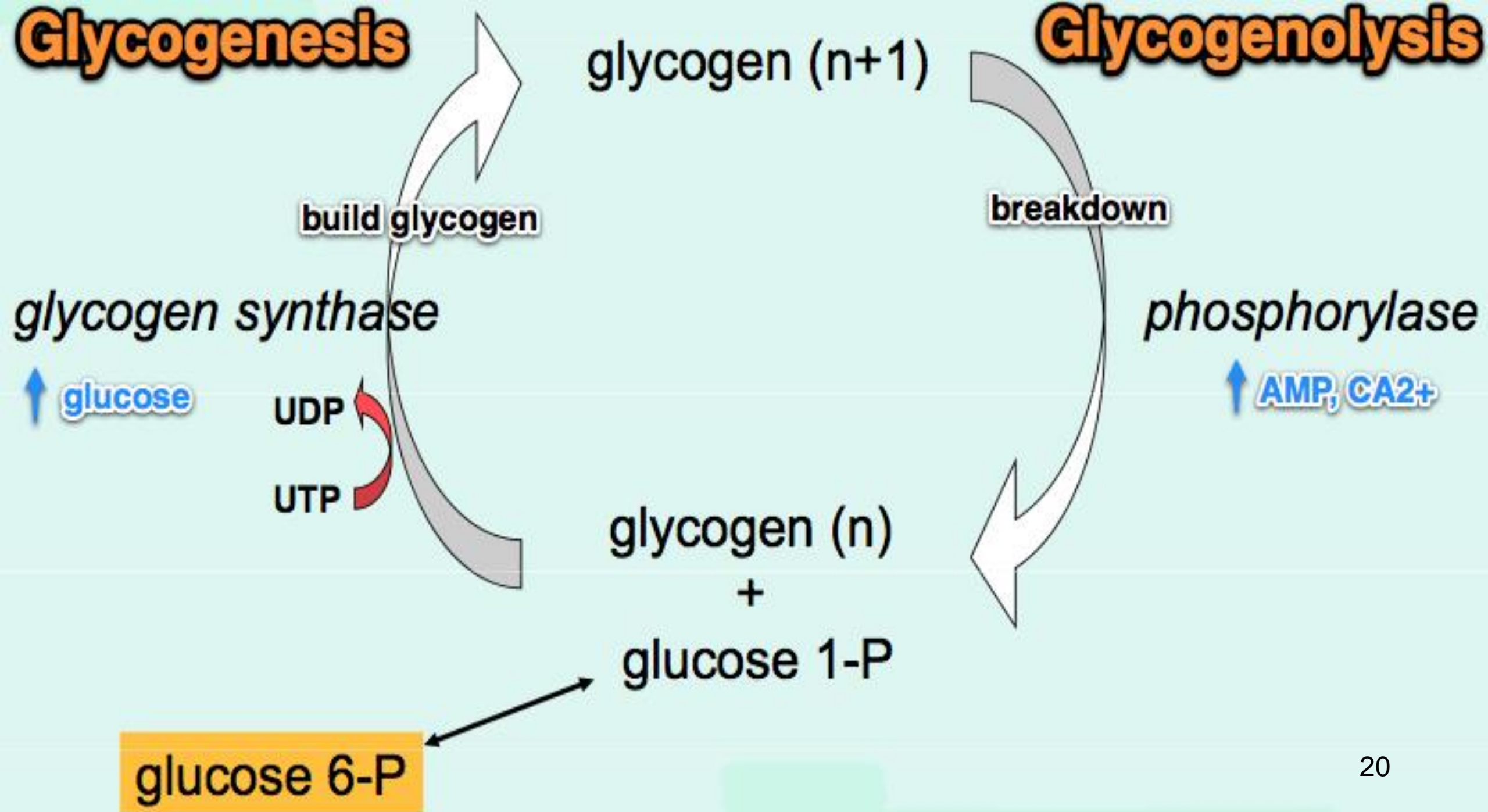
GP and GS control glycogen metabolism in liver and muscle cells.

C

Insulin, glucagon and epinephrine control glycogenesis and glycogenolysis.

Glycogenesis

Glycogenolysis



Reference

- Lippincotts Illustrated Reviews Biochemistry 3th
- Harper's Biochemistry 26th ed.
- <https://www.youtube.com/watch?v=vbZlws>

The background is a solid teal color. It features several stylized DNA double helix structures in various shades of teal and light blue, some appearing as faint, larger-scale patterns and others as more detailed, smaller-scale icons. Additionally, there are molecular network diagrams consisting of dark teal dots connected by thin lines, scattered across the left side of the image.

Thank You