

Module 16: Glycogen Metabolism

Glucose in the Body

- When blood glucose concentration is high, muscle and liver form glycogen
- Glycogen stores the glucose as a backup → stored in the liver and muscles
 - Muscles for work
 - Liver for when blood glucose dips
- Glycogen synthesized in the liver and muscles
 - Synthesized through **G6P** which can have multiple fates
- When blood glucose decreases
 - Muscles: break down glycogen for internal use
 - Liver: regulate blood glucose concentration

Glycogen Structure

- Characterized by α -(1→4) glycosidic bonds which form chains that have α -(1→6) linked branches every 8-14 residues
- Stored in large amounts in liver and smaller amounts within the muscle
- Glucose units stretch from one end to the other
- **Reducing end**
 - Anomeric carbon can perform reduction reaction
 - These are linked through alpha (1→4) linked
- Anomeric carbon in linkage is non-reducing



Glycogen Synthesis Enzymes

1. **UDP-glucose pyrophosphorylase**
2. **Glycogen synthase**
3. **Glycogen branching enzyme**

Phosphoglucomutase

- Glucose enters by GLUT
 - Converted to G6P by hexokinase or glucokinase
 - Enters glycolysis if glucose levels are high
 - Large surplus of glucose, then there are sufficient glucose molecules to meet glycolysis requirements and surplus glucose is prepared for storage in glycogen
- **G6P is converted to G1P by phosphoglucomutase**
- Step 1: Phosphorylation of the substrate at C1-OH
- Step 2: phosphorylation of the enzyme by the phosphoryl group at C6 of the substrate

UDP-glucose Pyrophosphorylase

- **UDP-glucose pyrophosphorylase** catalyzes the reaction to convert G1P into UDP-Glucose (UDPG)
- Overall reaction without hydrolysis of PP has $\Delta G=0$
- Reaction
 - G1 nucleophilic attack on alpha phosphate of UDP
 - Beta and gamma phosphate leave as pyrophosphate

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Table of Contents General Science Module 14 Study Guide Answers

1. Understanding the eBook General Science Module 14 Study Guide Answers
 - The Rise of Digital Reading General Science Module 14 Study Guide Answers
 - Advantages of eBooks Over Traditional Books
2. Identifying General Science Module 14 Study Guide Answers
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an General Science Module 14 Study Guide Answers
 - User-Friendly Interface
4. Exploring eBook Recommendations from General Science Module 14 Study Guide Answers
 - Personalized Recommendations
 - General Science Module 14 Study Guide Answers User Reviews and Ratings
 - General Science Module 14 Study Guide Answers and Bestseller Lists

5. Accessing General Science Module 14 Study Guide Answers Free and Paid eBooks
 - General Science Module 14 Study Guide Answers Public Domain eBooks
 - General Science Module 14 Study Guide Answers eBook Subscription Services
 - General Science Module 14 Study Guide Answers Budget-Friendly Options
6. Navigating General Science Module 14 Study Guide Answers eBook Formats
 - ePub, PDF, MOBI, and More
 - General Science Module 14 Study Guide Answers Compatibility with Devices
 - General Science Module 14 Study Guide Answers Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of General Science Module 14 Study Guide Answers
 - Highlighting and Note-Taking General Science Module 14 Study Guide Answers
 - Interactive Elements General Science Module 14 Study Guide Answers
8. Staying Engaged with General Science Module 14 Study Guide Answers
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers General Science Module 14 Study Guide Answers
9. Balancing eBooks and Physical Books General Science Module 14 Study Guide Answers
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection General Science Module 14 Study Guide Answers
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine General Science Module 14 Study Guide Answers
 - Setting Reading Goals General Science Module 14 Study Guide Answers
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of General Science Module 14 Study Guide Answers
 - Fact-Checking eBook Content of General Science Module 14 Study Guide Answers
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
- Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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