

# What is the Calvin Cycle?

## Worksheet

The Calvin cycle fixes CO<sub>2</sub> into G3P through three phases - carbon fixation, reduction, and regeneration of RuBP - powered by ATP and NADPH from the light reactions.

## Questions

1. Where does the Calvin cycle take place?
  - A) Thylakoid membrane
  - B) Mitochondrial matrix
  - C) Chloroplast stroma
  - D) Cytoplasm
2. Which enzyme catalyzes carbon fixation in the Calvin cycle?
  - A) ATP synthase
  - B) RuBisCO
  - C) Hexokinase
  - D) DNA polymerase
3. How many turns of the Calvin cycle are needed to make one glucose molecule?
  - A) 1
  - B) 3
  - C) 6
  - D) 12
4. What does the Calvin cycle use from the light reactions?
  - A) Oxygen and water
  - B) ATP and NADPH
  - C) Glucose and CO<sub>2</sub>
  - D) Chlorophyll only
5. How many CO<sub>2</sub> molecules and full turns of the Calvin cycle are needed to produce one molecule of glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>)?
6. If 6 turns of the Calvin cycle are needed for 1 glucose, and each turn uses 3 ATP and 2 NADPH, how much ATP and NADPH are needed total?
7. A plant cell fixes 15 CO<sub>2</sub> molecules in an hour. How many G3P molecules exit the cycle net (usable for sugar synthesis) in that time?
8. Define: Where does the Calvin cycle occur?
9. Define: What enzyme fixes CO<sub>2</sub> in the Calvin cycle?
10. Define: What are the three phases of the Calvin cycle?

## Answer Key

1. C) Chloroplast stroma - The Calvin cycle's reactions occur in the fluid stroma surrounding the thylakoids.
2. B) RuBisCO - RuBisCO attaches CO<sub>2</sub> to RuBP, the first step of carbon fixation.
3. C) 6 - Glucose has 6 carbons and each turn fixes 1 CO<sub>2</sub>, so 6 turns are required.
4. B) ATP and NADPH - ATP provides energy and NADPH provides reducing power for the reduction phase.
5. Glucose has 6 carbons, and each turn of the cycle fixes 1 CO<sub>2</sub> (1 carbon). Turns needed = 6 carbons / 1 carbon per turn = 6 turns. So 6 CO<sub>2</sub> molecules and 6 turns of the Calvin cycle are required to build one glucose molecule.
6. ATP per turn = 3, turns = 6, total ATP = 3 6 = 18 ATP. NADPH per turn = 2, turns = 6, total NADPH = 2 6 = 12 NADPH. So producing one glucose molecule costs 18 ATP and 12 NADPH.
7. Every 3 CO<sub>2</sub> fixed nets 1 G3P leaving the cycle (since 3 turns net 1 G3P for carbohydrate synthesis). G3P exported = 15 CO<sub>2</sub> / 3 = 5 G3P molecules. So 5 G3P molecules are available to build sugars.
8. In the stroma of the chloroplast.
9. RuBisCO (ribulose-1,5-bisphosphate carboxylase/oxygenase).
10. Carbon fixation, reduction, and regeneration of RuBP.

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