

## Photo Description



Two monarch butterfly chrysalises hang from a concrete surface. One chrysalis is light brown and appears to be empty, while the other is bright green with small yellow spots and a black line at the top. The green chrysalis shows that a caterpillar has transformed and is developing into an adult butterfly inside.

## Scientific Phenomena

This image captures complete metamorphosis, specifically the pupal stage of monarch butterfly development. The green chrysalis contains a monarch caterpillar that has undergone dramatic internal reorganization - its body structures are literally dissolving and rebuilding into entirely different adult butterfly parts. This process, called histolysis and histogenesis, involves the breakdown of larval tissues and formation of adult structures like wings, reproductive organs, and new digestive systems. The empty brown chrysalis shows where an adult butterfly has already emerged through a process called eclosion.

## Core Science Concepts

1. Complete Metamorphosis: Monarchs undergo four distinct life stages (egg, larva, pupa, adult) with dramatic body changes between each stage.
2. Structural Adaptations: The chrysalis provides protection while internal transformation occurs, with its hard outer casing and camouflage coloring helping survival.
3. Life Cycle Patterns: This predictable sequence of development ensures species survival and allows monarchs to take advantage of different resources at different life stages.
4. Energy and Matter Transfer: The caterpillar's stored energy and body mass are reorganized (not lost) during metamorphosis to create the adult butterfly's completely different body plan.

### Pedagogical Tip:

Use real chrysalises or high-quality models alongside this photo to help students understand the three-dimensional nature of the structure. Students often think chrysalises are flat when only seeing photos.

### UDL Suggestions:

Provide multiple ways for students to track metamorphosis by offering options like drawing sequences, creating physical models with clay, acting out the stages, or building digital timelines to accommodate different learning preferences.

## Zoom In / Zoom Out

1. Zoom In: Inside the chrysalis, imaginal discs (clusters of cells that remained dormant during the caterpillar stage) are rapidly dividing and differentiating to form wings, antennae, legs, and reproductive organs through controlled gene expression.
2. Zoom Out: Monarch metamorphosis timing connects to continental migration patterns, seasonal changes, and milkweed plant availability across North America, supporting ecosystem relationships spanning thousands of miles.

### Discussion Questions

1. What evidence from the photo shows that major changes happen during the chrysalis stage? (Bloom's: Analyze | DOK: 2)
2. How might the timing of metamorphosis help monarch butterflies survive in their environment? (Bloom's: Evaluate | DOK: 3)
3. What would happen to monarch populations if something disrupted their ability to form chrysalises? (Bloom's: Synthesize | DOK: 3)
4. Why do you think complete metamorphosis evolved as a successful life strategy for many insects? (Bloom's: Evaluate | DOK: 4)

### Potential Student Misconceptions

1. Misconception: The caterpillar simply grows wings inside the chrysalis.  
Reality: The caterpillar's body completely breaks down and rebuilds into an entirely different organism with different body parts, behaviors, and diet.
2. Misconception: The chrysalis is like a house or shelter the caterpillar builds.  
Reality: The chrysalis IS the transformed caterpillar - it's the caterpillar's own hardened outer skin, not a separate structure.
3. Misconception: All insects go through the same life cycle changes.  
Reality: Only some insects undergo complete metamorphosis; others have incomplete metamorphosis or direct development.

### Cross-Curricular Ideas

1. Mathematics - Data Collection & Graphing: Have students track the timeline of monarch metamorphosis by researching or observing chrysalises over time. Students can create bar graphs or line graphs showing how many days pass between chrysalis formation, development stages, and butterfly emergence. This connects to measurement, time, and data representation skills.
2. ELA - Narrative Writing & Life Cycle Stories: Students can write a first-person narrative from the perspective of a monarch caterpillar, describing what they "experience" during metamorphosis and emergence. Alternatively, students can research and write informational texts about monarch migration patterns, combining science knowledge with writing standards about organizing information logically.
3. Art - Symmetry & Natural Design: Students can create detailed drawings or paintings of monarch butterflies, focusing on the bilateral symmetry of wings and the geometric patterns of their markings. This connects art standards about observational drawing while reinforcing the concept that the chrysalis produces a beautifully patterned adult butterfly.

4. Social Studies - Migration & Environmental Stewardship: Investigate the monarch butterfly's multi-generational migration between Mexico and Canada, exploring geography, seasonal changes, and ecosystems across different regions. Students can learn about conservation efforts to protect milkweed habitats and discuss how human actions impact monarch populations and biodiversity.

### STEM Career Connection

1. Entomologist (Bug Scientist): Entomologists study insects like monarch butterflies to understand how they live, grow, and interact with their environments. They might raise monarchs in laboratories, track migration patterns, or figure out why butterfly populations are changing. They help protect endangered insects and teach others about their importance. Average Salary: \$65,000 - \$75,000 per year

2. Conservation Biologist: Conservation biologists work to protect animals and plants that are in danger of disappearing. Some conservation biologists focus on monarch butterflies by protecting the milkweed plants they need to survive and creating safe spaces for them to complete their life cycles. Average Salary: \$58,000 - \$70,000 per year

3. Science Educator or Museum Educator: These professionals teach people of all ages about insects, metamorphosis, and nature by creating exhibits, leading demonstrations, and running programs at museums, zoos, and nature centers. They might even raise live monarch chrysalises to show visitors the amazing transformation happening inside! Average Salary: \$42,000 - \$60,000 per year

### NGSS Connections

- Performance Expectation: 5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment
- Disciplinary Core Ideas: 5-LS1.B, 5-LS2.A, 3-LS1.B
- Crosscutting Concepts: Patterns, Systems and System Models, Energy and Matter

### Science Vocabulary

- \* Chrysalis: The hard protective casing where a caterpillar transforms into a butterfly.
- \* Metamorphosis: The process of changing from one life stage to a completely different form.
- \* Pupa: The life stage when an insect transforms from larva to adult inside a protective covering.
- \* Eclosion: The process of an adult insect emerging from its pupal case.
- \* Imaginal discs: Special groups of cells that develop into adult body parts during metamorphosis.

### External Resources

Children's Books:

- Monarch Butterfly by Gail Gibbons
- From Caterpillar to Butterfly by Deborah Heiligman
- Waiting for Wings by Lois Ehlert