

## Photo Description



A green chrysalis hangs from a wooden structure, showing the pupal stage of a butterfly's life cycle. The chrysalis has a smooth, jade-colored surface with small dark spots and appears to be firmly attached to the wood above it. This protective casing contains a developing butterfly that is undergoing complete metamorphosis.

## Scientific Phenomena

This image shows the pupal stage of complete metamorphosis in butterflies. Inside this chrysalis, the caterpillar's body is being completely reorganized through a process called histolysis (breaking down old tissues) and histogenesis (building new tissues). Special groups of cells called imaginal discs, which were dormant during the larval stage, are now rapidly dividing and forming the adult butterfly's wings, legs, antennae, and reproductive organs. This transformation is controlled by hormones and represents one of nature's most dramatic examples of biological reorganization.

## Core Science Concepts

1. Complete Metamorphosis: Butterflies undergo four distinct life stages - egg, larva (caterpillar), pupa (chrysalis), and adult - with dramatic changes between each stage.
2. Structural Adaptations: The chrysalis provides protection while allowing gas exchange and has attachment structures to secure it during the vulnerable transformation period.
3. Life Cycle Patterns: This represents a predictable, repeating pattern in butterfly development that ensures species survival and reproduction.
4. Energy and Matter Transformation: The caterpillar's stored energy and body materials are reorganized to build entirely new structures needed for the adult butterfly's different lifestyle.

### Pedagogical Tip:

Use a "Wonder Wall" where students can post questions about what they think is happening inside the chrysalis. Return to these questions throughout your unit to see how student thinking evolves.

### UDL Suggestions:

Provide multiple ways to represent metamorphosis: physical models students can manipulate, time-lapse videos, and hands-on activities like clay modeling of each stage to support different learning preferences.

## Zoom In / Zoom Out

1. Zoom In: At the cellular level, specialized enzymes are dissolving most of the caterpillar's tissues while stem cell-like structures called imaginal discs are rapidly dividing and differentiating to form completely new organs and body parts.

2. Zoom Out: This metamorphosis is part of a larger ecosystem strategy where the larval stage (caterpillar) specializes in growth and energy storage while the adult stage specializes in reproduction and dispersal, reducing competition between life stages and maximizing species survival.

### Discussion Questions

1. What advantages might complete metamorphosis give butterflies compared to animals that look similar throughout their lives? (Bloom's: Analyze | DOK: 3)
2. How do you think the chrysalis structure protects the developing butterfly while still meeting its needs? (Bloom's: Apply | DOK: 2)
3. What patterns do you notice in the timing and location where butterflies form their chrysalises? (Bloom's: Analyze | DOK: 2)
4. If you could design the perfect protection for a transforming animal, what features would you include and why? (Bloom's: Create | DOK: 3)

### Potential Student Misconceptions

1. Misconception: The caterpillar just grows wings inside the chrysalis.  
Reality: The caterpillar's body is almost completely broken down and rebuilt using entirely different body plans and structures.
2. Misconception: The chrysalis is like a cocoon that the caterpillar spins around itself.  
Reality: The chrysalis is actually the caterpillar's final molt - it's the hardened outer skin, while cocoons are silk structures spun by moths.
3. Misconception: The transformation happens quickly, like in cartoons.  
Reality: Metamorphosis typically takes 1-2 weeks and involves complex, gradual cellular changes throughout the entire process.

### Cross-Curricular Ideas

1. Math - Data Collection & Graphing: Have students research and graph the typical duration of chrysalis stages for different butterfly species. Create bar graphs comparing how long monarchs, swallowtails, and painted ladies stay in their chrysalis stage. Students can calculate averages and make predictions about when butterflies will emerge from collected chrysalises.
2. ELA - Narrative Writing & Poetry: Students write a "day in the life" narrative from the perspective of a caterpillar entering the chrysalis, describing what they imagine happening inside. Alternatively, create acrostic or haiku poems about metamorphosis, using sensory language to describe the transformation process.
3. Art - Mixed Media Sculpture: Students create three-dimensional chrysalis models using papier-mâché, clay, or other materials. They can paint them realistically or artistically, and create display pieces showing all four life stages. This tactile experience deepens understanding of the chrysalis structure and its protective features.
4. Social Studies - Environmental Conservation: Research how habitat loss affects butterfly populations and chrysalis survival. Students can create awareness campaigns or design butterfly gardens for their school or community, connecting life cycles to real-world environmental stewardship and local ecosystems.

### STEM Career Connection

1. Entomologist (Insect Scientist): Entomologists study insects, including how butterflies grow and change. They observe chrysalises, conduct experiments about metamorphosis, and work to protect butterfly populations. Some entomologists help farmers by studying how different insects affect crops. Average Salary: \$63,000/year
2. Ecological Restoration Specialist: These scientists help restore natural habitats where butterflies and other animals can thrive. They plant native flowers, create butterfly gardens, and monitor chrysalis survival in wild areas to keep butterfly populations healthy. Average Salary: \$58,000/year
3. Science Educator/Museum Curator: Science educators at nature centers and museums create live butterfly exhibits, care for chrysalises, and teach visitors about metamorphosis. They design hands-on activities that help people of all ages understand insect life cycles and appreciate nature. Average Salary: \$52,000/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 - Growth and Development of Organisms, 5-LS2.A - Interdependent Relationships in Ecosystems
- Crosscutting Concepts: Patterns, Systems and System Models, Structure and Function

### Science Vocabulary

- \* Metamorphosis: A complete change in form and structure as an animal develops from young to adult.
- \* Chrysalis: The hard protective casing around a developing butterfly during its pupal stage.
- \* Pupa: The life stage when an insect transforms from larva to adult inside a protective covering.
- \* Life cycle: The series of changes an organism goes through as it grows and develops.
- \* Adaptation: A special feature that helps an organism survive in its environment.

### External Resources

#### Children's Books:

- From Caterpillar to Butterfly by Deborah Heiligman
- The Very Hungry Caterpillar by Eric Carle
- Waiting for Wings by Lois Ehlert