Cicada Shell

Life Science | Lesson Guide

5th Grade

Photo Description

This image shows an empty brown shell, called an exoskeleton, that a cicada left behind on tree bark covered with colorful lichen. The shell still has the same shape as the cicada's body, including its legs and wings, but the cicada itself has crawled out and moved on. Around the shell, you can see patches of green and gray lichen growing on the bark.

Scientific Phenomena

This photograph captures exoskeleton shedding (ecdysis), a critical stage in the cicada's metamorphic life cycle. Cicadas spend most of their lives (2-17 years, depending on species) underground as nymphs. When conditions are right, they emerge, climb to vegetation, and their exoskeleton splits open along the back. The adult cicada pulls itself out and leaves behind this hollow shell. This happens because cicadas have hard, rigid outer skeletons that don't grow—they must shed these shells multiple times to reach adult size, and finally, to reveal their adult wings and body.

Core Science Concepts

1. Incomplete Metamorphosis & Life Cycles
   - Cicadas undergo incomplete metamorphosis with distinct life stages: egg, nymph, and adult
   - Each stage has different appearances, habitats, and behaviors
   - The nymph stage is the longest phase of the cicada's life

2. Adaptation & Structure Function
   - Exoskeletons are rigid outer coverings that protect soft body parts inside
   - As cicadas grow, they must shed their exoskeletons periodically to allow growth
   - The shedding process reveals wings and body structures adapted for adult survival (flight, reproduction, feeding)

3. Organism & Environment Interactions
   - Cicadas spend years underground in soil, feeding on plant roots
   - Environmental triggers (temperature, moisture, seasonal changes) signal when it's time to emerge
   - They must find safe places on trees to complete their transformation

4. Observable Evidence of Living Processes
   - Empty exoskeletons are evidence that an organism has grown and changed
   - Finding these shells helps scientists study cicada populations and timing

> **Pedagogical Tip:**
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> Rather than lecturing about cicada metamorphosis, bring in actual cicada shells (if available) or high-quality photos and ask students to observe first. Let them describe what they see—Is it empty? Does it have legs? Where would the insect's body have been?—before introducing the vocabulary. This observation-first approach builds genuine curiosity and makes the science stick.

UDL Suggestions:

Multiple Means of Representation: Provide visual models showing the stages of cicada life (diagrams, animations, or physical models). Include written descriptions alongside images. Consider showing a time-lapse video of a cicada actually shedding its skin to make the process concrete.

Multiple Means of Action & Expression: Allow students to demonstrate understanding by drawing the life cycle, creating a physical model with craft materials, or building a life cycle wheel they can manipulate. Some students may prefer verbal explanations or writing, while others benefit from hands-on creation.

Multiple Means of Engagement: Connect to student interests by asking, "Have you ever heard cicadas buzzing in summer?" or "Why might an animal need to shed its skin?" This makes the science personally relevant.

Zoom In / Zoom Out

Zoom In: Cellular Level – How the New Exoskeleton Forms

Beneath the old, rigid exoskeleton, cicada cells are busy building a brand-new, larger shell. This new exoskeleton is made of a tough material called chitin (pronounced "KY-tin"), which is produced layer by layer by special skin cells called the epidermis. Before the cicada sheds, the new exoskeleton is soft and wrinkled, folded up underneath the old one like an extra-large outfit packed into a tiny suitcase. Once the cicada breaks free and pumps air into its body, the new exoskeleton stretches out and hardens. At the cellular level, this is a race against time—if the new exoskeleton dries out too quickly, it won't expand properly, so cicadas must emerge in humid conditions and complete this process within hours.

Zoom Out: Ecosystem Level – Cicada Emergence and Food Webs

When thousands of cicadas emerge from the ground in a single season (especially during "brood years" when 17-year cicadas synchronize), they create a massive ecological event. These newly emerged adults become a temporary food bonanza for birds, reptiles, mammals, and even some spiders. The empty exoskeletons that litter tree bark and soil are recycled by decomposers and become nutrients that enrich the forest floor. Meanwhile, underground, the billions of nymph cicadas feeding on tree roots for years affect water and nutrient cycles in the soil. In some regions, cicada emergences are so predictable and abundant that local wildlife populations time their own breeding and feeding around this event. Understanding cicadas helps scientists see how one organism's life cycle connects to the health of entire forests and the creatures that depend on them.

Discussion Questions

1. "Why do you think the cicada had to leave its old shell behind instead of growing bigger while still wearing it?" (Bloom's: Understand | DOK: 2)

2. "If we found 100 of these empty shells at the base of one tree in July, what might that tell us about what happened there?" (Bloom's: Analyze | DOK: 3)

3. "How is a cicada shedding its exoskeleton similar to you outgrowing your clothes? How is it different?" (Bloom's: Evaluate | DOK: 3)

4. "Underground, cicada nymphs look very different from adults. Why might it be helpful for cicadas to look so different at each stage of their life?" (Bloom's: Synthesize | DOK: 4)

Potential Student Misconceptions

Misconception 1: "The cicada died and this is just its dead body left behind."
Clarification: The exoskeleton is not the cicada itself—it's like a suit of armor the cicada wore while it was growing underground. The real cicada (with its muscles, brain, and organs) crawled out and is alive and healthy! The empty shell is just the hard outer covering that was left behind because it couldn't stretch any bigger. The cicada that shed it is flying around, singing, and finding food as an adult.

Misconception 2: "All insects grow bigger each year like people do, so they should be able to wear the same exoskeleton."
Clarification: Unlike our skin, which can stretch and grow with us, an insect's exoskeleton is rigid and doesn't bend or expand. It's made of hard material called chitin (like the shell of a crab). Once the cicada inside gets too big for its shell, it has to split it open and crawl out, just like you'd have to take off your winter coat if you suddenly grew and it became too small. Insects shed their exoskeletons several times before becoming adults—humans just grow one new layer of skin underneath the old one.

Misconception 3: "The cicada probably finds a new shell somewhere else, like hermit crabs do."
Clarification: Cicadas don't "move into" a new exoskeleton like hermit crabs find new shells. Instead, their body makes a new exoskeleton underneath the old one while they're still wearing it. When it's time to shed, they split open the old shell and the new one (which has been growing underneath) expands and hardens in the air. Every cicada produces its own brand-new exoskeleton from the inside out—it's not something they find or borrow.

Extension Activities

1. Cicada Life Cycle Model Creation
   - Provide students with craft materials (paper, clay, yarn, markers) and ask them to create a 3D or 2D model showing all stages of the cicada life cycle: egg, underground nymph (multiple instars), emerging nymph, and winged adult. Display models and have students explain each stage to peers. This builds understanding through tactile, visual, and verbal modalities.

2. "Detective Investigation: What Can We Learn From an Empty Shell?"
   - If you can obtain cicada shells, give students hand lenses and observation sheets. Ask them to examine the shell's structure carefully: How many legs does it have? Can you see where the wings were? Is there an opening where the insect crawled out? Students can sketch their observations and record 3-5 facts they discover. Connect findings to adaptations and structure-function relationships.

3. Emergence Timeline & Local Research
   - Partner with your school librarian or use online resources (Project Cicada, University extension databases) to research when cicadas emerge in your region. Create a classroom timeline showing cicada emergence dates over several years. Discuss: Why do you think the dates vary? What environmental factors might affect timing? Students can track local cicadas during actual emergence season and report findings (with adult supervision and safety protocols).

Cross-Curricular Ideas

ELA Connection: Life Cycle Narrative Writing
Ask students to write a first-person narrative from the perspective of a cicada: "My Life Underground" or "The Day I Left My Shell Behind." Students describe their 13-year underground journey as a nymph, then their dramatic emergence and transformation into an adult. This combines storytelling with scientific accuracy and helps students internalize the cicada's life stages while practicing descriptive writing, sequencing, and perspective-taking.

Math Connection: Cicada Emergence Data & Graphing
Provide students with real data about cicada emergence populations over multiple years in your region (or a sample dataset). Have students create bar graphs, line graphs, or pictographs showing how many cicadas emerged each year, which years had the most emergence, and whether there are patterns. Extend by calculating: "If 1 million cicadas emerged in one forest and they cover 4 trees, about how many cicadas are on each tree?" This builds data interpretation and estimation skills.

Social Studies Connection: Indigenous Knowledge & Cicada Cycles
Research and discuss how Native American tribes and early settlers used cicada emergence as a natural calendar or seasonal marker (e.g., "Plant corn when the cicadas emerge"). Have students interview family members or community elders about local signs of seasonal change and create a classroom "seasonal calendar" that blends scientific understanding with cultural observations. This honors diverse ways of knowing and connects science to human communities and traditions.

Art Connection: Observational Drawing & Lichen Appreciation
Using the photo as inspiration, have students create detailed observational drawings of the exoskeleton and the lichen around it, paying attention to texture, color, and pattern. Use colored pencils, pastels, or watercolors to capture the browns, grays, and greens visible in the image. Display finished drawings alongside the original photo and discuss how artists use observation skills similar to scientists. Extend by researching lichen as a living organism and its role in forest ecosystems, then creating a mixed-media art piece that celebrates decomposition and nutrient cycling.

STEM Career Connection

Entomologist (Insect Scientist)
An entomologist is a scientist who studies insects—including cicadas! They observe cicadas in nature, count populations, track when they emerge, and study how they behave and survive. Some entomologists work in labs, while others spend time outside in forests catching and examining insects. They help us understand how insect populations are changing because of climate change or habitat loss, which helps protect forests and nature. To become an entomologist, you'd study science and biology in school, then go to college to learn even more about insects.
Average Annual Salary: $65,000–$75,000 USD

Wildlife Biologist
A wildlife biologist studies how animals like cicadas live in their habitats and how they interact with other plants and animals in their ecosystem. They ask questions like: "Why do cicadas time their emergence to match environmental conditions?" and "How do bird populations respond when billions of cicadas suddenly emerge?" Wildlife biologists use cameras, tracking devices, and careful observation to gather information. Some work for government agencies protecting forests and parks; others work for universities or nonprofits. This job involves lots of fieldwork outdoors and detective work!
Average Annual Salary: $62,000–$78,000 USD

Environmental Educator or Museum Naturalist
These professionals teach visitors (including students like you!) about insects, life cycles, and ecosystems through hands-on programs, exhibits, and nature walks. At nature centers, science museums, or outdoor education programs, they might bring live cicadas or exoskeletons to schools, lead guided forest walks where people hunt for evidence of metamorphosis, or create interactive displays explaining how insects fit into nature. If you love explaining science to others and sharing your excitement about nature, this career might be for you!
Average Annual Salary: $35,000–$55,000 USD

NGSS Connections

Performance Expectation:
5-LS1-1: Support an argument that plants get the materials they need for growth chiefly from air and water.
(Note: While this PE focuses on plants, cicada life cycles integrate with ecosystems and organism growth—see DCIs below)

Disciplinary Core Ideas:
- 5-LS1.A Structures and Functions: Exoskeletons and body parts have specific functions for survival
- 5-LS1.B Growth and Development of Organisms: Cicadas undergo metamorphosis in distinct life stages
- 5-LS2.A Interdependent Relationships in Ecosystems: Cicadas interact with soil, plants, and trees throughout their life cycle

Crosscutting Concepts:
- Patterns Life Cycle Patterns: Cicadas follow predictable patterns of growth, emergence, and reproduction
- Structure and Function The exoskeleton's rigid structure protects the insect, but must be shed for growth
- Cause and Effect Shedding occurs because the rigid exoskeleton cannot expand; environmental signals trigger emergence

Science Vocabulary

* Exoskeleton: A hard, stiff outer shell that covers and protects an insect's soft body (like armor made of chitin).
* Ecdysis (or molting/shedding): The process when an insect splits open its old exoskeleton and crawls out to reveal a new, bigger one underneath.
* Nymph: The young form of an insect that looks somewhat like the adult but is smaller and doesn't have wings yet.
* Metamorphosis: A big change in an organism's body shape and form as it grows from a baby to an adult.
* Lichen: A living thing made of a fungus and algae growing together; often seen as colorful patches on rocks and tree bark.
* Adaptation: A special body part or behavior that helps an organism survive and thrive in its environment.

External Resources

Children's Books:
- Cicadas: Mysterious Life Cycles by Joan Marie Galat (National Geographic Little Kids) – Picture book explaining cicada life stages with vibrant illustrations
- The Insect That Hides Inside a Tree by Monica Wellington – Narrative picture book following one cicada's journey
- Insects by Gail Gibbons – Comprehensive guide including detailed cicada information and diagrams
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Teaching Tip: This lesson works best in late spring or early summer when cicada emergence is actually occurring in your region. Real-time observation creates authentic engagement!