

The Caterpillar Lab

Educational Resources 2016



CECROPIA ECLOSION DETAILED VIDEO NARATIVE

BACKGROUND INFORMATION

This document focuses specifically on the cecropia eclosion video. For general information about eclosion, check out the “Eclosion FAQs and Teaching Guide” document at the top of our “Eclosion” resource page.

In the wild, cecropia caterpillars ([Hyalophora cecropia](#)) pupate inside a cocoon. Here in New England, cecropia pupation occurs in late summer and [pupae](#) remain inside their [cocoons](#) until it's time to emerge as adults. In New England, adult cecropia moths [eclose](#) from their pupa stage and emerge from their cocoons in May and June.

In this video, you will not see a cocoon. That's because we removed the pupa from its cocoon to view its eclosion process. While cecropia pupae need their cocoons for protection in the wild, in our lab they do not. [Properly removing the pupa from its cocoon](#) does not damage the pupa or pose a risk to the adult moth. You may have heard a popular myth that moths need to struggle out of their cocoons in order to become strong adults. Unfortunately, while that myth is often used as a pretty metaphor, it is untrue.

The Caterpillar Lab staff began filming this video as the pupa's body began to undulate in waves from the tip of its abdomen to its head. These movements, which you will observe in the video, signaled to us that the moth was preparing to [shed](#) its [old pupa skin](#) and emerge!

VIDEO NOTES

As the video begins, look for differences between the [creature](#) shown and the overwintering cecropia pupa in the photograph to the right. It looks pretty similar, right? But that's about to change.



In the first scene, the pupa is pulsing rhythmically. This pulsing is the first visible sign that its transformation is about to take place. An undeveloped pupa does not move like this.

Ten seconds in, notice how pale the creature looks in certain areas. The pale patterns are the white-colored parts of the adult moth's body, viewed through the pupa skin. Also observe how the creature's body moves in a wave, from abdomen to head. This undulation is the adult moth beginning to move forward within its old skin! Can you see how the adult moth inside is moving independently of its pupa skin now?



36 seconds in, look carefully at the creature's head. See some red and yellowish fuzz poking out from a split in the pupa skin? That is the adult moth, beginning to [eclose](#)! As the moth emerges, notice that it is facing down.

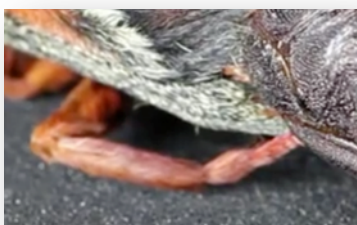


At 1:30, watch for the moth's antenna, which looks like a narrow, dark, curved line coming down from the moth's head.

At 1:42, the moth's progress really speeds up. If you look closely, you can see one of its folded wings emerging along its side, colored grey and white and reddish brown. The moth's abdominal segments come into view, one after another. See how yellow the moth's [skin](#) is, underneath its reddish brown and white fuzz? At this point the moth's skin is soft and flexible, which helps the moth wriggle out of its old pupa skin. With exposure to air, the skin will [sclerotize](#)—harden and darken.



At 1:52, watch one of the moth's reddish jointed legs emerge from the pupa skin.



By 1:59, your view has changed to the newly eclosed moth hanging from a stick. After a butterfly or moth ecloses, it must find a suitable place to expand and dry its wings. Cecropia moths seek out an overhanging surface to hang from during this process, which is exactly what this one has done. Watch as the moth's wings expand, like a two-dimensional water balloon, as it pumps [hemolymph](#) from its body into its wings. Notice how the moth's abdomen shrinks as its wings get larger.



At 2:57, admire the end result of the moth's wing pumping. Aren't its wings gorgeous? They have expanded and dried and the moth will soon be ready to fly.

Around 3:14, The Caterpillar Lab's Executive Director, Sam Jaffe, picks up the cecropia moth on his finger. [This won't harm the moth.](#)

At 3:25, check out the old shed pupa skin the moth left behind! It rolls off screen in a gentle breeze—not on its own. The skin is just a non-living shell at this point.



Technique: Properly removing a pupa from its cocoon

In order to give our audience a “behind the scenes” learning experience, we sometimes remove a pupa from its protective cocoon. This must be done with great care to avoid injuring the pupa. Use sharp, narrow scissors, making short snips with the blade tips only. Cut upwards, against the wall of the cocoon, rather than down into its contents. Work slowly. Cecropia cocoons are particularly easy to open, as they contain a relatively high amount of empty space to maneuver without hitting the pupa. Other cocoons may require more experience and skill to open without damaging the pupa.

After removal, pupae should be kept protected and placed on a rough surface so that an emerging moth can gain traction and pull itself out of the old pupa shell. If overwintering, a naked pupa needs to be kept warmer than those in cocoons – we place naked pupae in sealed containers in our refrigerator.

Technique: Handling giant silk moth adults

Large moths, like the cecropia, are relatively easy to hold and move around without causing harm. Put a finger in front of the moth's legs and gently push towards and underneath the moth until it grabs hold. Once the moth is on your hand, you can move it around or show it to an audience. If the moth begins to rapidly shiver its wings, this means it is preparing to take flight; at this point, you should quickly transfer it back to a cage or prepare to release it.

Sometimes large moths will tuck in their legs and flop about when disturbed. This makes picking them up much more difficult. We suggest that you let the flopping moth settle down and try again later. If you absolutely need to move a moth around but it will not grab onto your finger, or is too eager to take flight, carefully but firmly press all four wings together so the moth is being held with its wings closed over its back. Be careful not to rub the wings against each other and make sure no wings are left free to flap. A moth held in this way is completely restricted from making any movements that could lead to damage.

Leave any moth still expanding or drying its wings undisturbed, as moving the moth at this stage may seriously damage its wings. The first time you handle a moth after it ecloses, expect the moth to eject a stream of brown liquid called [meconium](#) from its abdomen. This fluid is a waste product of the metamorphic process and is ejected to lighten the moth's weight before its first flight.

Hyalophora cecropia

Cecropia giant silk moths are some of the largest flying insects in North America. They live in the United States, throughout the east coast and central states, from Florida to Ontario. Each year, Cecropia moths produce just one generation of caterpillars. In New England, they spin their cocoons and pupate by late summer and remain inside their cocoons until May or June, when they will emerge as adult moths. Though often uncommon, Cecropias are occasionally found in urban areas and may be more resistant to pesticides than other giant silk moth (Saturniidae) species. They are closely related to several other large, familiar moths, including luna and polyphemus moths.

GLOSSARY OF TERMS:

Cocoon: A shelter that some caterpillars construct and then pupate inside. Depending on caterpillar species, cocoons may range from a few leaves tied loosely together by silk, to complex and rugged silken structures. Not all caterpillars construct cocoons. It is important to distinguish the non-living cocoon from the living **pupa**.

Creature: During periods of transformation, it may be difficult to assign an organism to a well-defined life stage such as larva, pupa, or adult. There is a technical vocabulary that deals with these in-between states, but for our purposes we will refer to the transforming insect simply as "the creature".

Eclose: To emerge from a pupa as an adult insect.

Hemolymph: A fluid, similar to blood, that circulates within an insect's body. This fluid transports nutrients, but does not transport oxygen.

Hormone: A chemical an organism produces that acts within its own body, which changes its organs' activities and regulates its physiology and behavior.

Meconium: A waste product of the metamorphic process that a moth or butterfly expels before taking its first flight. Meconium is a liquid that, when ejected by a freshly **eclosed** moth or butterfly, may startle or repel predators.

Pheromone: A chemical an animal produces and secretes, which changes the behavior of another animal of the same species. Pheromones are capable of acting outside the body of the secreting animal.

Pupa: The middle stage between the larva (such as a caterpillar) and adult (such as a moth or butterfly) forms of an insect. The pupa stage is the creature's body itself, not a case or covering. Pupae are not mobile and they do not eat. Many species overwinter or wait out inclement seasons as pupae. All insects that go through complete metamorphosis go through a pupa stage, including butterflies and moths, beetles, flies, wasps, bees, ants, and others.

Sclerotin/Sclerotize: A component of insects' skin that makes it more rigid and tough. The harder structures of a caterpillar's body are sclerotized, including the head capsule and true legs. Pupae are heavily sclerotized.

Sericin: The glue that binds silk strands together to form a cocoon.

Shedding: The process of casting away an old exoskeleton to expose a newly grown exoskeleton beneath. All insects must shed their exoskeletons – including certain internal structures like the **tracheae**, foregut, and hindgut – as they grow. There are many vocabulary words associated with shedding that generally mean the same thing, including **shedding**, **moulting**, and **ecdysis**.

Shed Skin / Old Pupa Skin: The remains of an old layer of insect skin that has been replaced through the shedding process by a fresh, new layer. This discarded or soon-to-be discarded skin is called the **exuvia**.

Skin: There are many vocabulary words associated with an insect's skin, including **cuticle**, **integument**, **epidermis** and **exoskeleton**. These words may have subtle differences in when and how they are best used, but for our purposes here they may be considered synonymous.