

## EGG

1

**M**onarch eggs are usually attached to the underside of young milkweed leaves. They are laid singly, as opposed to the eggs that are laid in clusters by some other female insects. It is uncommon to find more than one on a single plant. The eggs are oval-shaped, off-white or yellow, and marked with a series of longitudinal ridges. The hard outer shell, or *chorion*, protects the developing larva.

**Height:** 1.2 mm  
**Time in this stage:** 3-8 days



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## MOLTING LARVA

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**W**hile the larval skin, or cuticle, supports and protects monarchs, its rigidity limits growth and it must be replaced periodically. The process of replacing the old cuticle is called molting. Molting begins when the old cuticle separates from the skin cells that underlie it, continues as the old cuticle is shed, and ends when the new cuticle hardens. The larva in this picture has just shed its old cuticle. The new cuticle is soft and flexible, thus permitting expansion before it hardens. After molting, monarch larvae usually eat the shed cuticle, thus recycling useful nutrients that it contains.



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## FIRST INSTAR LARVA

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**A** newly-hatched monarch larva is grayish-white, shiny, and almost translucent. It has no stripes or other markings. The body is covered with sparse setae (hair-like structures). Older first instar larvae have dark stripes.

After hatching, the first instar larva eats its eggshell. It then eats fine hairs on the surface of the milkweed leaf before eating the leaf itself. It feeds in a circular motion, leaving an arc-shaped hole in the leaf. First (and second) instar larvae respond to disturbance by dropping off the leaf on a silk thread, and hanging suspended in the air.

Photo of larva eating eggshell by Sonia Altizer



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## FIVE LARVAL INSTARS

4

**M**onarchs have five larval instars, or stages between shedding their cuticle (outer layer of skin). All five monarch instars, and an egg, are visible in this picture, at approximately life size.

**Length:** 2 mm to 45 mm  
**Time in this stage:** 9-16 days

During the 9-16 day period from the beginning of the first to the end of fifth instar stage, monarch larvae increase their body mass more than 2000 times, from about 0.5 mg to 1200 mg.



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## MILKWEED: ROYAL FOOD

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Monarch larvae can only eat plants in the milkweed family (*Asclepiadaceae*). There are over 100 species of milkweed in North America, but many of these species are very rare. The most common milkweed eaten by the larvae that will migrate to Mexico as adults is *Asclepias syriaca*, or common milkweed (left picture). This species is found throughout the northern US and southern Canada. A common host plant found in the southern US is *A. asperula*, or antelope horn milkweed (middle picture). *A. curassavica*, or tropical milkweed (right picture), grows wild in Mexico, and in gardens throughout the US.



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## LATE STAGE PUPA

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During the pupa stage, the body parts of the monarch are transformed to those that will be used during the adult stage. The muscles are reorganized to allow flight, and sperm and eggs begin to mature.

While the process of metamorphosis looks like four distinct stages (egg, larva, pupa and adult), by the time the larvae pupate, major changes toward the adult form have already occurred. The wings, proboscis, and antennae develop from clusters of cells within the larvae, and are visible on the surface of the newly-formed pupa.

One of the last changes to occur in the butterfly pupa is the formation and pigmentation of the scales. The day before the adult emerges the scales become visible under the pupal cuticle.

Photo by Mike Quinn, Texas Parks and Wildlife



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## PUPA

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Butterfly and moth pupae are immobile and hence vulnerable. Many moths form a cocoon around themselves before they pupate; this silken shelter protects them from predators. Most butterflies, including monarchs, rely on camouflage coloration to make the pupa inconspicuous.

Monarchs rarely pupate on milkweed, instead wandering up to several meters to find a pupation spot.

**Body length:** 18 to 25 mm  
**Time in this stage:** 8-15 days



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## NEWLY-ECLOSED ADULT

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The escape of an adult insect from the pupa cuticle is called eclosion. The cuticle splits and the adult pulls itself out. When the monarch first emerges from the pupa, its abdomen is very large and its wings are small and crumpled. The butterfly pumps hemolymph (blood) from its body into its wings, and the wings expand to full size over a period of several minutes. The monarch hangs with its head up, allowing gravity to help the wings unfold.

Monarchs, like many other insects, usually emerge early in the day. This may give them some degree of protection against predators during this vulnerable pre-flight period.

Photo by Carol Trench



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## ADULT MALE AND FEMALE 9

**M**ale monarchs can be distinguished from females by a dark spot on a vein on each hindwing. This spot is made of androconial scales. In close relatives of monarchs these scales produce a chemical used during courtship called a pheromone. Pheromones do not seem to be important in monarch courtship. Males are brighter orange than females, and have thinner wing veins.

**F**emale monarchs' veins are generally wider than males' and they have darker scales between the veins. Female monarch butterflies mate several times during their lives, and can lay more than 1000 eggs in captivity.

**Forewing length:** 45-55 mm

**Time in this stage:**

- 2-6 weeks, non-migratory
- 7-9 months, migratory



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## FALL MIGRATION 11

**M**onarchs cannot survive freezing temperatures, so they need to migrate to warmer locations for the winter. Butterflies from all over the central and northeastern US and southeastern Canada fly south to overwintering sites in Central Mexico. Another population west of the Rocky Mountains in the United States migrates to the coast of California, although recent research suggests that some monarchs from the west move south into Mexico; the dotted line on the map represents their movement.

No one knows exactly how monarchs navigate during their fall migration. Researchers have shown that monarchs use the position of the sun in the sky to tell them which direction to fly, but this doesn't explain how they find their relatively small overwintering area.

Map by Sonia Altizer, Michelle Solensky and Bruce Leventhal



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## MALE AND FEMALE ABDOMENS 10

**M**ale monarchs have a pair of claspers at the end of their abdomen that holds the female during mating.

**T**he end of the female's abdomen is rounder than the male's, and has a small notch on the lower side.

Photos by Bruce Leventhal



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## NECTARING ADULT 12

**W**hile monarch larvae can only eat plants in the milkweed family, the adults can consume nectar from a variety of flowers. Even though they do not grow in size, they need to eat to get the energy they need to stay alive. Nectar, which is about 20% sugar, provides this energy.

Fat, stored in the monarchs' abdomen, is critical to survival during the migration and also during the time that monarchs spend in Mexico. This fat comes from two sources, food the monarchs ate as larvae, and sugar in the nectar that they consume as adults. As they migrate south, the butterflies stop to drink nectar often and may even gain weight during their trip.

Photo by David Astin



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## FALL ROOSTING TREE

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Monarchs often cluster together in “roosting trees” as they migrate south in the fall. The same trees may be used over and over, and no one knows exactly how and why monarchs find the same trees year after year. It is very important that these trees are available during their fall migration. The photo on this card was taken in southern Texas.

Photo by Carol Cullar



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## MONARCH WINTER CLUSTERS

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Monarchs form clusters in trees located in oyamel forests on high mountain slopes. These forests serve as both an umbrella and a blanket for the butterflies, protecting them from weather extremes. Several researchers have found that more butterflies are killed during winter storms when they are in disturbed forests that provide less protection.



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## MEXICO MONARCH SITES

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Monarchs migrate to several locations in the Mexican Transvolcanic Belt. In most years, approximately 9 different colonies are occupied, but this number can range from 5 to 14. The number of monarchs that winter in Mexico varies a great deal from year to year.

Several presidential decrees have protected the land on which monarchs winter. This image, made from satellite photos, shows the area protected by a 1986 Presidential Decree and by a more recent 2000 Decree. The gold lines outline the buffer and core zones protected by the 1986 Decree around the Sierra Chincua, Sierra Campanario and Chivati-Huacal colonies (from top to bottom). The red line outlines the 2000 Decree core protected zone, and the blue line outlines the 2000 Decree buffer zone. The white dots are known locations of monarch colonies over the last 20 years.

Image courtesy of Lincoln Brower



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## BIRD PREDATION

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Predation by birds is an important natural cause of monarch mortality during the winter. Two bird species, black-headed grosbeaks and black-backed orioles, are the main predators. In some colonies, up to 9% of the butterflies are eaten by birds during the winter, and this number can be up to 15% when the forest is disturbed by logging, making it easier for the birds to reach the branches on which monarchs cluster.

Photo by Lincoln Brower



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## DRINKING WATER

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**T**hroughout the winter, millions of monarchs fly to nearby streams to drink water in the morning, returning to their trees in the afternoons. The monarch colonies move lower down the mountains later in the winter, probably because of the decreased availability of water at high altitudes as the dry season progresses.

The left image shows butterflies streaming down the mountain to reach streams at lower elevations. The butterflies in the image on the right are drinking from one of these streams.

Photos by Lincoln Brower



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## MONARCH COLONY

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**F**rom the air, monarch colonies in Mexico look like an orange blanket covering the oyamel forest. This photo, taken above the Campanario (Rosario) Reserve in 2000, shows how cleared areas are encroaching on monarch overwintering sites.



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## WINTER NECTARING

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**M**ost monarchs have enough fat when they arrive at the colonies to last them most of the winter. However, some run out of these fat reserves, and try to find nectar in flowers in and near the forests. Since there are millions of butterflies in a very small area, it is unlikely that many of them can get significant amounts of nectar from these flowers.



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## SPRING MIGRATION

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**I**n the middle of March, the monarchs that have survived the whole winter in the Mexican forest begin their flight back to the US. By the end of March, the colonies have completely dispersed, and the butterflies move back into the southern US, where they begin to lay eggs. The migratory butterflies move into the entire southeastern US, and their offspring continue the flight north after they become butterflies.

Map by Sonia Altizer, Michelle Solensky and Bruce Leventhal



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