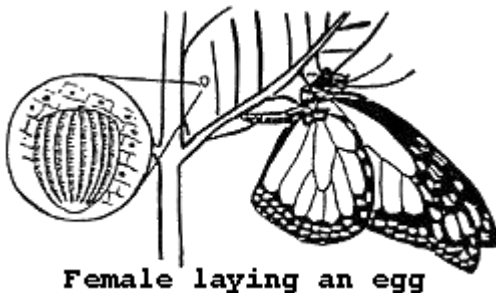


EGG STAGE

1. How many eggs does a female Monarch usually lay on one milkweed plant? ____
Given a choice, what age plant, or leaves, does she prefer?
2. The egg stage lasts 1-3 days. Look at the egg that you have been given. Is it upright or laying down on the leaf? _____
Describe its shape and size.
3. Describe the egg's color. How does the color change over time?
4. Is the egg located on top or on the underside of the leaf? _____,
near the leaf's edge or towards the center rib? _____
5. Use a hand lens or microscope to look more closely at the egg and the surrounding leaf surface. Describe what you see.
6. Newly born Monarch caterpillars are so small they could drown in a raindrop. When they are ready to pupate, after two weeks of eating, they weigh at least 2778 times as much as they did at birth. If an 8 pound newborn human baby could grow that fast, how much would, it weigh after two weeks? _____





1st instar

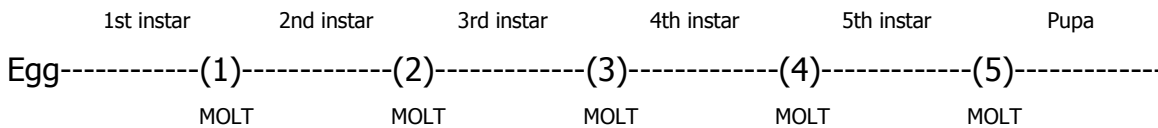


Head of 1st instar

YOUNG CATERPILLARS (1ST AND 2ND INSTARS)

Caterpillar growth is affected by temperature and humidity. They grow faster in warm, moist air than in cool, dry air. They can overheat when left in direct sunlight and will stop growing if left in a refrigerator or near an air conditioner vent.

Monarch caterpillars molt (shed their exoskeleton) five times as they grow. The stage between each molt is called an instar. When the 5th instar molts, it becomes the pupa.



Their appearance changes somewhat from one instar to another. The best way to identify the instar stage is by looking at (1) the length of the tentacles, (2) the size and markings on the head capsule. The length and width of the body, banding patterns and distinctive markings on the *prolegs* are also indicators of the instar stage.

1. How big are the caterpillars that you are observing?
2. Find some very small caterpillars with black heads and almost transparent bodies (no striping). What instar is this? _____
3. Can you see any tentacles on the head of these early instars? _____
Describe what you see.
4. It is difficult to pick up or touch young caterpillars without hurting them. Have one of your team transfer a small caterpillar from one leaf to another using a gentle rolling motion of a paintbrush. Describe any behavior you observe while doing this transfer.

Describe another way to do this transfer without using your hands or a paintbrush.

5. Find at least two kinds of evidence on or under the milkweed leaf that these caterpillars have been eating. Describe what you find.

Head of 2nd instar



2nd instar





Head of 3rd instar

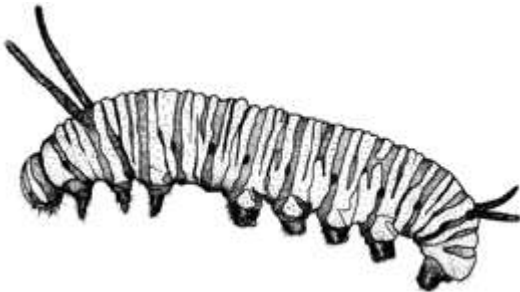


3rd instar

OLDER CATERPILLARS (3RD, 4TH AND 5TH INSTARS)

1. Describe the color pattern on your caterpillar.
2. How long are the tentacles? _____
Are they the same length on the front and back? _____
What do you think that they are used for?
3. Look at your caterpillar's feet. The three pair of legs (*true* or thoracic *legs*) behind the head are attached to the body segments that become the thorax of the adult butterfly. How are these true legs different from the other legs (*false* or *prolegs*) on the abdomen?

How many pairs of legs does a Monarch caterpillar have? _____
4. Older Monarch caterpillars have "white socks" above their shiny black "shoes." Does yours?
5. Have one member of your team transfer by hand an older caterpillar from one leaf to another. Describe any behavior that results and time how long it lasts.



4th instar



5th instar



Head of 4th instar

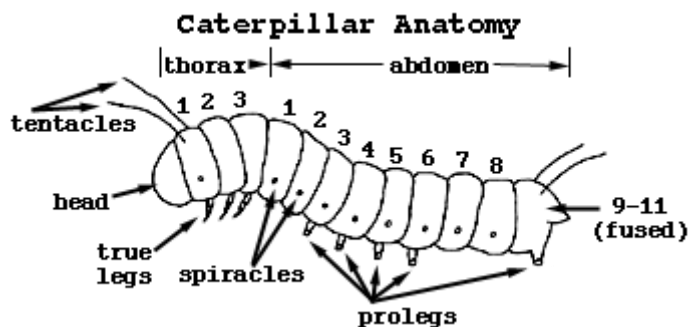


Head of 5th instar

6. A Monarch caterpillar can eat 20-30 milkweed leaves (perhaps an entire plant) during its two-week life as a larva. Observe your caterpillar as it eats. How is its eating different from the young caterpillar's?

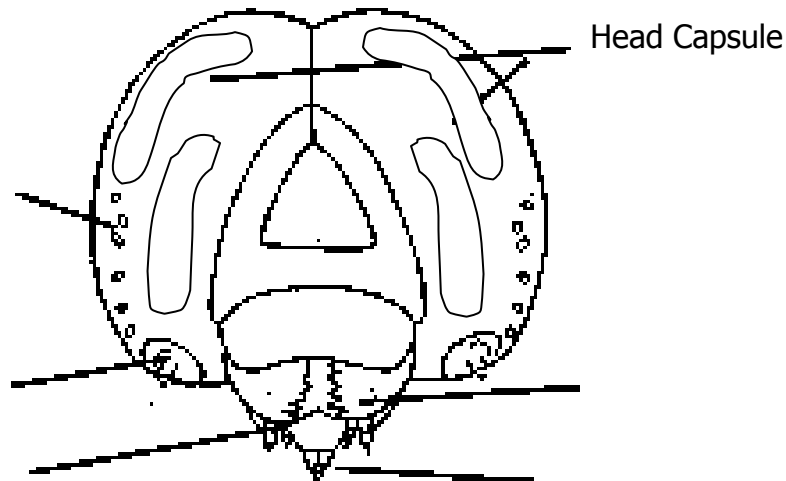
Towards the end of the 5th instar stage, the caterpillar may gnaw a notch in the leaf stem (petiole), like a logger felling a tree. This causes the leaf to fall to a vertical position with the caterpillar feeding underneath. Do you see evidence of this on your milkweed?

7. Monarch caterpillars breathe through 18 round holes (*spiracles*), nine on each side of their body. They are hard to find as they are usually hidden in a black stripe. See if you can find one of these *spiracles* on a large caterpillar by following the black stripe down from one of its rear tentacles.
8. When Monarch caterpillars are fully-grown, they suddenly stop eating and go on a "walkabout." The distance that they travel varies but pupae have been found as much as 70 meters from the closest milkweed. Having found a good site (a sheltered, horizontal surface), the caterpillar raises the front of its body and swings back and forth. Why do you think it does this?



MOLTING

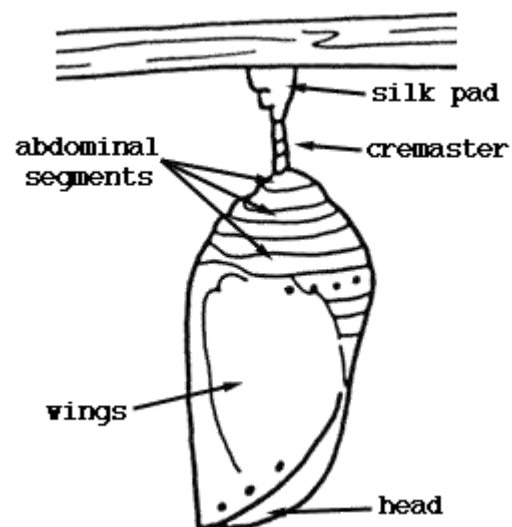
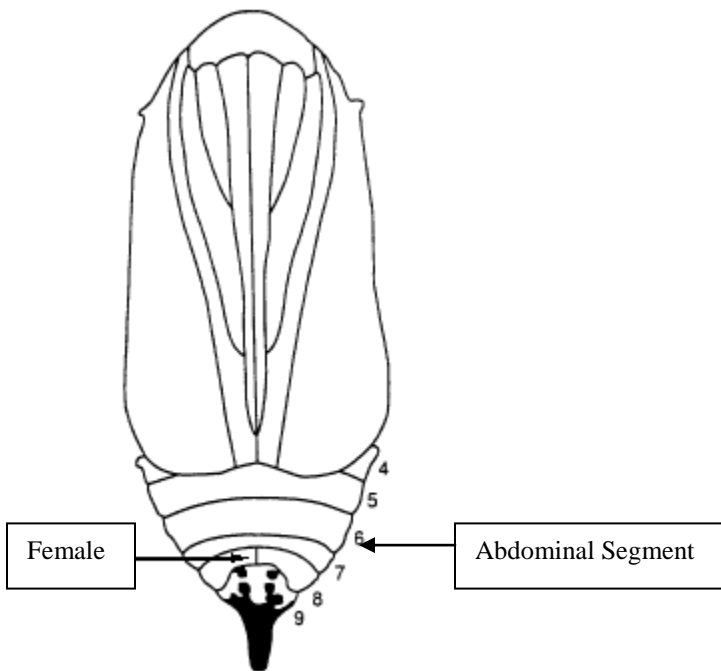
1. When a caterpillar is ready to molt or shed its exoskeleton, it stops feeding and may even leave the leaf that it is on. Through a series of motions, the exoskeleton is forced to the rear of the body and shed (molted). If you think that your caterpillar is getting ready to molt or has just molted, don't disturb it as it is very fragile in this condition. Look at the shed exoskeleton with a hand lens or microscope and describe what you see.
2. The head capsule is shed separately from the rest of the exoskeleton. Use a wet paintbrush to transfer a head capsule to a microscope for observation.
 - Follow the transparent stripe on the head capsule (It appeared yellow on the caterpillar's head) down either side to a black and white projection. These are the caterpillar's *antennae*.
 - In the black stripe above each of the antennae, are six dots, the size of pinpricks. These are the *ocelli* or simple eyes. There are twelve in all. These simple eyes are very different from the adult butterfly's compound eyes. Scientists believe that simple eyes are only capable of distinguishing light from dark and large from small.
 - Just below the antennae are two *maxillary palps* that are used to push food into the mouth. These palps have sensory cells which when they contact a leaf, can tell if it's milkweed. What do humans have that serves a similar purpose?
 - The *spinneret* is centered below the maxillary palps. This funnel-shaped device points downward and squirts two liquids together which when combined with air, form a silky thread. What does the caterpillar use this thread for?
 - Between the maxillary palps are the *mandibles* or jaws. Chewing is side-to-side rather than up-and-down as with humans.
3. Label and color (yellow) the head capsule.



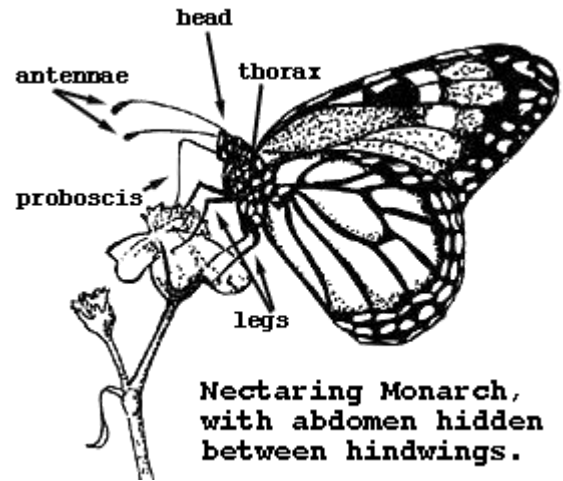
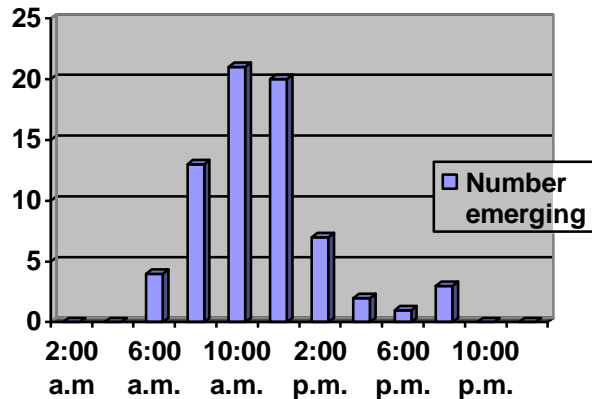
PUPA (CHRYSLIS) STAGE

A caterpillar in the "J" form will change into the pupa stage quickly. Keep an eye on the long front tentacles. When they shrivel, the pupa will form within two hours. When the head drops and the body looks more like an "L," the back tentacles shrivel and the prolegs begin to shrink, the pupa will form within about 30 minutes.

1. If you have a pupa, what is it hanging from?
2. In the first 12-19 hours after the pupa forms, it is soft with many folds and ridges. Over the next 7-12 days, it is a light jade green color. During the last 1-3 days, the pupa darkens revealing the butterfly inside. Which stage do you have?
3. Have one of your team members gently touch the pupa with a paintbrush. Does it move? ____ Newly formed pupae are very fragile and should not be disturbed until they harden (after 19 hours). Does the pupa still have its 5th instar exoskeleton attached or was it able to shake it off? ____ Why do most pupae try to shake off this molted exoskeleton?
4. Examine the ridges and folds on the outside of the pupa. You can make out the shape of the wings, adult antennae and the proboscis. The pair of gold dots closest to the unattached end are associated with the adult's large compound eyes. There is also a band of gold and dark spots higher up which lie over the 3rd segment of the butterfly's abdomen. How many more gold spots can you find? ____ What is their purpose?



ADULT STAGE



1. Study the graph. At what time of the day do adults most often eclose (emerge from the pupa)? Why do you think this is and what effect do you think that bad weather might have on this schedule?
2. The three main body parts of the adult are the head, _____ and _____.
3. How many wings does the adult have?
4. Describe 2-3 ways to distinguish between the male and the female Monarch.
5. How many legs can you find? _____ Why is this surprising?
6. Nearly the entire body of the Monarch is covered with scales of different shape and size. Put a wing under a microscope to see the scales layered like the shingles on a roof. Look at the thorax. Why do you think that the scales are so thick and long here? And why do you think that they are black in color?
7. Look at the compound eyes under a microscope. How do they differ from the simple eyes of the caterpillar?
8. Look at the *proboscis* (mouth) and see how it looks like a coiled drinking straw. The adult uses its *antennae* to hear, taste, and smell. In fact the adult can taste in four different places – on their antennae, their proboscis, their feet and even the tip of their abdomen! Describe the antennae.
9. Look at the feet (*tarsi*), which grip vegetation and flowers like Velcro. How many tarsi do you see? _____ The female tastes milkweed leaves with her feet before she lays an egg on it. When handling adult Monarchs, be gentle so as not to damage their tarsi.

MILKWEED

Monarch caterpillars only eat milkweed. There are at least 2,400 different kinds of milkweed in the world. Georgia has 22 native species. Swamp milkweed, (*Asclepias incarnata*) is one of those native species.



1. Look at the sample of milkweed. Does it grow as one stem or does it branch?
2. Are the stem and leaves hairy or smooth?
3. Do the leaves grow out from the stem in an alternate fashion or do they form opposite pairs?
4. Have one of your team break off a piece of the leaf to see the milky sap. What is the name of the plant that also has a milky sap and resembles milkweed (but Monarchs will not eat it)?
5. Compare the leaves of the two varieties of milkweed that you have. How are they different?
6. Take a milkweed flower apart. Describe what you see.

Resources: Monarch Watch <http://www.monarchwatch.org>
Monarch Larva Monitoring Project <http://www.mlmp.org>