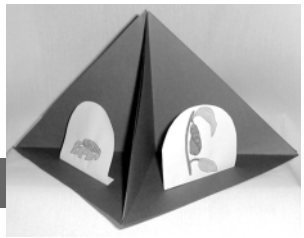
What is complete metamorphosis?

Insect Concepts:

- Nearly all insects pass through changes in their body form and structure as they grow.
- The process of developing in stages is called metmorphosis.
- There are two types of metamorphosis – complete and incomplete.
- Complete metamorphosis has four stages of development: egg, larva, pupa, and adult.
- Complete metamorphosis always begins with an egg.
- The larva that hatches from the egg looks different from the adult that laid the egg.
- The larval stage is an active period when the young consume great quantities of food.
- After a period of time, the larva enters an inactive period called the pupal stage.
- During the pupal stage, the larva develops into the adult form.
- An adult insect, or imago, emerges from the pupa.

Vocabulary: metamorphosis (met ah MORE fuh sis) egg larva pupa adult *imago (i MAY go) *pupate



Read: *Lots of Science Library Book #10.*

Complete Metamorphosis – Graphic Organizer – Option 1 is a 3D Activity

Focus Skill: communicating information
Paper Handouts: 4 sheets of 8.5" x 11" paper a copy of Graphics 10A–D index cards
Graphic Organizer: Make four Pyramid Projects. Cut out Graphics 10A–D and color. Glue each Graphic onto each Pyramid.

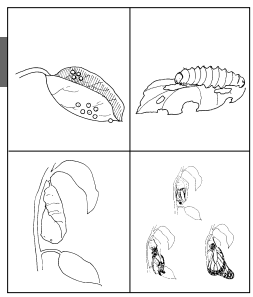
✎ Write one name on each of four index cards: *egg, larva, pupa, adult.* Match the card with the correct Pyramid Project.

✎✎ Complete ✎. Choose one insect that goes through complete metamorphosis and describe each stage on a separate index card.

✎✎✎ Complete ✎✎. Research insects and include the names of insects that undergo complete metamorphosis. Choose one insect and narrate its life in the first person.

Glue the Pyramid Projects together to make a Diorama. Review the four stages of complete metamorphosis.

Complete Metamorphosis – Graphic Organizer – Option 2 is a Lay–Flat Activity



Paper Handouts: 8.5" x 11" sheet of paper a copy of Graphics 10A–D
Graphic Organizer: Make a 4 Door Book. Cut out, color, and glue Graphics 10A–D on each tab of the 4 Door Book. Trim the graphic as needed. Refold it into a Hamburger. Write/copy *Complete Metamorphosis* on the cover. Open the tabs.

✎ Write the name of each stage accordingly: *egg, larva, pupa, adult.*

✎✎ Complete ✎. Choose one insect that goes through complete metamorphosis and describe each stage.

✎✎✎ Complete ✎✎. Research insects and include the names of insects that undergo complete metamorphosis. Choose one insect and narrate its life in the first person.

Butterfly in Waiting

Activity Materials: cardboard box plastic wrap tape jar knife

Activity: Find a chrysalis, a pupa case of a butterfly. Cut off a piece of the stem to which the chrysalis is attached. Cut off the lid of a cardboard box. Place the box on its side. Cut a hinged door on the top of the box. Make breathing holes or slits on the sides of the box. Tape plastic wrap over the front opening of the box. Open the hinged top and place the stem and chrysalis inside. Close the hinged top and watch the chrysalis. When the butterfly emerges from the chrysalis, wait until its wings are fully unfurled and dried (about 1–5 hours). Then release the butterfly in the location you found the chrysalis.

Raise Mealworms

Activity Materials: 2 dozen mealworms flat, plastic container with lid diced apple
piece of burlap or gauze window screening rolled oats
tape

Note: Mealworms are not worms, but the larvae of beetles.

Activity: Put a layer of oats in the bottom of the container. Place the apples on top of the oats. Place half of the mealworms on the apples. Cover this with the burlap. Repeat with layers of oats, apples, mealworms, and burlap. Cut a few holes in the container lid. Place the window screen over the holes and tape it securely in place. Place the lid on the container, place it where it will not be disturbed. Check it after a few days and periodically for the next few weeks.

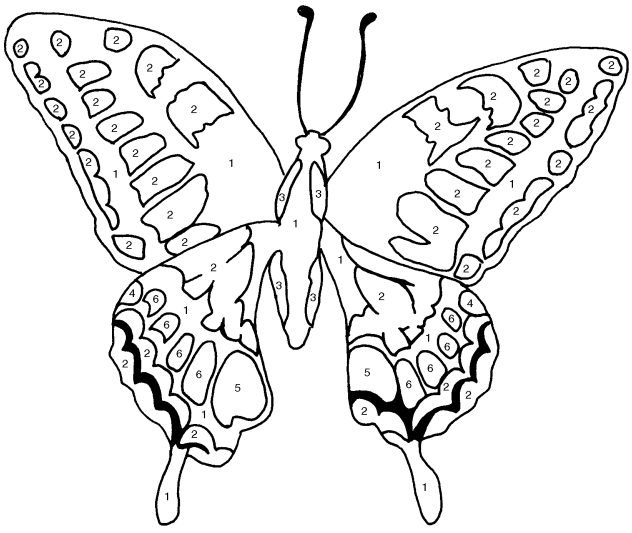
Note: The larvae will pupate in a few days and become adult beetles in a few weeks in a few weeks. The beetles will then lay eggs, and larvae will appear.

Butterfly and Chrysalis

Paper Handouts: a copy of Graphic 10E

Activity Materials: empty toilet paper tube black pipe cleaner popsicle stick
black paint or crayon

Activity: Cut out the butterfly or draw your own butterfly. Make a small hole on the top of the butterfly's head. Insert the pipe cleaner and make a V. Twist it to look like antennae. Glue the popsicle stick on the underside of the butterfly, and let dry. Color the toilet paper tube black to represent the chrysalis. Curl the wings slightly, and insert the butterfly into the chrysalis. Pull out the butterfly with the popsicle stick. Metamorphosis is now complete.



Experiences, Investigations, and Research

Select one or more of the following activities for individual or group enrichment projects. Allow your students to determine the format in which they would like to report, share, or graphically present what they have discovered. This should be a creative investigation that utilizes your students' strengths.

1. Compare and contrast the "direct development" of animals that are similar to their parents in form and structure at birth, to animals that develop through metamorphosis. Example: Compare and contrast the development of a cow and calf to a butterfly and caterpillar.

2. Using Graphics 10A–D, make stick puppets. Write a simple play about the metamorphosis of a butterfly and act it out with the puppets.

3. Research the use of maggots during World War II and in modern–day medicine.

4. *Who, What, When, Where:* Jan Swammerdam studied insects and defined the different types of metamorphosis.

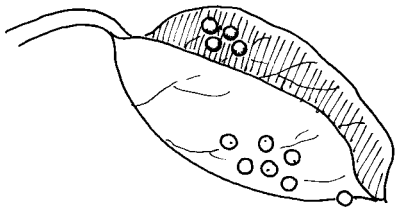
5. Research the molting process of an insect.

6. http://www.ifas.ufl.edu/~pest/vector/chapter_01.htm (University of Florida and the American Mosquito Control Association – Public Health Pest Control)

7. http://www.discovery.com/area/science/micro/butterfly.html

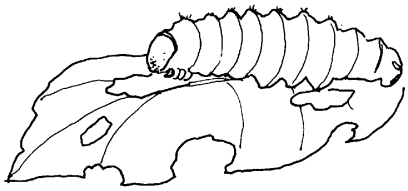
Complete Metamorphosis

10A



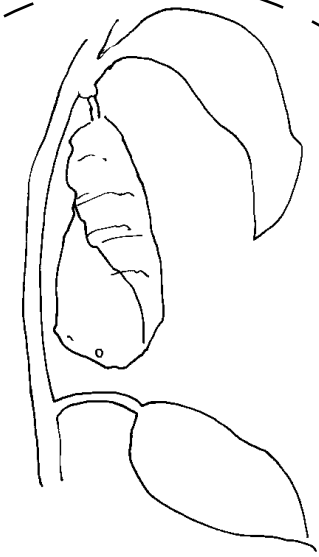
fold glue

10B



fold glue

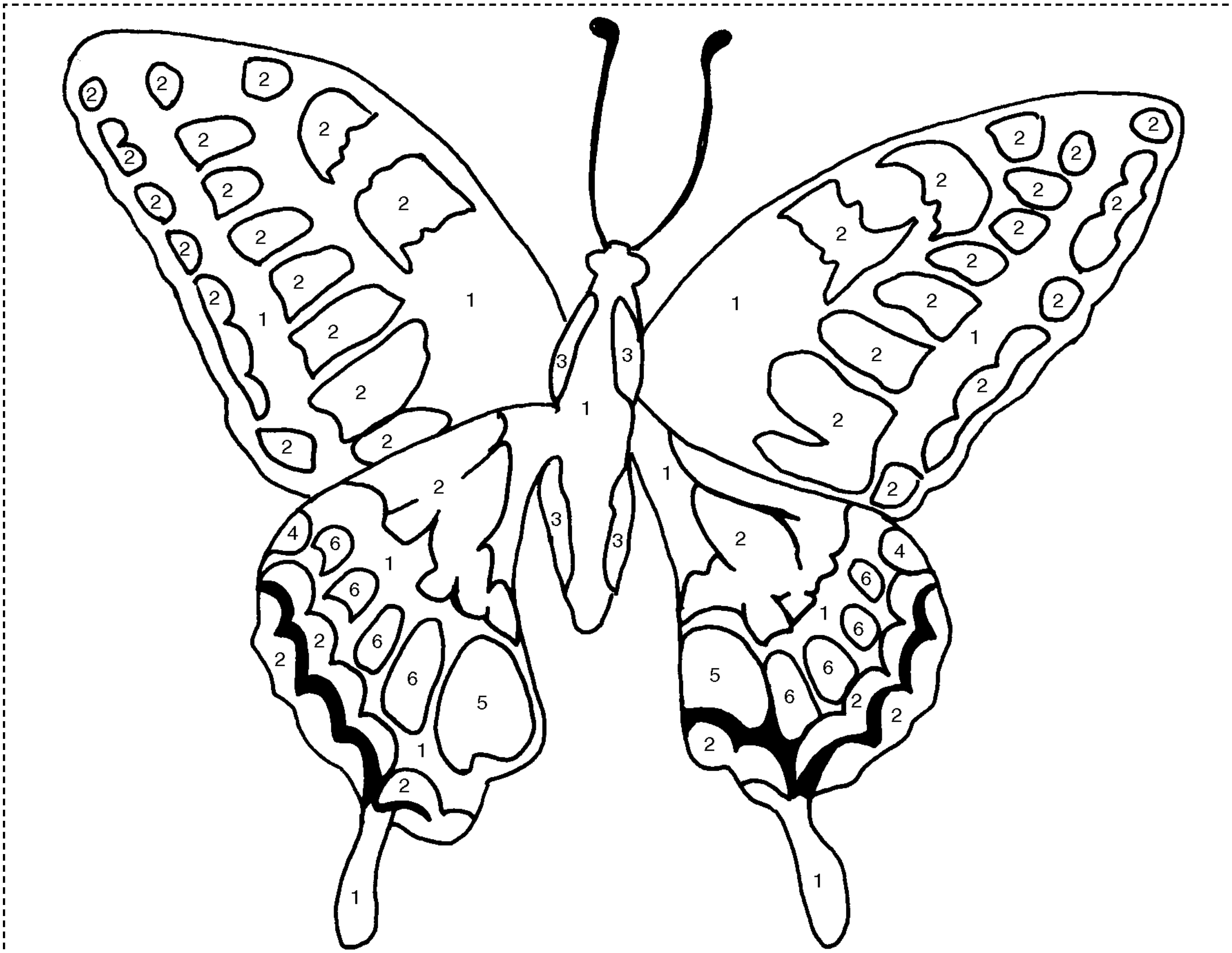
10C



fold glue

10D

fold glue



Lots of Science Library Books

Each *Lots of Science Library Book* is made up of 16 inside pages, plus a front and back cover. All the covers to the *Lots of Science Library Books* are located at the front of this section. The covers are followed by the inside pages of the books.

How to Photocopy the *Lots of Science Library Books*

As part of their *Great Science Adventure,* your students will create *Lots of Science Library Books.* The *Lots of Science Library Books* are provided as consumable pages which may be cut out of the *Great Science Adventures* book at the line on the top of each page. If, however, you wish to make photocopies for your students, you can do so by following the instructions below.

To photocopy the inside pages of the *Lots of Science Library Books:*

1. Note that there is a "Star" above the line at the top of each *LSLB* sheet.

2. Locate the *LSLB* sheet that has a Star on it above page 16. Position this sheet on the glass of your photocopier so the side of the sheet which contains page 16 is facing down, and the Star above page 16 is in the left corner closest to you. Photocopy the page.

3. Turn the *LSLB* sheet over so that the side of the *LSLB* sheet containing page 6 is now face down. Position the sheet so the Star above page 6 is again in the left corner closest to you.

4. Insert the previously photocopied paper into the copier again, inserting it face down, with the Star at the end of the sheet that enters the copier last. Photocopy the page.

5. Repeat steps 1 through 4, above, for each *LSLB* sheet.

To photocopy the covers of the *Lots of Science Library Books:*

1. Insert "Cover Sheet A" in the photocopier with a Star positioned in the left corner closest to you, facing down. Photocopy the page.

2. Turn "Cover Sheet A" over so that the side you just photocopied is now facing you. Position the sheet so the Star is again in the left corner closest to you, facing down.

3. Insert the previously photocopied paper into the copier again, inserting it face down, with the Star entering the copier last. Photocopy the page.

4. Repeat steps 1 through 3, above, for "Cover Sheets" B, C, D, E, and F.

How to assemble the *Lots of Science Library Books*

Once you have made the photocopies or cut the consumable pages out of this book, you are ready to assemble your *Lots of Science Library Books*. To do so, follow these instructions:

1. Cut each sheet, both covers and inside pages, on the solid lines.

2. Lay the inside pages on top of one another in this order: pages 2 and 15, pages 4 and 13, pages 6 and 11, pages 8 and 9.

3. Fold the stacked pages on the dotted line, with pages 8 and 9 facing each other.

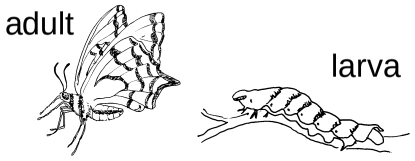
4. Turn the pages over so that pages 1 and 16 are on top.

5. Place the appropriate cover pages on top of the inside pages, with the front cover facing up.

6. Staple on the dotted line in two places.

You now have completed *Lots of Science Library Books*.

An advantage for insects that undergo complete metamorphosis is that they are able to have different habitats and food sources during their different stages.



The majority of insects develop from eggs. After hatching, most insects pass through stages of development called metamorphosis. Metamorphosis means a change in structure with age.

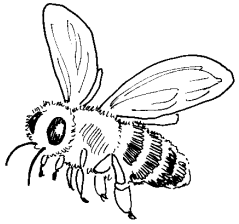
A newly formed adult insect emerges from the pupal case. It does not molt or grow any larger. Most insects that go through complete metamorphosis are winged as adults.

The adult stage in an insect's life is called the imago.

Female insects lay eggs. When the eggs hatch, the young insects, called larvae, do not look like adult insects. They are usually worm–like and wingless. A larva's diet is different from an adult's diet; therefore the larva has different mouthparts.

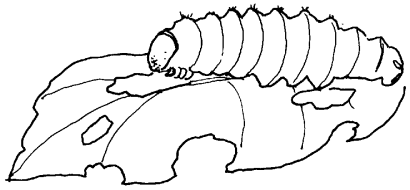
Some tropical butterflies live as adults for about a year, considerably longer than the time spent as caterpillars in their larval stage.

More advanced insects, such as beetles, moths, butterflies, bees, ants, flies, mosquitoes, and wasps, go through the stages of complete metamorphosis.

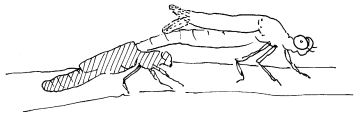


During this stage, insects develop reproductive parts and wings. When the changes are complete, the skin of the case splits and a newly formed adult emerges.

Each new larva that emerges looks similar to the previous one but it is larger. During this stage in an insect's life, a larva's job is to eat and eat and eat.

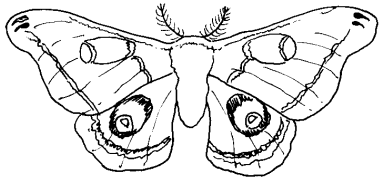


As a larva grows, it becomes too big for its exoskeleton, so it molts. The larva emerges, and soon its new exoskeleton hardens. The number of times a larva molts varies with each species.



Incredible Insights into Insects

Green–colored larva of polyphemus moths eat 86,000 times their birth weight in the first 48 hours of life.



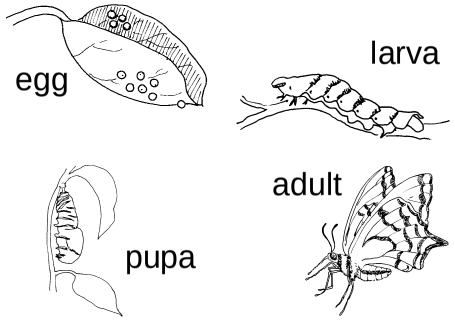
There are two kinds of metamorphoses: complete metamorphosis and incomplete metamorphosis. Some wingless insects, such as silverfish, do not go through any kind of metamorphosis. Young silverfish look very similar to adult silverfish. They molt until they are fully grown.

Insects that go through complete metamorphosis have one major disadvantage: They cannot move during their pupa stage. They are vulnerable to parasites and predators. Therefore, larvae must find a safe place to become a pupa.

The larval stages of some insects are so distinct that they have special names. For example, beetle larvae are called grubs. Fly larvae are called maggots. Butterfly and moth larvae are called caterpillars.

After a larva has eaten enough, it becomes a pupa. Pupa is a Latin word meaning “doll.” A pupa looks like a doll wrapped in a blanket. During the pupa stage, insects do not move around or eat. Their bodies break down completely and reassemble inside the protective case.

About 80% of all insects go through the four stages of complete metamorphosis: egg, larva, pupa, and adult.



An adult insect’s job is to mate. Females mate and then lay eggs. The length of time an insect lives as an adult varies considerably. A mayfly emerges as an adult, mates, lays eggs, and dies in one day.