Metamorphosis

Think Ahead Time: enough to have appropriate stages of insects

Objectives:
1. Students will be able to state that insects undergo a series of body transformations in which the insect may or may not look like the previous stage.
2. Students will be able to state that this process is called metamorphosis: change of form.
3. Students will be able to state that there are three types of metamorphosis: without metamorphosis, incomplete metamorphosis, and complete metamorphosis.
4. Students will know the meaning of immature and adult.
5. Students will be able to name the stages in complete metamorphosis: egg, larva, pupa, adult.
6. Students will be able to name the stages in incomplete metamorphosis: egg, nymph, adult.
7. Students will be to state that sometimes the type of mouthparts differs from immature form to adult.
8. Students will be able to state that immature insects never have functional wings but adults may.
9. Students will be able to state the type of metamorphosis of the following orders: butterflies and moths, flies and mosquitoes, beetles, true bugs, and grasshoppers and mantids.
10. Students will be able to state that the cocoon is a covering which surrounds the pupa in butterflies and moths.

Justification: Critical to understanding the success of the Class Insecta is an appreciation of the change of body form. It also poses certain obstacles which had to be overcome, such as molting.

Materials:
caterpillar (alive) large enough to be handled
fruit flies developing in Petri dishes
butterfly or moth pupa
dissecting microscope(s)
yellow mealworm larvae
yellow mealworm pupae
yellow mealworm adults
pictures of tadpoles and frogs
tobacco hornworm moth (alive or dead)
microscope
blowfly pupae
blowfly adults
cocoon of some butterfly or moth
blowfly larvae
small pantyhose
balloons with plastic containers

Preparation: none

Experiment Time: 45-60 minutes

Pre-assessment: Each student will demonstrate knowledge by correctly answering all of the following questions:
1. Do humans look different as they change from immatures to adults
2. What are some animals that look very different from immatures to adults?

Procedure:
K-2
1. Pass around all the different developmental stages of the milkweed bug, blow fly, mealworm, butterfly, and tobacco hornworm for the students to see. Allow the students to touch the hornworm pupa and larva.
2. Ask the students to explain what they see and feel. What are some of the differences and similarities?
3. Explain and show the students the correct order of the different stages of each insect (the teacher/student information sheet will help with terminology and understanding of each stage). You might want to put the different words on the calk board or make labels to put by each insect.
4. Once students have a good understanding of the stages have them do the “A Bug Life” worksheets.
5. Different Options for the worksheets (do one insect at a time)
   a. Students cut out only the pictures and then place them in the correct order
   b. Students cut out only the words and glue below the picture representing the correct stage
   c. Students cut out both the pictures and words. Teacher reads aloud a stage and the students have to point to or place the word cut out by the right stage.
   d. Mix together the different insect pictures from all the worksheets (with each stage cut out) and have the students put them in the right development order for that specie.
   e. A little more difficult task would be to leave the “word bank” off the bottom of the worksheet and have the students write the correct word in the space provided below.
6. Another alternative for this activity would be to have the different stages of each insect on a table and have the students observe them using a magnify glass or microscope. Then, have the students draw on a piece of paper (divided into sections) what they observed: specifically the different stages, but also the mouth parts, types of legs, body, outer covering, etc. For second grade students, have them write descriptive words below each picture.

**Grades 3 & up**

1. Pass around the shed exoskeleton of a cicada or other insect.
2. Ask students to speculate on what it is and why it is the way it is.
3. Ask students to examine the fruit flies in the dishes and fill out the Metamorphosis worksheet. **Caution students about opening the containers.**
4. Ask students to observe the differences of the milkweed bugs as they grow from immature to adult. Ask them how many stages they can observe in the dishes. (A teacher/student information sheet is included for knowledge on the different stages)
5. Ask students to compare the tobacco hornworm pupa and the tobacco hornworm larva. Ask them to try to tell what parts of the pupa will be when the adult moth emerges.
6. Finally students should compare the pupa of the tobacco hornworm, the yellow mealworm, and the blowfly. They specifically should look to see if they can find the body parts listed on the Metamorphosis worksheet.
State Standards Met

Kindergarten

Mathematics
K.3.1 Identify, sort, and classify objects by size, number, and other attributes. Identify objects that do not belong to a particular group.
K.5.1 Make direct comparisons of the length, capacity, weight, and temperature of objects and recognize which object is shorter, longer, taller, lighter, heavier, warmer, and cooler or holds more.

Science
K.2.2 Draw pictures and write words to describe objects and experiences.
K.6.1 Describe an object by saying how it is similar to or different from another object.

Social Studies
K.1.4 Identify and order events that take place in a sequence.

First

Science
1.1.1 Observe, describe, draw, and sort objects carefully to learn about them.
1.1.2 Investigate and make observations to seek answers to questions about the world, such as “In what ways do animals grow?”
1.1.3 Recognize that and demonstrate how people can learn much about plants and animals by observing them closely over a period of time. Recognize also that care must be taken to know the needs of living things and how to provide for them.
1.1.4 Use tools, such as rulers and magnifiers, to investigate the world and make observations.
1.2.5 Demonstrate that magnifiers help people see things they could not see without them.
1.2.6 Describe and compare objects in terms of number, shape, texture, size, weight, color, and motion.
1.6.2 Observe that and describe how certain things change in some ways and stay the same in others, such as in their color, size, and weight.

Mathematics
1.1.10 Represent, compare, and interpret data using pictures and picture graphs.

Language Arts/English
1.1.1 Match oral words to printed words.
1.7.1 Listen attentively.

Second

Science
2.1.3 Describe, both in writing and verbally, objects as accurately as possible and compare observations with those of other people.
2.2.5 Draw pictures and write brief descriptions that correctly portray key features of an object.
2.3.1 Investigate by observing and then describe that some events in nature have a repeating pattern, such as seasons, day and night, and migrations.
2.4.1 Observe and identify different external features of plants and animals and describe how these features help them live in different environments.
2.5.6 Explain that sometimes a person can find out a lot (but not everything) about a group of things, such as insects, plants, or rocks, by studying just a few of them.
2.6.3 Describe that things can change in different ways, such as in size, weight, color, age, and movement.

Language Arts
2.7.7 Tell experiences in a logical order.
Third

Science
3.2.6 Make sketches and write descriptions to aid in explaining procedures or ideas.
3.4.3 Observe that and describe how offspring are very much, but not exactly, like their parents and like one another.
3.6.5 Observe that and describe how some changes are very slow and some are very fast and that some of these changes may be hard to see and/or record.

Fourth

Language Arts
4.4.4 Use common organizational structures for providing information in writing, such as chronological order, cause and effect, or similarity and differences, and posing and answering a question.
4.6.2 Use simple sentences and compound sentences in writing.
4.6.3 Create interesting sentences by using words that describe, explain, or provide additional details and connections, such as adjectives, adverbs, appositives, participial phrases, prepositional phrases, and conjunctions.

Science
4.6.1 Demonstrate that in an object consisting of many parts, the parts usually influence or interact with one another.
4.2.5 Write descriptions of investigations, using observations and other evidence as support for explanations.

Fifth

Science
5.1.4 Give examples of technology, such as telescopes, microscopes, and cameras, that enable scientists and others to observe things that are too small or too far away to be seen without them and to study the motion of objects that are moving very rapidly or are hardly moving.
5.2.7 Read and follow step-by-step instructions when learning new procedures.

Sixth

Language Arts
6.6.1 Use simple sentences, compound sentences, and complex sentences; use effective coordination and subordination of ideas, including both main ideas and supporting ideas in single sentences, to express complete thoughts.

Science
6.4.8 Explain that in all environments, such as freshwater, marine, forest, desert, grassland, mountain, and others, organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. Note that in any environment, the growth and survival of organisms depend on the physical conditions.
When humans grow from babies to adults they look very similar as they get older. When insects grow they go through several stages. They first begin as eggs. Eggs are usually small since the adult females must produce them. When the eggs hatch out come either **nymphs** or larvae depending on the insect group (order). Most insect order eggs hatch to become nymphs. These nymphs look very much like adults but never have wings that will allow them to fly. Fully working wings occur only on adult insects. After several nymphal stages (instars) the nymphs turn into adults. In the other insect orders the eggs hatch to **larvae**. Larvae of insects look very different from adult insects. They move around and feed and grow, shedding their skin to become another instar. After several larval instars the larvae turn into **pupae**. The pupal stage is when the larva is turning into an adult. Pupae never move from one place to another. They can't walk or swim or fly. The insect will emerge from the pupal case as an adult, often with working wings. We call this process of changing from an egg to an immature (either nymph or larva) to an adult **metamorphosis**.

**Metamorphosis of a Grasshopper**

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egg  nymph 1  nymph 2  adult
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**Metamorphosis of a Butterfly**

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egg  larva  pupa  adult
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A Bug's Life
(Beetle Matching Activity)

Cut Out the Words and Paste Them in the Correct Box.

Pupa  Larva  Adult  Egg
A Bug's Life
(Butterfly Matching Activity)

Cut Out the Words and Paste Them in the Correct Box.

Pupa | Larva | Adult | Egg
A Bug's Life
(Blow Fly Matching Activity)

Cut Out the Words and Paste Them in the Correct Box.

Pupa | Larva | Adult | Egg
A Bug’s Life
(Dragon Fly Matching Activity)

| Nymph 1 | Adult | Nymph 2 | Egg |

Cut Out the Words and Paste Them in the Correct Box.
Cut Out the Words and Paste Them in the Correct Box.

Nymph 1  Adult  Nymph 2  Egg
# A Bug’s Life
(Milkweed Bug Matching Activity)

<table>
<thead>
<tr>
<th>Nymph 1</th>
<th>Adult</th>
<th>Nymph 2</th>
<th>Egg</th>
</tr>
</thead>
</table>

Cut Out the Words and Paste Them in the Correct Box.

© ACY: February 22, 2005
A Bug's Life
(Matching Activity)

<table>
<thead>
<tr>
<th>Pupa</th>
<th>Larva</th>
<th>Adult</th>
<th>Egg</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Pupa" /></td>
<td><img src="image2" alt="Larva" /></td>
<td><img src="image3" alt="Adult" /></td>
<td><img src="image4" alt="Egg" /></td>
</tr>
</tbody>
</table>

**Cut Out the Words and Paste Them in the Correct Box.**

ACY: February 22, 2005
# A Bug's Life
(Mosquito Matching Activity)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><img src="image1" alt="Pupa" /></td>
<td><img src="image2" alt="Larva" /></td>
</tr>
<tr>
<td><img src="image3" alt="Adult" /></td>
<td><img src="image4" alt="Egg" /></td>
</tr>
</tbody>
</table>

Cut Out the Words and Paste Them in the Correct Box.

| Pupa | Larva | Adult | Egg |

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Insect Metamorphosis  
(Grades 3-5)

How do insects grow up? Do they grow like human?

To become familiar with insect life stages and with using a dissecting microscope, get a microscope from the cabinet. Try to find all the life stages: egg, larva, pupa, adult.

1. Look at the **tobacco hornworm** caterpillar (Lepidoptera), and Make a sketch of each stage.

<table>
<thead>
<tr>
<th>Egg</th>
<th>Larva</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Pupa (don’t move around)</td>
<td>Adult</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Now TOUCH GENTLY the larva and pupa and CIRCLE how they feel.
   Does the Larva feel soft / hard?
   Does the Pupa feel soft / hard?
   Describe what you are feeling
   _______________________________________________________________

3. Is the Pupa alive? _______________ Does it move? ________________

4. Sketch the different life stages of a milkweed bug.

5. Mark with a (✓) check mark the body parts you can find on the 3 insects.

   Can you find the: | Tobacco hornworm pupa | yellow mealworm pupa | blow fly pupa
   head
   eyes
   antennae
   legs
   wings
   thorax
   abdomen
   mouthparts

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6. Do insects grow like humans? Yes / NO
Why/Why Not?
Going more in-depth…. (4th/5th grade)

What are some of the similarities and differences between the stages of a hornworm?

Do insects grow like humans? Why or Why not?
Insect Metamorphosis  
(Grades 6 & Up)

When humans grow from babies to adults they look very similar as they get older. When insects grow they go through several stages. They first begin as eggs. Eggs are usually small since the adult females must produce them. When the eggs hatch out come either nymphs or larvae depending on the insect group (order). Most insect order eggs hatch to become nymphs. These nymphs look very much like adults but never have wings that will allow them to fly. Fully working wings occur only on adult insects. After several nymphal stages (instars) the nymphs turn into adults. In the other insect orders the eggs hatch to larvae. Larvae of insects look very different from adult insects. They move around and feed and grow, shedding their skin to become another instar. After several larval instars the larvae turn into pupae. The pupal stage is when the larva is turning into an adult. Pupae never move from one place to another. They can’t walk or swim or fly. The insect will emerge from the pupal case as an adult, often with working wings. We call this process of changing from an egg to an immature (either nymph or larva) to an adult metamorphosis.

To become familiar with insect life stages and with using a dissecting microscope, get a microscope from the cabinet. When you're finished, put it away. Look at a Petri dish containing fruit flies using the microscope. Try to find all the life stages: egg, larva, pupa, adult.

Make a sketch of each so you can remember what they look like.

<table>
<thead>
<tr>
<th>Egg (very small compared to adults)</th>
<th>Larva</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupa (don’t move around)</td>
<td>Adult</td>
</tr>
</tbody>
</table>

2. Look at the life stages of a milkweed bug. How do the immatures (nymphs) differ from the adults? Make a sketch of several life stages of a milkweed bug.
3. Look at the tobacco hornworm caterpillar (Lepidoptera), [note the number of prolegs]. Compare it to the tobacco hornworm pupa. Touch each of the stages. Think about why is each the shape and feel that it is? Make a sketch of each.

<table>
<thead>
<tr>
<th>Larva</th>
<th>Pupa</th>
<th>Adult</th>
</tr>
</thead>
</table>

4. Look at a tobacco hornworm (Lepidoptera) pupa. See how many parts of the body can be identified. Compare this with the pupa of a yellow mealworm (Coleoptera), and a blowfly (Diptera). Mark the box of each body part you can find.

<table>
<thead>
<tr>
<th>Can you find the:</th>
<th>tobacco hornworm pupa</th>
<th>yellow mealworm pupa</th>
<th>blow fly pupa</th>
</tr>
</thead>
<tbody>
<tr>
<td>head</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>eyes</td>
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<td></td>
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<tr>
<td>antennae</td>
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<td></td>
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<tr>
<td>legs</td>
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<td></td>
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<tr>
<td>wings</td>
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<td></td>
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<tr>
<td>thorax</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>abdomen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mouthparts</td>
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</tbody>
</table>

5. Look closely at a blow fly larva (a maggot). Look also at the shape of a maggot head (which end is it: hint: the breathing holes, the spiracles, are on the other end); count the number of eyes, and legs. Make a sketch of a blow fly larva. Label the spiracles, eyes, and legs. Look at the blow fly pupa. Why does it look like it does? Make a sketch of the pupa.

<table>
<thead>
<tr>
<th>Blow fly larva</th>
<th>Pupa</th>
</tr>
</thead>
</table>