ECOS
Ecologists Educators and Schools: Partners in GK-12 Education

ECOS Inquiry

1. CONTRIBUTOR'S NAME: ALISON PERKINS

2. NAME OF INQUIRY: TO BEE OR NOT TO BEE

3. GOALS AND OBJECTIVES:

a. Inquiry Questions: What is an insect life cycle? Do all insects have similar life cycles? What is the life cycle of the Orchard Mason Bee? What are the needs of each of the stages in the mason bee's life cycle?

b. Ecological Theme(s): Different phases of the mason bee life cycles have different requirements for food and shelter. The timing of these different stages can be adaptations to the insects' environment.

c. General Goal: To learn about the life cycles of Orchard Mason Bees and several other holometabolous insects (insects that completely change life forms) to understand their ecological roles.

d. Specific Objectives:

Academic: Insects have different life stages, and needs for food and shelter change as insects change life stages.

Experimental: Students will determine explore the different life stages of Orchard Mason Bees and their food requirements.

Procedural/technical: Students will learn about the life cycle of insects undergoing complete metamorphosis.

Social: Students work as a team to develop stories about insect life cycles.

Communication: Students have the opportunity to share their ideas about life cycles with the rest of the class.

e. Grade Level: 1-2

f. Duration/Time Required: one class period

4. ECOLOGICAL AND SCIENCE CONTEXT:

Background (for Teachers):

Insects have different life cycles depending on whether they are **holometabolous** (insects that undergo complete metamorphosis, like butterflies) or **hemimetabolous** (insects that undergo incomplete metamorphosis, like "stink bugs"). As a result, a holometabolous species' life cycle will move from **eggs** to **larvae** to **pupae** to **adults**, whereas a hemimetabolous species' life cycle will move from **eggs** to **nymphs** to **adults**. Larvae tend to look completely different than adults; it is during the pupal stage that metamorphosis occurs resulting in the transformation.

Students will compare and contrast the Orchard Mason Bee life cycle with Honey Bee life cycle. Both species are holometabolous, but their ecological needs and adaptations to their life cycles are completely different.

Orchard Mason Bees are native, solitary bees. They complete their entire life cycle in the nest hole where the adult females laid the eggs. Females build a nest cell using mud as mortar, provision the cell with pollen, lay the egg in the cell, and then close the cell within another mud wall. (The female can control fertilization – if she allows the egg to be fertilized, the resulting offspring will be female. Males hatch from unfertilized eggs.) The egg hatches and the larva eats the pollen. In Orchard Mason Bees, the larva spins a cocoon, pupates inside the cocoon, and as an adult, remains in the cocoon in a state of dormancy (**diapause**) throughout winter. The

adults chew their way out of the cocoons and the mud cells in the spring. Males emerge first, followed in a few days to a week, by females.

Honey Bees are an introduced, eusocial nesting species – that means the hive has one breeding female (the queen), a large population of sterile female workers, and a rather large number males, or drones. Just as in the Orchard Mason Bee, the unfertilized eggs of the Honey Bee develop into drones or male bees and the fertilized eggs develop into either workers (or virgin queens). The worker population size may vary seasonally, but workers are always present. Some time in the late winter or early spring, the queen begins to lay eggs in individual cells in the honeycomb of a hive. The workers expand the brood nest as pollen becomes more and more available. In about 1-3 days, the egg hatches into a larva. The larval stage lasts about 4-9 days, at which point the larva spins a cocoon around itself and pupates. The adult chews its way out of the cocoon and begins tasks such as cleaning the hive. As it matures, tasks change to building the honeycomb and becoming a forager. In winter, the colony forms a "winter cluster" – bees clinging tightly together on the combs of the hive. These clusters can stay quite warm, and the larger the cluster the better the chances of survival. The cluster moves around in the hive to access and use the food stores.

5. MOTIVATION AND INCENTIVE FOR LEARNING:

Students get to learn about life cycles of mason bees and other insects in their local communities and schoolyards.

6. VOCABULARY:

holometabolous – insects that undergo a complete metamorphosis, completely changing life forms. Holometabolous insects have a pupa, and their wings develop inside their bodies. As a result their wings cannot be seen at all until the adult insect emerges.
hemimetabolous – insects that undergo a series of metamorphoses but do not change life form, they look like miniature adults that just gradually get larger and larger. Insects with an incomplete metamorphosis have no pupa and their wings, in those species with wings, develop on the outside of their body.
larva (plural larvae) – the juvenile form of an insect that undergoes metamorphosis.
nymph – the juvenile form of a hemimetabolous insect.
metamorphosis – the process of change from one life form to another. Metamorphosis is complex and fascinating, and scientists are just beginning to understand some of the intricate details that take place during this process.

7. SAFETY INFORMATION:

8. MATERIALS LIST (including any handouts or transparency masters):

- Life Cycle Chart – Figure 1
- Life Cycle Handout

9. METHODS/PROCEDURE FOR STUDENTS:

a. Investigation work:

Provide students with a copy of the life cycle chart for Orchard Mason Bees and some natural history information for other bees. We could potentially buy some meal worms or other larva and have them "growing" for observation (1st and 2nd graders already do this).

b. Building on it:

where different stages spend their lives, what the function of the different stages are, what stages are the most susceptible to predation/parasites, and how Montana weather etc. may affect production of mason bees.

10. ASSESSMENT:

11. EXTENSION IDEAS:

Compare and contrast the Orchard Mason Bee Life Cycle with other holometabolous insects.

12. SCALABILITY:

This activity fits well with FOSS activity kits targeting incest life cycles. Teachers can simply fill out the life cycle chart with the class as they watch their FOSS insects grow. Older students could be required to research other bees and insects, compare and contrast life histories, and infer advantages and disadvantages of life history evolution in terms of Montana.

13. REFERENCES AND SOURCES FOR ADDITIONAL INFORMATION:

http://www.ent.iastate.edu/zoo/lessonplans/journal_drawings.pdf
http://www.earthlife.net/insects/blatodae.html

14. LIST OF EXPERTS AND CONSULTANTS

Jen Marangelo
Byron Weber

15. EVALUATION/REFLECTION BY FELLOWS AND TEACHERS OF HOW IT WENT

This activity has not been tested.

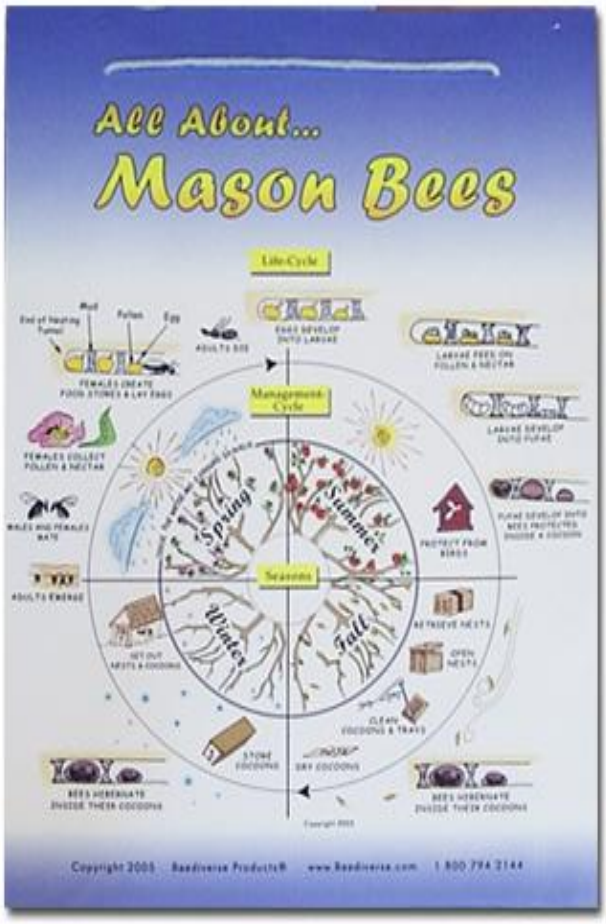
INSECT LIFE CYCLE CHART:

Name:_____

COMMON NAME:_____

SCIENTIFIC NAME:_____

	Jan.	**Feb.**	**Mar.**	**Apr.**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
EGG:												
where												
LARVA:												
what												
where												
PUPA:												
where												
ADULT:												
what												
where												


All About...
Mason Bees
Life-Cycle
Management-Cycle
Seasons
Spring
Summer
Fall
Winter
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Journal Drawings: Draw pictures and descriptions of the stages of your insect. Cut the pages out on the lines and staple in the correct order.

LIFE CYCLE OF _____	Stage 1
Stage 2	Stage 3
Stage 4	Stage 5

Adapted from… http://www.ent.iastate.edu/zoo/lessonplans/journal_drawings.pdf ...