

ECOS Inquiry Template

1. **Contributor's Name:** Jen Marangelo

2. **Name of Inquiry:** Classification using insects

3. **Goals and Objectives:**

a. Inquiry Questions:

How do taxonomists classify organisms?

What are some common characteristics of insects?

b. Ecological Theme(s): Observation, Classification

c. General Goal:

Provide an introduction to the process of classification.

d. Specific Objectives:

Students will learn about the process of classification.

Students will develop a criteria for classifying some insects.

Students will communicate their findings.

Students will learn about the limitations of classifying organisms through their own experience (it is a human-constructed system).

Students will learn what physical characteristics taxonomists consider to classify insects.

Students will learn what physical characteristics to look at in order to identify an insect to order.

e. Grade Level: Fifth grade – Eighth grade

f. Duration/Time Required:

→ **Prep time** – prepare/borrow pinned insects

→ **Implementing Exercise During Class** – 1 hour

→ **Assessment** – during inquiry plus < 1 hour

4. **Ecological and Science Context:**

a. Background (for Teachers):

Classification can be thought of as a filing system for biology and a taxonomist is a person who organizes that system. There are so many organisms in our world that in order to make sense of them and communicate about them, humans put them into groups based on similarities and differences of physical characteristics (and more recently, DNA).

These groups are Kingdom, Phylum, Class, Order, Family, Genus and Species with species being the most specific level of description and kingdom being the most general. For example, in the kingdom Animalia there is the Arthropodia phylum. Arthropods are different from other phyla in the animal kingdom in that they have an exoskeleton, a segmented body and jointed limbs. In this phylum there are several classes of animals including insects (Hexapoda), spiders (Arachnida), millipedes (Diplopoda) and centipedes (Chilopoda). All these animals have an exoskeleton, a segmented and jointed limbs but each have characteristics unique to their class. Insects have 3 body parts (head, thorax and abdomen) and 3 pairs of legs. No other class of arthropods have both those characteristics.

The next level of classification after class is the order. There are differences of opinion amongst taxonomists regarding the number of insect orders but there are approximately 25-31 orders of insects. These are distinguished by their wings, mouthparts and metamorphosis. Adult insects may have 0, 1 or 2 pairs of wings and these may be modified in a variety of ways unique to their order. When identifying an insect to order it's easiest to look at the wings. When working with your students on how

to distinguish between common insect orders, use the following guidelines. With older students it may be interesting to introduce the scientific name and translation to help them remember the characteristics of the animal.

Insect (Scientific name – meaning)	Number of Pairs of Wings	Description of Wings
Beetles (Coleoptera – sheath wing)	2	Front wings (elytra) are hard and leathery and meet in a straight line down the middle of the back. Hind wings are membranous and fold underneath front wings.
Wasps, Bees, Ants (Hymenoptera – membrane wing)	0-2	If there are wings, both pairs are membranous with few veins. The front wings are larger than the hind wings.
Flies and Mosquitoes (Diptera – two wings)	1	One pair of membranous wings. Hind wings are reduced to halteres which sometimes look like a short stick with a ball at the end and are thought to stabilize the body during flight.
Butterflies and Moths (Lepidoptera – scale wing)	2	Adults have 4 large wings covered with scales. The front wings are usually triangular and hindwings more oval.
True Bugs (Heteroptera – half wings)	2	The part of the front wing closest to the thorax is thickened and the rest is membranous. The hind wings are all membranous. At rest, the wings are held flat over the abdomen with the membranous tips overlapping. Abdomen looks like it has 3 triangles and a diamond shape on it (roughly).
Grasshoppers and Crickets (Orthoptera – straight wing)	0-2	The front wings are thickened and many-veined and hind wings are membranous. Hind wings fold fanlike underneath front wings when not in use.
Dragonflies and Damselflies (Odonata – tooth)	2	Wings are long, narrow and both are membranous.

The classification system is crucial to understanding and communicating about our world but it is important to remember that it is a human-made system and not everyone agrees about how it should be done.

b. Background (to present to Students):

See methods/procedures

5. Motivation and Incentive for Learning:

Students will learn some of the skills of being a scientist.

This is an opportunity for student to look closely at some local insects.

6. Vocabulary:

Classification – grouping organisms into categories of varying ranks, and describing and naming these categories

Taxonomist – a person who studies the science of classification

7. Safety Information: N/A

8. Materials List (including any handouts or transparency masters):

Handout (attached)

A box of 6 pinned insects (representing 3 different orders) for every four students. Each insect should be numbered. Give each group of students the same types of insects. This helps with the discussion and keeps kids from wanting to look at another group's insects.

9. Methods/Procedure for students:

a. Pre-investigation work: Students should have a general knowledge about insects.

Lead a discussion with your students regarding how and why scientists classify organisms.

b. Investigation work:

1) What evidence (data, samples) do students collect?

Pass out a handout and 1 box of six (more if appropriate) pinned insects representing three different orders to every 3-4 students. Each box should contain the same insects. Tell the students that they are scientists who have just returned from the field and they have found 6 new insects never seen before and it is their job to classify the insects. The first thing they need to do is spend some time looking at the insects and determine what physical characteristic they will use in order to classify them. Then they should separate the insects based on that physical characteristic. So if the physical characteristic they've focused on is body color, than all insects that are blue would be in one group, all that are brown would be in another group and all that are black would be in a different group. Encourage students to really think about what characteristic is important to being an insect. If they choose color, why do they think that's the best way to group insects? Finally, ask students to give each group of insects an appropriate name. The handout is designed to guide students through the task.

2) How do students present the evidence (data)?

Each group will present their findings.

3) What conclusions are drawn from the evidence students collect?

It is likely that students will classify the insects in different ways. This is an excellent time to point out that taxonomists, whose profession it is to do this, also don't always agree. This is a human-constructed system and will vary depending on the characteristics considered. After students present their findings, go over how taxonomists have classified insect orders.

4) Include examples of data sheets.

10. Assessment: Assessment can be done by reviewing the handout and monitoring the class discussion.

11. Extension Ideas:

After this inquiry, students can look for insects outside and try to identify them to order.

12. Scalability:

13. Science Standards Accomplished:

Diversity and adaptations of organisms
Science as a human endeavor

14. References:

Borror, D.J., Triplehorn, C.A. & N.F. Johnson. 1989. An introduction to the study of insects, sixth edition. New York: Harcourt Brace College Publishers,.
Brewer, C. 2004. Teaching about classification. Presented at ECOS In-Service Workshop.

15. List of Experts and Consultants: Contact local entomologist/extension service to obtain pinned insects.

16. Evaluation/Reflection by Fellows and Teachers of how it went: This inquiry was tested in a 6th grade classroom. I think the students were disappointed to see insects they recognized since the premise was that these were undiscovered insects. It was done this way out of necessity (I needed to give the same insects to all groups so common ones were used and I didn't want to use rare specimens for educational purposes). I also think this inquiry would be more affective with more background on classification and/or followed by more work with insect classification/identification.

Classification Data Sheet

Names _____

You have just returned from your research site and you've found six new insects that have never been identified. It is your job to classify and name the insects.

1. Name the physical characteristic that you will focus on to classify the insects and why. (Example - number of legs.)

2. Group the insects that are similar based on the characteristic you listed in number 1. For example, if you were classifying invertebrates and decided that the number of legs was important, you'd group all the animals with the same number of legs together.

Name of insect group	Identification number	What makes this group different from the other groups?
EXAMPLE - Insects	1-6	6 legs
EXAMPLE - Spiders	-	8 legs