

## Coleoptera

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Fig. 1. Sample of the morphological variation in beetles.

The Coleoptera (beetles) is the largest insect order, with almost 400,000 described species and many more that are known but remain undescribed. In fact, the number of described beetles correspond to almost a quarter of all described animal species, which means that one of every four kinds of animals on earth is a beetle!

Around 30,000 Coleoptera species occur in the United States and Canada, and we will only cover a small portion of these in this course. Keep that in mind while you are sorting your own specimens, as you may find different families than the ones we will analyze today.

With such an impressive diversity, **how can you distinguish different beetle families?** For this, it is particularly important that you learn how to use the **identification key**.

Beetles are found from pole to pole, their size range from 0.25 mm up to 20 cm, and they utilize almost every terrestrial and freshwater habitat. One of the most distinctive features of beetles is the structure of their wings. They have hard forewings (**elytra**) that, unlike the wings of other insects, normally meet in a straight line down the beetle's back; they cover the intricately folded membranous hind wings and in most species encase much of the beetle's body. A beetle with its forewings snapped shut is like an insect tank, able to resist damage while penetrating varied sorts of media.

Although the Coleoptera is divided into four suborders, members of the suborders Archostemata and Myxophaga are exceedingly rare. Therefore, we will focus this activity on the two suborders that you are most likely to encounter: **Adephaga** and **Polyphaga**.

**Suborder Adephaga:** This suborder comprises around 50,000 species, most of which are predaceous, both as larvae and as adults, and are distributed in terrestrial and aquatic environments. In Adephaga, the **hind coxae extend all the way across the first abdominal segment**, seemingly dividing it into two halves. In addition, **they have notopleural sutures** (Fig. 2).

**Suborder Polyphaga:** This suborder contains over 300,000 described species, with significant variation in body size, shape, diets, and life history. In the suborder Polyphaga, **the first abdominal segment is not divided by the hind coxae**. In this case, the posterior margin of the first abdominal segment extends completely across the abdomen. In addition, **they do not have notopleural sutures** (Fig. 2).

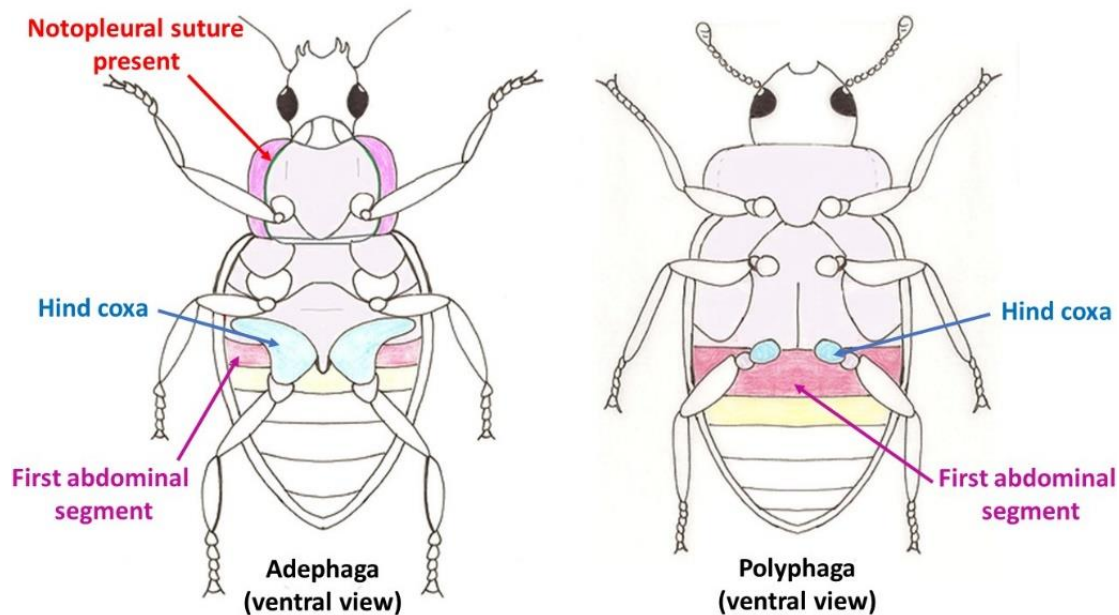


Fig. 2. Contrasting characteristics of beetles in the suborders Adephaga and Polyphaga.

## Group activity

In groups of 3-4 students, use the Coleoptera identification key on the page 377 of “Borror and Delong’s Introduction to the Study of Insects” and identify the **four specimens** provided to you to **family level**.

In the space below, please write down: **the suborder and family each specimen belongs to, the steps you followed until identifying it to family level, and their diagnostic characters**. We will use this information on a discussion with the entire class, so please be ready to participate or designate a speaker that will represent your group. In addition, be prepared to discuss the **challenges you faced** while running the key. For example, was there any part of the key that your group found particularly hard, puzzling or confusing?

### Specimen A:

Suborder:

Family:

Steps on the key:

Diagnostic characters:

### Specimen B:

Suborder:

Family:

Steps on the key:

Diagnostic characters:

**Specimen C:**

Suborder:

Family:

Steps on the key:

Diagnostic characters:

**Specimen D (bonus):**

Suborder:

Family:

Steps on the key:

Diagnostic characters:

**Individual activity**

Please select one specimen from the drawers or from your own collection and **run the Coleoptera identification key for at least one different family** from the ones we analyzed in groups.

**Specimen you selected:**

Suborder:

Family:

Steps on the key:

Diagnostic characters:

## Observation guide - optional

1 – North America is home to around 3,100 of the world's 60,000 weevil species, most of which belong in the family Curculionidae. This is the biggest family of living things. In fact, there are more species of weevils than of vertebrates! Study in the book which diagnostic characters are shared by all members of this family.

2 – The scarab beetles (family Scarabaeidae) are one of the most well-recognized symbols in Ancient Egypt. This beetle was associated to the sun god Khepri, who would bring the sunrise over the horizon each day, similar to a dung beetle rolling a ball of dung. Take a look in the impressive diversity of body sizes, shapes, and colors of Scarabaeidae in the drawers, and look in the book for the diagnostic characters that are shared by all members of this family.

3 – The 1,500-plus species of leaf beetles (Chrysomelidae) in North America seems to come in almost every shape and color imaginable. Take a look at their diversity in the drawers, and study in the book which diagnostic characters are shared by all members of this family.

4 – During our field trip to the stream of flowing water we collected water penny larvae. To which family do they belong? In which environment does the adults live? How do you distinguish the two life stages?

5 – There are multiple Coleoptera families that contain aquatic species. Among them, we can highlight the families Dytiscidae, Gyrinidae, and Hydrophilidae. To which suborder (i.e., Adephaga or Polyphaga) do each of them belong? How can you distinguish them? What kind of adaptations to they have that indicate they are aquatic?

6 – There is a great variation in antennal morphology among beetles. In the drawers, locate the families Curculionidae, Elateridae, Histeridae, Lycidae, Scarabaeidae, Silphidae, and Tenebrionidae and find specimens that exhibit the following antennal modifications: capitate, clavate, filiform, geniculate, lamelliform, pectinate, and serrate. Alternatively, look in BugGuide or iNaturalist for representatives of these orders with the antennal modifications mentioned above.

7 – Cerambycidae are frequently recognized by the presence of their very long antennae. However, this character is not present in all cerambycids. Take a look at the material in the drawers and locate some specimens with short antennae. Then, compare them with individuals from the family Cucujidae. How do you compare their antennae? Which characters could you use to distinguish these families?

8 – One Coleoptera family contains species with very conspicuous sexual dimorphism. The males have a pair of enlarged mandibles that are used to combat other males while defending a food site where females may come to feed. The females, on the other hand, do not exhibit enlarged mandibles. To which family do these beetles belong?

9 – In warm summer nights, we can appreciate fireflies flying around, flashing lights that they chemically produce. In your childhood, you may even have had jars full of blinking adult fireflies. Curiously, all firefly larvae and some firefly eggs also produce a bit of light. To which family do fireflies belong? How can you distinguish them from Cantharidae?

10 – Some beetles are considered pests. Among them, we can point out the dermestids, Asian Longhorn Beetles, and Emerald Ash Borer. To which families do they belong? What are their diagnostic characters? What kind of damage do they cause?

11 – Some beetle species are associated with fungi. This is the case of the family Erotylidae, which often live beneath the bark of dead stumps, especially where rotting fruits are abundant. What are the diagnostic characters of this family?

12 – Members of the family Nitidulidae vary considerably in size, shape, and habits. A few species live on or near the dried carcasses of dead animals, in flowers, or under bark. However, most species are found where plant fluids are fermenting or souring. If you ever decide to go dining or drinking outside on a warm August afternoon, you may end up finding some picnic beetles or beer beetles, whose fondness for fermentation leads them to cavort in your ripe fruit and belly flop in your beer. What are the diagnostic characters of this family?

13 – Many of North America's almost 500 lady beetle species are familiar round, red, convex consumers of soft-bodied insects, like aphids. Some lady beetles eat almost 60 aphids per day and consume up to 500 aphids before laying hundreds of eggs destined to hatch into voracious aphid-eating larvae. To which family do lady beetles belong? What are their diagnostic characters? How can you use them to your advantage?

14 – Checkered beetles (Cleridae) are distinctively shaped, somewhat hairy beetles often found on pollen-rich flowers or on fresh-cut wood. Some of the most colorful clerids are commonly found on freshly cut logs occupied by other wood-boring insects, since the larvae of predacious species pursue wood-boring larvae in their burrows, and adult clerids often consume adults of wood-boring species. What are their diagnostic characters of the family Cleridae? How can you use them to your advantage?

15 – As you may expect from such a large insect order, our understanding about the classification and relationships among beetle families changes over time. For example, the family Silphidae has been recently (March 2022) placed inside Staphylinidae, becoming a subfamily. However, Borror and DeLong consider them distinct families, and you will receive credit for either of them on your collection. Take a look at Staphylinidae and Silphidae in the drawers. Compare and contrast their morphology. Would you have placed them in the same family?