

INSECTS AND OTHER ARTHROPODS

Living organisms are classified into kingdoms, which are then subdivided into phyla, which are further subdivided as follows: Phylum > Class > Order > Family > Genus > Species

The animal kingdom consists of many phyla, the largest of which is the phylum arthropoda, consisting of insects, crustaceans and their relatives. The class of arthropods consisting of all insects contains many, many species. There are 900,000 known species of insects, with approximately 91,000 in the United States. There are many more that have yet to be discovered - perhaps as many as 30 million unique species, according to experts. Insects also make up a lot of the earth's biomass. Though small in size, their sheer number may reach 10 quintillion (10,000,000,000,000,000,000) individual insects alive at any given time.

All insects have 6 legs and 3 main body segments: the head, thorax and abdomen. Insects begin their lives as eggs. When the juvenile insect hatches from the egg, it may not look at all like the adult. This first stage is called the larval stage. An example is a moth caterpillar. In the case of the moth caterpillar, the larva encloses itself into a cocoon and sheds its skin, becoming a pupa, which begins to metamorphose into an adult. (A butterfly caterpillar sheds into a pupa called a chrysalis.) The stage between larva and adult is called the pupal stage. Insects may go through all or some of these major stages in their transition from egg to adult and most people do not recognize the intermediate forms as being the same species as the adult. Look at the display boards for images of the various stages of an insect's life.

In this laboratory, you will examine a representative of 2 of the 25 orders of insects, looking for features they have in common, leading them to be classified as insects and features that differentiate them, leading them to be classified as separate orders of insects. Then, you will examine other arthropods and see what features make them similar to and different from insects.

BEES

Bees belong to the order Hymenoptera, along with wasps and ants and others. All Hymenoptera have a constricted or "pinched in" abdomen and usually have 4 wings, with the hind wings being shorter. Most are important pollinators of flowers.

Most bees live solitary lives, but some are social insects, meaning they live in colonies and each bee has a specific job within the colony. The queen is responsible for laying eggs. Interestingly, she can lay either unfertilized or fertilized eggs. The unfertilized eggs have only half the genetic material of the fertilized eggs and develop into males, or drones, whose job it is to fertilize the queen's eggs. The fertilized eggs develop into females - the workers of the colony. Thus, all worker bees are sisters or half sisters.

Workers live for 2-3 months, changing jobs as they mature into their final job as a forager. It is the forager's job to gather nectar, pollen, propolis and water and bring them back to the hive to be made into honey. Worker bees also produce a glandular secretion called "royal jelly" and use it to feed other bees. The substance known as propolis, is made of sticky substances produced by plants and is used as "bee glue" to attach and seal hive parts.

Let's look at the anatomy of a bee:

First, identify the head, thorax and abdomen.

1. Which segment is largest?
2. Can you find evidence of further segmentation within the abdomen? Describe what you see.

Pull of both wings from one side and measure them..

3. How long (in millimeters) is the forewing of your bee?
4. How long (in millimeters) is the rear wing of your bee?
5. Is the difference between forewings and rear wings typical of the Hymenoptera?

Place the wings on a slide and look at them under a microscope.

6. How are the rear wings attached to the forewings?

Bees have two types of eyes: large compound eyes and smaller simple eyes called ocelli. Detach the head of your

bee and place it under a slide and use the microscope to answer questions 7-9.

7. How many compound eyes are on the honeybee's head?
8. How many ocelli are on the honeybee's head?
9. How many antenna does your bee have?

Bees obtain nectar by unfurling their mouthpart, called a proboscis, deep into the nectar glands of a flower.

10. Draw a diagram of the bee's proboscis.

Flowers have coevolved with their pollinators and their appearance indicates the types of pollinators they attract. Bees are generally attracted to fragrant and brightly colored, often blue or yellow, flowers. Red or orange flowers with a long tube like structure are likely to be pollinated by hummingbirds. White smelly flowers may attract beetles and moths.

11. How do flowers benefit from bee visits?

Look at the flowers on display on the front desk labeled numbers 1-3.

12. Which do you think might be bee pollinated?

flower #1 is probably pollinated by a _____

flower #2 is probably pollinated by a _____

flower #3 is probably pollinated by a _____

Now look at your bee's proboscis again.

13. Why do you think bees do not pollinate the same flowers as hummingbirds?

Examine the front and rear legs of the bee.

14. Make a sketch showing the differences.

The pollen baskets on the rear legs catch pollen grains some of which rub off onto the next flower, pollinating it in the process. Look at the display board showing the pollen baskets. Some people believe that pollen is good for their health and one can purchase pollen baskets that have been removed from bees.

Take a sample of the balls of pollen and examine them under the microscope. Tease the pollen grains away so you can see them individually.

15. Draw two kinds of individual pollen grains and indicate their color.

Draw a single pollen grain from each of the flowers on display and indicate its color

16. What do you think it means if the pollen grains from your bee's legs consist of many different types?

On the front desk, there are some samples of honey from nectar collected from different types of flowers. You may want to try some and taste the differences!

Lastly, as you well know, bees defend their hives by stinging. Remove your bee's stinger apparatus as demonstrated by your instructor and identify the stinger, stinger anchors and the poison sac.

17. Show your instructor and have him/her initial here _____

Unfortunately for the bee, she suffers fatal injuries after stinging a victim (and you thought it was a bad getting stung!).

18. If natural selection favors those that leave behind the most copies of their genes, then how could natural selection favor an organism that dies defending her sisters? This is not an easy question, but it's a good one to start thinking about.

BEETLES

Beetles belong to the order Coleoptera, characterized by insects having 4 wings, the upper pair hard and shell-like, and chewing mouthparts. Some, like weevils, are grain eaters and create problems for humans by eating their food stores, others are important detritivores and play a key role in decomposition and nutrient cycling, other are of benefit to humans because they feed on injurious insects.

19. Like the bee, beetles are insects and adults have _____ legs and _____ body segments.

The beetles you will examine are called flour beetles. Their larvae are often sold at pet stores as live food. Though the larvae are called "mealworms," they are not worms at all. Like all arthropods, they have a hard external skeleton made of a substance called chitin and they have jointed appendages (legs).

20. Identify a larva, pupa, and adult. (Hint: the pupa is more like the adult than is the larva.). Show your instructor and have him/her initial here _____

These beetles eat wheat grains. Obtain a dead adult and examine its mouthparts.

21. Are the mouthparts like those of a bee?

22. Draw the mouthparts and discuss how their form might reflect the different diet of these insects.

Some beetles have huge mandibles, but don't necessarily use them for eating. Males may use them when fighting for dominance. Perhaps they just use them to look "studly" to attract females. Features may be selected for because they increase the likelihood of successful reproduction, even though they do not increase (and may even decrease!) chances of survival. The term for this is "sexual selection" and it is a special type of natural selection.

23. Can you think of another example in which males have features that make them showy, but don't necessarily appear to give a survival advantage?

24. Where are the wings on the adult beetle?

25. How many wings does the adult beetle have?

~~26. Complete the attached data sheet, measuring larvae, pupae, and adults and add your data to the class data on the board.~~

~~27. Why do you think beetles fall into such distinct size categories compared with humans at different stages of maturity? (Hint: consider the differences in skeletal structure between arthropods and humans)~~

OTHER ARTHROPODS

28. Examine some of the other arthropods on display and fill out the table below.

CLASS	Examples	Exoskeleton? y/n	Jointed appendages? y/n	# body segments in the adult?	# legs in the adult?
Insecta					
Arachnida					
Crustacea					
Diplopoda					
Chilopoda					

29. What do they all have in common? (Hint: The answer was given earlier.)

30. Spiders and scorpions are classified as arachnids, not insects. What is an obvious and easy way to tell arachnids from insects?

31. Lobsters are classified as crustaceans, not insects. What is an obvious and easy way to tell crustaceans from insects?