# Pre-Lab Information

Purpose Use a virtual lab to explore how a dichotomous key can be developed to help classify organisms.

Time Approximately 45 minutes

Question How is a dichotomous key developed?

Summary You will create a dichotomous key that can be used to identify arthropods. First, you will observe a group of eight arthropods with a magnifying glass to become familiar with their appearance. You will then select yes-no questions that can be used to divide the group of organisms into two smaller groups. You will continue the procedure until each arthropod has its own branch.

# Lab Procedure

1. **Observe the arthropods.**
	1. Start by clicking the **Magnifying Glass**. A window will open with two views of the fire ant. Above it are images of the other arthropods.
	2. Look for body parts or characteristics that are found in some, but not all, of the specimens. These are the most useful characteristics for building a key. Note: When examining insects that are types of beetles (e.g., ladybugs), you may have difficulty determining the presence or number of wings. Elytra, in beetles, are hardened covers that protect and hide the flying wings. These protective coverings are not counted as wings. You may mistakenly interpret these insects as having no wings if the elytra are obscuring them, or as having two sets of wings if you consider the elytra themselves to be wings.
	3. Write the number of each characteristic for each arthropod in Table A of the data section below. This chart will help you to group the arthropods. Refer to it as often as necessary. Note: When recording the number of wings and antennae, only include the **visible** wings and antennae.
	4. When you have finished filling in Table A, click in the white open area on the screen to close the tool. You can use the **Magnifying Glass** or refer to your chart at any time.
2. **Select a question for use in your key.**
	1. Go to the list of body parts, and select a body part to use in building your key.
	2. Click on the colored bar for a body part to reveal a list of possible yes–no questions that you can use in constructing a dichotomous key.
	3. Select an appropriate yes–no question by clicking and moving it to **Drag Your Question Here** to insert the question into your key. Once you have inserted a question into the key, **Yes** and **No** branches will appear below the question in your tree. Each branch contains a box that arthropods can be placed in.
3. **Use the question to sort the specimens.**
	1. One at a time, click on an arthropod in the box below the **Magnifying Glass**, then drag and drop it into either the **Yes** or **No** branch located below the question to sort the organisms into two groups.
	2. Continue placing the arthropods into the **Yes** and **No** branches as appropriate until no arthropods remain below the **Magnifying Glass**. If you accidentally place an arthropod in the wrong branch, simply drag and drop it into the other branch. You can also click **Undo** to return the arthropod to its starting location.
4. **Check your work.**
	1. When you have moved every arthropod in the current part of the key into the **Yes** or **No** branches, click **Check** to have the system check whether all of the organisms have been appropriately placed. If all of the organisms have been appropriately placed, clicking **Check** will make the list of body parts reappear on the screen so that you can continue adding questions to build more branches on your key. If the list does not reappear, then one or more of the arthropods has been placed in the wrong category. Reexamine the arthropods with the **Magnifying Glass** and reposition them.
5. **Extend and finish the key.**
	1. Continue adding key questions and building branches on your key by repeating Steps 2, 3, and 4 until every arthropod has been categorized into its own box. Instead of moving the arthropods from the box below the **Magnifying Glass**, you will now move the arthropods from the most recent **Yes** and **No** locations into the current question’s **Yes** and **No** branches.
	2. When your key has been completed, click **Submit**.
	3. Copy your completed key into Figure A in the data section below. If it will not fit on the page, use an extra sheet of paper.

# Data

**Table A:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Legs** | **Visible Wings** | **Visible Antennae** | **Stinger** | **Claws** |
| **Ant** |  |  |  |  |  |
| **Bee** |  |  |  |  |  |
| **Butterfly** |  |  |  |  |  |
| **Dragonfly** |  |  |  |  |  |
| **Ladybug** |  |  |  |  |  |
| **Scorpion** |  |  |  |  |  |
| **Spider** |  |  |  |  |  |
| **Wasp** |  |  |  |  |  |

When you have completed your dichotomous key, draw it in the space below or in your lab notebook.

**Figure A:**

# Purpose

Students will use a virtual lab to explore how a dichotomous key can be developed to help classify organisms.

# Student Guide

A link to a PDF of the Student Guide is provided to students during the lab lesson just before they perform the experiment. Be sure to either provide copies to students or enable them to print the guides themselves when they reach this phase of the lab lesson.

# Background Information

In all branches of science, classification is important. Geologists classify types of rocks and minerals and pathologists classify diseases and disease-causing agents. Biologists use dichotomous keys in the field to help them determine the identity of a species.

No single dichotomous key exists that can be used to identify all organisms on Earth. Individual keys are generally regional and focus on certain types of organisms (birds, insects, flowering plants, etc.). A key to the reptiles of Arizona would be an example of a typical key used by herpetologists.

Biologists use physical characteristics that can be measured, counted, or determined to be present or absent when constructing keys. Traits that vary between different individuals of the same species, in the same individual as it ages, or by season are best to avoid when constructing a key.

Dichotomous keys consist of questions, or statements, that divide the group of organisms into two smaller subgroups. If questions are used, they are often yes–no questions that focus on the presence or absence of features or the number of these features. Keys occasionally consist of questions or statements that have more than two responses. This is done when organisms naturally fall into three or more discrete groups and the author believes that including all options makes the key easier to use.

There are two methods for creating a dichotomous key: a flow chart and a table. This lab is designed for students to create a flow chart key.

In this lab, students build a dichotomous key by selecting yes-no questions. The number of questions needed to construct any key is equal to *n* – 1, where *n* is the number of organisms to be classified. For this virtual lab activity, students will classify eight arthropods, so seven questions are required to complete the key and isolate each arthropod from one another.

# Preparation

* Remind students of the segmented nature and basic body parts of arthropods (head, abdomen, thorax, legs, antennae, and mouthparts). Without this knowledge, some students may have trouble understanding why some body parts are not considered legs.
* Practice building a key using the virtual lab to familiarize yourself with how it works.

# Monitoring the Lab Procedure

* Ensure that behavior in the lab is purposeful.
* Make sure students refer to the Student Guide, which provides detailed instructions on completing the virtual lab. Reading the instructions before beginning will be helpful for students.
* When examining insects that are types of beetles (e.g., ladybugs), students may have difficulty determining the presence or number of wings. Elytra, in beetles, are hardened covers that protect and hide the flying wings. These protective coverings are not counted as wings. Students may mistakenly interpret these insects as having no wings if the elytra are obscuring them, or as having two sets of wings if they consider the elytra themselves to be wings.
* Students may also have difficulty with the number of antennae. Dragonflies have antennae but are too small to be visible in this lab. Students are asked to classify the arthropods according to the number of visible antennae.
* More than one view may be needed to see the features of the arthropods. The **Magnifying Glass** allows students to see two views of the arthropods.
* If a student inserts a question that was used earlier on the same branch, the question will not stick. If students do not understand why the key will not accept a particular question, ask them to check if they have already used it.

# Data

**Table A:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Legs** | **Visible Wings** | **Visible Antennae** | **Stinger** | **Claws** |
| **Ant** | 6 |  | 2 | 1 |  |
| **Bee** | 6 | 4 | 2 | 1 |  |
| **Butterfly** | 6 | 4 | 2 |  |  |
| **Dragonfly** | 6 | 4 |  |  |  |
| **Ladybug** | 6 | 2 | 2 |  |  |
| **Scorpion** | 8 |  |  | 1 | 2 |
| **Spider** | 8 |  |  |  |  |
| **Wasp** | 6 | 2 | 2 | 1 |  |

When students have finished the procedure, they should record their key in the space provided in the Student Guide. Student keys will vary, but all correct keys will result in each of the eight arthropods being isolated in its own box at the end of a branch. Some keys may contain questions that result in only one branch. These are not useful, because they do not distinguish between the organisms in that part of the key. Sample data are shown below.

**Figure A.**



# Analysis

Students will analyze the data in the reflection assignment.

# Conclusion

Students will draw conclusions about the virtual lab in the reflection assignment.