Insect Dichotomous Keys

Contributors

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Intended Audience

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<td>K-4</td>
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<td>5-8</td>
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<td>9-12</td>
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Activity Characteristics

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<th>Feature</th>
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<td>Classroom Setting</td>
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<tr>
<td>Requires special equipment</td>
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<td>Uses hands-on manipulatives</td>
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<td>Requires mathematical skills</td>
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<td>Can be performed individually</td>
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<tr>
<td>Requires group work</td>
<td>X</td>
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<td>Requires more than one (45 min class) period</td>
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<td>Appropriate for special needs student</td>
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Introduction

Description
Students practice classification using dichotomous keys and pictures of marine organisms. After successful completion of the paper keys, students are given insect specimens and appropriate keys.

Abstract
This dichotomous key exercise utilizes local insects to demonstrate how physical changes signaled at a genetic level culminate in the identifying features of species, genera, families, etc. Students are given the opportunity to find insects (potentially for extra credit) and subsequently use simple dichotomous keys to identify the insects down to the order. Emphasis is placed on how keys operate and students are encouraged to use magnify glasses and/or microscopes to assist them in indentification.

Core Themes Addressed

<table>
<thead>
<tr>
<th>Microbial Cell Biology</th>
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<tr>
<td>Microbial Genetics</td>
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<td>Microorganisms and Humans</td>
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<td>Microorganisms and the Environment</td>
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<td>Microbial Evolution and Diversity</td>
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<td>Other - Classification</td>
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Keywords
Classification, dichotomous key, couplet

Learning Objectives
At completion of this activity, students will be able to:

1. List the categories of biological classification, starting with the broadest (kingdoms) and ending with the most specific (species).
2. Demonstrate the ability to correctly key out an unknown organism.

National Science Education Standards Addressed
Standard A: Science as inquiry
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Standard C: Life science
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

Standard F: Science in personal and social perspectives
- Natural resources
- Environmental quality

Standard G: History and nature of science
- Science as a human endeavor
- Nature of scientific knowledge
Class Time

This activity will require a minimum of one 90-minute class period.

1. Introductory PowerPoint. (10 minutes)
2. Paper marine invertebrates key exercise. (~60 minutes)
3. Real insect ID with dichotomous keys. (~30 minutes)

Teacher Preparation Time

This exercise may require several hours of bug hunting. Actual time involved varies based on location, time of year, etc. Try to collect at least 40-50 bugs. It’s ok to have duplicate copies of some insects, since you’ll have multiple groups, but try not to have more than 4 of each insect. Insects should be collected in Tupperware containers and then placed in the freezer for 4 or more hours. Insects can then be transferred to empty Petri dishes (1 insect/dish) and stored at room temperature. Label each dish with a unique number, so that you can check students’ work.

Materials and Equipment

Per group:

1. 2 magnifying glasses OR 1 dissecting (stereo) microscope
2. 5-10 insects in individual Petri dishes
3. Forceps
4. Scissors
5. Glue
6. 6 sheets construction paper
7. Permanent marker

Methods

1. Distribute the student packet. Instruct students to turn to the marine invertebrate dichotomous key and pictures. Students should cut out each marine creature before proceeding. After cutting the marine invertebrates out, students then classify each creature out to the phylum level and glue all the representatives of a phylum (ex.
Mollusca) to a single page. Repeat with all phyla until every marine invertebrate is classified. Help students as much as possible and make sure they understand how to use a key before you allow them to move on to the next activity.

2. After successful completion of the paper activity, distribute 5-10 insect specimens, 2 pairs of forceps, and magnifying glasses or a dissecting microscope to each group. Tell students to use the blank chart and insect dichotomous keys in their packet to classify each insect.

Tips/Suggestions

1. Make sure you freeze insects after capturing them. This will kill them in a way that preserves all the physical features. I prefer to freeze insects overnight, but 3-4 hours is adequate.
2. Try to avoid too many insect duplicates. Find as diverse a group of insects as you can. It’s important to show students how widely members of the same order can vary.
3. Insects may get pretty beaten up throughout the day of handling. Get some extra insects, so that if too many bits break off you can just replace a specimen.
4. Try collecting insects in the morning, in the early afternoon, and at night. Each time of day will yield different specimens.
5. Students always love a good gross-out moment. Check with local wildlife centers, museums, park gift shops, etc. and see if you can obtain edible insects. They come in a variety of flavors (cheddar cheese, sour cream and onion, salt and vinegar, chocolate, etc.) and species (mealworms, crickets, locusts, etc.). Tell the students about the edible bugs at the beginning of class, but don’t let them try any until the end, after they’ve played with their own insects!

References

- The marine invertebrate key exercise was obtained from USC Sea Grant Island Explorers and is located at: http://www.usc.edu/org/seagrant/Education/IELessons/Unit2/Lesson8/CrittersClassified.pdf (Last accessed: 5/16/12)
  o Original activity came from “Marine Life of Southern California” (2nd Ed.) by Donald J. Reish (1995)
- Insect Dichotomous Keys were obtained from InsectIdentification.org. Exact links to keys are as follows:
  o Arachnid Key: http://www.insectidentification.org/arachnid-key.asp
  o Wingless Insect Key: http://www.insectidentification.org/wingless-insect-key.asp
  o Winged Insect Key: http://www.insectidentification.org/winged-insect-key.asp
• All pictures are authorized for open copyright usage. Links to the original source of each picture can be found in the “Notes” section of the PowerPoint presentation.
Answers to Student Handout

Porifera
Cnidaria (Cnidarians)
Mollusca (Mollusks)
Annelida (Annelids)
Echinodermata (Echinoderms)
Arthropoda (Arthropods)
Introduction

Scientists use dichotomous keys to quickly and simply classify organisms. Dichotomous keys present users with 2 options, called a couplet. Users pick the correct descriptor and proceed to the next number as instructed. For example: think of a snake.

1. a. The snake has circular pupils … Proceed to 2
   b. The snake has slitted pupils, like a cat … Proceed to 3.

Each couplet leads to another, until the user finally finds the correct classification. The specificity of keys varies depending on what you are looking for. Some dichotomous keys will only go to the class or order. Other, much more technical, dichotomous keys are able to identify a specimen down to the exact species.

Vocabulary

Classification: the process of grouping organisms into categories based upon shared characteristics or traits

Dichotomous key: a key used to identify a plant or animal in which each stage presents descriptions of two distinguishing characters, with a direction to another stage in the key, until the species is identified

Couplet: a pair of descriptive sentences that provide two different options

Materials Checklist

<table>
<thead>
<tr>
<th>First Activity:</th>
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<tbody>
<tr>
<td>Marine Invertebrates pictures &amp; dichotomous key</td>
</tr>
<tr>
<td>Glue</td>
</tr>
<tr>
<td>Scissors</td>
</tr>
<tr>
<td>6 sheets of construction paper (different colors)</td>
</tr>
<tr>
<td>Permanent marker</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Activity:</th>
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<tbody>
<tr>
<td>2 pairs of forceps</td>
</tr>
<tr>
<td>2 magnifying glasses or dissecting microscope</td>
</tr>
<tr>
<td>5-10 insects in Petri dishes</td>
</tr>
<tr>
<td>3 insect dichotomous keys (Arachnid, Winged, and Wingless)</td>
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</table>

Procedure

1. Take the six sheets of construction paper, and at the top of each write one of the following phyla: Annelida, Arthropoda, Cnidaria, Echinodermata, Mollusca, Porifera.
2. Cut out all of the creatures from the marine invertebrate packet. Use the included key to key out each invertebrate to the correct phylum. Once you identify an animal’s phylum, glue it to the sheet with the correct label. Do this with all of the creatures, until you have each creature on the correct page. Call your instructor over to check your work.

3. After your instructor has confirmed that you classified the invertebrates properly, she or he will give you 5-10 insect specimens, depending on the time remaining in class. Use the appropriate insect dichotomous key from your packet and the provided materials (forceps and magnifying glasses or dissecting microscopes) to examine the specimens. Do your best to key the insects out to the correct order. If you have questions about the terminology used, ask your instructor for assistance.
# Student Worksheet

## Marine Invertebrate Dichotomous Key

**DICHOTOMOUS KEY**

1. Body shape is regular ................................................................. Go to 2
   - Body shape is not regular (like a lumpy blob) ......................... Porifera

2. Has a head or eyes ................................................................. Go to 3
   - Does not have a head or eyes ............................................... Go to 4

3. Body is segmented (it has distinct body sections) .................... Go to 5
   - Body is not segmented .......................................................... Mollusca

4. Has tentacles ............................................................................ Cnidaria
   - Does not have tentacles .......................................................... Go to 6

5. All body segments look the same .......................................... Go to 7
   - Body segments do not all look the same (some are different) ... Arthropoda

6. Has spines .............................................................................. Echinodermata
   - Does not have spines ............................................................... Go to 8

7. Animal has legs (even tiny ones) .......................................... Go to 10
   - Does not have legs ................................................................ Mollusca

8. Animal attached to bottom ..................................................... Porifera
   - Not attached to bottom ............................................................ Go to 9

9. Body very soft and jelly-like .................................................. Cnidaria
   - Body more firm ..................................................................... Echinodermata

10. Animal has hard covering all over body (including legs) ...... Arthropoda
    - Does not have hard covering ................................................. Annelida
Student Worksheet

Arachnid Key

Starting with question #1, determine which statement (a or b) is true for your creature. Follow the directions at the end of that true statement until you are given the name of the Order your specimen belongs to.

1. a. Insect has a tail or a stinger ................................................................. go to #2
   b. Insect has no tail or stinger ................................................................. go to #3

2. a. Tail is straight like a needle ........................................................... Order Uropygi (whipscorpions)
   b. Tail curves with a stinger at the tip ............................................. Order Scorpiones (scorpions)

3. a. Has enlarged pedipalps (claws) .................................................... go to #4
   b. Lacks pedipalps (claws) ................................................................. go to #5

4. a. Insect is less than 5mm long & flat ............ Order Pseudoscorpiones (pseudoscorpions)
   b. Insect is 8-51mm long & spider-like ............ Order Amblypygi (whipscorpions)

5. a. Insect has regular legs ................................................................. go to #6
   b. Insect legs are thin & stilt-like with "high" knees & a body low to the ground ...... Order Opiliones (harvestmen)

6. a. Body is separated into a cephalothorax & an abdomen (has a waist) .......... go to #7
   b. Body is oval-shaped & lacks a waist ............................................. Order Acari (ticks and mites)

7. a. Has 7 segments on each leg & 1st pair of legs are not longer than the rest ........ Order Araneae (spiders)
   b. Has some other number of segments on each leg; 1st pair of legs are longer than the rest.............................................................. Order Solifugae (windscorpions)
Student Worksheet

Winged Insect Key

Starting with question #1, determine which statement (a or b) is true for your insect. Follow the direction at the end of the true statement until you are finally given the name of the Order your insect belongs to.

1. a. Insect has 1 pair of wings .............................................. Order Diptera (flies, mosquitoes)
   b. Insect has 2 pair of wings ............................................. go to #2

2. a. Insect has extremely long prothorax (neck) ..................................... go to #3
   b. Insect has a regular length or no prothorax ................................ go to #4

3. a. Forelegs come together in a 'praying' position ........................ Order Mantodea (mantids)
   b. Forelegs don't come together in a 'praying' position.... Order Raphidoptera (snakeflies)

4. a. Wings are armour-like with membraneous hindwings underneath them ........
   Order Coleoptera (beetles)
   b. Wings are not armour-like .................................................. go to #5

5. a. Wings twist when insect is in flight ........................................ Order Strepsiptera (twisted-wing parasites)
   b. Wings flap up and down (no twisting) when in flight ....................... go to #6

6. a. Wings are triangular in shape .................................................. go to #7
   b. Wings are not triangular in shape ............................................ go to #8

7. a. Insect lacks a proboscis and has long filaments at abdominal tip ............
   Order Ephemeroptera (mayflies)
   b. Insect has a proboscis and lacks long filaments at abdominal .................
   Order Lepidoptera (butterflies)

8. a. Head is elongated (snout-like) .............................................. Order Mecoptera (scorpionflies)
   b. Head is not elongated (snout-like) ............................................ go to #9

9. a. Insect has 2 pair of cerci (pincers) at tip of abdomen ............ Order Dermaptera (earwigs)
   b. Insect does not have 2 pair of cerci (pincers) at tip of abdomen ........... go to #10

10. a. All 4 wings are both similar in size and in shape to each other .............. go to #11
    b. All 4 wings are not similar in size nor in shape to each other .............. go to #16

11. a. Eyes nearly cover or make up entire head ............................... Order Odonata (dragonflies)
    b. Eyes do not nearly cover nor make up entire head .......................... go to #12

12. a. All 4 wings are finely veined and are almost 2x longer than abdomen ........

Order Isoptera (termites)
b. All 4 wings are not finely veined and are not almost 2x longer than abdomen..............
go to #13

13. a. All 4 wings are transparent with many criss-crossing veins
Order Neuroptera (lacewings)
b. All 4 wings are not transparent with many criss-crossing veins
..............go to #14

14. a. Mouth parts are beak-like and are far back beneath the head
Order Homoptera (leaf hoppers)
b. Mouth parts are beak-like and are far back beneath the head
..............go to #15

15. a. Fan-like hind wings fold flat under fore wings covering most of abdomen
Order Plecoptera (stoneflies)
b. Hind wings fold ‘roof-like’ and are wider at the base than the forewings
Order Megaloptera (dobsonflies)

16. a. Insect is less than 3mm long and has 3 simple eyes as well as compound eyes...
Order Zoraptera (zorapterans)
b. Insect lacks 3 simple eyes in addition to compound eyes
..............go to #17

17. a. Insect has long hind legs used for jumping and a flat-sided head
Order Orthoptera (crickets, grasshoppers)
b. Insect lacks long hind legs and has a typical rounded head
..............go to #18

18. a. Membraneous wings have tiny hairs on (around) them; body also has tiny hairs
Order Trichoptera (caddisflies)
b. Wings lack tiny hairs on (around) them
..............go to #19

19. a. Fore wings are half-leathery (at base) and half-membraneous (at tip) in texture
Order Hemiptera (squash bugs)
b. Fore wings are uniform in texture and appearance
..............go to #20

20. a. Body is both oval and flattened
Order Blattodea (cockroaches)
b. Body is not both oval and flattened
..............go to #21

21. a. Insect has a constricted waist
Order Hymenoptera (bees, wasps)
b. Insect lacks a constricted waist
Order Embioptera (web-spinners)
Student Worksheet

Wingless Insect Key

Starting with question #1, determine which statement (a or b) is true for your insect. Follow the direction at the end of the true statement until you are given the name of the Order your insect belongs to.

1. a. Insect does not have eyes ......................................................... go to #2
   b. Insect has eyes ................................................................. go to #4

2. a. Insect was found on a cold mountaintop (icy region) ............Order Grylloblattodea
   b. Insect was not found on a cold mountaintop (icy region) .................go to #3

3. a. Insect is microscopic and has 12 body segments .................Order Protura
   b. Insect is not microscopic and is thin at the waist ...................... Order Zoraptera

4. a. Insect has less than 6 segments on its abdomen ....................Order Collembola
   b. Insect has more than 6 segments on its abdomen ...........................go to #5

5. a. Insect tail is split at the end of its abdomen (appears to have 2 tails) ......Order Diplura
   b. Insect lacks a 2-split tail at the end of its abdomen ..........................go to #6

6. a. Insect has a 3 or more 'tails' at the tip of its abdomen* ....................go to #7
   b. Insect does not have a tail ......................................................... go to #8

*Note: Insects in Order Grylloblattodea may appear to have a 3-part tail, but the center 'tail' is an ovipositor.

7. a. Insect’s eyes meet at the top of its head ..............................Order Microcorypha
   b. Insect’s eyes do not meet at the top of its head ...........................Order Thysanura

8. a. Insect body is shaped like a stick ........................................Order Phasmatodea
   b. Insect body is not shaped like a stick .......................................... go to #9

9. a. Enlarged and large coxae (hip joint) with a flat abdomen ............Order Siphonaptera
   b. Regular coxae (hip joint) ............................................................. go to #10

10. a. Insect has both a thin waist and elbowed (bent) antennae ..........Order Hymenoptera
    b. Insect does not have both a thin waist and an elbowed (bent) antennae ..........go to #11

11. a. Insect abdomen curls up over its back when crawling .............Order Thysanoptera
    b. Insect abdomen does not curl over its back when crawling ..............go to #12

12. a. Insect has long antennae ............................................................. go to #13
    b. Insect has short antennae ..............................................................go to #14
13.  a. Long antennae point forward over its head ........................................Order Isoptera  
b. Long antennae sweep back toward its body ......................................Order Psocoptera

14.  a. Head is large, or bigger than its thorax ('chest') ................................Order Mallophaga  
b. Head is smaller than the rest of its body ...........................................Order Anoplura
Student Worksheet
Insect Dichotomous Key Answer Sheet

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<tr>
<th>Insect #</th>
<th>Order</th>
<th>Pathway</th>
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For pathway, indicate the choices that led you to your final classification. Ex. 1A→2B→5B→7A. Show how you arrived at your conclusion!