Science Grade 07 Unit 12 Exemplar Lesson 01: Genetic Variation

This lesson is one approach to teaching the State Standards associated with this unit. Districts are encouraged to customize this lesson by supplementing with district-approved resources, materials, and activities to best meet the needs of learners. The duration for this lesson is only a recommendation, and districts may modify the time frame to meet students’ needs. To better understand how your district may be implementing CSCOPE lessons, please contact your child’s teacher. (For your convenience, please find linked the TEA Commissioner’s List of State Board of Education Approved Instructional Resources and Midcycle State Adopted Instructional Materials.)

Lesson Synopsis

Students will use dichotomous keys to identify organisms such as leaves or insects based on the examination of their external structures and physical traits.

TEKS

The Texas Essential Knowledge and Skills (TEKS) listed below are the standards adopted by the State Board of Education, which are required by Texas law. Any standard that has a strike-through (e.g. sample phrase) indicates that portion of the standard is taught in a previous or subsequent unit. The TEKS are available on the Texas Education Agency website at http://www.tea.state.tx.us/index2.aspx?id=6148.

7.11 Organisms and environments. The student knows that populations and species demonstrate variation and inherit many of their unique traits through gradual processes over many generations. The student is expected to:

7.11A Examine organisms or their structures such as insects or leaves and use dichotomous keys for identification. Supporting Standard

Scientific Process TEKS

7.1 Scientific investigation and reasoning. The student, for at least 40% of the instructional time, conducts laboratory and field investigations following safety procedures and environmentally appropriate and ethical practices. The student is expected to:

7.1A Demonstrate safe practices during laboratory and field investigations as outlined in the Texas Safety Standards.

7.2 Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to:

7.2C Collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers.

7.2E Analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends.

7.4 Scientific investigation and reasoning. The student knows how to use a variety of tools and safety equipment to conduct science inquiry. The student is expected to:

7.4A Use appropriate tools to collect, record, and analyze information, including life science models, hand lens, stereoscopes, microscopes, beakers, Petri dishes, microscope slides, graduated cylinders, test tubes, meter sticks, metric rulers, metric tape measures, timing devices, hot plates, balances, thermometers, calculators, water test kits, computers, temperature and pH probes, collecting nets, insect traps, globes, digital cameras, journals/notebooks, and other equipment as needed to teach the curriculum.

GETTING READY FOR INSTRUCTION

Performance Indicators

Grade 07 Science Unit 12 PI 01
Gather a collection of leaves or insects. Use a dichotomous key to identify and label each specimen based on their structures.
Standard(s): 7.2C , 7.11A

ELPS ELPS.c.5B

Key Understandings

- Living organisms can be classified by their structures.
  — How do external structures allow for organisms to be identified?
- Organisms can be identified by their traits.
  — How are dichotomous keys useful in the identification of organisms?
  — How do dichotomous keys show relationships between organisms?

Vocabulary of Instruction
**Materials**

- cardboard circle (1 per jar)
- cloth cover (large, 1 per teacher)
- collecting nets (1 per group)
- collection of various items (20 various items, see Advance Preparation, 1 collection per teacher)
- computers (1 per group)
- cotton balls (2–3 per jar)
- dichotomous key (see Advance Preparation, 1 per group)
- digital camera (1 per class) – Optional
- digital microscope (1 per group) – Optional
- drawing compass (1 per teacher)
- first aid kit (1 per teacher)
- insect collection (see Advance Preparation, various per group)
- insect models (1 per group) – Optional
- insect traps (1 per student)
- kill jar (see Advance Preparation, 1 per group) – Optional
- leaf illustrations (see Advance Preparation)
- leaf morphology cheat sheet (see Advance Preparation, 1 per group)
- microscope slides (3–6 per group)
- microscopes (1 per group)
- nail polish remover (containing acetone, 1 bottle per teacher)
- Petri dishes or small vials (3–6 per group)
- plant or leaf models (per class) – Optional
- scissors (1 per teacher)
- stereoscopes (1 per group)
- tape or glue (per class)
- timing device (1 per teacher)
- tree leaves (local, see Advance Preparation, 8 types per group)
- stereo scope (1 per group)

***Possible collection items may include:

- desk items: hole punch, stapler, scissors, pen, pencil, roll of tape, highlighter, marker, staple puller, ruler, sticky note pad, board eraser, etc.
- lab items (mix glass and plastic objects): small graduated cylinder, small beaker, funnel, test tube, test tube rack, test tube holder, forceps, Petri dish, etc.
- toy items (mix wood, plastic, and metal objects): glass marbles, wood blocks, plastic animals, toy cars, spring toys, tops, balls, etc.

**Attachments**

All attachments associated with this lesson are referenced in the body of the lesson. Due to considerations for grading or student assessment, attachments that are connected with Performance Indicators or serve as answer keys are available in the district site and are not accessible on the public website.

- Teacher Resource: Insect Cards (see Advance Preparation, 1 set per pair)
- Handout: Using a Dichotomous Key (1 per student and 1 for projection)
- Teacher Resource: Using a Dichotomous Key and Script KEY
- Handout: Insect Parts (1 per student or 1 for projection)
- Optional Teacher Resource: Leaf Morphology (1 per group)

**Resources**

- Suggested Websites:
  - Interactive Dichotomous Keys:
    - Trees of Texas: [http://texastreeid.tamu.edu/content/idByLeaf](http://texastreeid.tamu.edu/content/idByLeaf)
    - Tree Identification Key: [http://www.uwsp.edu/cnr-ap/leaf/Pages/TreeKey/treeToidentify.aspx?feature=Main](http://www.uwsp.edu/cnr-ap/leaf/Pages/TreeKey/treeToidentify.aspx?feature=Main)
- Aquatic Critters Sample Key: [http://dnr.wi.gov/org/caer/ce/eek/critter/watercritter/key.htm](http://dnr.wi.gov/org/caer/ce/eek/critter/watercritter/key.htm)
- How to Make a Dichotomous Key: [http://www.mdsu.umd.edu/programs/education/interactive_lessons/key/student1.htm](http://www.mdsu.umd.edu/programs/education/interactive_lessons/key/student1.htm)
- Dichotomous Key Resources: [http://www.internet4classrooms.com/grade_level_help/life_science_identify_organism_with_simple_key_eighth_8th_grade_science.htm](http://www.internet4classrooms.com/grade_level_help/life_science_identify_organism_with_simple_key_eighth_8th_grade_science.htm)
- Forestry: [http://forestry.about.com/od/forestry/tp/tree_id_start.htm](http://forestry.about.com/od/forestry/tp/tree_id_start.htm)

**Suggested Books:**

**State Resources:**
- *Texas Safety Standards: Kindergarten through Grade 12, 2nd Edition*
- *“Science Safety Information and Resources”*
- *“Laws and Rules”*

## Advance Preparation

1. **Prior to Day 1:**
   - Collect a variety of about 20 items from the desk, toys, and lab equipment. Only 20 total items per class will be needed. Suggested items:
     - desk items: hole punch, stapler, scissors, pen, pencil, roll of tape, highlighter, marker, staple puller, ruler, sticky note pad, board eraser, etc.
     - lab items (mix glass and plastic objects): small graduated cylinder, small beaker, funnel, test tube, test tube rack, test tube holder, forceps, Petri dish, etc.
     - toy items (mix wood, plastic, and metal objects): glass marbles, wood blocks, plastic animals, toy cars, spring toys, tops, balls, etc.
   - Print, laminate, cut apart, and bag the Teacher Resource: Insect Cards. You will need one set per pair of students.
   - Recommended Option: Locate and purchase sets of toy insects, and develop a dichotomous key to match. These sets are inexpensive and will allow students to see more details than the card sets.
   - Locate and project a dichotomous key to model with students (See the Resources and References section for possible selections.).

2. **Prior to Day 2:**
   - Set up insect traps to collect insects for students to observe. If allowing students to use collecting nets the day of the lesson, locate an appropriate area. **Caution:** Avoid collecting stinging insects such as wasps and bees.
   - Handle ants with care. Place captured insects in small vials or Petri dishes. Prepare to review safety precautions and established field guidelines with students.
   - If using kill jars, construct several ahead of time. If a kill jar is used, insects need to be left in it long enough to prevent revival. The collection of insects could be assigned as an over the weekend project. Non-moving insects are easier to observe than active ones. Directions for a kill jar could be sent home with students who wish to collect insects in advance.
     - Cut a cardboard circle so that it will fit inside the jar snugly.
     - Punch some holes in the cardboard circle with a compass point or large push pin. The holes should be large enough to allow fumes through but not large enough to allow the insects to enter.
     - Fill the jar about one-third to one-half full of cotton balls.
     - Pour the nail polish remover over the cotton balls until they are wet.
     - Push the cardboard circle inside the jar until it sits just above the cotton balls.
     - Keep lid on the jar.
     - If the cotton balls appear to be drying, remove the cardboard, add more polish remover, and reassemble the jar.

3. **Prior to Day 3:**
   - Collect a sample of local leaves. Optional: Place leaves flat between sheets of newspaper, and lay books on top of the papers to press the leaves. The book listed above as Texas Trees, A Friendly Guide is a good book for teacher use. It is not in a dichotomous key format. Here are some suggestions:
     - Limit the types of leaves to no more than eight.
     - Collect at least one conifer, if possible.
     - Avoid collecting shrubs and house plants.
     - Do not use all of one type of tree such as all types of oak trees.
   - Locate or construct a dichotomous key for the leaves in your collection (See the Resource and References section for possible selections and instructions for constructing a dichotomous key.).
   - Perform a search to locate illustrations of leaf morphology including type, shape, margin, and venation patterns (See the Resources and References section for a possible selection: Tree Identification Tool: [http://www.earlyforest.com/2009/10/tree-leaf-identification-tool.html](http://www.earlyforest.com/2009/10/tree-leaf-identification-tool.html)). The Optional Teacher Resource: Leaf Morphology is one possible choice. The illustrations will be used when you demonstrate the requirements for identifying a leaf in the Evaluate section of the lesson.
   - Using illustrations located through a search, prepare a cheat sheet for each group to use with the dichotomous key for leaf identification (See the Resources and References section for possible selections.). Print and laminate the sheet for each group. The dichotomous key selected or constructed for student use will determine which illustrations are appropriate.
   - Optional: Arrange for student computer/Internet access if using an interactive dichotomous key.
4. Prepare attachment(s) as necessary.

**Background Information**

Prior to this unit, students have been introduced to concepts relating to heredity and sexual and asexual reproduction and learned that inherited traits of individuals are governed in the genetic material found in genes. This material included an introduction to the basic structure of DNA. During this unit, students will learn that traits may be used to classify the organism. After this unit, these concepts will not be directly taught again in middle school.

This lesson focuses on the use of a dichotomous key. A dichotomous key is a series of paired statements (yes or no questions) that help identify plant or animal species, gems, minerals, rocks, shells, etc. It organizes species by their physical characteristics. Ultimately, a key can show relationships between species based on these characteristics. The TEKS do not address the parts of the insects, types of leaf margins, venation patterns, or leaf shapes to be taught or learned.

Students may not have enough background to understand the technical terms used in keys. Supplemental materials need to be provided to help students navigate the terminology in a key. There is not time to teach all of the information on insects and plants that students are missing. This is a short lesson for the amount of material that needs to be covered. Students should not be held responsible for terminology concerning insects and leaves. Rather, focus on how to navigate a dichotomous key and how it is organized.

**STAAR Note:** Student expectation 7.11A is a Supporting Standard that will be assessed on the STAAR Grade 8 Science Assessment.

For more information, please visit the following websites:

- [http://www.internet4classrooms.com/grade_level_help/life_science_identify_organism_with_simple_key_eighth_8th_grade_science.htm](http://www.internet4classrooms.com/grade_level_help/life_science_identify_organism_with_simple_key_eighth_8th_grade_science.htm)

### INSTRUCTIONAL PROCEDURES

<table>
<thead>
<tr>
<th>Instructional Procedures</th>
<th>Notes for Teacher</th>
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</thead>
<tbody>
<tr>
<td>ENGAGE – Sort Me (Optional, see Instructional Notes)</td>
<td><strong>Materials:</strong></td>
</tr>
<tr>
<td><strong>1.</strong> This activity should take approximately ten minutes. Place a collected variety of about 20 items on a flat surface at the front of the room (see Advance Preparation). The items should be visible to all of the students; they may have to stand around the display table/desk.</td>
<td><strong>collection of various items (20 various items, see Advance Preparation, 1 collection per teacher)</strong></td>
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<tr>
<td><strong>2.</strong> Allow students to view the objects for 30 seconds, and then cover the items with a cloth.</td>
<td><strong>cloth cover (large, 1 per teacher)</strong></td>
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<tr>
<td><strong>3.</strong> Instruct students to return to their seats, and allow them two minutes to list as many items as they can remember seeing on the table/desk in their science notebooks.</td>
<td><strong>timing device (1 per teacher)</strong></td>
</tr>
<tr>
<td><strong>4.</strong> Move the items out of the sight of the students, and sort them into groups while students are writing. Cover the objects with the cloth. Suggestions to sort items by:</td>
<td>*<strong>Possible collection items may include:</strong></td>
</tr>
<tr>
<td>• Composition – metal, plastic, glass, wood, etc.</td>
<td>• desk items: hole punch, stapler, scissors, pen, pencil, roll of tape, highlighter, marker, staple puller, ruler, sticky note pad, board eraser, etc.</td>
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<tr>
<td>• Shape – round, square, rectangular, cylindrical, triangular, etc.</td>
<td>• lab items (mix glass and plastic objects): small graduated cylinder, small beaker, funnel, test tube, test tube rack, test tube holder, forceps, Petri dish, etc.</td>
</tr>
<tr>
<td>• Use – lab equipment, desk equipment, play objects, etc.</td>
<td>• toy items (mix wood, plastic, and metal objects): glass marbles, wood blocks, plastic animals, toy cars, spring toys, tops, balls, etc.</td>
</tr>
<tr>
<td><strong>5.</strong> After two minutes, stop students from writing items in their notebooks.</td>
<td><strong>Materials:</strong></td>
</tr>
<tr>
<td><strong>6.</strong> Show students the grouped objects for another 30 seconds, and then cover the items with the cloth.</td>
<td><strong>collection of various items (20 various items, see Advance Preparation, 1 collection per teacher)</strong></td>
</tr>
<tr>
<td><strong>7.</strong> Allow students two minutes to create a second list of all of the items that they can remember.</td>
<td><strong>cloth cover (large, 1 per teacher)</strong></td>
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<tr>
<td><strong>8.</strong> Allow a minute for students to compare their lists.</td>
<td><strong>timing device (1 per teacher)</strong></td>
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<tr>
<td><strong>9.</strong> Facilitate reflective discussion including the following ideas.</td>
<td>*<strong>Possible collection items may include:</strong></td>
</tr>
<tr>
<td>• <strong>What was different the second time you were allowed to observe the items? They were grouped.</strong></td>
<td>• desk items: hole punch, stapler, scissors, pen, pencil, roll of tape, highlighter, marker, staple puller, ruler, sticky note pad, board eraser, etc.</td>
</tr>
<tr>
<td>• <strong>Why were certain items placed in a particular group? According to similarities of physical properties</strong></td>
<td>• lab items (mix glass and plastic objects): small graduated cylinder, small beaker, funnel, test tube, test tube rack, test tube holder, forceps, Petri dish, etc.</td>
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### EXPLORE/EXPLAIN – Using a Dichotomous Key

1. Divide students into pairs, and distribute a set of Insect Cards (see Advance Preparation) to each. Instruct students to display the Insect Cards at their work stations.  

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***Instructional Notes:***  
Optional Engage: Based on time constraints, you may wish to omit the Engage activity. The Explore/Explain section has a nice Engage built in.
space and observe the images carefully.

2. Instruct students to group the cards based on a physical characteristic. Allow about five minutes for them to do this. Do not specify the number of groups or characteristics for sorting.

3. Monitor and assist as needed.

4. Ask each pair to share the characteristic that they used to group the insects and how many sorting groups they had. Acknowledge all answers.

5. Facilitate a discussion including the following ideas.

- What is the importance of placing items in categories? Answers may vary.
- Have you ever been somewhere and noticed items placed in categories? Grocery stores, libraries, department stores, etc.
- How is having items organized helpful? Answers may vary; easier to find items when they are organized
- Explain the reasoning of the categories in which you grouped your cards.
- Suppose we needed to identify students in our class based on the kinds of shoes they are wearing. What kind of tool or guide may be helpful in doing so? Answers may vary. Some students may indicate that we need a “key”.
- Scientists use a tool called a “dichotomous key” to identify organisms.
- A dichotomous key is a tool that allows the user to determine the identity of items based on physical traits. Keys have a series of two choices in each step that lead the user to the correct name of a given object.
- What does the prefix “di” mean? Two. “Dichotomous” means “divided into two parts”. Dichotomous keys always give only two choices in each step.
- For example, if we are identifying shoes, the key may ask “Heels? No heels?” It will only give us two choices in each step.
- If you answered “yes” to heels, then go to the left side of the room. If you answered “no”, then go to the right side of the room.
- Now the “heels” group will be given two more choices. For example, square heels or not square heels? The two groups would separate. This would continue until each category is separated out to an individual type of shoe. The “no heels” group would go through the same process.

6. Locate and project an example of a dichotomous key, and work through it with the class (see Advance Preparation and Resources and References).

7. Ask students to work with a partner to define dichotomous key in their science notebooks.

8. Monitor to ensure accuracy of definitions, and allow volunteers to share out with the class.

9. Project and distribute the Handout: Using a Dichotomous Key to each student. Explain to them that they will use a dichotomous key to identify insects based on wing traits.

10. Review procedures for Using a Dichotomous Key investigation with students. Include information on how to use the dichotomous key correctly. You may wish to do one example as a class.

11. At this point, refer to Teacher Resource: Using a Dichotomous Key and Script KEY for further directions. Lead students through the activity by scaffolding from most support down to least support (modeling; working together large group, small group, pairs, individual).

12. Monitor and assist students in completing the investigation. Students may need assistance in using the dichotomous key to complete this lesson.

13. After facilitating a discussion from the Teacher Resource: Using a Dichotomous Key and Script KEY, instruct students to affix their Handout: Using a Dichotomous Key to their notebooks.

4. Collect Insect Card sets.

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### ELABORATE – Comparing Insects

1. Set insect traps the day before, or allow students to use collecting nets to collect some insects (see Advance Preparation). **Caution:** Review safety precautions and established field investigation guidelines with students. Avoid collecting stinging insects such as wasps and bees. Handle ants with care. Place captured insects in small vials or Petri dishes.

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### Materials:

- insect collection (see Advance Preparation, various per group)
2. Optional: Create a kill jar to allow for easier observation of insects. To construct the kill jar, see Advance Preparation. If a kill jar is used, insects need to be left in it long enough to prevent.

3. Distribute the Handout: Insect Parts. Students may use the handout as a reference guide for the insect parts that they are observing. Insect models are useful in this activity as well. Instruct students to affix the handout to their notebooks.

4. Use stereoscopes, microscopes, hand lenses, or digital microscopes and computers to view mouth parts, legs, and/or wings of captured animals. A digital camera may also be used to capture images of small mouth parts or wing cells.

5. Instruct students to illustrate observations of insect traits in their notebooks.

6. Project the following questions, and facilitate a class discussion.

   - How do dichotomous keys show the relationships between organisms? Organisms with similar traits are in the same categories. Organisms within the same categories may be related at some level.
   - How do external structures allow for organisms to be identified? The structures allow us to place organisms into categories.
   - How are dichotomous keys useful in the identification of organisms? They help us by placing the organism into smaller and smaller categories based on external structures and physical traits.

7. Instruct students to explain (in their science notebooks) how the observation of physical traits and structures can help in the grouping and identification of organisms.

- **Materials**
  - tree leaves (local, see Advance Preparation, 8 types per group)
  - dichotomous key (see Advance Preparation, 1 per group)
  - insect models (1 per group) – Optional
  - hand lens (1 per student)
  - stereoscopes (1 per group)
  - microscopes (1 per group)
  - microscope slides (3–6 per group)
  - computers (1 per group)
  - collecting nets (1 per group)
  - insect traps (1 per student)
  - digital camera (1 per class) – Optional
  - Petri dishes or small vials (3–6 per group)
  - digital microscope (1 per group) – Optional
  - tape or glue (per class)
  - first aid kit (1 per teacher)
  - kill jar (see Advance Preparation, 1 per group) – Optional
  - glass jar with lid (1 per group)
  - cotton balls (2–3 per jar)
  - nail polish remover (containing acetone, 1 bottle per teacher)
  - cardboard circle (1 per jar)
  - scissors (1 per teacher)
  - drawing compass (1 per teacher)

- **Attachments**
  - Handout: Insect Parts (1 per student and 1 for projection)

- **Safety Notes:**
  - Caution: Do not collect stinging insects such as bees or wasps.
  - Use care when collecting ants to avoid bites, stings, or a swarm attack.

  When taking students to do field investigations, carry a first aid kit.

- **Instructional Notes:**
  - The collection of insects could be assigned as homework.

  Insects may be gathered from the grills of cars as a last resort. Often, butterflies, dragonflies, and other insects are commonly found there.

- **Science Notebooks:**
  - Students affix the Handout: Insect Parts to their notebooks.
  - Students illustrate observations of insect traits in their notebooks.
  - Students explain how the observation of physical traits and structures can help in the grouping and identification of organisms.

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**EVALUATE – Performance Indicator**

**Grade 07 Science Unit 12 PI 01**

Gather a collection of leaves or insects. Use a dichotomous key to identify and label each specimen based on their structures.

**Standard(s):** 7.2C, 7.11A

**ELPS:** ELPS.c.5B

1. Collect a variety of local tree leaves (see Advance Preparation).
2. Locate and/or create dichotomous keys for identification of the leaves (see Advance Preparation and Resources and References).

3. Project the Performance Indicator on the board.

4. Share Performance Indicator rubric or your expectations with students prior to students beginning the assessment.

5. Inform students that they are to use a key to identify the leaves (see Advance Preparation). If they are using a paper key, they can write the names on the paper in the appropriate spot. If students are using the Internet key, they are to list the step choices they chose and the name of the leaf.

6. Locate illustrations of leaf morphology including type, shape, margin, and venation patterns (see Advance Preparation).

7. Explain and project illustrations to demonstrate the requirements for identifying a leaf (see Advance Preparation and Instructional Notes):

   - Leaves are often the easiest way used to identify a tree. Individual leaves can be classified as either simple or compound. Simple leaves have a single leaf blade. Compound leaves have two or more little leaves, called leaflets, attached to the stem.
   - The direction that veins run along the blade also helps to identify a tree. Veins are described as parallel, palmate, or pinnate. Parallel veins run side by side and never touch. Palmate veins start at a central point at the bottom of the leaf near the stem and spread out like fingers on a hand. Pinnate veins look like a net across the leaf. The best way to view the venation pattern is from the underside of the leaf.
   - The shape of the leaf is very helpful in identification. Leaves that grow on conifers (evergreens) can be needle-shaped, overlapping scales, or in clusters. All other leaves are called broad leaf plants. These are either single leaves or leaflets on a stem. The margins of the leaf are varied. An edge can be wavy (lobed), toothed (dentate), smooth (entire), etc. You will be looking at some of these characteristics as you use the dichotomous key to identify your leaves.

8. Answer any questions students may have regarding the assessment.

9. Demonstrate the expectations to students by modeling one example.

10. Divide students into groups of 4–5.

11. Distribute a cheat sheet of leaf morphology and set of leaves to each group (see Advance Preparation).

12. Distribute a teacher created dichotomous key to each group, or direct students to the appropriate website for a key.

13. Allow students to use stereoscopes, microscopes, and hand lenses to view leaf margins, shape, surface covering, and/or venation patterns.

Attachments:
- Optional Teacher Resource: Leaf Morphology (1 per group)

Instructional Notes:
See Resources and References for a selection of sites that are available as interactive dichotomous keys.

Provide a cheat sheet of illustrations of leaf types, shapes, margins, and veins for each group (see Advance Preparation). Students are not responsible for knowing leaf morphology. They only need an illustration to help them through the process of using a dichotomous key.
Insect Cards

butterfly  ant  damselfly  grasshopper

fly  dragonfly  moth  ladybug

butterfly  ant  damselfly  grasshopper

fly  dragonfly  moth  ladybug

Images courtesy Clip Art
Using a Dichotomous Key

A simple dichotomous key can be a useful tool to identify and organize objects by physical traits. Physical traits are important for learning how to classify things. Keys are made following these basic rules:

- Observing the physical characteristics of objects to be identified by using the key
- Identifying the most general trait that can be used to divide the organisms into categories. For this activity, we are using wings. The number of legs would not be a good trait to use when trying to narrow down the species of an insect because all insects have six legs.
- Two choices are written for each number. One choice has a trait, and the other choice is NOT the trait. A different trait for a choice is not generally used. For example, since the trait we’re using is wings, we would not use antenna as a choice.
- Each step in the key should narrow down identification. Choices should not be confusing.
- There should be one less numbered step than the total number of objects to be identified.

Follow the teacher instructions to complete the key. Be sure that you understand the process for using the key.

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<table>
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<tbody>
<tr>
<td>1. a) can see wings</td>
<td>b) can't see wings</td>
<td>go to step 3 go to step 2</td>
</tr>
<tr>
<td>2. a) has exoskeleton covering wings</td>
<td>b) doesn't have exoskeleton covering wings as it has no wings to cover</td>
<td>go to step 4</td>
</tr>
<tr>
<td>3. a) holds wings straight out to sides</td>
<td>b) doesn't hold wings out to sides</td>
<td>go to step 5</td>
</tr>
<tr>
<td>4. a) has rounded wing covers</td>
<td>b) doesn't have rounded wing covers</td>
<td></td>
</tr>
<tr>
<td>5. a) folds wings together over back</td>
<td>b) doesn't fold wings together over back</td>
<td>go to step 6 go to step 7</td>
</tr>
<tr>
<td>6. a) wings are transparent</td>
<td>b) wings are not transparent</td>
<td></td>
</tr>
<tr>
<td>7. a) wings lay in a flat, triangular shape</td>
<td>b) wings do not lay in a flat, triangular shape</td>
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</table>
Using a Dichotomous Key and Script KEY

Lead students through the key one step at a time. It is necessary that students understand how a dichotomous key is organized and what it does. They will have to use a different key later in the lesson. Students may recognize some of the insects, but they may not know how to use a key to identify them by physical characteristics.

1. Distribute the Handout: **Using a Dichotomous Key** to each student. Explain to them that you will lead them thorough the identification and grouping of the insects based on the trait concerning wings.

2. Read the first paragraph to the students. Refer them back to the description that they wrote for the term “dichotomous key”.

3. Say:
   - **Look at the choices in step 1.** Divide your cards into two groups based on the given criteria. Place them in two separate rows. *Model, monitor, correct, and continue*

   | 1. a) can see wings | butterfly, damselfly, fly, dragonfly, moth | .......... go to step 3 |
   | b) can’t see wings   | ant, grasshopper, lady bug               | .......... go to step 2 |

   - **Look at the insects in the “can’t see wings” pile.** There should be three cards. Where does step 1b instruct us to go? *(Go to step 2.)* Look at the choices in step 2.

   | 2. a) has exoskeleton | covering wings | .......... go to step 4 |
   | b) doesn’t have exoskeleton | covering wings as it has no wings to cover | .......... ant |

Say:
- Insects have no bones. Their hard outer covering is their skeleton. The prefix exo- means outside. Some insects have a hard covering over their wings. This covering is a part of their exoskeleton. Examine the cards closely. Which of the three will complete line 2b? *(The ant is the only insect pictured with no wings.)* Instruct students to write the word “ant” beside the dots on line 2b. Where does step 2a instruct us to go? *(It instructs us to go to step 4.)* Go to step 4.

   | 4. a) has rounded wing covers | .......... lady bug |
   | b) doesn’t have rounded wing covers | .......... grasshopper |

Say:
- **Look at the choices in step 4, and look at your cards.** Which insect has rounded pieces of exoskeleton covering their wings? *(The lady bug is the only insect pictured with rounded wing coverings.)* Instruct students to write the word “lady bug” beside the dots...
on line 4a. Which insect fits the criteria for 4b? (The grasshopper is the only insect pictured without rounded wing coverings from the step 2 sort.) Instruct students to write the word “grasshopper” beside the dots on line 4b.

- Go back to step 1, and retrace how you got the ant, grasshopper, and lady bug identified by the characteristics of their wings. Lead students through the steps again before continuing with the rest of the insects.

- Now, go back to the remaining cards left from the sort you made in step 1. You should have five cards remaining. (butterfly, damselfly, fly, dragonfly, and moth)

- Where does step 1a instruct us to go? (It instructs us to go to step 3.) Go to step 3.

3. a) holds wings straight out to sides dragonfly
   b) doesn't hold wings out to sides butterfly, fly, damselfly, moth

Say:
- Look at your cards and the choices. Which insect fits the description in step 3a? (The dragonfly holds its wings straight to the side.) Dragonflies are unable to fold their wings in any direction. They are always out to their side. It is one way to tell a dragonfly and a damselfly apart when they are at rest. Instruct students to write the word “dragonfly” beside the dots on line 3a.

- Where does step 3b instruct us to go? (It instructs us to go to step 5.) Go to step 5.

5. a) folds wings together over back butterfly, damselfly
   b) doesn't fold wings together over back fly, moth

Say:
- Look at the cards you have left. Sort them into the two groups described in step #5. Look at step 5a. Where does it instruct us to go? (It instructs us to go to step 6.) Go to step 6.

6. a) wings are transparent damselfly
   b) wings are not transparent butterfly

Say:
- Look at your cards and the choices. Which insect fits the description in step 6a? (The damselfly has transparent wings.) Instruct students to write the word “damselfly” beside the dots on line 6a. Look at step 6b. Which insect from this sort fits the description? (The only card left from the sort for step 5a is the butterfly.) Instruct students to write the word “dragonfly” beside the dots on line 6b.
• Look back at step 5b. What cards do you have left? *(The fly and the moth are left.)*
Where does step 5b instruct us to go? *(It instructs us to go to step 7.)* Go to step 7.

• Read the choices for step 7, and place the name of each insect on the correct line next to the dots.

| 7.  | a) wings lay in a flat triangular shape | moth |
|     | b) wings do not lay in a flat triangular shape | fly |

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<tr>
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<th>moth</th>
<th>fly</th>
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Ask the following questions to check for student understanding and clarification.

• What did you notice about the choices for each step? *Answers may vary but lead students to the idea that one choice in a step describes a trait and the other choice is a “not” statement of that trait.*

• Did you have to go in numerical order through the key? *Only to a point. It is necessary to follow the numbering identified in the a or b choice in each step.*

• How does a dichotomous key show relationships between organisms? *The key focus on a physical characteristic that was inherited. By refining the sorting based on differences in that trait, the relationship between organisms becomes clearer. The dichotomous key allows us to compare and contrast groups of similar organisms.*

• If these were live insects instead of cards, what are some characteristics, other than wings, that could be used to classify the insects? *Answers may vary as students may not have studied insects in detail. Some suggestions are: mouth parts; leg structure, such as number of toes; hairs or spines on legs; antenna structure; eyes; patterns of veins in wings; body covering; etc.*
Insect Parts

Legend: a, antennae; c, compound eye; lb, labium; lr, labrum; md, mandibles; mx, maxillae; hp, hypopharynx

The types of insect mouthparts:

a) chewing mouthparts of a grasshopper in the center
b) the lapping type of a bee
c) the siphoning type of a butterfly
d) the sucking type of a female mosquito
The wings are strengthened by a number of longitudinal veins, which often have cross-connections that form closed "cells" in the membrane. These patterns can be used for identification purposes.

Insects and their relatives are hexapods: having six legs connected to the thorax and each with five components. In order from the body, they are the coxa, trochanter, femur, tibia, and tarsus. Each is a single segment, except the tarsus which can be from three to seven segments and can be used for identification.
Key to Leaf Morphology

http://commons.wikimedia.org/wiki/File:Leaf_morphology.png