



13. Tree Identification: Create a Dichotomous Key

Lesson Overview: In this activity, students use photographs and botanical specimens to create a dichotomous key for 10 tree species native to forests of the northern Rocky Mountains and the North Cascades.

Lesson Goals: Increase students' understanding of morphological characteristics of trees, and increase their ability to identify tree species in the northern Rocky Mountains and the North Cascades.

Subjects: Science, Speaking and Listening, Writing

Duration: One 30- to 40-minute session

Group size: whole class/groups

Setting: Classroom

Vocabulary: *dichotomous key*



Objectives:

- Students will use botanical specimens and photographs to create a dichotomous key for 10 tree species.

Standards:		9th	10th	11th	12th
CCSS	Writing Standards	2, 4, 8, 10		2, 4, 8, 10	
	Speaking and Listening Standards	1, 2, 4, 6		1, 2, 4, 6	
	Language	1, 2, 3		1, 2, 3	
	Writing Science/Technical Subjects	2, 4, 9, 10		2, 4, 9, 10	
NGSS	From Molecules to Organisms: Structure and Processes	LS1.B			
	Ecosystems: Interactions, Energy, and Dynamics	LS2.C, LS4.D			
EEEEGL	Strand 1	A, B, C, E, F, G			

Teacher Background: Wildland ecosystems are characterized by diversity. The diversity and species of trees in a forest influence the kinds of fire that occur there. To understand the complexity of fire's role in forests, students must be able to distinguish among tree species. In this activity, students use their observation skills to create a dichotomous key for 10 tree species that are important in forests of the northern Rocky Mountains and the North Cascades. An example key for these species is included at the end of the activity, but each student's (or team's) key will be unique.

As an introduction to the concept of developing a key, students construct a “practice” key for identifying a few members of the class. Then in the **Assessment**, they create a key for identifying 10 tree species. If you are able to take the class to a field site that contains a few of these tree species, it would be great to do a second, real-world assessment: Have them use their keys (possibly supplemented by other keys or natural history books) to identify trees in the field.

Materials and preparation:

- Decide how you will have students work on the keys – individually, in pairs, or in larger teams. Also consider both options for **Assessment** described below. Your decisions will determine how you set up the classroom.
- Obtain a few examples of dichotomous keys from a library.
- Assemble 10 stations in the classroom. Each station should have the following items from the trunk for every tree species:

- Photos for the species from **Tree_ID_photos.pdf**.
(There are 2 pages of photos for each species, labeled with a code letter for the species.)
- Tree Bark/trunk specimen
- Cone or flower specimen
- Foliage specimen
- Species name label from **Tree_spp_labels.pdf**
(contains the species letter code and name)
- Ruler

Code letters for tree species:

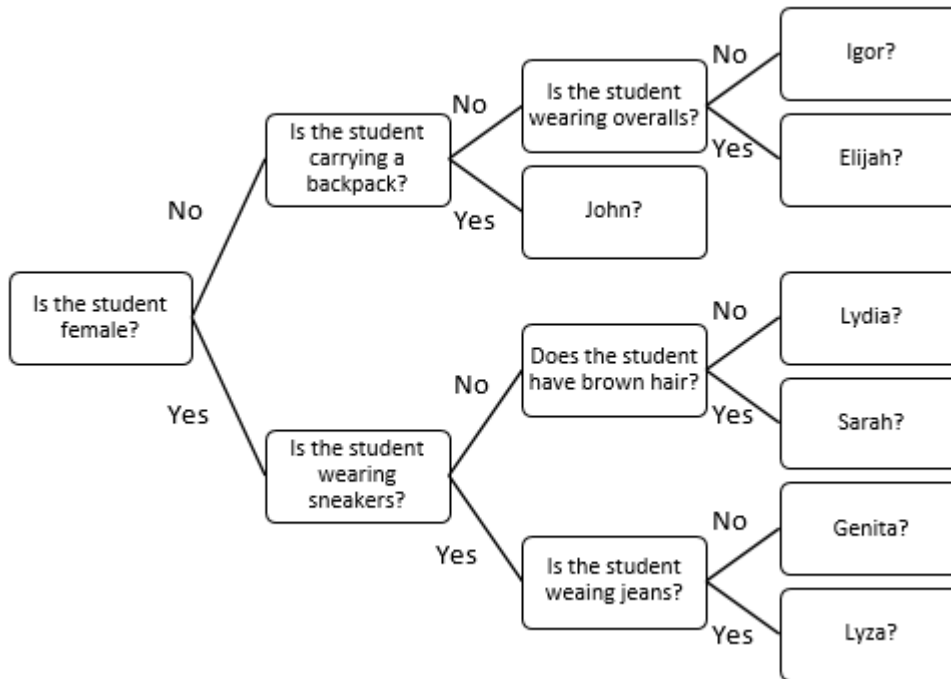
Black cottonwood	B
Douglas-fir	V
Engelmann spruce	H
Lodgepole pine	E
Ponderosa pine	O
Quaking aspen	L
Subalpine fir	C
Western larch	T
Western redcedar	D
Whitebark pine	J

Procedure:

1. Ask: Name some tree species that live in the northern Rocky Mountains and the North Cascades. **List species names on the board. Names of classes of trees (pines, oaks, firs, etc.) would also be good.** Are all of these kinds of trees native to the wildlands of our area? **If you are uncertain, have students consult http://www.treesforme.com/a-z_common_name.html, a list of all tree species native to North America; select the species name to find a map and a list of the states where it occurs.**
2. Ask: When we see a person in school or a tree in the woods, how do we identify him/her/it? **We use distinguishing characteristics, that is, traits that are unique to that person or thing or group.**
3. Let’s figure out a way to help a new student at school identify some of our class members. We’re going to build a dichotomous key. The new student will be able to go through a series of yes-no choices about characteristics of the class members. (The word *dichotomous*

comes from the Greek *dich-* (“in two”) and *temnein* (“to cut”). The yes-no choices will lead the new student to the right name for each person in the key.

- Select eight volunteers. Write the key on the board as it develops. You might want to provide the first question. Then have students create the rest of the key until all eight students are identified. Here is an example of a dichotomous key for 8 students:



- Explain: Dichotomous keys usually contain additional information in narrative form that can be used to verify the identification. What additional information would you offer so the new student can confirm his/her identifications and learn more about his/her new classmates?
Example narrative for the key above to distinguish John from Elijah: “John is a male student who is 6 feet tall, has brown hair, and often carries a backpack. He plays the trombone. Elijah is also male; he is wearing a brown t-shirt today and carrying most of his stuff in the pockets of his overalls. He drives a car that he rebuilt himself.”
- Ask: Do you see any problems with this key? For example, will it work tomorrow if everyone changes clothes? ... if they dye their hair or shave their heads? **A key should be based on characteristics that do not change much from day to day or season to season or even year to year.**

Explain: We’ve just built a key for identifying individual people. In the sciences, keys are used for identifying whole groups of things – people, rocks, plants, animals, micro-organisms, etc. Now we’re going to create a dichotomous key for some important tree species that grow in the

forests of the northern Rocky Mountains and North Cascades.¹ We'll identify only 10 species, even though the keys used by professionals (land managers, ecologists, botanists, wildlife biologists, microbiologists) cover ALL of a kind of organism (trees, insects, etc.) – often hundreds or even thousands of kinds.

7. Distribute copies of a few field guides with dichotomous keys or show examples from the internet so students can see what a dichotomous key looks like and how it is used.

Assessment – Option 1.

1. Explain: Each team will create a dichotomous key for 10 important tree species that occur in the northern Rocky Mountains and North Cascades. We'll refer to these species often in the rest of our fire-related activities, because they all have different ways of dealing with fire.
2. Each station has information on **one species**: a label with the species' name and code letter, 2 pages of photos that show its characteristics in the field, and a collection of botanical specimens (bark, foliage, and cones or flowers).
3. Circulate among the stations to find characteristics that can be used to distinguish groups of species and individual species from one another. Take notes on these distinguishing characteristics.
4. Use the distinguishing characteristics to create a draft of your key. This process will probably require several iterations, so it will be easiest if you draft it in pencil.
5. When you think you're done, have another student or team try your key out to see if it is accurate and easy to use.
6. Make a clean copy of your key for evaluation. It can be digital² or done by hand. It can use text only (like most field guides), or include graphics (like the pasta example).
7. To accompany your key's diagram, write a short narrative description of each tree species (2-3 sentences) that can be used to confirm the identification.

¹ Consider having students practice making one more dichotomous key with something easy, such as different kinds of pasta. There are many examples available online. If you do this, you will need additional supplies (e.g., pasta).

² **Tip:** Students can use computer software to create their keys, if they want to. Here's a way to do it in Microsoft Word: Use the *Insert* tab, select *SmartArt* in the *Illustrations* box, select *Hierarchy*, and then select *Horizontal Hierarchy*. This will set up a template similar to those used for examples in this activity. First, you insert the decision criteria into the hierarchy. Then, to make the resulting chart into a key, insert text boxes (without borders or fill) that label the decision lines "yes" or "no."

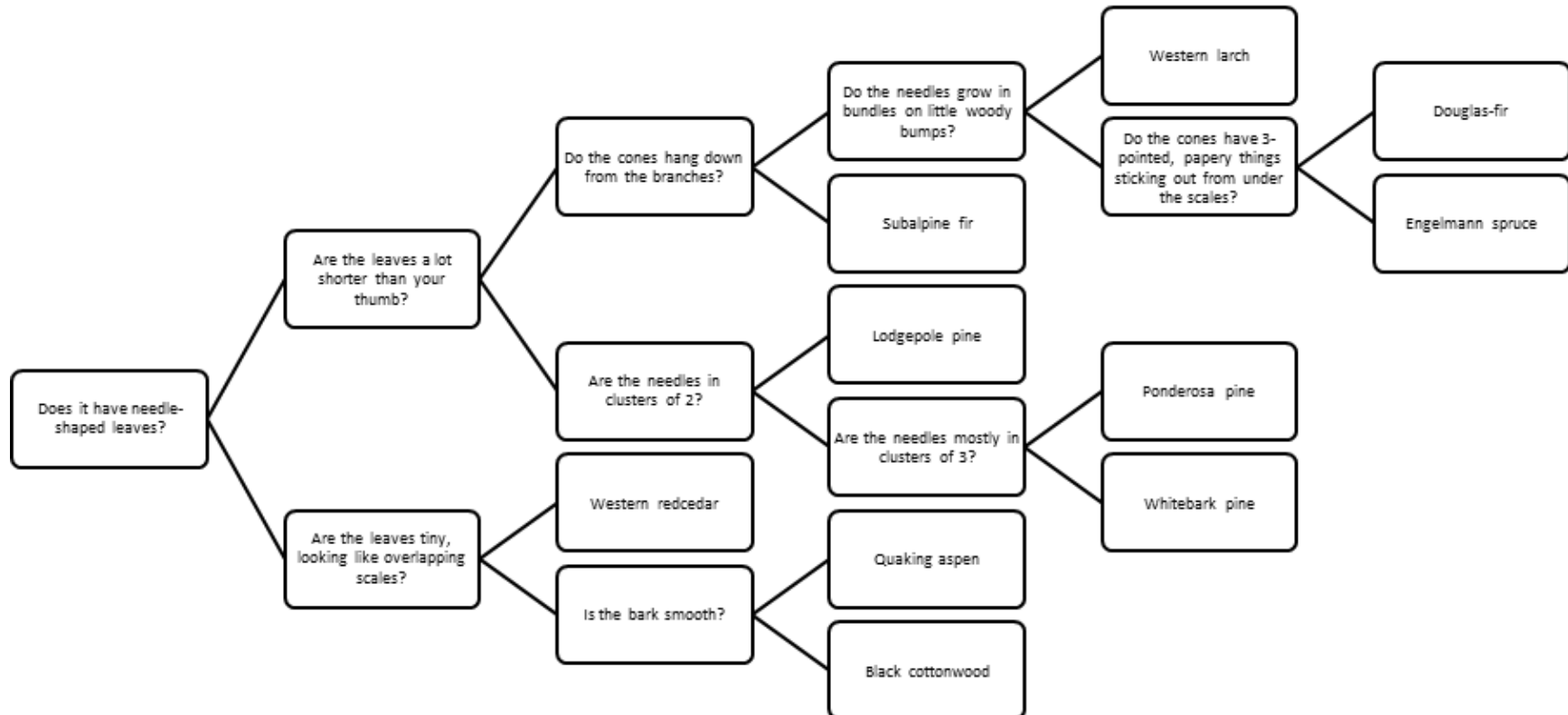
Assessment – Option 2: This approach simplifies the key-building process for the students and may be more fun to evaluate than Option 1:

1. Split the class in half, so half of the teams are on one side of the classroom and half on the other.
2. Split the collections of tree specimens in half too – placing the materials for 5 species on one side of the classroom and the materials for the other 5 species on the other side.
3. Have the student teams create keys for the 5 tree species on their side of the room.
4. Then remove the trees’ name labels from the displays.
5. Have each student team exchange keys with a team from the other side of the room, use the other team’s key to identify the 5 “unknown” tree species. Then have the teams critique the keys.

Evaluation (written for Option 1 Assessment): Each team’s key will be unique, but you can refer to the **Example for Teachers** below to see one sample of a dichotomous key and narrative descriptions.

	Excellent	Good	Fair	Poor
Dichotomous key	Created clear, accurate key for identifying 9-10 species.	~Created key useful for identifying 7-8 species. ~Key contained ambiguity or errors for 2-3 species.	~Created key useful for identifying 5-6 species. ~Key contained ambiguity or errors for 4-5 species.	~Created key useful for identifying <5 species. ~Key contained ambiguity or errors for >5 species.
Species descriptions	Created clear, concise descriptions for 9-10 species.	Created clear, concise descriptions for 7-8 species.	Created clear, concise descriptions for 5-6 species.	Created clear, concise descriptions for <5 species.

Example for Teachers: Dichotomous key for 10 tree species in the northern Rocky Mountains and North Cascades



Example for Teachers: Narratives for 10 tree species:

1. **Black cottonwoods** have wide leaves that may be very shiny. The buds at the ends of their twigs are pointy. In spring, they are very sticky. Old cottonwoods have gray, deeply furrowed bark. Cottonwood seeds are packaged with lots of cottony fluff, which helps them float a long way on wind and water.
2. **Douglas-firs** have short, flat needles and brown, furrowed bark. The buds at the ends of their twigs are pointy. Their cones feel kind of papery (like spruce cones) but with this difference: Little, 3-pointed “wings” stick out from under the cone scales. It looks like tiny mice are trying to burrow in, but they can’t hide completely!
3. **Engelmann spruces** have short needles with very sharp tips, which gives them the name “Sticky Spruce.” Their cones feel kind of papery. Their bark is grayish, with roundish scales that sometimes flake off.
4. **Lodgepole pines** have fairly long needles that usually grow from the twig in bundles of 2. Their cones are pointy and very prickly. Sometimes their cones are closed tight so the seeds can’t get out; sometimes they are open. Lodgepole pine bark is dark and scaly.
5. **Ponderosa pines** have long needles that usually grow from the twig in bundles of 3. Their cones are big and have prickles on the scales. Their bark is yellowish or brown, sometimes even orange. It falls off in pieces that look like they belong in a jigsaw puzzle. Ponderosa pines produce a vanilla-like smell, especially in the springtime.
6. **Quaking aspens** have roundish leaves with a pointed tip. Their leaves move almost constantly because they are very sensitive to wind. Their bark is mostly grayish-white and smooth, although old trees can have furrowed bark down near the ground. Their seeds are packaged with cottony fluff that helps them float long distances on wind and water.
7. **Subalpine firs** have short, flat needles and gray bark. Their bark often looks like it has spots or blisters in it. Their cones grow at the very tops of the trees, pointing upward toward the sky. The cones don’t fall off. Instead, they fall apart on the tree, and the pieces fall to the ground.
8. **Western larches** have short, soft needles, which grow in tufts of 10 or more out of little woody bumps on the twigs. Their leaves turn gold in the autumn and then fall off. Therefore, they are conifers (cone bearers) but not evergreens like pines, firs, and spruces. Western larch cones are small and lightweight. The tree’s bark is brown to reddish-brown.
9. **Western redcedars** have leaves that look like tiny, overlapping scales. Because many leaves grow together, the trees may look a little like they have small ferns for leaves. Their cones are small—about as big across as your thumbnail. Western redcedar bark is grayish, with furrows and loose strands. It looks like someone tried to peel or shred the bark.
10. **Whitebark pines** have fairly long needles that grow from the twig in clusters of 5. Their cones are purplish-brown. The cones don’t usually fall off the tree. Most of them ripen in the treetops and then get pulled apart by Clark’s nutcrackers, who want their large seeds. The pieces of cone that the nutcrackers remove fall to the ground under the tree. Whitebark pine’s bark is whitish on young trees but gray to black on older trees.