SCOPE, SEQUENCE, and COORDINATION

A National Curriculum Project for High School Science Education

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Student Materials

Learning Sequence Item:

901

Classification Schemes

March 1996
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Science as Inquiry

Algae Identification

How can algae be quickly identified?

Overview:

Algae are easy to see using a microscope. Try to identify as many different types as you can using the following dichotomous key. A dichomotous key uses two distinctive choices or characteristics to narrow down the possible names of the object you are studying. Notice how each choice leads you closer to identifying each type of alga.

Procedure:

Prepare a culture of algae according to the instructions provided by your teacher. Examine your culture and draw as many different types as you can. Next, use the dichotomous key to identify each type. Begin with number 1 and follow the directions until you identify the algae that you have seen.

Questions:

1. How did the different types of algae compare?

2. What characteristics were the most useful in this process of identification?

3. How did the key help you in this identification process?

Key to Common Algae

1a.	Color green or blue-green.	go to 2
1b.	Color not green but brownish, with patterned grooves in cell wall.	Diatoms
2a.	Color blue-green; cell without chloroplast or definite nucleus.	go to 3
2b.	Color grass-green; pigment contained in chloroplasts.	go to 4
3a.	Has cells within filaments.	go to 5
3b.	Filaments have cylindrical cells or with oscillating movements.	Oscillatoria
4a.	Algae swimming with flagella.	go to 6
4b.	Algae (no means of locomotion) with filamentous cell organization.	go to 7
5a.	Many filaments contained in a globular sheath.	Nostoc
5b.	Filaments in random arrangement, free connecting mucus.	Anabaenac
6a.	Cells solitary.	go to 8
6b.	Cells in large colonies (500–50,000 cells).	Volvox
7a.	Spiral chloroplast runs through the entire length of the cell.	Spirogyra
7b.	Chloroplast forms a network extending the entire length of the cell.	Oedogonium
7c.	Rod-shaped cells joined in a net-like shape.	Hydrodictyon
8a.	Globular with cup-shaped chloroplast and 2 flagella.	Chlamydomonas
8b.	More than one chloroplast in a cigar-shaped cell and with one flagellum.	Euglena

Student Sheet

Science as Inquiry

Leaf Impressions

How can leaves be identified?

Overview:

If you were asked to draw a leaf, what would it look like? A basic but important activity in science is distinguishing between similar life forms and then classifying and recording them. In this activity you will study some leaf samples to practice this important skill. After doing this, would your leaf drawing be different?

Procedure:

In this exercise you will use a tool for identifying organisms. This tool is called a dichotomous key. Use the key to identify the tree leaves shown in the diagram. To use this key begin with descriptions 1a and 1b and follow the directions until you identify the leaf in question. Write the name next to the leaf you have just identified.

Questions:

1. What other characteristics might be used to identify leaves with a dichotomous key?

2. Does a dichotomous key begin with general descriptions and then proceed to more specific descriptions or vice versa? Explain.

3. What characteristics might be used to identify birds or other animals using dichotomous keys?

Key to Common Leaves

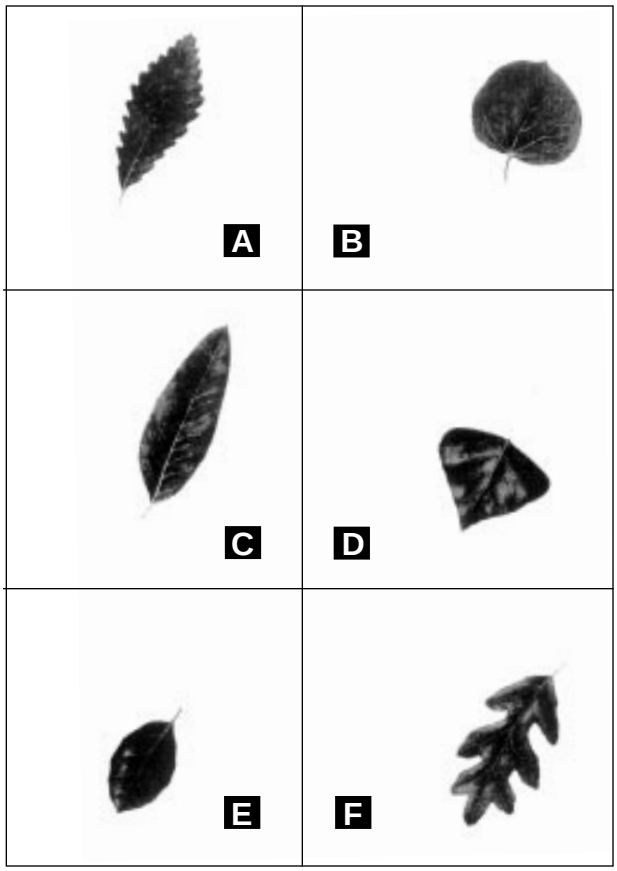
1a. If the edge of the leaf has no teeth, waves, or lobes, go to 2.
1b. If the edge of the leaf has teeth, waves, or lobes, go to 3.

2a. If the leaf has a single bristle at its tip, it is a shingle oak.
2b. If the leaf has no single bristle at its tip, go to 4.

3a. If the leaf edge is toothed, it is a lombardy poplar.
3b. If the leaf edge has waves or lobes, go to 5.

4a. If the leaf is a heart-shaped leaf with veins branching from the base, it is a redbud.
4b. If the leaf is not heart shaped, it is a live oak.

5a. If the leaf edge has lobes, it is an English oak.
5b. If the leaf edge has waves, it is a chestnut oak.



Student Sheet

Science as Inquiry

The Face of a Fish

How can we identify fish?

Overview:

Obviously, plants aren't the only living things that need to be identified. How many fish can you name? What are the distinguishing characteristics of various species of fish? This activity will help you sort out fins from scales and lead you to the names of some typical native fishes. Is identifying fish harder or easier than identifying leaves?

Procedure:

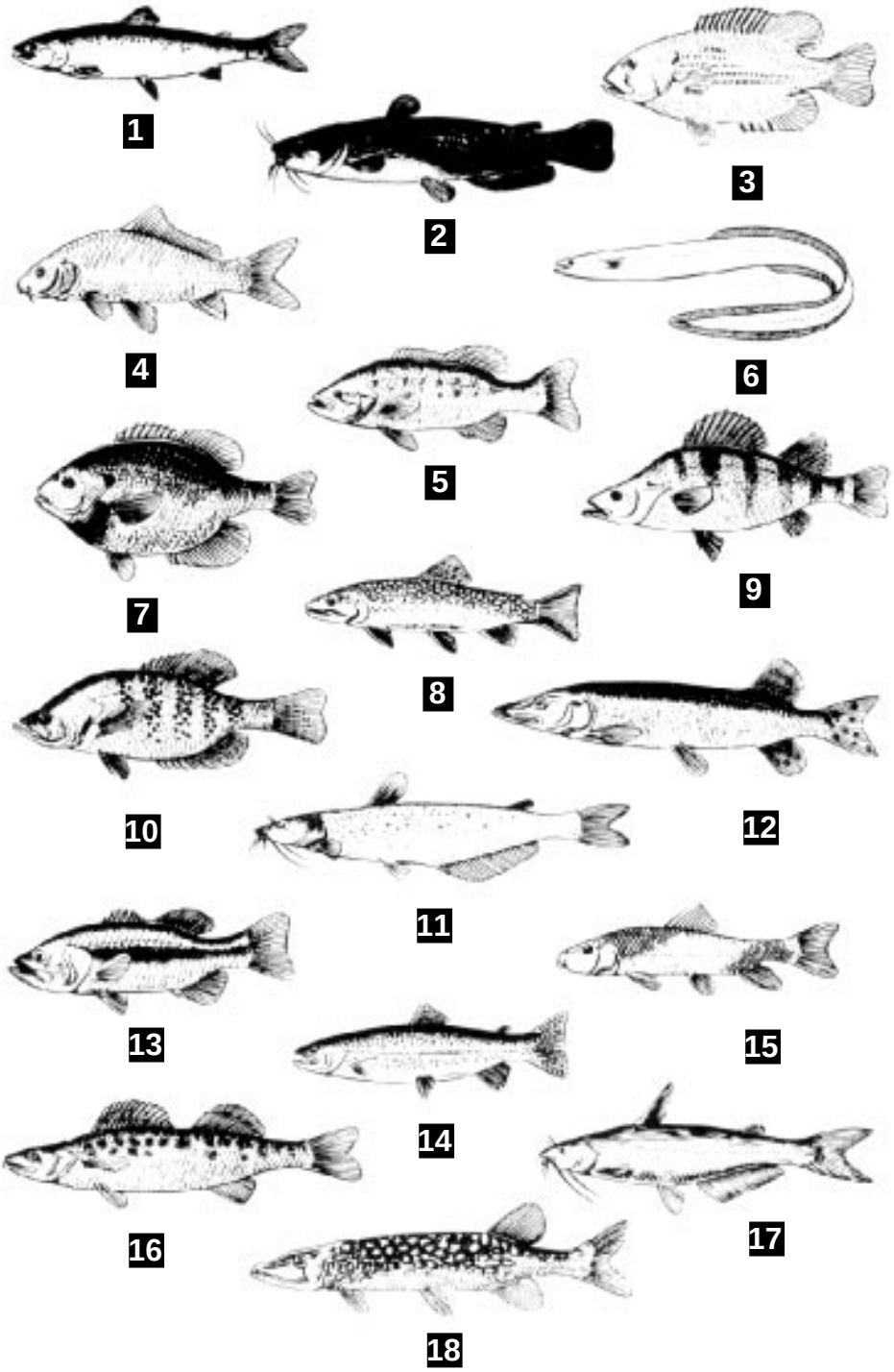
Review the illustration of native fish. Closely examine the drawing of one of the fish. Read both statements listed under number 1 of the Classification Key. One of these statements should describe the fish you have chosen; the other should not. Refer to the number after the statement that fits your fish and look for that number in the key. Again select the statement that describes the fish that you picked. Continue through the key until you can name that fish. Follow the same procedure for the other fish. Refer to the Glossary for terms used in the fish key. Write the names of these fish next to the number given.

Questions:

1. How is a dichotomous key a useful tool in science?

2. What might happen if we did not accurately classify living things?

Diagrams of Some Typical Native Fishes



Classification Key to Certain Fishes

la. Body noticeably covered with scales—2
lb. Scales not covering body or too small to be seen—12

2a. Dorsal fin single—3
2b. Dorsal fins two or more, joined or separated—6

3a. Body more than four times as long as broad (top to bottom); front edge of dorsal fin far back on body; mouth large, hinge in back of eye 1
3b. Body less than four times as long as broad; front edge of dorsal fin about midway between head and tail; mouth not large, hinge in front of eye—5

4a. Dark lines forming netted design on body; fins not spotted—Pickerel
4b. Body covered with spots; fins spotted—Northern pike

5a. Mouth turned downward; barbels absent; dorsal fin not elongated—White sucker
5b. Mouth not turned downward; barbels present; dorsal fin elongated—Carp

6a. Two dorsal fins separated, the anterior spiny and the posterior soft—7
6b. Two dorsal fins united, forming an anterior spiny portion and a posterior soft portion—8

7a. Top of head concave, fanning a hump in front of dorsal fin; dark vertical bars on body—Yellow perch
7b. Top of head not concave, body sloping to dorsal fin and not forming a hump; dark blotches on body—Walleyed pike

8a. Body more than three times as long as broad—9
8b. Body less than three times as long as broad—10

9a. Hinge of jaws behind the eye; notch between spiny and soft dorsal fin deep and nearly separating into two fins—Largemouth black bass
9b. Hinge of jaws below the eye; notch between spiny and soft dorsal fin not nearly separating into two fins—Small-mouth black bass

10a. Mouth large, hinge below or behind eye—11
10b. Mouth small, hinge in front of eye—Bluegill

11a. Five to seven spines in dorsal fin; dark spots forming broad vertical bars on sides—White crappie
11b. Ten or more spines in dorsal fin; sides flecked with dark spots—Rock bass (Redeye)

12a. Body much elongated and snakelike; dorsal, caudal, and anal fins continuous—Eel
12b. Body not elongated and snakelike; dorsal, caudal, and anal fins separate; adipose fin present—13

13a. Barbels growing from lips and top of head; head large and broad—14
13b. Barbels lacking; head not large and broad—16

14a. Caudal fin deeply forked; head tapering—15
14b. Caudal fin rounded or slightly indented but not forked; head blunt—Bullhead catfish

15a. Dorsal fin rounded at top; body silvery, speckled with black markings—Channel catfish
15b. Dorsal fin long and pointed at top; body bluish-gray without speckles—Blue catfish

16a. Caudal fin deeply forked; back not mottled and with few spots—Atlantic salmon
16b. Caudal fin square or slightly indented; back mottled or spotted—17

17a. Back and caudal fin spotted; broad horizontal band along sides—Rainbow trout
17b. Back mottled with dark lines; caudal fin not spotted; fins edged with white—Brook trout

Glossary

Barbel: A fleshy projection from the lips or head.
Scales: Overlapping outgrowths of the skin.
Fins: **Adipose.** A small fin on the top midline of the body near the tail fin.
Anal. A fin along the lower midline of the body near the tail fin.
Caudal. Tail fin.
Dorsal. The fin or fins along the top midline of the body.
Pectoral. Paired fins nearest the head, corresponding to front legs.
Pelvic. The paired fins nearest the tail, corresponding to hind legs.

Student Sheet

Science as Inquiry

A Sack of Seeds

What are properties that can be used to classify seeds?

Overview:

As you know, not all seeds are exactly alike. You have probably seen an apple seed, but have you ever compared one with a corn or sunflower seed? All living things have observable and/or measurable properties. In this activity you will determine which properties can be used to classify seeds. Is this a skill you can use in other areas of your life? Don't answer too quickly. Think about how you decided what to wear today.

Procedure:

Empty the seed packet provided for you onto a sheet of white paper. Observe the seeds with your hand lens and metric ruler. Describe the properties of each seed. Divide the seeds into two groups based on size. Then divide the two groups into smaller groups using a property other than size. Draw a diagram that shows how you classified the seeds.

Questions:

1. What properties did you use to classify the seeds?

2. How would you classify a group of objects such as books?

3. Compare your classification system with that of another group. Describe the similarities and differences between the two.

4. Why is it an advantage to scientists to use a standardized system to classify organisms?

Student Sheet

Science as Inquiry

A Rose by Any Other Name

How is a key used to identify flowers?

Overview:

A dichotomous key can help you determine the name of a flower. A dichotomous key uses two distinctive choices or characteristics to systematically narrow down the possible names of the object you're studying. Could a dichotomous key be used to find the names of people? What other uses are there for such a system?

Procedure:

Identify the flowers your teacher has given you using a dichotomous key such as the one below. Observe the flowers closely as you follow the step-by-step directions.

Key to Flowers

1a. Leaves are broad and toothed: Go to 2.
1b. Leaves are long and slender: Go to 3.

2a. Numerous petals form round, tufted flower: Thistle.
2b. Flower petals are in flat, round layers: Go to 4.

3a. Flower is bell-shaped: Daffodil.
3b. Flower is round and composed of many flowers: Cornflower.

4a. Yellow flower with squared off petals at the outer edge: Dandelion.
4b. Red flower with four petals: Poppy.

Questions:

1. When using a dichotomous key, why can you not begin with the second or third pair of descriptions?

2. Why can't two different kinds of organisms be classified as the same species when using a dichotomous key?

3. Choose five common fruits or vegetables. Create a dichotomous key for these fruits or vegetables.

4. Check the usefulness of your key by letting another student see if he or she can use it to identify each of the fruits or vegetables.

Student Sheet

Science as Inquiry

Classification of Living Things

How are all living organisms classified?

Overview:

There are more than 1.5 million kinds of living organisms that have been described. Every year many more are discovered and added to our list. How do we keep them all straight? How do we know which one we are talking about? To do these things, we must be able to describe organisms carefully and sort them out. This activity will focus on this problem.

Procedure:

Obtain your set of objects and describe each of them. What stands out about each one? What makes one different from the other? Try to group them according to these characteristics. During this process describe the characteristics of each group

After this process, discuss your groupings with your teacher and create a scheme that sorts out all of the objects so that only one object belongs in each group. Several schemes need to be created. Examine each one and decide why one might be better than the others.

Obtain representatives of the five kingdoms and describe their characteristics.

Questions:

1. Why do we have to group living organisms?

2. How do you know if something is living or nonliving?

3. Which classification scheme was better? Why?

4. What are the characteristics of the five kingdoms?

5. Using the seven-level hierarchical approach (kingdom, phylum, class, order, family, genus, species), at what level are organisms the most related?