How to Use a Dichotomous Key

Field and Museum Skills; Series 8400 Program 8417

Written by: Communication Skills Corporation
Modified by: Science Learning Center Staff
University of Michigan – Dearborn

Objectives

1. Use a dichotomous key to identify
   - Common desk items
   - Animals to phylum and class
   - Flowering plants to family

2. Construct a dichotomous key

What is a Dichotomous Key?

- A dichotomous key is a tool used to identify organisms or objects.

- It is similar to a flowchart that only has two choices per step.

Structure of a Dichotomous Key

- Dichotomous keys are organized into couplets.
- A couplet consists of two clearly contrasting choices about the object/organism.
  - The choices should not allow for ambiguity
    "scales vs. no scales" rather than "scales vs. feathers"
- Based on which statement is chosen, the key leads to another couplet or a conclusion.

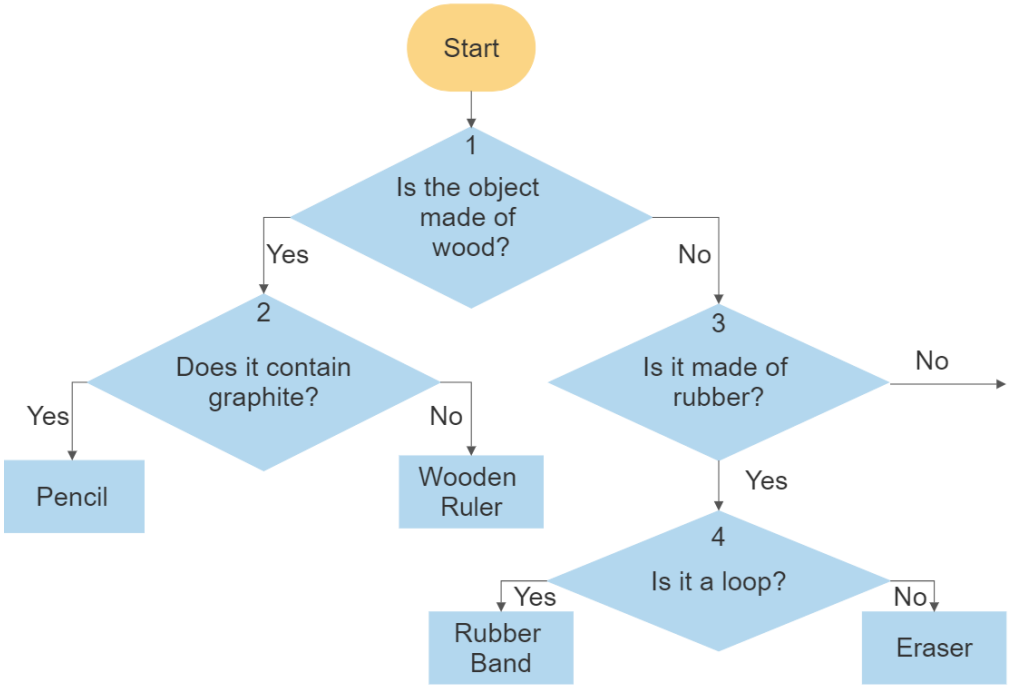
#	Choice-Description	Response
1a	Made of wood	2
1b	Not made of wood	3
2a	Contains graphite	pencil
2b	Does not contain graphite	wooden ruler

Dichotomous Key vs. Flowchart

Dichotomous Key

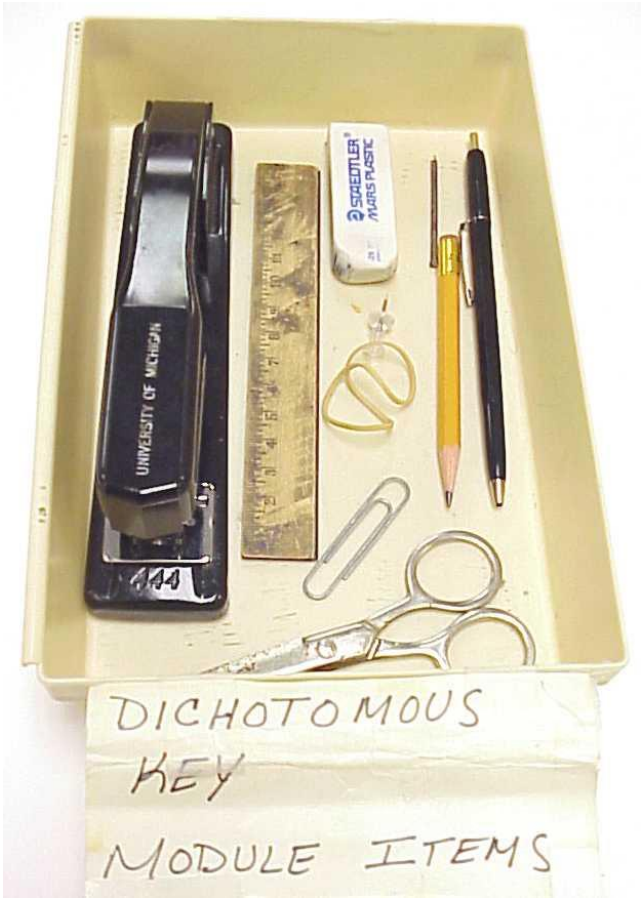
1a	Made of wood	2
1b	Not made of wood	3
2a	Contains graphite	pencil
2b	Does not contain graphite	wooden ruler
3a	Made of rubber or rubber-like material	4
3b	Not made of rubber or rubber-like material	5
4a	Made in a loop pattern	rubber band
4b	A solid object	eraser

Flowchart



Supplies

stapler	eraser
pencil	wooden ruler
pen	thumb tack
scissors	rubber band
thin nail	paper clip



A <u>study guide handout</u> is included in this module on the next 3 slides.

You will use a separate printed version.

Key to Common Desk Items

1a	Made of wood	2
1b	Not made of wood	3
2a	Contains graphite	pencil
2b	Does not contain graphite	wooden ruler
3a	Made of rubber or rubber-like material	4
3b	Not made of rubber or rubber-like material	5
4a	Made in a loop pattern	rubber band
4b	A solid object	eraser
5a	Made of a single piece of material	6
5b	Not made of a single piece of material	8
6a	One end definitely sharper than the other	7
6b	Both ends of similar sharpness	paper clip
7a	Small head	straight pin
7b	Large head	thumbtack
8a	A cutting instrument	scissors
8b	Not for cutting	9
9a	Contains ink	ball-point pen
9b	Does not contain ink	stapler

Key to Major Animal Groups

1a	Vertebral column (backbone) present	Phylum Chordata 2
1b	Vertebral column absent	8
2a	Hair present	Class Mammalia
2b	Hair absent	3
3a	Feathers present	Class Aves
3b	Feathers absent	4
4a	Fins present	5
4b	Fins absent	7
5a	Jaws present	6
5b	Jaws absent	Class Agnatha
6a	Gills covered by an operculum	Class Osteichthyes
6b	Gills not covered by an operculum	Class Chondrichthyes
7a	Skin scales present	Class Reptilia
7b	Skin scales absent	Class Amphibia
8a	Body symmetry radial	9
8b	Body symmetry not radial	10
9a	Tentacles present, body soft	Phylum Coelenterata
9b	Tentacles absent, body hard and rough	Phylum Echinodermata
10a	Exoskeleton present	11
10b	Exoskeleton absent	12
11a	Jointed legs present	Phylum Arthropoda 13
11b	Jointed legs absent	Phylum Mollusca

12a	Body segmented	Phylum Annelida
12b	Body not segmented	Phylum Platyhelminthes
13a	Walking legs, more than 5 pairs	14
13b	Walking legs, 5 or fewer pairs	15
14a	Legs, 1 pair for each body segmented	Class Chilopoda
14b	Legs, 2 pair for each body segmented	Class Diplopoda
15a	Antennae present	16
15b	Antennae absent	Class Arachnida
16a	Antennae, 1 pair	Class Insecta
16b	Antennae, more than 1 pair	Class Crustacea

Key to Major Plant Families

1a	Flower parts in 3's or multiples of 3; leaves mostly parallel-veined	2
1b	Flower parts in 4's or 5's or multiples of these numbers; leaves mostly net-veined	9
2a	Ovary inferior	3
2b	Ovary superior	5
3a	Stamens three or less	4
3b	Stamens six	Amaryllidaceae
4a	Stamens one or two	Orchidaceae
4b	Stamens three	Iridaceae
5a	Petals absent; plants grass-like	7
5b	Petals present; plants usually not grass-like	6
6a	One pistil	8
6b	More than one pistil	Alismataceae
7a	Stems triangular in cross section, solid; leaves three-ranked	Cyperaceae
7b	Stems round in cross section, hollow; leaves two-ranked	Poaceae
8a	Leaves without sheathes; petals and sepals similar in color	Liliaceae
8b	Leaves with sheathes; petals and sepals unlike in color	Commelinaceae
9a	Ovary superior	10
9b	Ovary inferior	17
10a	More than 1 pistil	11
10b	1 pistil	12
11a	Stamens and petals apparently on calyx	Rosaceae
11b	Stamens and petals receptacle	Ranunculaceae
12a	Leaves with stipules	15
12b	Leaves without stipules	13
13a	Petals united	14
13b	Petals separated and four	Brassicaceae
14a	Flowers regular	Polemoniaceae
14b	Flowers irregular	Scrophulariaceae
15a	Flower regular	16
15b	Flower irregular	Fabaceae
16a	Fruit fleshy	Rosaceae
16b	Fruit a pod	Fabaceae
17a	Petals separate	18
17b	Petals united	19
18a	Stamens five; flowers in umbels or heads	Umbelliferae
18b	Stamens ten to many; flowers not in umbels or in heads	Rosaceae
19a	Flowers in dense heads; plants herbaceous	Asteraceae
19b	Flowers not in heads; plants woody	Caprifoliaceae

Common Desk Items

Use the Key to Common Desk items provided in your study guide. Divide the items into two groups:

1a	Made of wood	2
1b	Not made of wood	3

Wooden Items

Non-Wooden Items

Divide the wooden items according to:

2a	Contains graphite	pencil
2b	Does not contain graphite	wooden ruler

Contains graphite

Does not contain graphite

Only one items is in each category and you have thus identified these items. Set the pencil and ruler aside.

Having eliminated the wooden items, divide the rest of the desk items into two groups according to:

3a	Made of rubber/rubber-like material	4
3b	Not made rubber/rubber-like material	5

Rubber/rubber-like

Non rubber/rubber-like

Group 3a includes two items. Divide the rubber items into groups according to:

4a	Made in a loop pattern	rubber band
4b	A solid object	eraser

Made in a loop pattern

A solid object

The rubber band and eraser have been identified.

Divide the remainder of the items into groups according to:

5a	Made of a single piece of material	6
5b	Not made of a single piece of material	8

Single piece

Not a single piece

Divide the items composed of a single piece of material according to:

6a	One end definitely sharper than the other	7
6b	Both ends of similar sharpness	paper clip

One end sharper than other

Both ends similar

The paper clip is in a category by itself, and now has been identified. Set it aside.

Divide the items in category 6a according to:

7a	Small head	straight pin
7b	Large head	thumbtack

Small head

Large head

There is only one item in each subgroup of couplet 7, and the straight pin and thumbtack have been identified.

Divide the remaining items according to:

8a	A cutting instrument	scissors
8b	Not for cutting	9

Cutting instrument

Not for cutting

One items fits category 8a. The pair of scissors have been identified.

Separate the 8b items according to:

9a	Contains ink	ball-point pen
9b	Does not contain ink	stapler

Contains ink

Does not contain ink

The ball point pen and the stapler now have been identified. A given key represents but one possible way to describe items.

For review, key out the pair of scissors as though it was unidentified. The trail is as follows:

1b	Not made of wood	3
3b	Not made rubber/rubber-like material	5
5b	Not made of a single piece of material	8
8a	A cutting instrument	scissors

Notice that the key becomes more specific as you proceed through it. Try keying out another desk item if you are still unsure of the technique.

Major Animal Groups

Turn to the key of Major Animal Groups in your study guide and consider the illustrated organism. It has a vertebral column or backbone and thus fits category (1a), Phylum Chordata, which sends you to couplet 2.

Vertebral column (backbone)

1a	**Vertebral column present**	**Phylum Chordata 2**
1b	Vertebral column absent	8

It has no hair, which sends you to 3. You notice there are no feathers, you proceed to 4.

2a	Hair present	Class Mammalia
2b	**Hair absent**	**3**
3a	Feathers present	Class Aves
3b	**Feathers absent**	**4**

It has fins, so you move to 5. There are jaws, go to 6.

4a	**Fins present**	**5**
4b	Fins absent	7
5a	**Jaws present**	**6**
5b	Jaws absent	Class Agnatha

Its gills are covered by an operculum which places the organism in Class Osteichthyes, the true bony fish.

6a	**Gills covered by an operculum**	**Class Osteichthyes**
6b	Gills not covered by an operculum	Class Chondrichtyes

Consider another organism, one having no vertebral column. Therefore it fits category b of couplet 1, sending you to 8.

1a	Vertebral column present	Phylum Chordata 2
1b	**Vertebral column absent**	**8**

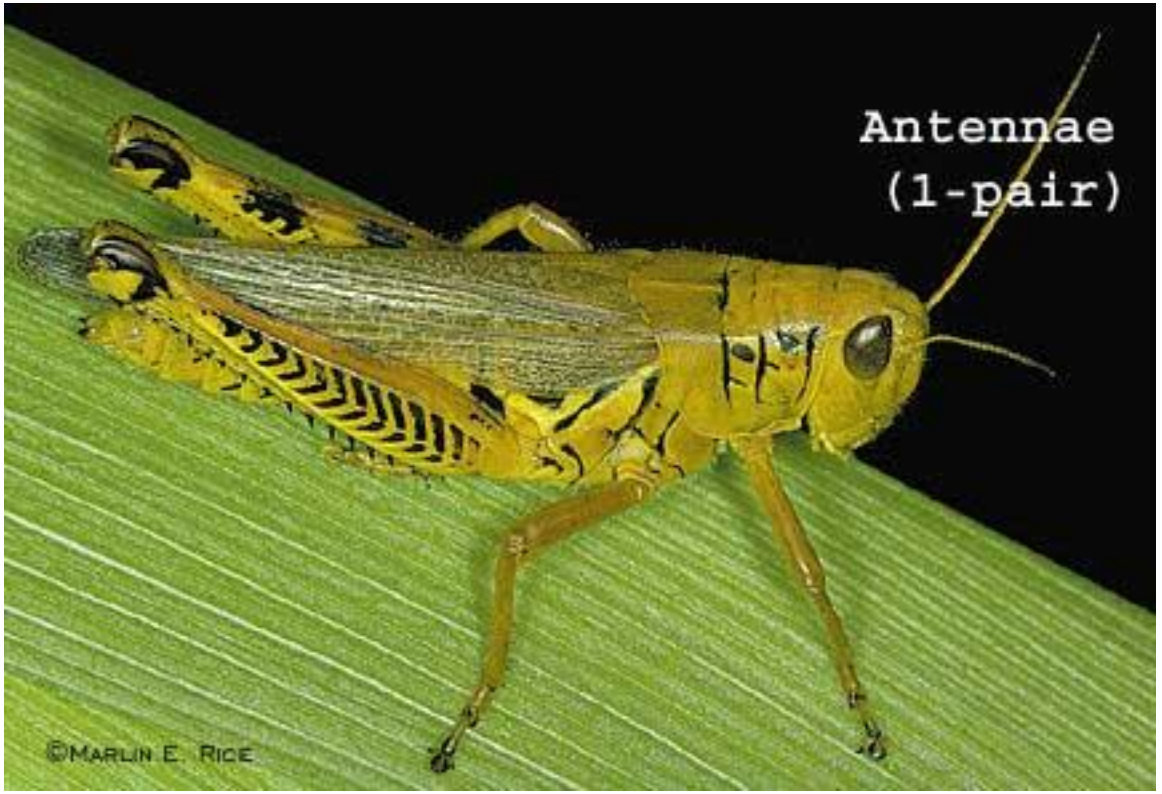
The organism is not radially symmetrical, sending you to couplet 10. An exoskeleton is present, sending you to 11.

8a	Body symmetry radial	9
8b	**Body symmetry not radial**	**10**
10a	**Exoskeleton present**	**11**
10b	Exoskeleton absent	12

It has jointed legs. It is in Phylum Arthropoda, go to couplet 13. The organism possesses fewer than 5 pairs of legs. Go to couplet 15.

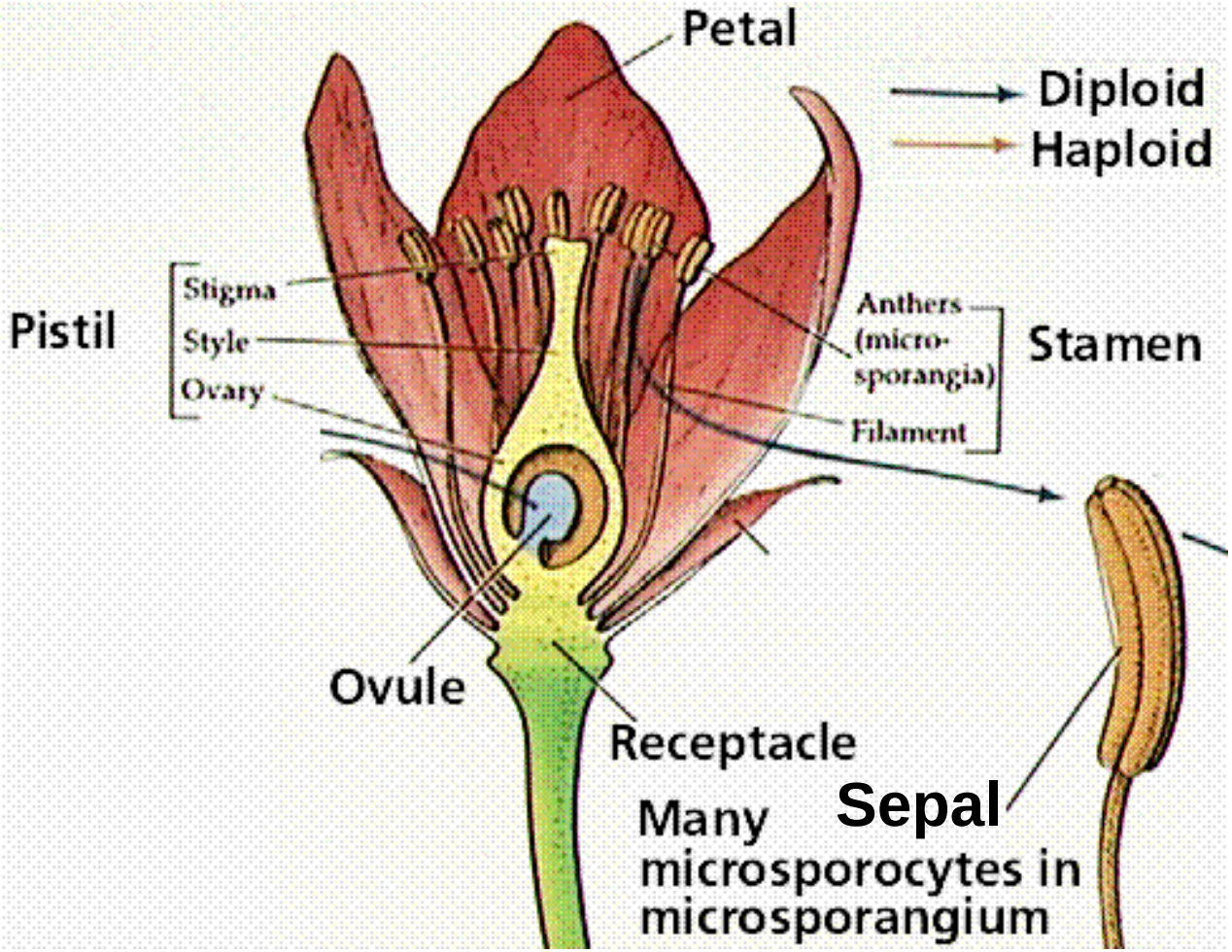
11a	**Jointed legs present**	**Phylum Anthropoda 13**
11b	Jointed legs absent	Phylum Mollusca
13a	Walking legs, more than 5 pair	14
13b	**Walking legs, 5 or fewer pairs**	**15**

Antennae are present, go to couplet 16. The organism possesses one pair of antennae so it belongs to class Insecta.



15a	**Antennae present**	**16**
15b	Antennae absent	Class Arachnida
16a	**Antennae, 1 pair**	**Class Insecta**
16b	Antennae, more than 1 pair	Class Crustacea

Major Plant Families

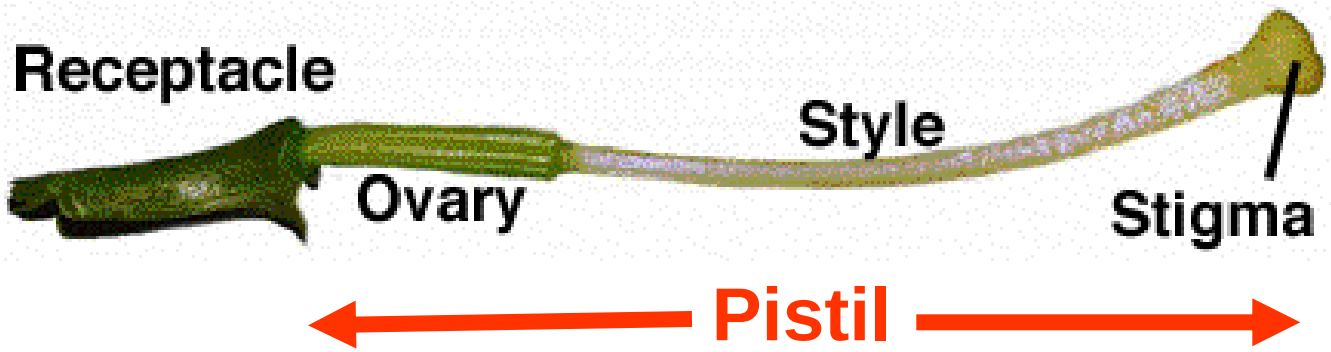


Turn to the key to Major Plant Families in your study guide.

The flower parts are in threes and the leaves are mostly parallel-veined. Proceed to couplet 2.

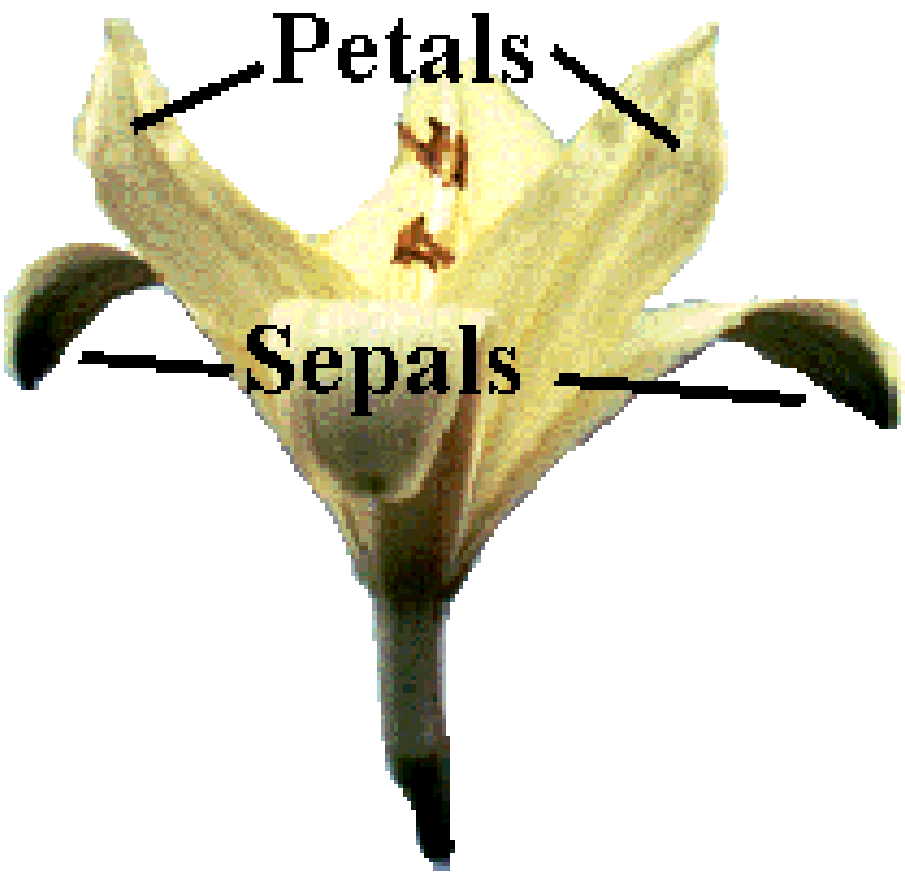
1a	**Flower parts in 3's or multiples of three; leaves mostly parallel-veined**	**2**
1b	Flower parts in 4's or 5's or multiples of these numbers; leaves mostly net-veined	9

The ovary is above the outer circle of flower parts and is therefore superior. Go to couplet 5. Petals are present, go to couplet 6. There is only one pistil, go to couplet 8.



2a	Ovary inferior	3
2b	**Ovary superior**	**5**
5a	Petals are absent; plants grasslike	7
5b	**Petals present; plants usually not grasslike**	**6**
6a	**One pistil**	**8**
6b	More than one pistil	Alismataceae

Sheaths are coverings that enclose the stem for some distance above the base of the connection of the leaf to the stem. Sheaths are absent and the petals and sepals are the same color. Thus the plan belongs to family Liliaceae.



8a	**Leaves without sheaths; petals and sepals similar in color**	**Liliaceae**
8b	Leaves with sheaths; petals and sepals unlike in color	Commelinaceae

Look at another plant specimen. The flower parts are in fives and the leaves are net-veined. The organism fits the category b of couplet 1. Proceed to couplet 9.

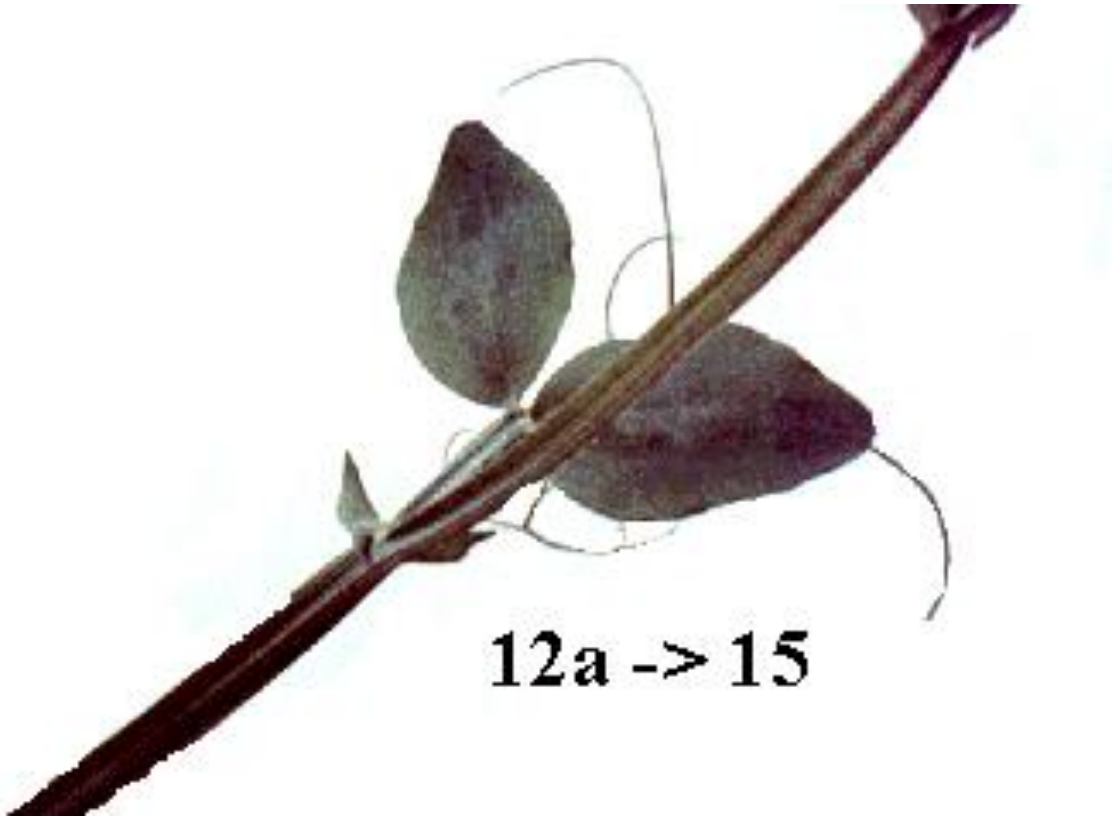
1a	Flower parts in 3's or multiples of three; leaves mostly parallel-veined	2
1b	**Flower parts in 4's or 5's or multiples of these numbers; leaves mostly net-veined**	**9**

The ovary is superior which fits category (9a). Go to couplet 10. Only one pistil is present, go to couplet 12.

9a -> 10b -> 12

9a	**Ovary superior**	**10**
9b	Ovary inferior	17
10a	More than on pistil	11
10b	**One pistil**	**12**

Stipules are pairs of supplementary structures at the base of the leaf stalk or petioles. Stipules are present, proceed to couplet 15.



12a	**Leaves with stipules**	**15**
12b	Leaves without stipules	13

The flower is irregular, that is the petals are not all the same size and shape within the flower circle. Thus the plant is a member of the family Fabaceae.

15a	Flowers regular	16
15b	**Flowers irregular**	**Fabaceae**

This concludes this portion of this module. If you followed the procedures described, you will understand the concept of a dichotomous key because you identified common desk items, two animals to phylum or class and two flowering plants to family.

To complete this module, you must obtain a posttest from the SLC staff, in which you will create your own dichotomous key using eight given items.