Chapter 7

How to Construct and Use a Dichotomous Key

Stephen L. Timme

Theodore M. Sperry Herbarium
Department of Biology
Pittsburg State University
Pittsburg, Kansas 66762
(316) 235-4740

Stephen L. Timme is an assistant professor of botany at Pittsburg State University. He received his B.S. (1978) and M.S. (1981) in Biology from Southwest Missouri State University, Springfield, and his Ph.D. (1985) in bryophyte floristics and taxonomy from Mississippi State University, Starkville. His research interests are in the floristics and taxonomy of the bryophytes of the Peruvian Amazon and the Midwestern United States, and floristics of midwest prairies.

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Introduction

Identification is the recognition of characteristics of organisms and the application of a name to an organism with those particular characters (Jones and Luchsinger, 1986). The dichotomous key is the method employed for identifying unknown organisms. The evolution of keys has been the result of work by taxonomists who study the characteristics of organisms at some taxonomic level (= category) and often develop keys for their identification.

A dichotomous key is constructed of a series of couplets, each consisting of two separate statements. For example:

couplet	1. Seeds round	soybeans
	1. Seeds oblong	2 (this statement indicates that you go to couplet "2")
couplet	2. Seeds white	northern beans
	2. Seeds black	black beans

By reading the two statements of each couplet, you progress through the key from typically broad characteristics to narrower characteristics until only a single choice remains. As long as the correct statement of each couplet is chosen, and the unknown organism is included in the key, a confident identification is usually achieved.

This exercise introduces non-major biology and general biology students to the construction and use of a dichotomous key. It is not meant to provide students a method of quick memorization of scientific names. The proficiency level of using keys, and learning names, is a reflection of the amount of time one spends keying organisms. The more time spent using keys, the more familiar the characteristics of organisms become, and the more proficient one becomes with keys.

Terminology applied to any group of organisms is usually a stumbling block for students using most keys for the first time. Thus it is important that students begin their keying experience by understanding how a key is designed, and using a key with relatively comprehendible terminology. This exercise provides students with a few plant illustration, and a glossary of terms found in the keys.

Constructing a Dichotomous Key

Not all taxonomists agree on the design of dichotomous keys. Some use numbers to separate the couplets while others use letters. Also, some taxonomists place each couplet together, while others may separate couplets (see examples below). It is important to indent every other couplet for ease in reading.

Example A: Numerical key with couplets together

1. Seeds round..... ..... soybeans
1. Seeds oblong..... 2
2. Seeds white .... northern beans
2. Seeds black .... black beans

Example B: Alphabetical key with some couplets separated

A. Seeds oblong..... ..... B
  B. Seeds white..... ..... northern beans
  B. Seeds black..... ..... black beans
A. Seeds round..... ..... soybeans

A way of introducing students to constructing keys is to have them key their fellow classmates using various human or non-human characteristics. Some of these characters include sex, hair color, height, type of clothing (jeans, slacks, dress, etc.), whether or not they wear glasses, etc. The following key is an example:

1. Sex female..... 2
1. Sex male..... 5
  2. Hair color red..... .... Susan
  2. Hair color brown or blond 3
3. Hair color blonde..... .... Jane
3. Hair color brown 4
  4. Glasses worn..... .... Donna
  4. Glasses not worn.. .... Linda
5. Pants jeans..... .... Caleb
5. Pants slacks 6
  6. Hair color black ... . James
  6. Hair color brown.. .... Zach

Once students are familiar with the mechanics of developing a key to their fellow classmates, they can now attempt to construct a key to other objects or organisms. Seed characteristics that can be employed include color, shape, texture, and length. Each student should obtain five different seeds and construct a numerical key using any or all of the above seed characteristics. Each student will need a small ruler, preferably a centimeter ruler.

Using a Key in the Field

Keys that are developed for state or regional floras often require that plants be collected for laboratory identification, where dissecting scopes are available to magnify extremely small parts not discernible with a field lens.

The following keys have employed terminology that can be easily observed in the field with the unaided eye or a 10× hand lens. The keys are useful for plants blooming from the middle of May to early July, and found on prairies in southwest Missouri and southeast Kansas. Local common names are given in the keys. Names followed by a number in parentheses indicate different species with the same common names (refer to section on scientific names). Following the keys, scientific names are given for the common names, followed by a glossary of terms used in the keys, and several illustrations.

An Artificial Key to Some of the Common Prairie Plants of Southwest Missouri and Southeast Kansas

Key to Sections

A. Flowers white ..... Section A
A1. Flowers cream, yellow, or orange ..... Section B
A2. Flowers pink or red ..... Section C
A3. Flowers blue or purple ..... Section D
A4. Flowers green ..... Section E

Section A
Flowers White

01. Leaves compound 02
01. Leaves simple 03
    02. Inflorescence terminal and axillary; stamens much longer than the corolla ..... Illinois Bundle Flower
    02. Inflorescence terminal only; stamens not longer than the corolla ..... White Prairie Clover
03. Lower leaves spoon-shaped ..... Pussy Toes
03. Lower leaves of various shapes, but not spoon-shaped 04
    04. Leaves opposite 05
    04. Leaves alternate 06
05. Corolla 4-lobed ..... Narrowleaf Bluet
05. Corolla 5-lobed 06
    06. Base of stem with obvious hairs ..... Pale Penstemon
    06. Base of stem smooth (without hairs) 07
07. Inside of flower (throat) with reddish or purplish lines ..... Smooth Penstemon
07. Inside of flower white; without reddish or purplish lines ..... Tube Penstemon
    08. Leaves basal ..... Shooting Star
    08. Leaves found up the stem 09
09. Inflorescence an umbel ..... Queen Anne's Lace
09. Inflorescence of other types, but not an umbel 10
    10. Leaves feather-like ..... Yarrow

10. Leaves of other shapes, but not feather-like 11
11. Leaves trifoliate ..... White Wild Indigo
11. Leaves simple 12
12. Plants with a square stem ..... Slender Mountain Mint
12. Plants with a round stem 13
13. Inflorescence a raceme ..... Prairie Larkspur
13. Inflorescence a head 14
14. Ray flowers less than 40 ..... Ox-eye Daisy
14. Ray flowers more than 40 15
15. Lower leaves to 7 cm wide, conspicuously toothed; stem hairs spreading..... ..... Daisy Fleabane (1)
15. Lower leaves less than 3 cm wide, slightly toothed; stem hairs appressed..... ..... Daisy Fleabane (2)

Section B
Flowers Cream, Yellow, or Orange

01. Leaves basal ..... Wild False Garlic
01. Leaves opposite or alternate 02
02. Leaves opposite ..... Coreopsis
02. Leaves alternate 03
03. Leaves compound 04
03. Leaves simple 05
04. Leaves trifoliate 06
04. Leaves pinnate 07
05. Leaves toothed ..... Five Finger
05. Leaves entire or deeply lobed 08
06. Inflorescence spike-like; plants without hairs ..... Long-bracted Wild Indigo
06. Inflorescence umbel-like; plants with hairs ..... Yellow Wood Sorrel
07. Inflorescence terminal ..... Goat's Rue
07. Inflorescence axillary or nearly so ..... Partridge Pea
08. Lower leaves deeply dissected, appearing to be compound .... Grey-headed Coneflower
08. Lower leaves entire or toothed 09
09. Largest leaves less than 6 cm long ..... Orange Puccoon
09. Largest leaves more than 6 cm long 10
10. Inflorescence a head ..... Black-eyed Susan
10. Inflorescence spike-like ..... Common Mullein

Section C
Flowers Pink or Red

01. Stems square ..... Wild Bergamont
01. Stems round 02
    02. Leaves opposite 03
    02. Leaves alternate or whorled 04
03. Inflorescence an umbel; leaves narrowly lance-shaped over 6 cm long ..... Swamp Milkweed
03. Inflorescence terminal; leaves mostly oval-shaped, less than 6 cm long ..... Rose Pink
    04. Leaves compound 05
    04. Leaves simple 07
05. Stems with prickles 06
05. Stems without prickles ..... Goat's Rue
    06. Leaflets 8 or more per leaf ..... Sensitive Briar
    06. Leaflets 7 or less per leaf ..... Prairie Rose
07. Leaves entire and basal ..... Shooting Star
07. Leaves toothed and found up the stem ..... Indian Paint Brush

Section D
Flowers Blue or Purple

01. Leaves compound 02
01. Leaves simple 05
    02. Flowers regular ..... Violet Wood Sorrel
    02. Flowers irregular 03
03. Leaves trifoliate ..... Blue False Indigo
03. Leaves pinnate 04
    04. Leaflets mostly 10 or more, oval-shaped ..... Lead Plant
    04. Leaflets less than 10, linear ..... Purple Prairie Clover
05. Flowers regular 06
05. Flowers irregular 11
    06. Leaves mostly basal 07
    06. Leaves occurring up the stem 08
07. Leaves 3 mm or more in width ..... Yellow-eyed Grass
07. Leaves 2 mm or less in width ..... Pale Yellow-eyed Grass
    08. Leaves with petioles ..... Verbena
    08. Leaves sessile 09
09. Leaves with toothed margins ..... American Blue Hearts
09. Leaves entire 10
    10. Leaves narrowly lance-shaped ..... Prairie Phlox
    10. Leaves oval-shape or oval-lance-shaped ..... Wild Petunia
11. Stems square 12
11. Stems round 14

12. Leaves sessile ..... False Dragonhead
12. Leaves with petioles 13
13. Inflorescence a spike ..... American Germander
13. Inflorescence a head ..... Wild Bergamot
14. Leaves basal ..... Bird's Foot Violet
14. Leaves occurring up the stem 15
15. Leaves sheathing the stem 16
15. Leaves with or without petioles, but not sheathing the stem 18
16. Sepals without hairs ..... Spiderwort (1)
16. Sepals with hairs 17
17. Stems and leaves sparsely hairy ..... Spiderwort (2)
17. Stems and leaves very hairy ..... Spiderwort (3)
18. Leaves sessile or with short petioles, entire to slightly toothed ..... Spiked Lobelia
18. Leaves with long petioles, deeply dissected ..... Carolina Larkspur

Section E
Flowers Green

01. Leaves alternate ..... Antelope Horn
01. Leaves opposite or whorled 02
02. Leaves in whorls ..... Whorled Milkweed
02. Leaves opposite 03
03. Inflorescence terminal and nodding; flowers very fragrant ..... Meade's Milkweed
03. Inflorescence mostly axillary; flower not noticeably fragrant ..... Green Milkweed

Scientific Names

American Germander	*Teucrium canadense* L.
Annual Fleabane	*Erigeron annuus* (L.) Pers.
Antelope Horn	*Asclepias viridis* Walt.
Bird's Foot Violet	*Viola pedata* L.
Black-eyed Susan	*Rudbeckia hirta* L.
Blue False Indigo	*Baptisia australis* var. minor (Lehm.) S. Wats.
Carolina Larkspur	*Delphinium carolinianum* Walt.
Common Mullein	*Verbascum thapsus* L.
Coreopsis	*Coreopsis lanceolata* L.
Daisy Fleabane	*Erigeron strigosus* Muhl. ex Willd.
False Dragon Head	*Physostegia virginiana* (L.) Benth.
False Garlic	*Nothoscordum bivalve* (L.) Britt.
Five Finger	*Potentilla norvegica* L.
Goat's Rue	*Tephrosia virginiana* (L.) Pers.
Gray-headed Coneflower	*Ratibida pinnata* (Vent.) Barnh.
Green Milkweed	*Asclepias viridiflora* Raf.
Illinois Bundleflower	*Desmanthus illinoensis* (Michx.) MacM.

Indian Paint Brush	*Castilleja coccinea* (L.) Spreng.
Lead Plant	*Amorpha canescens* Pursh
Long Bracted Wild Indigo	*Baptisia bracteata* Muhl. ex Ell.
Mead's Milkweed	*Asclepias meadii* Torr.
Narrowleaf Bluet	*Hedyotis nigricans* (Lam.) Fosb.
Orange Puccoon	*Lithospermum canescens* (Michx.) Lehm.
Queen Anne's Lace	*Daucus carota* L.
Ox-eye Daisy	*Chrysanthemum leucanthemum* L.
Pale Penstemon	*Penstemon pallidus* Small
Palespike Lobelia	*Lobelia spicata* Lam.
Pale Yellow-eyed Grass	*Sisyrinchium campestre* Bickn.
Partridge Pea	*Cassia chamaecrista* L.
Prairie Larkspur	*Delphinium virescens* Nutt.
Prairie Phlox	*Phlox pilosa* L.
Prairie Rose	*Rosa setigera* Michx.
Purple Prairie Clover	*Dalea purpurea* Vent.
Pussy Toes	*Antennaria parlinii* Fern.
Rose Pink	*Sabatia angularis* (L.) Pursh
Sensitive Briar	*Schrankia nuttallii* (DC.) Standl.
Shooting Star	*Dodecatheon meadia* L.
Slender Mountain Mint	*Pycanthemum tenuifolium* Schrad.
Smooth Beardtongue	*Penstemon digitalis* Nutt. ex Sims
Spiderwort (1)	*Tradescantia ohiensis* Raf.
Spiderwort (2)	*Tradescantia bracheata* Small
Spiderwort (3)	*Tradescantia tharpii* Anders. and Woods.
Swamp Milkweed	*Asclepias incarnata* L.
Tube Penstemon	*Penstemon tabaeflorus* Nutt.
Violet Wood Sorrel	*Oxalis violacea* L.
White Prairie Clover	*Dalea candida* Michx. ex Willd.
White Wild Indigo	*Baptisia lactea* (Raf.) Thieret
Whorled Milkweed	*Asclepias verticillata* L.
Wild Bergamont	*Monarda fistulosa* L.
Wild Petunia	*Ruellia humilis* Nutt.
Yarrow	*Achillea millefolium* L.
Yellow-eyed Grass	*Sisyrinchium angustifolium* P. Mill.
Yellow Wood Sorrel	*Oxalis dillenii* Jacq.

Glossary

Axillary: on or related to the axis.
Bipinnately compound: twice compound (Figure 7.4).
Compound: made up of two or more parts.
Corolla: all the petals together (Figure 7.1)
Head: a short, dense cluster of sessile flowers (Figure 7.3)
Inflorescence: the mode of arrangement of flowers.
Irregular flower: longitudinally divisible into two equal halves (Figure 7.2).
Lance-shaped: much longer than broad; widest near base and tapering to the apex.
Oval-shaped: egg-shaped with the broader part near the base.

Panicle: compound inflorescence; branched raceme (Figure 7.3).
Pedicel: stalk of a flower or flower cluster (Figure 7.3).
Petiole: stalk of a leaf (Figure 7.4).
Pinnately compound: leaf with a central stalk in which leaflets arise (Figure 7.4).
Raceme: elongated inflorescence with pedicellate flowers (Figure 7.3).
Regular flower: symmetrical in shape (Figure 7.2).
Spike: elongated inflorescence with stalkless (sessile) flowers (Figure 7.3).
Trifoliate leaf: a compound leaf consisting of three leaflets (Figure 7.4).
Umbel: a flat-topped or rounded inflorescence in which the pedicels arise from a common point (Figure 7.3).

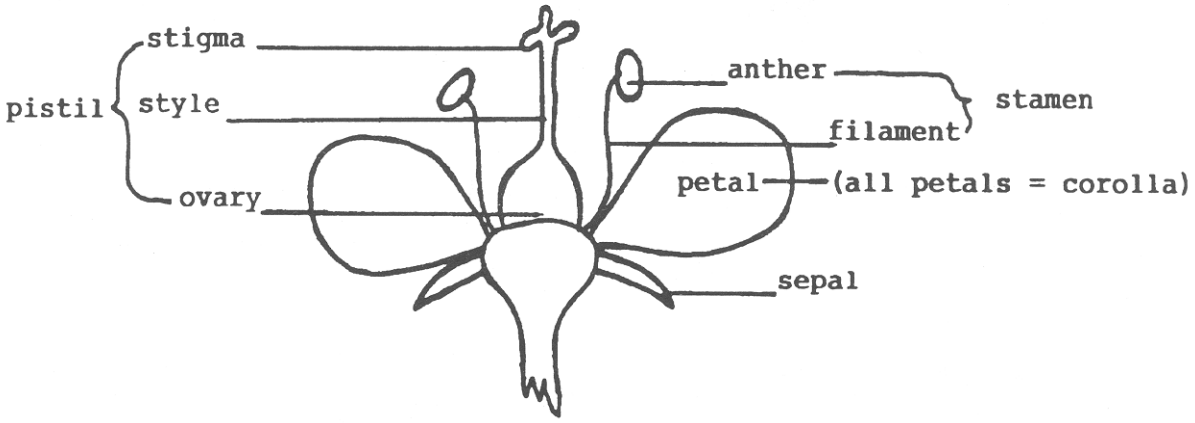

Figure 7.1. Typical flower.

regular irregular

Figure 7.2 Flower shape.

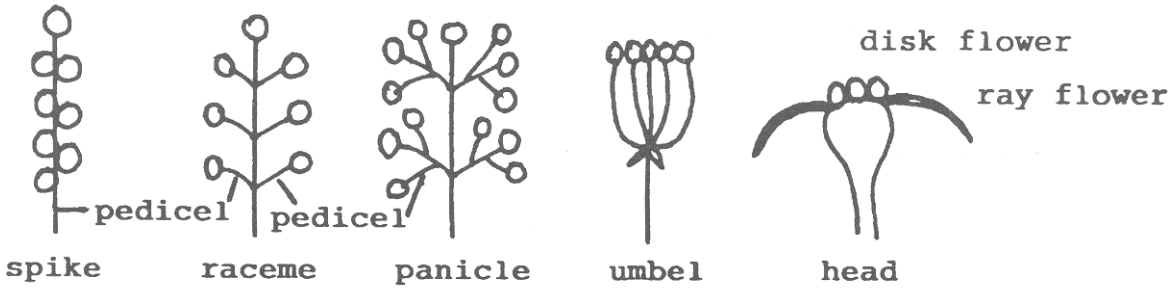

Figure 7.3. Inflorescence types.

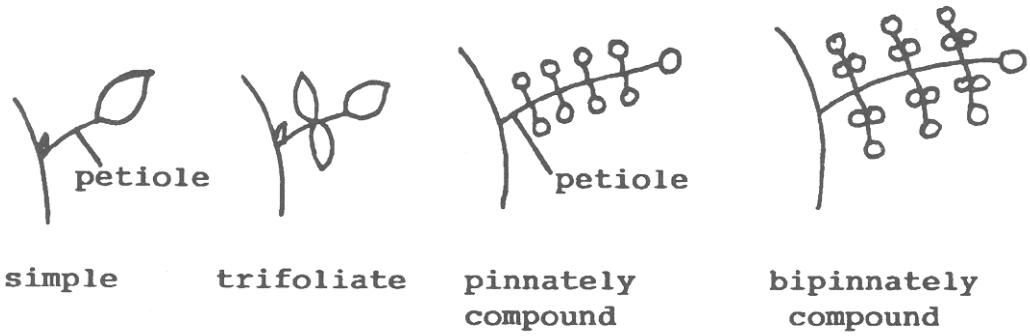

Figure 7.4. Leaf types.

Figure 7.5. Leaf arrangement.

Acknowledgements

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Literature Cited

Jones, S. B., and A. E. Luchsinger. 1986. Plant systematics. McGraw-Hill, New York, 512 pages.