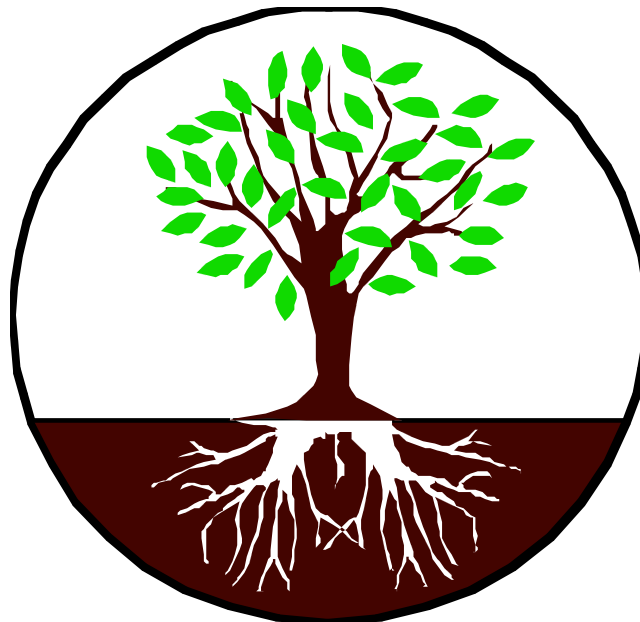


INTRODUCTION

During the semester we will conduct several laboratory experiments and a field studies. These studies are designed not only to reinforce concepts that we will discuss in lecture and but are designed to teach basic ecological research techniques and to answer specific ecological questions. Thus, you will be doing science.

The reason we will be taking this approach in lab is that it allows students to become actively involved in “real” research projects. By doing research, students will learn how to apply the scientific method to ecology, how to plan and conduct an ecological research project, and how to collect, analyze, and interpret ecological data. None of these are trivial matters. Students are generally poorly trained on how to conduct and complete a research project even though this skill is fundamental to both becoming a scientist and gaining fruitful employment in a science field. Plus, it is the best (and most fun!) way to learn the concepts and applications of ecological theory.



FIELD/LAB NOTEBOOK

Before discussing the research project, we need to discuss how to maintain a Field/Lab Notebook. ***KEEPING GOOD, ACCURATE FIELD AND LAB NOTES ARE ESSENTIAL FOR AN ECOLOGIST OR ANY SCIENTIST.*** These notes provide an accurate description on what you did on a particular day and will be a record of the data you collect. This is essential to conducting a successful research project.

Do not rely on your memory is probably the number one rule in data and note collection. You must carry your notebook whenever you are in the field and have it whenever you are doing lab work. And you must record in it at the moment you collect data or make observations. *I cannot stress this enough.* You'll find that data and observations quickly become muddled and that it will be hard to accurately remember what you have just done even just a few minutes after you do it. A legible and accurate notebook is a sign of a competent scientist. It is not trivial to say that scientists that keep poor notebooks are poor scientists. If you go on to graduate school or industry you will be required to keep accurate notebooks. Believe it or not, these are legal documents and you will be held accountable for their content. Moreover, if you do not have an accurate record of your data and observations you will not be able to analyze your data or produce a manuscript from your research; all your effort in the field will be wasted. Therefore, it's best to acquire the good habits now of keeping a notebook.

You can use whatever type of book you like as your notebook, quad- or horizontal-ruled, as long as it is bound (e.g., composition book). However, the following guidelines must be followed.

- Make sure that your name, address, and telephone number is on the cover of the notebook. Nothing is worse than a lost notebook whose owner can't be found.
- Write the dates that the notebook covers on the front cover. Begin with, for example, "5 September 2001 - " and then fill in the final date when you are finished. Always use the international format to write dates--DDMMYYYY.
- Number each page in the upper right hand corner if the pages are not numbered.
- There is no standard format on recording observations and data in your field notebook. As long as your notes are complete and can be understood by you days, or even years, later and by other scientists, you may follow any format that you are comfortable with. However,
 - Start each entry with the date and location. The location must be specific enough so that you could go back to the exact area even decades later. Describe the location specific to general. For example:

Management plot #4, Acopian Center for Conservation Learning, Hawk Mountain Sanctuary, Kempton, PA USA
- use military time, e.g, 1300 instead of 1:00 PM.
- If it is a field entry, begin with description of the weather.

- If you need to cross anything out, use a single line. Do not use white-out or obliterate the entry
- Do not leave any empty lines or spaces.
- Use either pencil or a pen with waterproof ink (I recommend the Uniball Roller Deluxe—it is carried by the bookstore).
- Each student will keep her own notebook. These will be handed in together at the end of the course.

If foul weather is expected, bring a plastic bag that can hold the book and give you enough room to write. This way you can still collect data without worrying about getting your book wet.



WRITTEN REPORT FORMAT

A written report must be submitted for each project. The format of this report will follow that of a scientific paper, specifically the journal *Ecology*. Please refer to the attached copy of a manuscript published in *Ecology*. Below, I have pasted the instructions that the journal gives to authors for proper preparation of manuscripts (with minor modifications). I edited out some requirements that are not relevant to this course and modified others.

Manuscript format

Consult recent issues for examples of journal style. A few specifics:

All papers must be in English. Use American spellings (e.g., behavior, not behaviour). The CBE Style Manual, Fifth Edition, is recommended for details of style.

Spaces, margins & fonts

The entire manuscript must be double-spaced (text, quotations, figure legends, tables, literature cited, etc.). Print on only one side of letter (8.5 x 11 inch). Leave at least 1 inch (2.54-cm) margins on all sides of each page. Use a 12-point font. Do not hyphenate words at the right margin or justify the right margin. Put the author's name in the header for each page and number all pages, starting with the title page.

Symbols and abbreviations

Define all symbols, abbreviations and acronyms the first time they are used. Use leading zeroes with all number <1, including probability values (e.g., $P < 0.001$).

Italics

Italicize scientific names and the symbols for all variables and constants except Greek letters. Symbols should be italic in the illustrations to match the text. Italics should rarely be used for emphasis.

Footnotes

Footnotes to text should be avoided; most footnote material can be incorporated in the text (parenthetically if necessary) to the benefit of readers, editors, and printers.

Organization of the paper

Title. -- Titles should be concise, informative, tell what the paper is about and what it found. It should contain keywords necessary for digital search and retrieval methods. Avoid vague declarations (e.g., "effects of ..."); strive for information content (e.g., "fungi kill tardigrades"). The maximum length is 13 words or 100 characters.

List of Authors -- For each author, give the relevant address – usually the institutional affiliation of the author during the period when all or most of the research was done.

Abstract --The abstract should explain to the general reader why the research was done and why the results should be viewed as important. It should provide a brief summary of the research, including the purpose, methods, results, and major conclusions. Do not include literature citations in the Abstract. Avoid long lists of common methods or discursive explanations of what you set out to accomplish.

The primary purpose of an abstract is to allow readers to determine quickly and easily the content and results of a paper. Abstracts should not exceed 350 words.

Body of the article--If appropriate, organize your article in sections labeled Introduction, Methods, Results, and Discussion. You may need to add a section for Conclusions. Brief articles usually do not require a label for the Introduction. If the nature of your research requires a different organization, specify the level of each section heading (1st-order head, 2nd-order head, etc.) in the margin.

*A brief **Introduction** describing the paper's significance should be intelligible to the general reader of the journal. The Introduction should state the reason for doing the research, the nature of the questions or hypotheses under consideration, and essential background. The Introduction is not a place for a lengthy review of the topic!*

*The **Methods** section should provide sufficient information to allow someone to repeat your work. A clear description of your experimental design, sampling procedures, and statistical procedures is especially important. Do not describe commonplace statistical tests in Methods, but allude to them briefly in Results. If you list a product (e.g., animal food, analytical device), supply the name and location of the manufacturer. Give the model number for equipment specified. Supply complete citations, including author (or editor), title, year, publisher and version number, for computer software mentioned in your article.*

***Results** generally should be stated concisely and without interpretation, though in complex studies modest interpretation of individual parts can provide context helpful for understanding subsequent parts. The **Discussion** should explain the significance of the results. Distinguish factual results from speculation and interpretation. Avoid excessive review.*

Acknowledgments--Acknowledgments, including funding information, should appear in a brief statement at the end of the body of the text. [NO NEED TO INCLUDE]

Literature cited (and other citations)--Avoid excessive citations; cite only essential sources. Before submitting the manuscript, check each citation in the text against the Literature Cited to see that they match exactly. Delete citations if they are not actually cited in the article. The list should conform in sequencing and punctuation to that in recent issues of the journal. All journal titles should be spelled out completely. Provide the publisher's name and location when you cite conference proceedings or other books.

Do not list abstracts or unpublished material in the Literature Cited. These materials may be listed in the text as personal observations (by an author of the present paper), personal communications (information from others), public communications (information in published abstracts, or information publicly distributed over the Internet but not permanently archived), unpublished manuscript, or unpublished data. The author(s) is expected to verify for all "personal communications" that the authority cited agrees to the use of his or her name. For public communications, the reference should include date printed or accessed, and title of the source, and basic access information such as URL.

Citations in body of text must follow the following format:

(Jones 1982)

(Jones and Smith 1982)

(Jones et al. 1982) –for more than 2 authors

Citations in Literature Cited section

Journal article:

*Zimmerman, M. 1980. Reproduction in *Palemonium* : competition for pollinators. Ecology 61:497-501.*

Young, H.J. and T.P. Young. 1992. Alternative outcomes of natural and experimental high pollen loads. Ecology 73:639-647

Book:

Klubek, B. P.J. Eberhardt, and J. Skujins. 1978. Ammonia volatilization from Great Basin desert soils. Pages 107-129 in N.E. West and Skujins, editors. Nitrogen in desert ecosystems. Dowden, Hutchinson, and Ross, Inc., Stroudsburg, Pennsylvania, USA.

Web site:

Brown, L.P. 2003. Three Icons of the Delta: The River, The Plantation, and The Juke. <http://www.blueshighway.org/icons.htm>

Tables--Tables should supplement, not duplicate, the text. They should be numbered in the order of their citation in the text (e.g., Table 1). Start each table on a separate page and attach them at the end of the paper, following the Literature Cited section. Provide a short descriptive title at the top of each table; rather than simply repeating the labels on columns and rows of the table, the title should reveal the point of grouping certain data in the table. Statistical and other details should be provided as footnotes rather than appearing in the title. Do not add vertical or horizontal lines to tables unless essential to avoid ambiguity. Never repeat the same material in figures and tables; when either is equally clear, a figure is preferable. Do not include any class of information in tables that is not discussed in the text of the manuscript.

Illustrations--Number illustrations in the order in which they are discussed in the text (e.g., Fig. 1). Put each figure on a separate page and attach them at the end of the paper following the tables.

Conventions

Identification of the objects of study--Early in the manuscript, identify the type(s) of organism or ecosystem you studied; e.g., "Cornus florida L. (flowering dogwood), a small deciduous tree" or "eastern deciduous forest". Avoid descriptive terms that may be familiar only to specialists. Provide the scientific names of all organisms. Common names may be used when convenient after stating the scientific names.

Genus names must be spelled out the first time they are used, but may be abbreviated to a single letter thereafter if no confusion will result. If the article contains several different scientific names, it is a good idea to spell out the generic name the first time it appears in each major section. Species names must always be spelled out in text; space limitations in tables or figures may require use of a "code," such as the first letter of the genus and species name; these letters should be in italics, like the original scientific name.

Check carefully the spelling of all scientific nomenclature. Copy editors cannot be expected to do this.

Authorities for scientific names must be provided (preferably when first used), or a reference can be given wherein the authorities can be found. Because usage of scientific names varies between investigators and can be ambiguous when out of context, conformance to a comprehensive nomenclatural standard is highly desirable. Suggestions for nomenclature standards are available for commonly studied groups.

Statistical analyses and data presentation

Authors are free to interpret statistical analyses as they see fit. The author, however, needs to provide the reader with information sufficient for an independent assessment of the analysis. Thus, the assumptions and the model underlying any statistical analysis must be clearly stated, and the presentation of results must be sufficiently detailed. Sampling designs, experimental designs, data-collection protocols, precision of measurements, sampling units, and sample sizes must be succinctly described. Reported statistics usually include the sample size and some measure of their precision (standard error [SE] or specified confidence interval [CI]) except where this would interfere with graphical clarity. The specific statistical procedure must always be stated. If a software product was used, complete citation should be given, including version number. When reporting results, actual P values are preferred.

Units--Units of measure should conform to the International System of Units (SI), i.e., metric. If measurements were made in other units, include the SI equivalents.

When preparing text and figures, note in particular that SI requires the use of the terms mass or force rather than weight. When one unit appears in a denominator, use the solidus (e.g., g/m²); for two or more units in a denominator, use negative exponents (e.g., g·m⁻²·d⁻¹). Use a capital L as the symbol for liter.

Other recommendations:

- I strongly recommend that you read <http://biology.luther.edu/paper.htm>. This reference discusses not only how to write a scientific paper but how to relate your study to the existing state of knowledge.
- A good general guide to writing scientific papers can be found at <http://www.ccc.commnet.edu/mla/index.shtml>. This is a general guide so please follow the specific guidelines stated above if there are conflicting suggestions. **It also has a wonderful section on grammar and writing. It is recommended that you review this.**
- Be clear and concise. Brevity is a virtue!!
- Avoid using colloquialisms and slang.
- Use of the active voice and first person are recommended (produces clarity and conciseness).
- Do not editorialize. Only state facts and conclusions, not opinions.

All reports must be typed (HAND-WRITTEN REPORTS WILL NOT BE ACCEPTED), double-spaced, with 2.54 cm (1 inch) margins, and 12-pt. font. And there is no required minimum length for a paper. It only needs to be long enough to communicate clearly and completely the study and your findings. Remember brevity is a virtue.

Drafts are required (see syllabus for schedule) and I will be happy to read and critique additional drafts. The point here is to learn how to analyze and interpret data and to write an effective scientific paper. I know that this does not come easy to most of us. So, show me your drafts!

While all of the studies will be collaborative, each student must turn in her own paper. You may collaborate on data collection, analysis, and interpretation but **YOU MUST WRITE YOUR PAPER BY YOURSELF.**

FIELD TRIPS

Tree Identification and Dominant Vegetation, Wildlands Conservancy

Introduction

Plant communities contain several to many different species. However, not all species have equal representation in the community. Generally, a few plants contribute more to the community than others. An important measure of this is **percent coverage**. **Coverage** is the area covered by the above ground parts of a plant. The plants that contribute the greatest coverage are said to be the **dominant plants** of the community. It is important to determine which plants are dominant because these are the most influential species in a community; they control the **structure** (i.e., species composition) of the community by affecting physical factors such as shade, humidity, temperature, wind and the availability of nutrients. Thus, **we define a TERRESTRIAL community by its dominant plants.** It is also important to determine the dominant vegetation because it allows us to monitor changes to the community due to anthropogenic disturbances and because

sometimes certain types of communities are targeted for preservation because they have been identified as key to the preservation of certain animal species (think of Pacific Old Growth Forest and the Spotted Owl – or the Arkansas bottomland forest where the Ivory Woodpecker was found).

The objectives of this field trip are: (1) to get a feel for the concept of dominant vegetation and (2) to learn to identify common trees found in Pennsylvania forests. This is to prepare you for the field studies that we will be conducting this semester.

Assignment

The Pool Wildlife Sanctuary/Wildlands Conservancy maintains several walking trails. As we walk the trails, we will observe the forest and other habitats to determine qualitatively the dominant vegetation of these habitats (you will learn how to quantitatively determine dominant vegetation in other field studies). To learn how to identify plants, we will go to the “Pennsylvania Tree Identification Trail,” where trees common to Pennsylvania have been planted and identified. EACH STUDENT WILL BE REQUIRED TO IDENTIFY **TWO** TREES AND TO RECORD IN THEIR FIELD NOTEBOOKS THE CHARACTERISTIC TRAITS OF EACH SPECIES. **See the attached appendix for examples of plant characteristics that are used to identify species.** Sketches are required. Traits that you should focus on (but don’t overlook other useful traits) are:

Leaf characteristics

- Shape
- needle-like vs. not needle like
- lobed vs. not lobed
- linear, oval, oblong, etc.
- Position of leaves
- opposite vs. alternate
- whorled vs. not whorled)

Type

- compound vs. simple
- margin Type
- undulate
- coarsely serrate
- heart shaped base
- square base
- etc.

Petiole length

Fruit type

Habitat affinities

- dry or wet soil
- shade or sun, etc.

Other useful traits

A copy of a dichotomous key to trees, shrubs, and vines will be given to each student. Use this key when on the trails. By "keying out" the trees, you will learn the diagnostic traits for each species, which you need for your field guide.

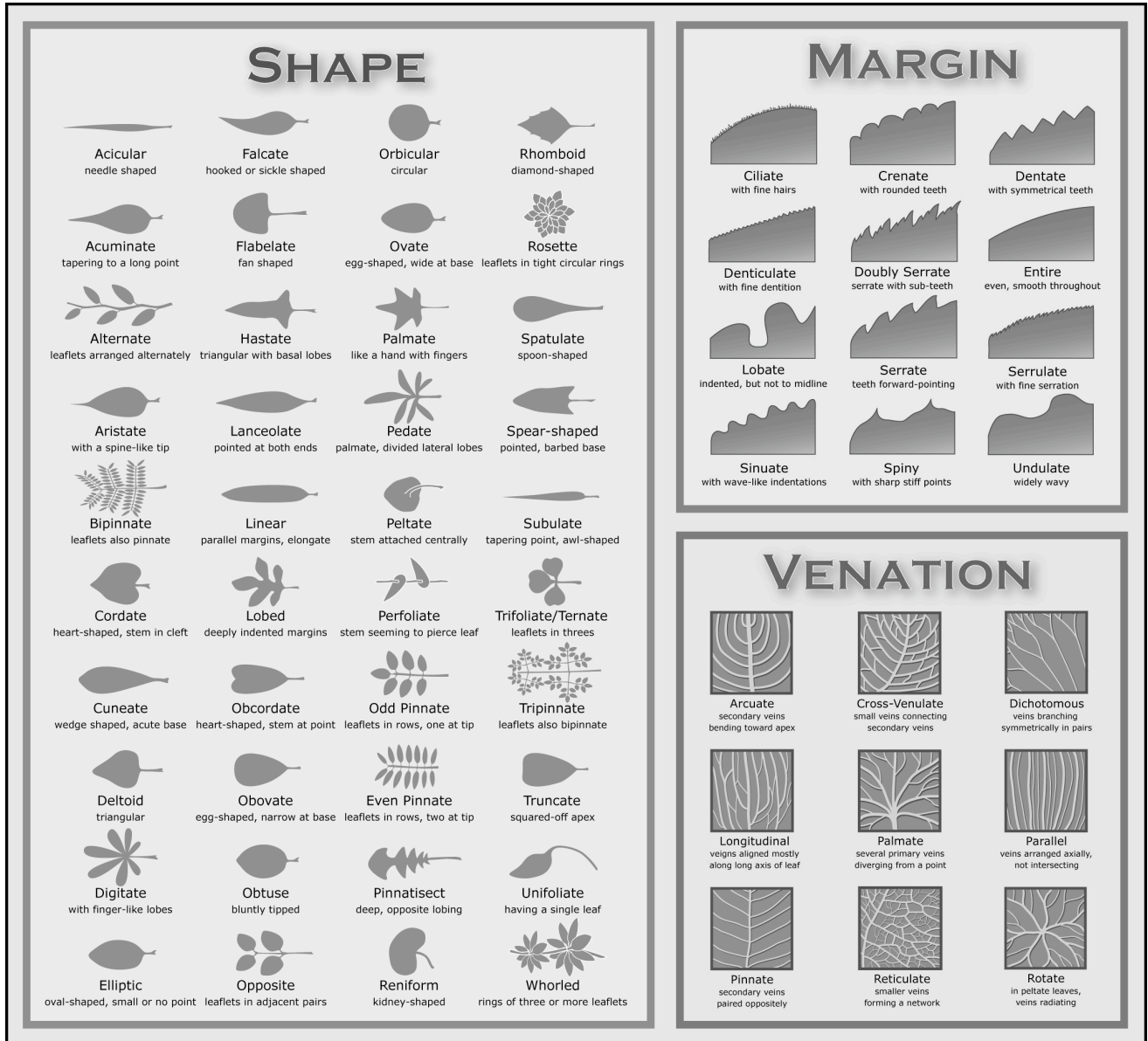
We also have pressed specimens of common trees and several tree identification field guides. These are kept in SC 10.

The requirements for your notebook entries are:

- Correct identification of the tree (scientific and common name)
- Sketches of the leaf and other diagnostic traits for the tree (see fig. 3 for an example of the type illustration that you should have in your field guide)
- A description of traits used to identify the tree
- A description of the habitat that the tree occurs in (e.g., wetlands, upland forest, etc.)

YOU WILL NOT BE GRADED ON ARTISTIC ABILITY but on accuracy, legibility, and completeness.

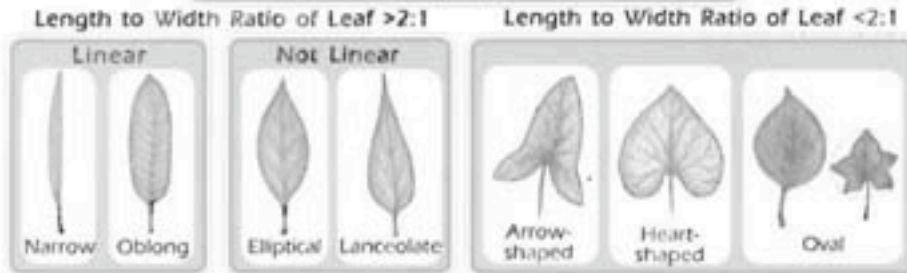
APPENDIX I. Diagnostic plant characteristics.



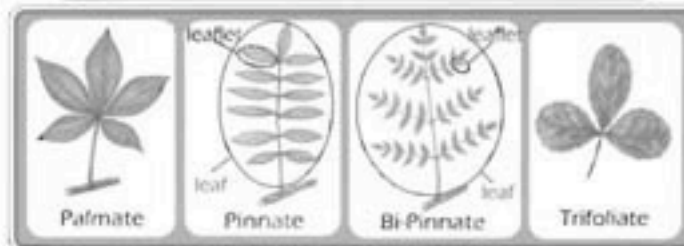
http://en.wikipedia.org/wiki/Image:Leaf_morphology_no_title.png

Pictorial Glossary of Leaf Characteristics

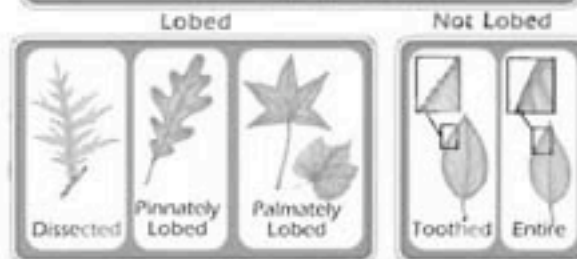
Simple Leaf Shape (leaves are singular)



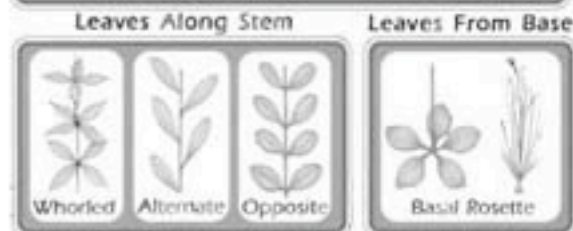
Compound Leaf Shape (leaves are divided into leaflets)



Leaf Margin (leaf edge)



Leaf Arrangement



Examples shown are leaves that fit descriptions; however, there are many variations.

<http://www.bridgingthewatershed.org/samples/leafcharacteristics.jpg>

