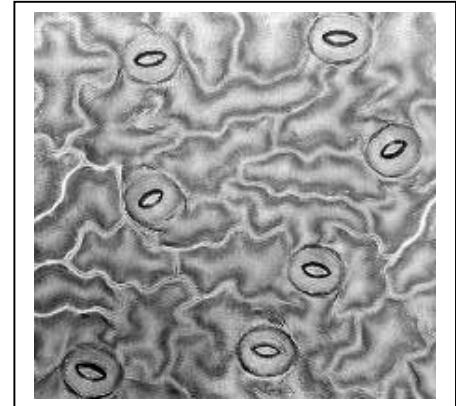


## **EXPERIMENTS**

### **Environmental Correlates of Leaf Stomata Density**

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stomata viewed at 400x in nail polish impression from leaf underside © Marc Brodtkin, 2000

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## **Appendix 3. Stomata Assessment Scoring Rubrics**

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**Rubric for Answers to Questions for Thought.**

	points
In an 1/2 page appropriately formatted essay, the author provided a clear, concise, and insightful answer that is substantiated by details of both content and context. If appropriate, additional Tables and/or Figures are clearly presented and well-documented. Appropriate source materials are creatively woven into the narrative using succinct summaries, graphics, and/or short quotes, and all sources are accurately cited. However, the vast majority of the answer is the author's own writing. The prose flows effortlessly and indicates a high level of organization and effort by the author.	10
Similar to above, except that the length and/or format are insufficient, there is a lack of focus and/or over-reliance on source materials with little synthesis, the answer includes poorly conceived graphics, or some sources are inadequately documented. In addition, paragraph structure may be weak and/or containing poorly worded sentences, misspellings, grammatical errors, and/or other evidence of cursory proofreading.	9-6
The answer lacks structure and coherency, lacks credible source materials and/or uses non-credible sources. In addition, paragraph structure is weak and replete with poorly worded sentences, misspellings, grammatical errors, and little evidence of proofreading.	5-1
The authors did not satisfy any of the requirements of the assignment.	0
Plagiarism, which if flagrant will result in failure in the course (see policy in your course syllabus).	X

## Rubrics for Stomata Research Proposals.

### Rubric for Research Proposal: Introduction.

	points
In two clear, well-written sentences, the authors stated the environmental difference of interest and clearly described how and why stomata density should vary among environmental types.	5
Similar to above, the authors stated the environmental difference of interest and described how and why stomata density should vary among environmental types; however, their sentences are not clear, contain typos, or their ideas are poorly organized.	4-3
The authors omitted or poorly described either the environmental difference of interest or how and why stomata density should vary among environmental types.	2-1
The authors did not satisfy any of the requirements of the assignment.	0

### Rubric for Research Proposal: Methods.

	points
In one clear, well-written paragraph, the authors explained exactly where their plants are located (including a map), where on their plants their leaves are located, and other pertinent details needed to replicate the collection of their samples exactly. In addition, only methods unique to their study are given.	5
Similar to above, however, the authors' sentences are not clear, contain typos, or the ideas are poorly organized - or, if the map or description of field sampling are unclear or ambiguous.	4-3
The authors omitted major details of their sampling.	2-1
The authors did not satisfy any of the requirements of the assignment.	0

### Rubric for Research Proposal: Possible Results.

	points
In one clear, well-written paragraph that refers closely to one clearly labeled figure of hypothetical results, the authors explained and visually demonstrated what their results would look like if their hypothesis were true vs. false. The explanations are clear and precise (whether or not they used the suggestions in the "Guide").	10
Similar to above, however, a few of the authors' sentences are not clear, contain typos, or the ideas are not well organized - or, if the figure has only minor problems in visual clarity or documentation.	9-8
Many of the authors' sentences are not clear, contain typos, and/or the ideas are not well organized - or, if the figure has substantial problems in visual clarity or documentation.	7-5
The text is incomprehensible and/or the figure is uninterpretable.	4-1
The authors did not satisfy any of the requirements of the assignment.	0

## Rubrics for Stomata Oral Presentations

### Oral Presentation: Introduction.

	points
Using about 3 minutes, the introductory comments and visual materials motivated interest in the research topic in the mind of the reader and led her or him without digression through the process of constructing the specific research question of the study. The authors stated the environmental difference of interest and clearly and thoroughly described their hypothesis(es) for how and why stomata density should vary among environmental types. The talk flowed effortlessly, was delivered skillfully and comfortably, and indicated a high level of organization, rehearsal, and effort by the authors. Lastly, if PowerPoint was used, their visuals contained appealing color combinations with NO animations or sound effects.	10
Similar to above, however, the length was way above or below 3 minutes, the opening words and visual materials were uninteresting, unfocused, or confusing, and/or a few of their comments or visuals were not clear, irrelevant, many comments were simply read from notes, and/or the ideas were not well organized. Lastly, if PowerPoint was used, their visuals contained ineffective color combinations and/or distracting animations or sound effects.	9-7
Similar to above, however, the length was way above or below 3 minutes, or the environmental difference and hypothesis(es) were stated but the explanation for why stomata density should vary was poorly conceived or unclear, and/or numerous comments or visuals were not clear, irrelevant, notes were read in monotone, or the ideas were poorly organized. Lastly, if PowerPoint was used, their visuals contained annoying colors, animations, or sound effects.	6-4
The authors did not clearly state the environmental difference and/or their hypothesis(es) for stomata variation, and/or many comments and visuals were unclear, and poorly organized.	3-1
The authors did not satisfy any of the requirements of the assignment.	0

**Oral Presentation: Materials and Methods.**

	points
Using about 3 minutes, the authors offered a clear description and visual materials (including a well-documented map) that explained and showed exactly where their plants are located, where on their plants their leaves are located, and other pertinent details needed to replicate the collection of their samples exactly. In addition, salient methods from the lab handout were also cogently summarized (but in much less detail than their written report), and any methods unique to their study were explained in sufficient detail to enable all steps to be replicated exactly. Statistical tests to be performed were stated last. The talk flowed effortlessly, was delivered skillfully and comfortably, and indicated a high level of organization, rehearsal, and effort by the authors. Lastly, if PowerPoint was used, their visuals contained appealing color combinations with NO animations or sound effects.	10
Similar to above, however, the length was way above or below 3 minutes, some ambiguity remains about exactly where and how their samples were collected and/or their map is unclear, and/or the statistical tests to be performed are not mentioned. In addition, a few of their comments or visuals were not clear, many were simply read from notes, and/or their ideas were not well organized. Lastly, if PowerPoint was used their visuals contained ineffective color combinations and/or distracting animations or sound effects.	9-7
Similar to above, however, the length was way above or below 3 minutes, and/or there were substantive omissions or ambiguities in explaining critical methods unique to their study. In addition, numerous comments or visuals were not clear, were read in monotone, and/or their ideas were poorly organized. Lastly, if PowerPoint was used their visuals contained annoying colors, animations, or sound effects.	6-4
The authors did not clearly state where and how their samples were taken and how their stomata were counted, and/or many comments and visuals were unclear, irrelevant, and poorly organized.	3-1
The authors did not satisfy any of the requirements of the assignment.	0

**Oral Presentation: Specific Discussion of Results.**

	points
Using about 3 minutes, the authors offered a clear description and a coherent, well-documented, and visually appealing series of Tables and Figures that enabled the audience to follow effortlessly through the numerical results of their study. All Tables and Figures enabled the audience to quickly perceive the findings, and clear and concise comments pointed out the key conclusions to be drawn specifically from each graphic. Statistical tests were specifically cited to reinforce proximate conclusions drawn from descriptive statistics that appeared in their Tables and Figures. In addition, the authors briefly discussed each result in terms of the hypothesis under investigation. The talk flowed effortlessly, was delivered skillfully and comfortably, and indicated a high level of organization, rehearsal, and effort by the authors. Lastly, if PowerPoint was used, their visuals contained appealing color combinations with NO animations or sound effects.	10
Similar to above, however, the length was way above or below 3 minutes, explanations of some Tables and/or Figures were unclear, inadequate, redundant, and/or there were minor omissions or misconceptions in explaining any of their numerical results or statistical analyses. Results were insufficiently related to the hypothesis under investigation. In addition, a few of their comments or visuals were confusing, possibly misleading, were simply read from notes, and/or their ideas were not well organized. Lastly, if PowerPoint was used their visuals contained ineffective color combinations and/or distracting animations or sound effects.	9-7
Similar to above, however, explanations of some Tables and/or Figures were inadequate, and/or there were major omissions or misconceptions in explaining numerical results or statistical analyses, in grounding the results in the hypothesis under investigation, and/or many comments and visuals were very confusing, misleading, or were read in monotone, and/or their ideas were poorly organized. Lastly, if PowerPoint was used, their visuals contained annoying colors, animations, or sound effects.	6-4
The authors omitted or otherwise failed to explain major portions of their results which may include Tables, Figures, or statistical analyses, and many comments were unclear, irrelevant, and poorly organized.	3-1
The authors did not satisfy any of the requirements of the assignment.	0

**Oral Presentation: General Discussion and Future Directions.**

	points
Using about 3 minutes, the authors offered insightful and thought-provoking points that were substantiated by details of both content and context (i.e., by mentioning or listing data presented in the Tables and Figures). All interpretations flowed logically from the data and analyses presented. Alternative interpretations were insightfully discussed. Implications or extensions of the results of the investigation logically led from the material presented and elicited clear and interesting directions for future research. The talk flowed effortlessly, was delivered skillfully and comfortably, and indicated a high level of organization, rehearsal, and effort by the authors. Lastly, if PowerPoint was used, their visuals contained appealing color combinations with NO animations or sound effects.	10
Similar to above, however, some interpretations were choppy and/or disconnected. In addition, new observations/ interpretations were presented that should have been made earlier. Some explanations of some Tables and/or Figures were unclear or inadequate, and/or there were minor omissions or misconceptions in summarizing numerical results or statistical analyses. In addition, a few of their comments or visuals were confusing, irrelevant, notes were simply read, and/or the ideas were not well organized. Lastly, if PowerPoint was used their visuals contained ineffective color combinations and/or distracting animations or sound effects.	9-7
Similar to above, however, some interpretations were illogical, and/or the hypothesis was insufficiently addressed using the evidence from the data collected. Numerous explanations of Tables and/or Figures were unclear or inadequate, and/or there are major omissions or misconceptions in explaining their numerical results or statistical analyses. Future directions were unclear and/or uninteresting. In addition, numerous comments or visuals were confusing, irrelevant, misleading, were read in monotone, and/or the ideas were poorly organized. Lastly, if PowerPoint was used their visuals contained annoying colors, animations, or sound effects	6-4
The authors omitted or otherwise failed to explain major portions of their results which may include Tables, Figures, or statistical analyses, and many comments were unclear, irrelevant, and poorly organized.	3-1
The authors did not satisfy any of the requirements of the assignment.	0

## Rubrics for Stomata Written Reports

### Rubric for Written Report: Abstract.

	points
In a 200-250 word paragraph, the authors concisely summarized the main sections of their report. Relevant details are given, including the hypothesis(es) and critical methods unique to their study, summaries of numerical results, and a cogent synopsis of their discussion. The prose flows effortlessly and indicates a high level of organization and effort by the authors.	5
Similar to above, however, the authors omitted or insufficiently described important information from one of their sections, and/or a few of their sentences are not clear, contain typos, or are not well organized.	4-3
The authors omitted or poorly described important information from more than one section and/or many sentences are not clear, contain typos, or are poorly organized.	2-1
The authors did not satisfy any of the requirements of the assignment.	0

### Rubric for Written Report: Introduction.

	points
In 1-2 pages, the introductory comments motivate interest in the research topic in the mind of the reader and lead her or him without digression through the process of constructing the specific research question of the study. The authors stated the environmental difference of interest and clearly and thoroughly described their hypothesis(es) for how and why stomata density should vary among environmental types. The prose flows effortlessly and indicates a high level of organization and effort by the authors.	5
Similar to above, however, the opening prose is uninteresting or laborious, or the environmental difference and hypothesis(es) are stated but the explanation for why stomata density should vary is poorly conceived or unclear, and/or a few of their sentences are not clear, contain typos, or are poorly organized.	4-3
The authors did not clearly state the environmental difference and/or their hypothesis(es) for stomata variation, and/or many sentences are not clear, contain typos, or are poorly organized.	2-1
The authors did not satisfy any of the requirements of the assignment.	0



**Rubric for Written Report: Materials and Methods.**

	points
In 1-2 pages, this section includes a clear description and a well-documented map (labeled Figure 1) that explain and show exactly where their plants are located, where on their plants their leaves are located, and other pertinent details needed to replicate the collection of their samples exactly. In addition, salient methods from the lab handout are also cogently summarized (but in much less detail than the handout), and any methods unique to their study are explained in sufficient detail to enable all steps to be replicated exactly. Statistical tests to be performed are stated last. The prose flows effortlessly and indicates a high level of organization and effort by the authors.	5
Similar to above, however, some ambiguity remains about exactly where and how their samples were collected and/or their map is unclear, and/or there are minor omissions or ambiguities in explaining any methods unique to their study, and/or if the statistical tests to be performed are not mentioned, and/or a few of their sentences are not clear, contain typos, or are poorly organized.	4-3
The authors did not clearly state where and how their samples were taken and how their stomata were counted, and/or many sentences are not clear, contain typos, or are poorly organized.	2-1
The authors did not satisfy any of the requirements of the assignment.	0

**Rubric for Written Report: Results - Text.**

	points
In one page, this section presents the numerical results of summary statistics and statistical tests of the hypothesized differences in stomata density. All Tables and Figures are presented in their numbered order, and clear and concise sentences point out the key conclusions to be drawn specifically from each one. Statistical tests are specifically cited to reinforce proximate conclusions drawn from descriptive statistics in either Tables or Figures. However, the authors abstained from discussing their results in terms of their hypothesis, which is the subject of the Discussion section next. The prose flows effortlessly and indicates a high level of organization and effort by the authors.	10
Similar to above, however, explanations of some Tables and/or Figures are unclear or inadequate, and/or there are minor omissions or misconceptions in explaining any of their numerical results or statistical analyses, and/or a few of their sentences are not clear, contain typos, or are poorly organized.	9-7
Similar to above, however, explanations of some Tables and/or Figures are inadequate, and/or there are major omissions or misconceptions in explaining numerical results or statistical analyses, and/or many sentences are unclear, contain typos, or are poorly organized.	6-4
The authors omitted or otherwise failed to explain major portions of their results which may include Tables, Figures, or statistical analyses, and/or many sentences are unclear, contain typos, or are poorly organized.	3-1
The authors did not satisfy any of the requirements of the assignment.	0

**Rubric for Written Report: Results - Tables and Figures.**

	points
A coherent, well-documented, and visually appealing series of Tables and Figures is presented that enables a reader to quickly perceive the numerical results of summary statistics and statistical tests of the hypothesized differences in stomata density. These graphics complement each other, show a minimum of redundancy, enable a reader to flow effortlessly through the results, and indicate a high level of organization and effort by the authors. All Tables and Figures are presented in their numbered order, and clear, concise, and well-written "legends" appear for each Table and Figure that enable each to stand alone.	5
Similar to above, however, some Tables and/or Figures are inadequately documented, poorly conceived, unnecessarily redundant, possibly misleading, or visually confusing. Or, some legends exhibit minor omissions or misconceptions, and/or a few of their sentences are not clear, contain typos, or are poorly organized.	4-3
The authors omitted or otherwise failed to include major portions of their results in their Tables and Figures, and/or many graphics are misleading, and/or many sentences are not clear, contain typos, or are poorly organized.	2-1
The authors did not satisfy any of the requirements of the assignment.	0

**Rubric for Written Report: Discussion.**

	points
In 1-2 pages, this section interprets the data presented in the Results section in light of the hypotheses presented in the Introduction. Sentences convey insightful and thought-provoking points that are substantiated by details of both content and context (i.e., by referring to the data presented in the Tables and Figures). All interpretations flow logically from the data and analyses presented. Alternative interpretations are insightfully discussed. Implications or extensions of the results of the investigation logically lead from the material presented and elicit clear and interesting directions for future research. The prose flows effortlessly and indicates a high level of organization and effort by the authors.	5
Similar to above, however, some interpretations are choppy, illogical, and/or disconnected, and/or the hypothesis(es) is(are) insufficiently addressed using the evidence from the data collected. In addition, new observations/ interpretations may be presented that should have been made in the Results section. Some explanations of some Tables and/or Figures are unclear or inadequate, and/or there are minor omissions or misconceptions in explaining their numerical results or statistical analyses. Future directions may be unclear and/or uninteresting. Lastly, some sentences are not clear, contain typos, grammatical errors, or are poorly organized.	4-3
The authors omitted or otherwise failed to explain major portions of their results which may include Tables, Figures, or statistical analyses, and/or many sentences are not clear, contain typos, grammatical errors, or are poorly organized.	2-1
The authors did not satisfy any of the requirements of the assignment.	0

**Rubric for Written Report: Literature Cited and Data Appendix.**

	points
If previously published material is cited somewhere in the paper, then the format for citations is followed exactly. The required data Appendix contains a copy of the set of original handwritten stomata data sheets that is well documented (including clear labels for measurement units), and all words and numerical entries are unambiguously legible. In addition, clearly labeled original printouts of all statistical analyses are included as well.	5
Similar to above, however, if there is a Literature Cited section then some of the previously published material is inadequately cited. Or, the required data Appendix contains data that are weakly documented, with some illegible words, symbols, or numbers, and/or the printouts of statistical analyses are incomplete or weakly documented.	4-3
The Literature Cited section and/or data Appendix are incomplete and/or incomprehensible.	2-1
The authors did not satisfy any of the requirements of the assignment.	0

**Computer Data File Management.**

	points
All three required computer files exactly follow the Guidelines for Data Management.	20
Similar to above, however, a minor oversight or two occurs in one of the files.	19-18
Numerous minor oversights occur in multiple files.	17-15
A major oversight, such as missing or uninterpretable data or analyses, occurs in one of the three files, with minor oversights in the others.	14-10
Multiple major oversights occur one or more files.	9-1
The authors did not satisfy any of the requirements of the assignment, or their disk and its backup were lost.	0

**Research Symposium Participation.**

	points
The student asked numerous questions that were insightful, novel, thought provoking, constructive, supportive, elicited important information, and contributed substantively toward building a community of learners. Also, the student was respectful and attentive at all times.	10
The student asked at least one question that was insightful, novel, and thought provoking, and at least several others that were constructive, supportive, and elicited important information. Also, the student was respectful and attentive at all times.	9-8
The student asked at least one question that was constructive, supportive, and elicited important information. Also, the student was respectful and attentive at all times.	7-6
The student was respectful and attentive at all times.	5
Questions were asked, but were of a trivial nature and/or with obvious or uninteresting answers. Also, the student may not have been entirely respectful and attentive at all times (talking, reading his/her own notes, etc.).	4-1
The student did not satisfy any aspect of participation.	0

**Critical Reviews of the Lab.**

	points
In an 1-2 page clear and concise essay, the author conveys reflective and constructive criticism of the lab activity with insightful and thought-provoking points that are substantiated by details of both content and context (i.e., by referring to...). The prose flows effortlessly and indicates a high level of organization and effort by the author.	20
Similar to above, too few and/or too narrow a set of comments are offered, there may be redundancy, and/or some comments are trivial or unconstructive. In addition, some sentences are not clear, contain typos, grammatical errors, or are not well organized.	19-10
Similar to above, however, most comments are trivial, belabored, and unconstructive, or at the opposite extreme overflowing with ingratiating deference. In addition, many sentences are not clear, contain typos, grammatical errors, or are poorly organized. 9-1	
The author did not satisfy any of the requirements of the assignment.	0