INTERACTIVE VERSUS NON-INTERACTIVE PLATFORMS FOR TEACHING PLANT MORPHOLOGY

Brian Wayne Brown

A Thesis

Submitted to

the Graduate Faculty of

Auburn University

in Partial Fulfillment of the

Requirements for the

Degree of

Master of Science

Auburn, Alabama

December 16, 2005

INTERACTIVE VERSUS NON-INTERACTIVE PLATFORMS FOR TEACHING

PLANT MORPHOLOGY

Except where reference is made to the work of others, the work described in this thesis is my own or was done in collaboration with my advisory committee. This thesis does not include proprietary or classified information.

_____

Brian Wayne Brown

Certificate of Approval:

_____	_____
Jeff L. Sibley Alumni Associate Professor Horticulture	J. David Williams, Chair Professor Horticulture
_____	_____
Ken M. Tilt Professor Horticulture	Stephen L. McFarland Acting Dean Graduate School

INTERACTIVE VERSUS NON-INTERACTIVE PLATFORMS FOR

TEACHING PLANT MORPHOLOGY

Brian Wayne Brown

_____

Signature of Author

December 16, 2005

VITA

Brian Wayne Brown, son of Rayford and Brenda Brown, was born September 5, 1979 in Birmingham, Alabama. He graduated from Oakman High School in 1997. He attended Bevill State Community College for two years where he earned an Associate of Science degree in Industrial Electronics. He then entered Auburn University in August 1999, and earned a Bachelor of Science degree in Horticulture in December, 2002, after which he entered Graduate School at Auburn University in January 2003.

THESIS ABSTRACT

INTERACTIVE VERSUS NON-INTERACTIVE PLATFORMS FOR TEACHING PLANT MORPHOLOGY

Brian Wayne Brown
Master of Science, December 16, 2005
(B.S., Auburn University, 2002)
71 Typed Pages

Directed By J. David Williams

A study was conducted in the Spring semester at Auburn University involving 46 undergraduate and graduate volunteers. Two learning modules with different formats were developed for the study. Both modules were created to be graphically similar, using the same colors, design, and photographs. One of the modules included interactive content created with Macromedia Flash; the other learning module was created using Macromedia Dreamweaver and was non-interactive or static format. Students were randomly assigned to access either the interactive or non-interactive format. A pretest was administered through Auburn University's WebCT servers to determine previous knowledge about the subject. The student was then given time to study the learning module, and after studying the module, the student was to log onto WebCT

again and complete the posttest and demographics survey. Student mean pretest scores and mean posttest scores showed no significant differences between the interactive and non-interactive learning modules, however, students' posttest scores on both the interactive and non-interactive modules improved significantly. Students expressed in the comments portion of the evaluation section of the demographic study that the module was beneficial to their learning of the material, making learning plant morphology via computer aided instruction a viable alternative to traditional methods of teaching.

ACKNOWLEDGMENTS

I would like to thank first of all my mom and dad. Words cannot express how much I love and appreciate you both! I would also like to thank Dr. Dave Williams for directing my study and providing guidance in my undergraduate and graduate years, and for being a Christian example that you show everywhere you go. To my committee members, Dr. Jeff Sibley and Dr. Ken Tilt - thanks for all the input you provided in my graduate studies. To my friends Tracy Tidwell, Robert Martin, Joshua Fuller, Mark Foshee, Betsy Hays, and Ashley Pickers, Shawn and Katie Sandlin, and Trent Jackson - I thank you for making my college days at Auburn memorable. To Dr. Wheeler and Marie Foshee, thank you both for encouraging me so much throughout the years. Lastly, and most importantly, I would like to thank Jesus Christ for saving my soul, and for being my comfort in times of need. Without Him I would be nothing!

Style manual or journal used: NACTA Journal

Computer software used: Macromedia Studio MX 2004 (Macromedia Flash MX Professional 2004, Macromedia Dreamweaver MX 2004, Macromedia Fireworks MX 2004), WordPerfect 11, Adobe Photoshop 7.0.

TABLE OF CONTENTS

LIST OF FIGURES..... x

I. INTRODUCTION AND LITERATURE REVIEW..... 1

LITERATURE CITED - CHAPTER 1..... 6

II. INTERACTIVE VERSUS NON-INTERACTIVE PLATFORMS FOR TEACHING PLANT MORPHOLOGY..... 9

LITERATURE CITED - CHAPTER 2..... 22

III. FIGURES..... 25

IV. APPENDICES..... 32

APPENDIX A - FLASH TUTORIAL..... 33

APPENDIX B - HTML TUTORIAL..... 38

APPENDIX C - DEMOGRAPHIC SURVEY..... 43

APPENDIX D -PRETEST..... 46

APPENDIX E - POSTTEST..... 51

APPENDIX F - STUDENT COMMENTS - FLASH..... 56

APPENDIX G - STUDENT COMMENTS - HTML..... 58

APPENDIX H - LETTER TO THE OFFICE OF HUMAN SUBJECTS RESEARCH..... 61

LIST OF FIGURES

FIGURE 1 - PRETEST AND POSTTEST COMPARISON..... 26

FIGURE 2 - FLASH VERSION RESULTS BY GENDER..... 27

FIGURE 3 - HTML VERSION RESULTS BY GENDER..... 28

FIGURE 4 - TUTORIAL EVALUATION - HELPFULNESS..... 29

FIGURE 5 - TUTORIAL EVALUATION - EASE OF USE..... 30

FIGURE 6 - TUTORIAL EVALUATION - ORGANIZATION.....31

CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Computers are considered vital to one's everyday life. People use computers for many tasks, from communication via e-mail and browsing the internet for information to paying bills. In the past, a person may have spent hours in a library looking for information, but today information is rapidly accessed by computer. Computers have revolutionized the way people work, play, and learn. Computers have not only changed the way we live, work, and play, but also the way we approach learning The use of computers in education is growing at an astounding rate. Teachers are now able to effectively communicate visually using video projectors, keep in touch with students via e-mail, and post classroom assignments or conduct entire classes with the help of the internet. With these advancements in technology, educational institutions are relying more on the use of the internet to conduct classes via distance education.

Computers in the classroom can be found in almost every classroom and teachers are utilizing these technologies to share slides of notes, pictures, and videos. Computers have made it much easier for a teacher to prepare for a lesson, communicate with students, and keep track of grades. Many higher education institutions routinely offer classes via distance education. Distance

education is: “the acquisition of knowledge and skills through mediated information and instruction, encompassing all technologies and other forms of learning at a distance” (United States Distance Learning Association, 2005).

Modern day distance education includes many different forms of media such as: satellite uplinks for video conferencing, e-mail, streaming video, and via the internet. Universities and colleges utilize the internet to offer courses to students who would otherwise have no other means to attend a class on a college campus. Teaching can now be conducted over the internet, without the teacher and student ever seeing each other face to face. Place-bound students, students with disabilities, and people that are constrained by their jobs have a significant opportunity to attend college via distance education. Computers used in distance education help students learn at their own pace, creating a way for students with learning disabilities a way to learn in a non-stressed environment. Ludlow (1994) stated the benefits of distance education to the learner include:

- Accessible training to students in rural areas
- Students may complete their course of study without suffering loss of salary
- Students are exposed to the expertise of the most qualified faculty.

Many studies support that distance education is as effective as face to face instruction. In 1996, Thomas Russell compiled a list of comprehensive research reports, summaries, and papers that stated that there were no significant differences between distance education and face to face instruction (Russell, 1999). Najjar found that learning was higher when information was

presented via computer-based multimedia systems than with traditional classroom lectures (Najjar, 1996). With the internet being a staple in the modern college campus, more colleges are adopting this method of teaching classes.

Postsecondary institutions offer distance education to improve their ability to reach new audiences as well as to increase enrollments and students' access to learning. A study conducted by the National Center for Education Statistics stated that 89% of four year public institutions offered distance education courses. (National Center for Education Statistics, 2003). Twelve percent of all institutions indicated that they planned to start offering distance education courses in the next three years. Of the institutions that offered distance education courses or that planned to offer distance education courses, 88% indicated plans to start using or increase the number of internet courses using asynchronous computer-based instruction as a primary mode of instructional delivery for distance education courses (National Center for Education Statistics, 2003). The use of the internet has grown so much in the past two decades that it is now the medium through which most distance education courses are offered because of its ease of use and availability to anyone with access to a computer. A study in 2002 by the Pew Institute and American Life Project found that 86 percent of college students have gone online, compared with 59 percent of the general population (Jones, 2002), with more growth every year.

Internet and Horticulture

According to the US Department of Education, distance education courses in agriculture comprise only 7% of all distance education courses

(National Center for Education Statistics, 2000). However, a survey of colleges of agriculture conducted in 1994 by Bekkum and Miller, indicated that the direction of agriculture education is heading towards being more computer-oriented. They concluded that computers will be more integrated into courses throughout curricula (Bekkum and Miller, 1994). The use of distance education is growing every year, and many agriculture-related sciences are slowly becoming more accustomed to the use of the internet and computers within their curriculums. Current university data shows that students are increasingly becoming proficient in utilizing computers as educational tools (Donaldson, 1999). Horticulture students are now using the internet as a resource to search for plant pictures and descriptions. There appears to be great potential for using the internet for an online course within horticulture. Pictures, videos, and text can all be combined within one website, providing students with an interesting and convenient way to study plants. Rieger in 2002 conducted a study at the University of Georgia to determine the difference in teaching methods. He compared classroom instruction with online education in a horticulture class and concluded that equal or better performance of the distance education students suggests that survey courses can be offered via distance education without compromising learning outcomes (Rieger, 2002). In another study, distance education courses in agriculture compare favorably to agriculture courses offered on campus (Miller and Pilcher, 2001).

Learning horticulture involves using all of the senses. Computers as used in distance education presently can only make use of the senses of sight and

hearing. Barrett (2003) found no significant differences in posttest scores of particpants when comparing audio accompanied versus non-audio accompanied plant identification and plant morphology tutorials. She stated that further exploration of different learning styles and how they relate to multimedia may give more insight on the best delivery method of plant identification and plant morphology distance education courses. Rhodus and Hoskins (1996) stated that a strong visual component can assist in memorization of specific plant morphological features. Building upon these studies, the purpose of this study is to determine if learning plant morphology can be improved by incorporating a greater degree of visual interactivity into a computer based learning module.

LITERATURE CITED

Barrett, P. 2003. Plant Identification: A Computer Assisted Instruction Approach. Master's Thesis, Dept. of Horticulture, Auburn University, Auburn, Alabama 36849.

Bekkum, V.A. and Miller, W.W. 1994. Computer proficiency for undergraduate students in agriculture. NACTA Journal 38:43-46.

Donaldson, J. L. 1999. Computer access, usage, and literacy of undergraduates in the agricultural sciences. HortTechnology. 43(3): 20-29.

Ludlow, B.L. 1994. A comparison of traditional and distance education models. Proceedings of the Annual National Conference of the American Council on Rural Special Education, Austin, TX, 23-26 March. (ED 369 599)

Miller, G. and Pilcher, C.L. 2001. Levels of Cognition Reached in Agricultural Distance Education Courses in Comparison to On-Campus Courses and to the Faculty Perceptions Concerning an Appropriate Level. Journal of Agriculture Education 42(1):20-27.

Najjar, L. J. 1996. Multimedia Information and Learning. Journal of Educational Multimedia and Hypermedia, 5(2), 129-150.

National Center for Education Statistics, U.S. Department of Education. 2000. Distance Education at Postsecondary Institutions. (http://nces.ed.gov/surveys/peqis/publications/2000013/). (June 12, 2005).

National Center for Education Statistics, U.S. Department of Education. 2003. Distance Education at Postsecondary Institutions. (http://nces.ed.gov/surveys/peqis/publications/2003017/). (June 12, 2005).

Rieger, M. 2002. Distance Education Versus Classroom Instruction in Horticulture - An Introduction to Fruit Crops - Case Study. HortTechnology 12(3):513-515.

Rhodus, T., Hoskins, J. 1996. The internet: changing the way horticulturist communicate. HortTechnology 6(4):308-314.

Russell, T. 1999. The No Significant Difference Phenomenon. (http://www.nosignificantdifference.org/). (June 12, 2005).

Schwartz, J. 2003. Professors Vie With Web for Class's Attention. New York Times, January 2, 2003. (http://www.nytimes.com/2003/01/02/technology/02WIRE.html). (September 11, 2003).

United States Distance Learning Association. 2005. USDLA - Home. (http://www.usdla.org). (June 13, 2005).

CHAPTER II

INTERACTIVE VERSUS NON-INTERACTIVE PLATFORMS FOR TEACHING PLANT MORPHOLOGY

Index Words: distance education, plant morphology, interactive, multimedia.

Summary

A study was conducted in the Spring semester 2005 at Auburn University involving 45 undergraduate and one graduate volunteers from many various majors. Two learning modules with different formats were developed for the study. Both modules were created to be graphically similar, using the same colors, design, and photographs. However, one of the modules included interactive content created with Macromedia Flash; the other learning module was created using Macromedia Dreamweaver and was non-interactive or static format. Students were randomly assigned to access either the interactive or non-interactive format. A pretest was administered through Auburn University's WebCT servers to determine participant's previous knowledge about the subject. The student was then given time to study the learning module, and after studying the module, the student was instructed to log onto WebCT again and complete the posttest and demographics survey. Student mean pretest scores and mean posttest scores showed no significant differences between the interactive and non-interactive learning modules, however, students' posttest scores on both the

interactive and non-interactive modules improved significantly. Students expressed in the comments portion of the evaluation section of the demographic study that the module was beneficial to their learning of the material, making learning plant morphology via computer aided instruction a viable alternative to traditional methods of teaching.

Introduction

Computers play a valuable role in today's world. They have become a staple in today's modern home. People use computers for all types of entertainment, informational, and instructional purposes.

Education has also been changed by the invention of computers and the internet. Teachers have the ability to share class notes with students, create slides of notes for lectures, and keep track of students' records. Students also benefit from the use of these technologies. Now students are able to download lecture notes from a class, gather information for reports via the internet, and be able to communicate effectively with teachers and classmates.

In making use of these technologies, many postsecondary institutions are now offering some form of distance education. A study conducted by the National Center for Education Statistics stated that 89% of all public four year postsecondary institutions offered distance education courses. (National Center for Education Statistics, 2003).

Distance education can be beneficial in many ways. Ludlow (1994) found that distance education offered students:

- Accessible training to students in rural areas

- Students may complete their courses of study without suffering a loss of salary
- Students are exposed to the expertise of the most qualified faculty

Colleges are using technology to create new ways to offer students who would otherwise not have the chance an opportunity to learn. A study by Najjar in 1996 stated that learning was higher when information was presented via computer-based multimedia systems than traditional classroom lectures (Najjar, 1996).

In a 1999 study by the United States Department of Education, it was noted that distance education courses in agriculture comprise only 7% of all distance education courses (National Center for Education Statistics, 2000). In a study by Bekkum and Miller, surveys of colleges of agriculture concluded that they are becoming more computer oriented. They also stated that computers are becoming more integrated throughout curricula and are being used as a teaching and learning tool for instructors and students to use in analyzing and solving problems. (Bekkum & Miller, 1994). Within the field of horticulture, students are now using the internet as a resource for finding information such as plant pictures, plant descriptions, and various other horticulture related information. Online courses are a natural development, since students are becoming more proficient in utilizing computers as educational tools (Donaldson, 1999).

In 2002 a University of Georgia study was conducted to determine differences in teaching methods using a classroom oriented horticulture class versus an online course. The results concluded that students performed equal

to or better in the online distance education course compared to classroom instruction (Rieger, 2002).

Plant morphology is the study of the structure, and form of a plant, and is a key component of a horticulture curriculum. At Auburn University, plant morphology is taught in all plant identification, plant propagation, and plant growth and development courses. Traditionally, the plant morphology sections of these courses are introduced in a classroom setting, with the teachers using paper handouts with line drawings of plant parts, leaf shapes, and other plant features. Material covered within the plant morphology lectures may include subjects such as plant forms, leaf characteristics (arrangement, leaf types, shapes, and margins), bud shapes, floral structures, branching forms, plant cell characteristics, root characteristics, and fruit shapes. Students in several classes are presented with the similar materials at the beginning of every semester. Teachers often cover plant morphology at the beginning of the courses, since most material covered throughout the remainder of these courses will relate to and build upon the foundation laid through the concepts learned in the plant morphology lectures. However, these lectures can consume valuable instructional and laboratory time.

Teaching methods in the past have relied on traditional ways of teaching plant morphology. Handouts are the most common medium and usually include black and white line drawings, along with descriptions of the material. As technology use in the classroom has increased, the use of computers has changed the way teachers present their materials. Multimedia projectors are

rapidly becoming an essential part of every collegiate classroom, and teachers make use of them by using presentation software, such as Microsoft PowerPoint. By utilizing these technologies, a teacher can creatively present color photographs, along with lecture text to students.

Learning horticulture requires a student to use all of the senses, but only two senses can be involved in electronic instruction, i.e., sight and hearing. In a study at Auburn University, Barrett (2003) compared different modalities of delivery within horticulture. She compared audio versus non-audio presentations for teaching plant morphology and plant identification. She concluded that there were no significant differences between participant's mean pretest scores and mean posttest scores between audio accompanied and non-audio learning modules.

This study was undertaken to investigate the other sense that can be involved in an online course, sight. Rhodus & Hoskins (1996) stated that a strong visual component can assist in memorization of specific plant morphological features. Multimedia material may be either interactive or non-interactive (Anderson, 2005). Interactivity can be defined as a program that responds to user activity (Interactivity, 2005). This study used one component of multimedia - interactivity. The goal of this study was to determine if learning plant morphology online may be improved by incorporating interactivity into a computer based learning module in comparison with a non-interactive version via the internet.

Materials & Methods

In this study, two tutorials were developed using Macromedia Flash and Macromedia Dreamweaver. Macromedia Flash was used for the development of an interactive tutorial. Its selection was based on the fact that over 98% of computers worldwide can be reached using this platform (NPD Online survey, conducted March 2005). Macromedia Dreamweaver is a general HTML editor program, and can easily create non-interactive web pages in the HTML programming language. Both tutorials included sections labeled: Flower Parts, Leaf Shapes and Arrangement, and Inflorescences. They also utilized the same colors, pictures, fonts, and basic arrangement within the web browser.

The opening page of tutorial built using the Flash platform (Appendix A), the user was first presented with an a menu with three different options. It included a section for flower parts, leaf shape and arrangement, and inflorescences. The menu options were created as buttons for the user to click on to choose. As the user moved the cursor over the buttons, the section would animate and would increase slightly in size, indicating that the user could click that button.

The Flower Parts section included a picture of a basic flower on the left side of the window, showing the internal structures of the flower. As the user rolled the cursor over the flower, different structures would appear to highlight, indicating to the user that they could select the structure. When the user selected the floral part, a dialog box on the right within the window displayed a description of that specific floral structure.

For the Leaf Shape and Arrangement section line drawings were initially displayed, arranged around the window. As the user rolled the cursor over these, the line drawings would increase slightly in size, indicating the user was able to select that leaf shape or arrangement. When the user selected a line drawing, a larger version of the drawing and a photograph of an example of the leaf shape or arrangement would appear in the center of the window.

In the Inflorescences section, the user was presented with a scrollable menu at the bottom of the browser window. The scrollable menu included line drawings of different plant inflorescences. The menu was scrolled using arrow buttons to the left and right of the menu. When the user clicked the line drawings, a window would appear in the center of the browser window showing a larger version of the line drawing, a photographic example of the inflorescence, and a written description.

The tutorial built using Macromedia Dreamweaver (HTML) (Appendix B) was created to be the same graphically as the tutorial built using Flash except drawings and text were static images rather than animated. All three sections (Flower Parts, Leaf Shape & Arrangement, and Inflorescences) were included in the tutorial. The opening menu was designed to be the same as the Flash version also as the user was presented with the three section choices.

The Flower Parts section included the same basic flower picture as the Flash version. The flower parts were cropped and labeled using Macromedia Fireworks. Below the labeled flower part was a written description of the part. A picture of the complete flower was shown at the top of the website.

The Leaf Shape & Arrangement section utilized the same pictures, line drawings, and descriptions as the tutorial built using Flash. A line drawing, a picture of an example plant, and a written description were all included in the section.

In the Inflorescences section, line drawings, pictures, and written descriptions were also the same as used in the Flash version of the tutorial. The boxes containing all three components were arranged side by side on the webpage.

Sample Size and Demographics

Undergraduate students were recruited from various majors and classification through two horticultural service courses, Organic Gardening and Vegetable Production, that attract students from throughout campus. The common assumption is the students in these classes have an interest in plants, but since a large percentage of them being non-horticulture majors they were assumed to have little horticultural knowledge. A total of 426 students were recruited from four different class sections. Of these students, 46 students chose to participate in the study. There were a total of 23 (50%) females and 23 (50%) males. A total of 24 students completed the Flash version of the learning module; 14 (58.3%) were female, and 10 (41.7%) were male. In the HTML version, a total of 22 students completed the test, of which 9 (40.9%) were female, and 13 (59.1%) were male.

Data Collection and Analysis

Students were randomly assigned to either the interactive group (Group 1, Flash), or the non-interactive group (Group 2, HTML). Participants were given a letter (Appendix H) giving information and significance of the study and how they should proceed to participate. Students were added to a list using the university's WebCT server. WebCT is a campus-wide e-learning course management system (WebCT, 2005). Auburn University's WebCT server was used because of its security, reliability, and ease of use for the participant and developer of the course. The participant would log onto WebCT, and the WebCT course would be listed on the student's courses. Then the participants would choose the Plant Morphology course and take the pretest (Appendix D). The pretest was used to determine the level of previous knowledge the student had about the material. The pretest included 10 questions about general plant morphology subjects. The participants would then select a link to the online learning module and were asked to study the module. Students were then instructed to sign back onto WebCT, and complete the posttest (Appendix E) and demographic survey (Appendix C) after they had completed the learning module. As with the pretest, the posttest consisted of 10 general plant morphology questions. The posttest questions were different from the pretest, but the same subject matter was presented. Questions from both the pretest and posttest consisted of the same pictures and descriptions that were included in the learning module. The participants were encouraged to provide personal comments about the tutorial and quizzes in the demographic section. The

demographic portion of the study used the Likert scale, which measures attitudes and subjective reasoning based on a level, in this case, 1 to 5 with 1 being extremely poor, 2 - below average, 3 - average, 4 - above average, and 5 being excellent (Diamond Bullet Design, 2005). Pretest and posttest scores were analyzed using the SAS (The SAS Institute, 2005) statistical program using the general linear model (GLM) procedure and Duncan's multiple range test. The results were analyzed at the 0.05 significance level.

Results and Discussion

The mean pretest scores for the group that used the interactive Flash version (Group 1) was 40.4 out of a possible 100 points. The non-interactive HTML version (Group 2) had a mean pretest score of 35.9. A comparison of the mean scores at the 0.05 level showed no differences between the two versions (Figure 1). Group 1 had a minimum pretest score of 10, and a maximum of 90. Group 2 had a minimum pretest score of 0, and a maximum of 100.

Mean posttest score of the Flash version (Group 1) was 63.8. The HTML version (Group 2) had a mean posttest score of 73.6 (Figure 1). Posttest scores of both groups did not differ significantly at the 0.05 level. Group 1 (Flash) had a minimum posttest score of 30, and Group 2 (HTML) had a minimum posttest score of 20.

In a comparison of gender by version (Figure 2), the Flash version (Group 1) males had a mean pretest score of 36.0 and females had a mean pretest score of 43.6. Male and female pretest scores showed no difference at the 0.05 level. In the posttest for the Flash version, males had a mean score of 64.0, and

females had a mean of 63.6. Likewise, the posttest scores for the male versus females did not differ.

For the HTML version (Group 2), pretest (Figure 3), males had a mean score of 32.3, and females had a mean of 41.1. The comparison showed no differences between males and females for the pretest at the 0.05 level. In the posttest for the HTML version, males had mean score of 68.5, and while females had a mean of 81.1, there were no differences between males and females at the 0.05 level.

In a comparison of the pretest and posttest by version (Figure 1), participants that were selected for the Flash version had a mean pretest score of 40.4, and a mean posttest score of 63.8. There was a difference shown in the comparison of the pretest and posttest at the 0.05 level. There also was a difference in the participants pretest versus posttest scores in the HTML version with a mean pretest score of 37.7, and a mean posttest score of 73.1. Clearly learning took place, and this data supports the idea that learning plant morphology, regardless of the method of delivery, can be effectively conducted online.

For the Flash version, participants' responses indicate that the tutorial was above average in helpfulness at 44.4%. 40.7% rated it excellent and 44.4% rated it as above average. Only 7.4% rated it average and 3.7% rated it below average. None of the participants rated the tutorial as being extremely poor in helpfulness (Figure 4). Based on these responses, participants indicate the tutorial was excellent in the ease of use. Participants rated the ease of use of

the tutorial as excellent also, with 59.3% of them indicating this (Figure 5). 22.2% of participants rated the tutorial as above average, and 11.1% rated it as average. Only 3.7% rated the tutorial as extremely poor or below average (0%). In the category of organization (Figure 6), participants rated that tutorial as excellent at 59.3%. 18.5% of the participants rated it as average and 14.8% rated it as above average. Only a small percentage indicated that organization of the tutorial was below average of extremely poor (0% and 3.7%, respectively).

For the HTML version, participants rated helpfulness as above average at 42.9%. 28.6% rated helpfulness as excellent while 23.8% rated it as average. 4.8% indicated that the tutorial was extremely poor in the category of helpfulness, and none rated it at below average (Figure 4). For ease of use in the HTML version (Figure 5), participants rated the tutorial as excellent (42.7%). 28.6% rated the tutorial's ease of use at above average, and 19.1% indicating it was average. 9.5% indicated ease of use for the HTML version was extremely poor, and none of the participants rated it as below. In the category of organization for the HTML version, participants rated the tutorial as excellent at 71.4% (Figure 6). 9.5% of the students indicated it was above average, and 9.5% said it was average. 9.5% of the students rated it as below average in organization, with none indicating that it was extremely poor.

Implications for Horticulture

With use of a tutorial similar to this one, an instructor for classes involving plant morphology, such as plant identification or plant propagation, could save valuable instruction time by allowing the students to use the online tutorial for

reviewing. Instead of spending many classroom hours on the subject of plant morphology creating an opportunity for the instructor to cover more of the core material of the class. Other benefits may include the possibility of offering complete horticulture classes online. Distance education is gaining in popularity, and horticulture can benefit from this trend. More classes being offered online to students generates more revenue for the instructional unit and allows students to have more, and easier opportunities for learning. Students' comments in the demographic survey were very positive. Several students indicated on both tutorials were beneficial and they enjoyed participating in the study (Appendix F, G). Results of this study reveal there are no differences between an interactive and non-interactive online tutorial. The Flash program development requires considerable learning and build time, as compared to the traditional text and picture HTML website. Since the Flash version showed no benefit over the HTML, there appears to be no advantage to interactivity versus a non-interactive static tutorial. Therefore the simpler HTML version can be used with confidence that it can be employed for effective learning. Both versions of the learning module showed an increase in posttest scores, proving that online instruction increased knowledge gained, and therefore is viable for use as tool for an instructor teaching plant morphology. Future studies on this subject might focus on integrating audio into the interactivity, making use of both auditory and visual stimulation.

LITERATURE CITED

Anderson, S. 2005. Definitions. Last accessed June 12, 2005. http://www.usu.edu/sanderso/multinet/definiti.html

Barrett, P. 2003. Plant Identification: A Computer Assisted Instruction Approach. Unpublished master's thesis, Auburn University, Auburn, Alabama.

Bekkum, V.A. and Miller, W.W.. 1994. Computer proficiency for undergraduate students in agriculture. NACTA Journal. 38:43-46.

Diamond Bullet Design. 2005. Usability first: Usability glossary: Likert scale. Last accessed June 13, 2005. http://www.usabilityfirst.com/glossary/main.cgi?function=display_term&term_id=968

Donaldson, J. L. 1999. Computer access, usage, and literacy of undergraduates in the agricultural sciences. HortTechnology. 43 (3): 20-29.

"Interactivity". 2005. The American Heritage Dictionary. http://dictionary.reference.com/

Ludlow, B.L. 1994. A comparison of traditional and distance education models. Proceedings of the Annual National Conference of the American Council on Rural Special Education, Austin, TX. (ED 369 599)

Macromedia Corporation. 2005. Macromedia Studio MX 2004 Professional. San Francisco, CA

Najjar, L. J. 1996. Multimedia Information and Learning. Journal of Educational Multimedia and Hypermedia*,* 5(2), 129-150.

National Center for Education Statistics, U.S. Department of Education. 2000. Distance Education at Postsecondary Institutions. Last accessed June 12, 2005 http://nces.ed.gov/surveys/peqis/publications/2000013/

National Center for Education Statistics, U.S. Department of Education. 2003. Distance Education at Postsecondary Institutions. Last accessed June 12, 2005. http://nces.ed.gov/surveys/peqis/publications/2003017/

NDP Online Survey. 2005, March. Macromedia Flash Player Statistics. Last accessed June 12, 2005. http://www.macromedia.com/software/player_census/flashplayer

Rhodus, T., Hoskins, J. 1996. The internet: changing the way horticulturists communicate. HortTechnology. 6 (4): 308-314.

Rieger, M. 2002. Distance Education Versus Classroom Instruction in Horticulture - An Introduction to Fruit Crops - Case Study. HortTechnology 12(3):513-515.

SAS Institute Inc. 2001. The SAS® System Release 8e. SAS Institute, Cary, NC.

WebCT. 2005. WebCT.com. Last accessed June 13, 2005. http://www.webct.com/entrypage

FIGURES

FIGURE 1

FLASH VERSUS HTML
COMPARISON OF PRETEST AND POSTTEST SCORES

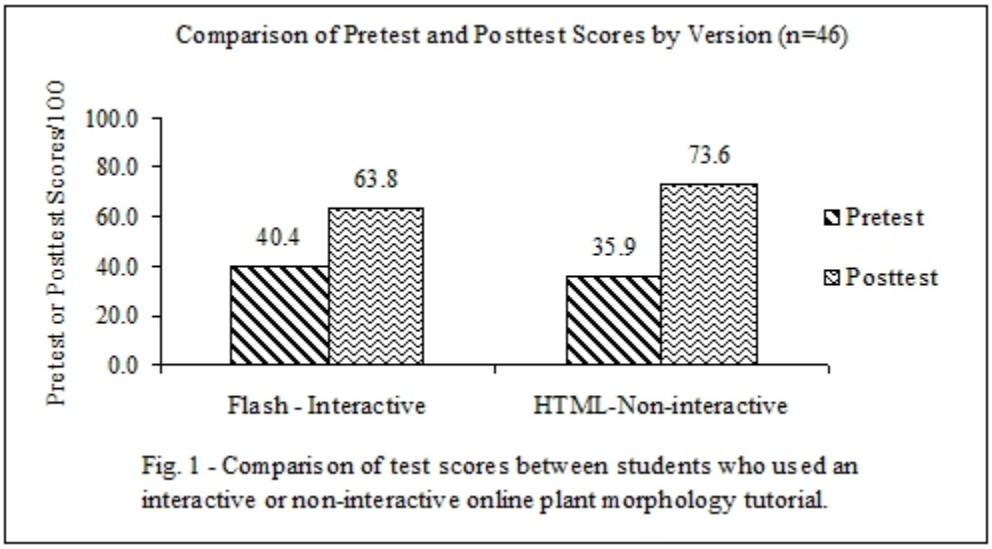


Fig. 1 - Comparison of test scores between students who used an interactive or non-interactive online plant morphology tutorial.

FIGURE 2

FLASH VERSION - RESULTS BY GENDER

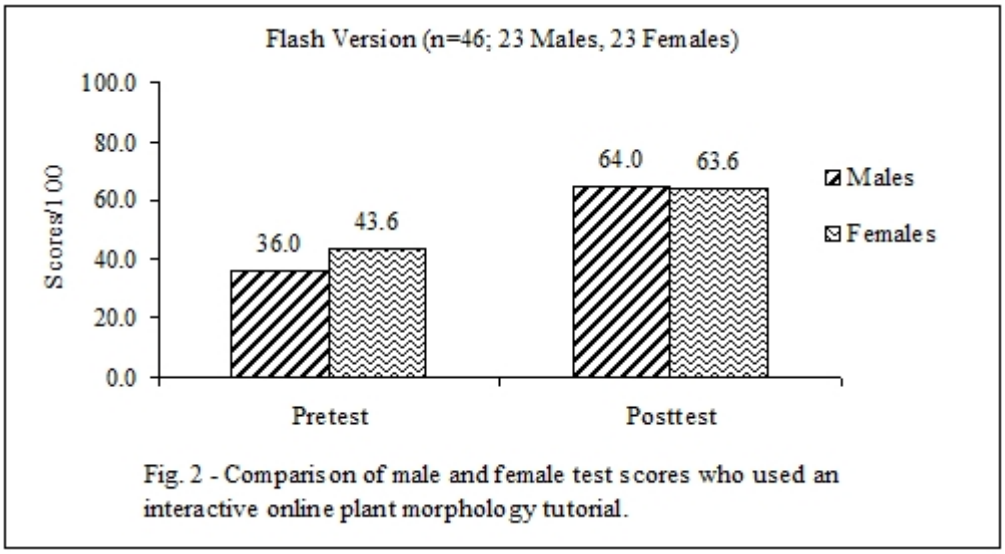


Fig. 2 - Comparison of male and female test scores who used an interactive online plant morphology tutorial.

FIGURE 3

HTML VERSION - RESULTS BY GENDER

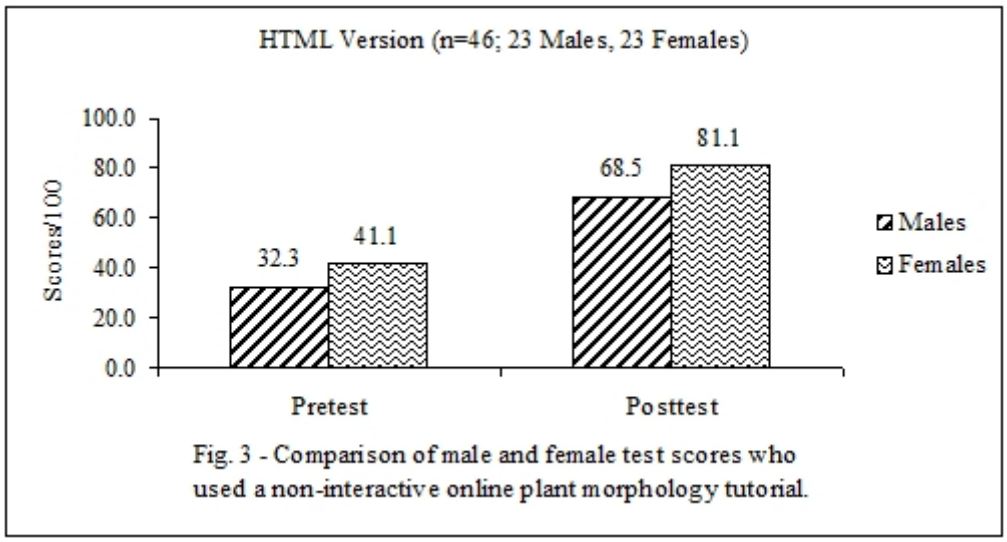


Fig. 3 - Comparison of male and female test scores who used a non-interactive online plant morphology tutorial.

FIGURE 4

TUTORIAL EVALUATION
HELPFULNESS

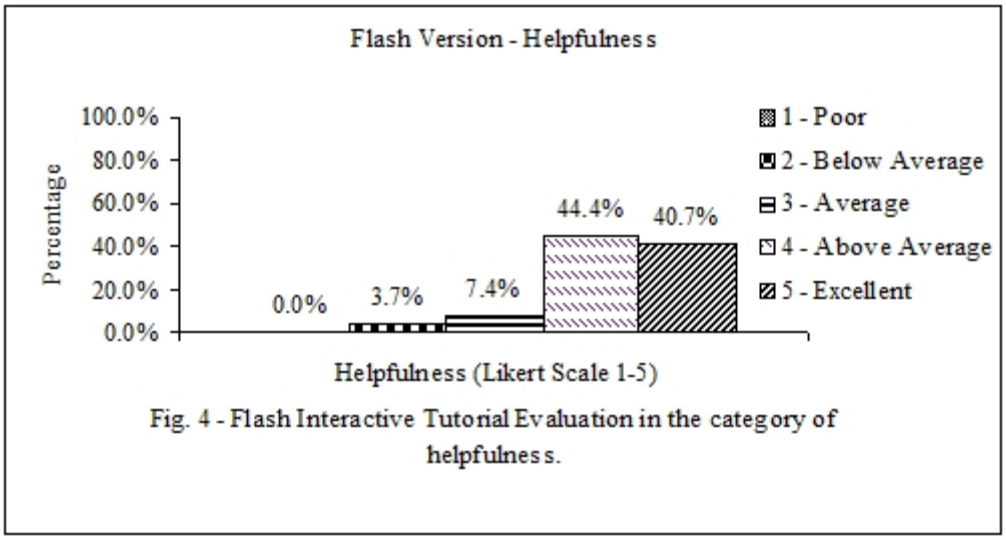


Fig. 4 - Flash Interactive Tutorial Evaluation in the category of helpfulness.

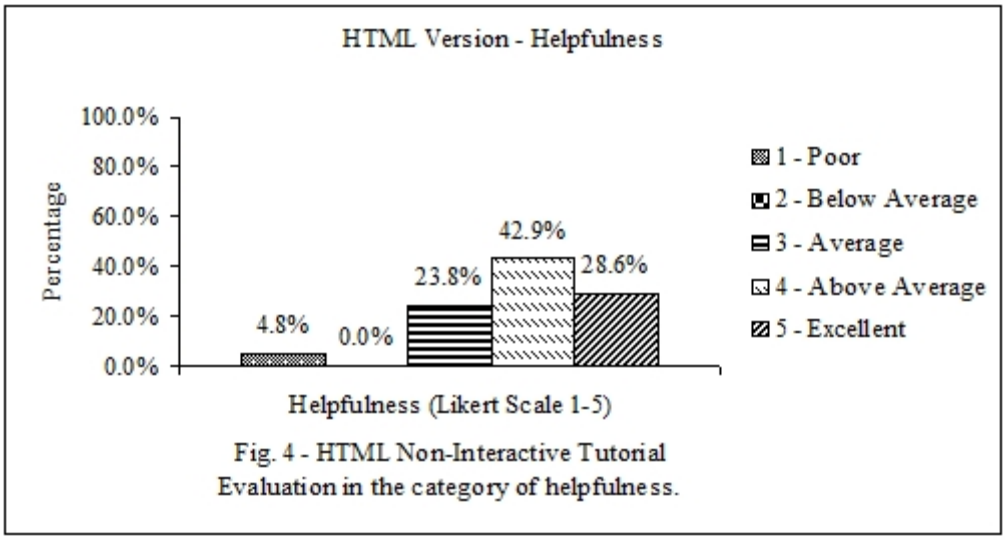


Fig. 4 - HTML Non-Interactive Tutorial Evaluation in the category of helpfulness.

FIGURE 5

TUTORIAL EVALUATION
EASE OF USE

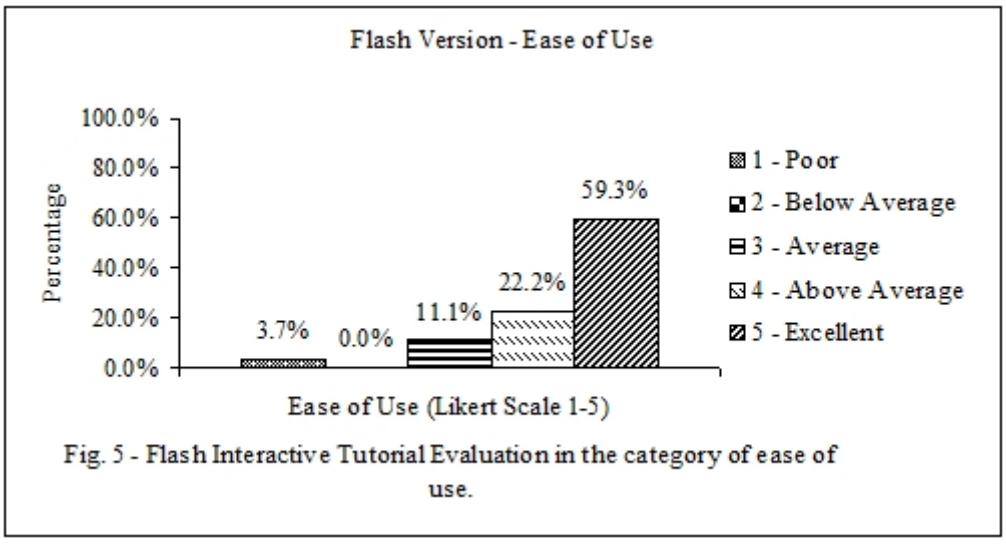


Fig. 5 - Flash Interactive Tutorial Evaluation in the category of ease of use.

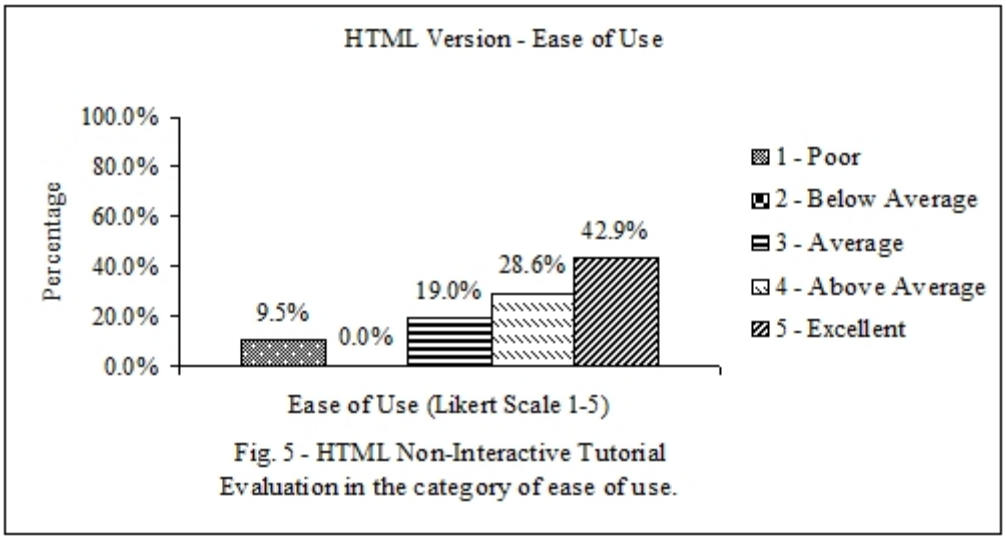


Fig. 5 - HTML Non-Interactive Tutorial Evaluation in the category of ease of use.

FIGURE 6

TUTORIAL EVALUATION
ORGANIZATION

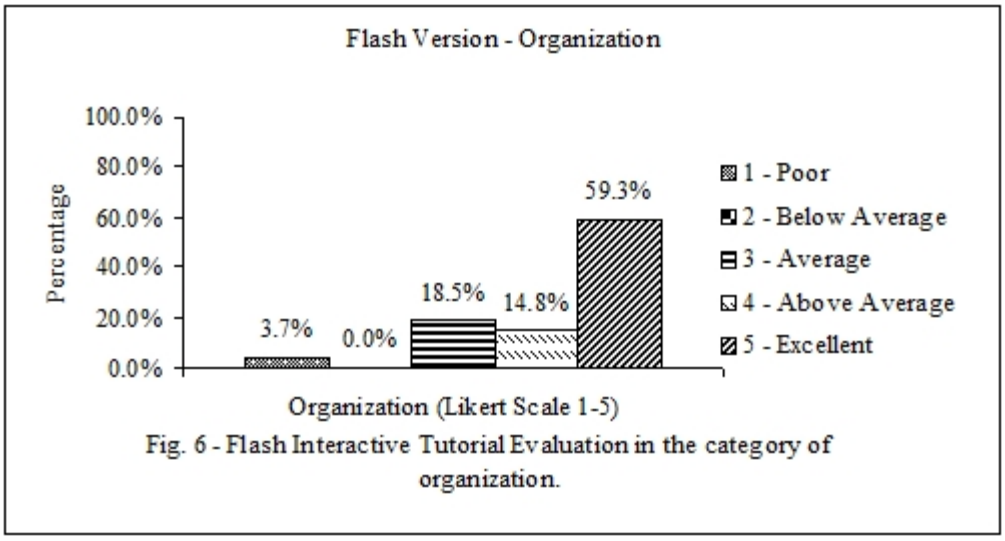


Fig. 6 - Flash Interactive Tutorial Evaluation in the category of organization.

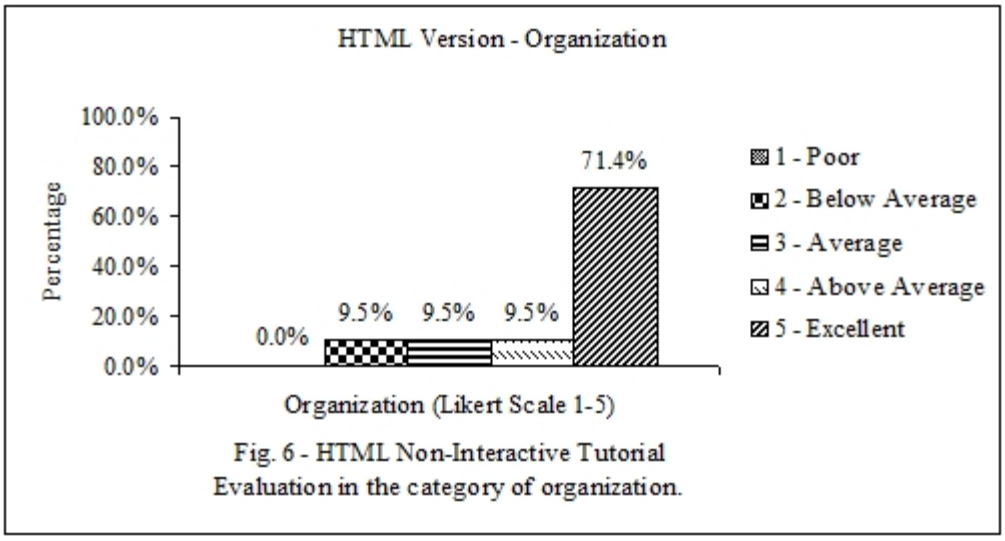
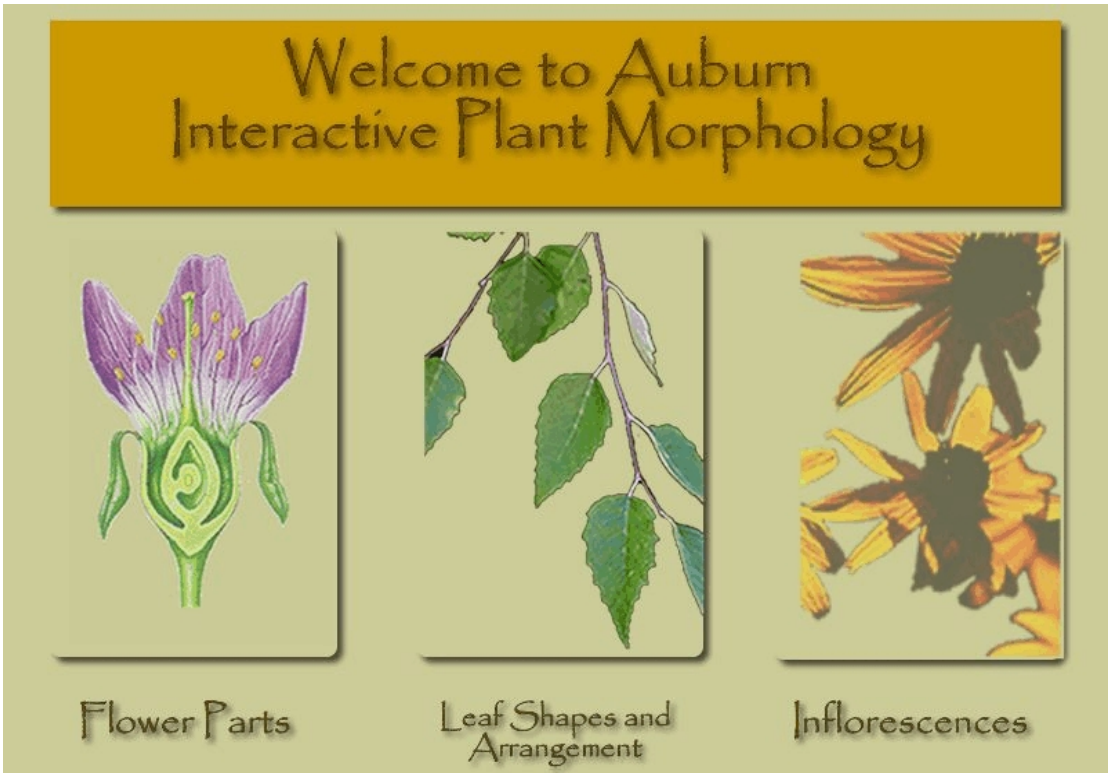


Fig. 6 - HTML Non-Interactive Tutorial Evaluation in the category of organization.

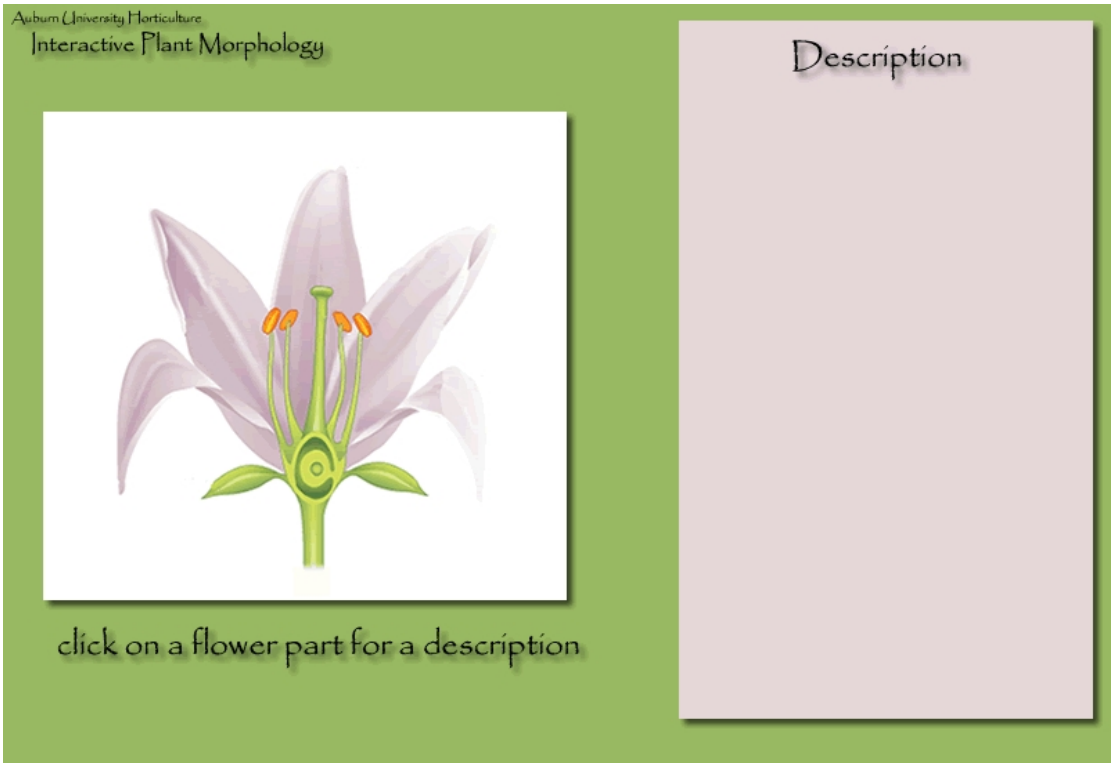
APPENDICES

APPENDIX A

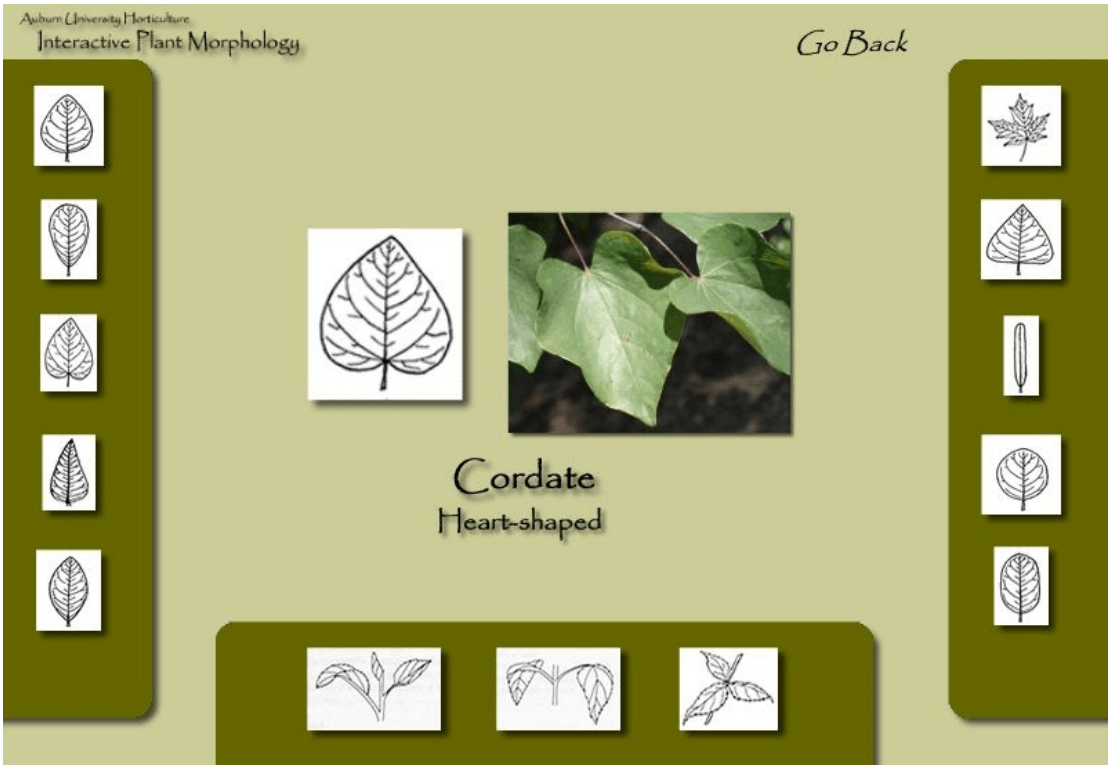
TUTORIAL - FLASH VERSION



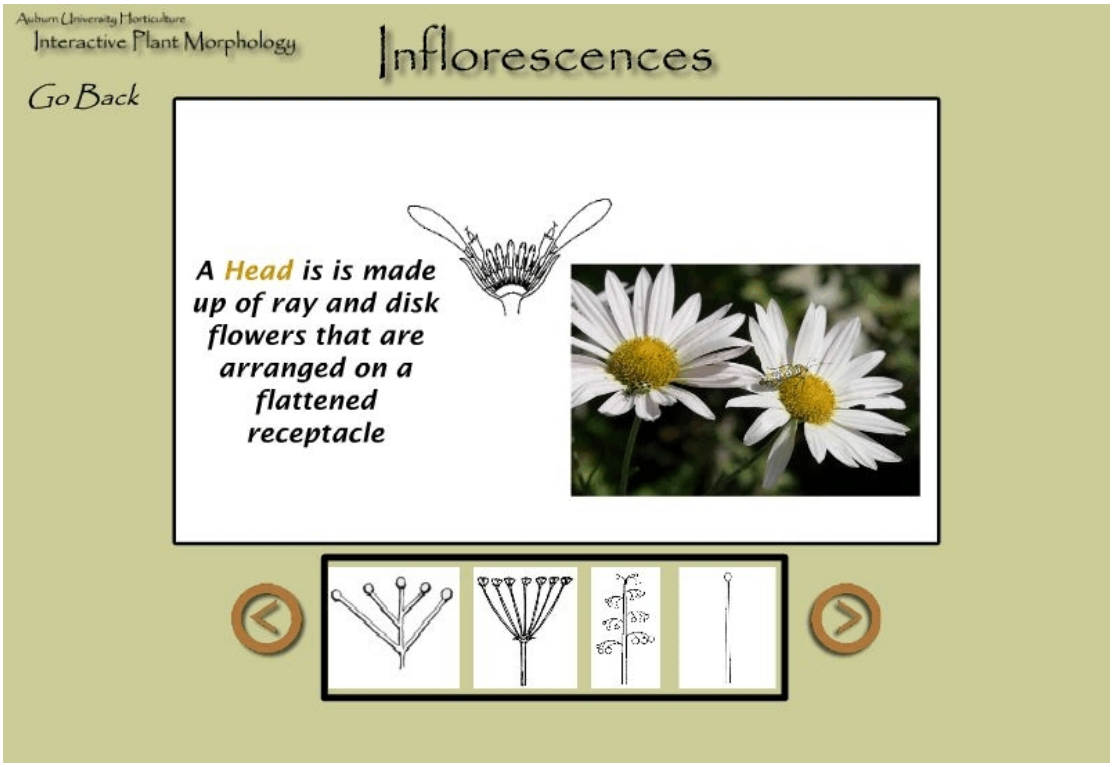
FLASH VERSION - OPENING MENU



FLASH VERSION - FLOWER PARTS



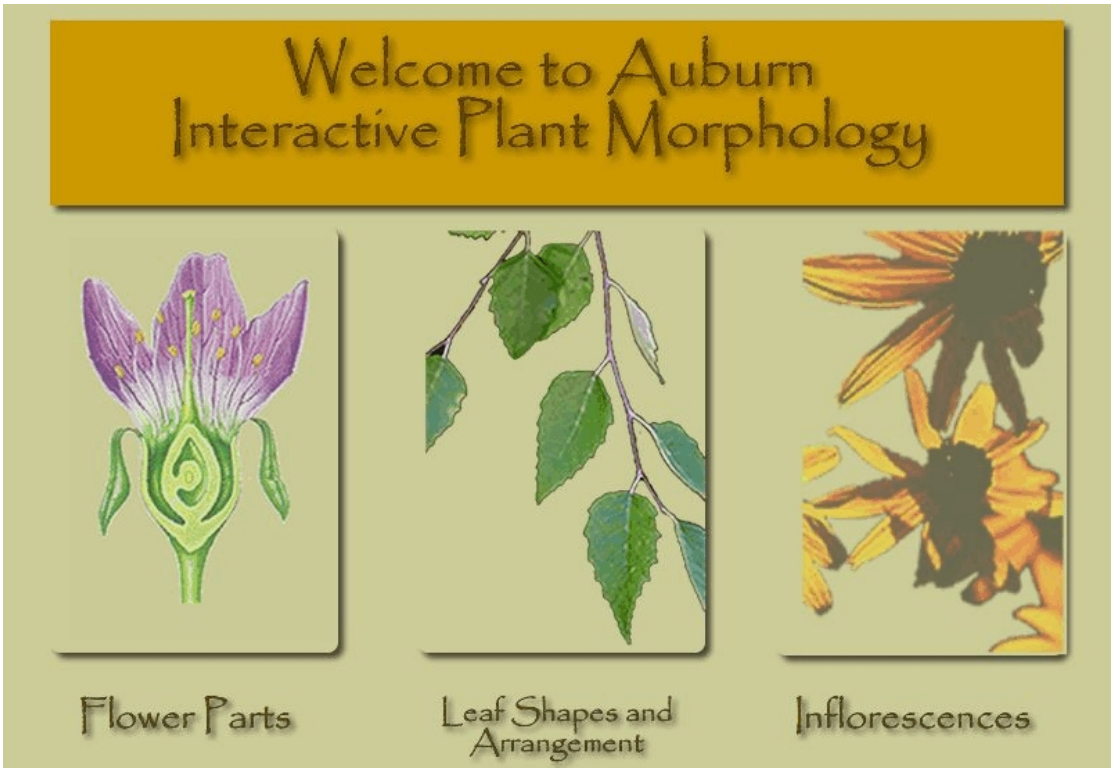
FLASH VERSION - LEAF SHAPES AND ARRANGEMENT



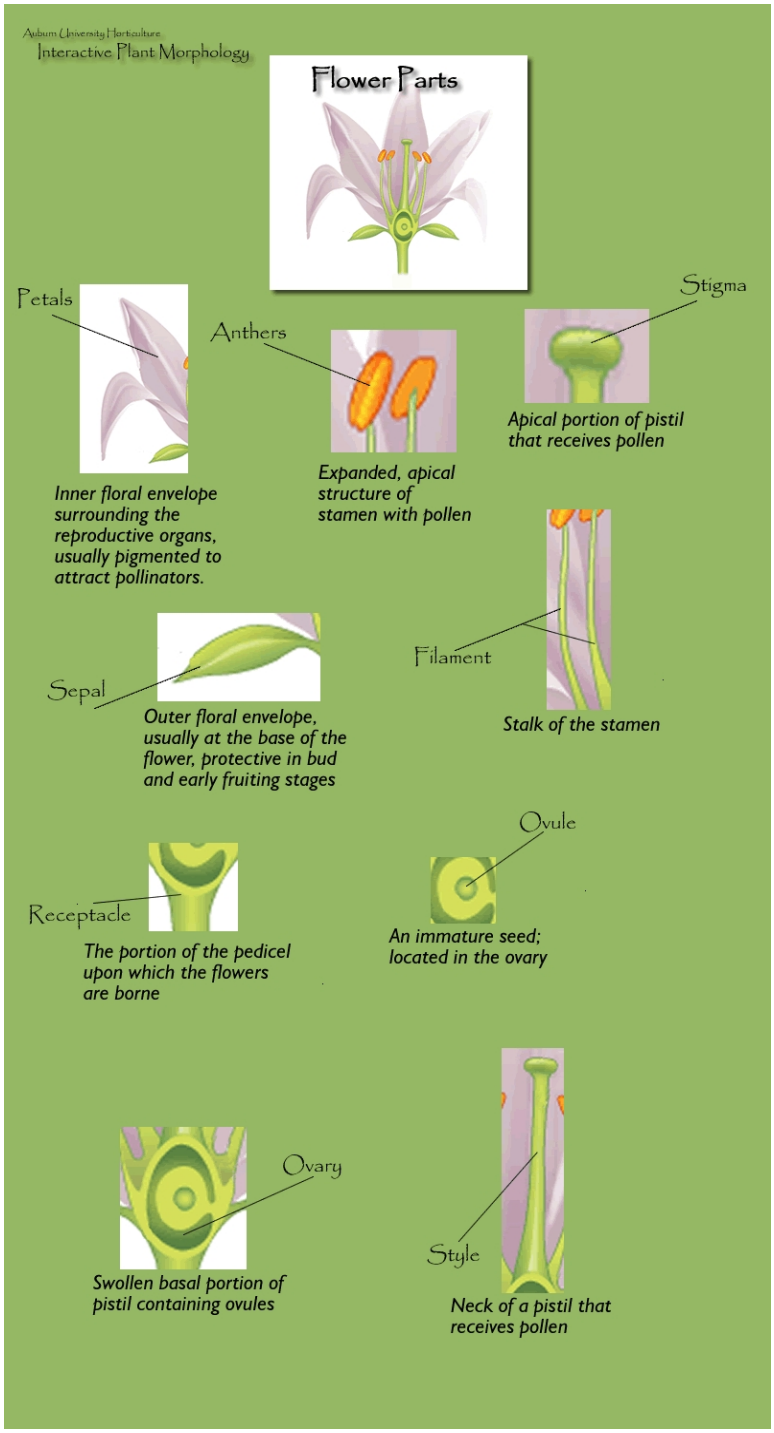
FLASH VERSION - INFLORESCENCES

APPENDIX B

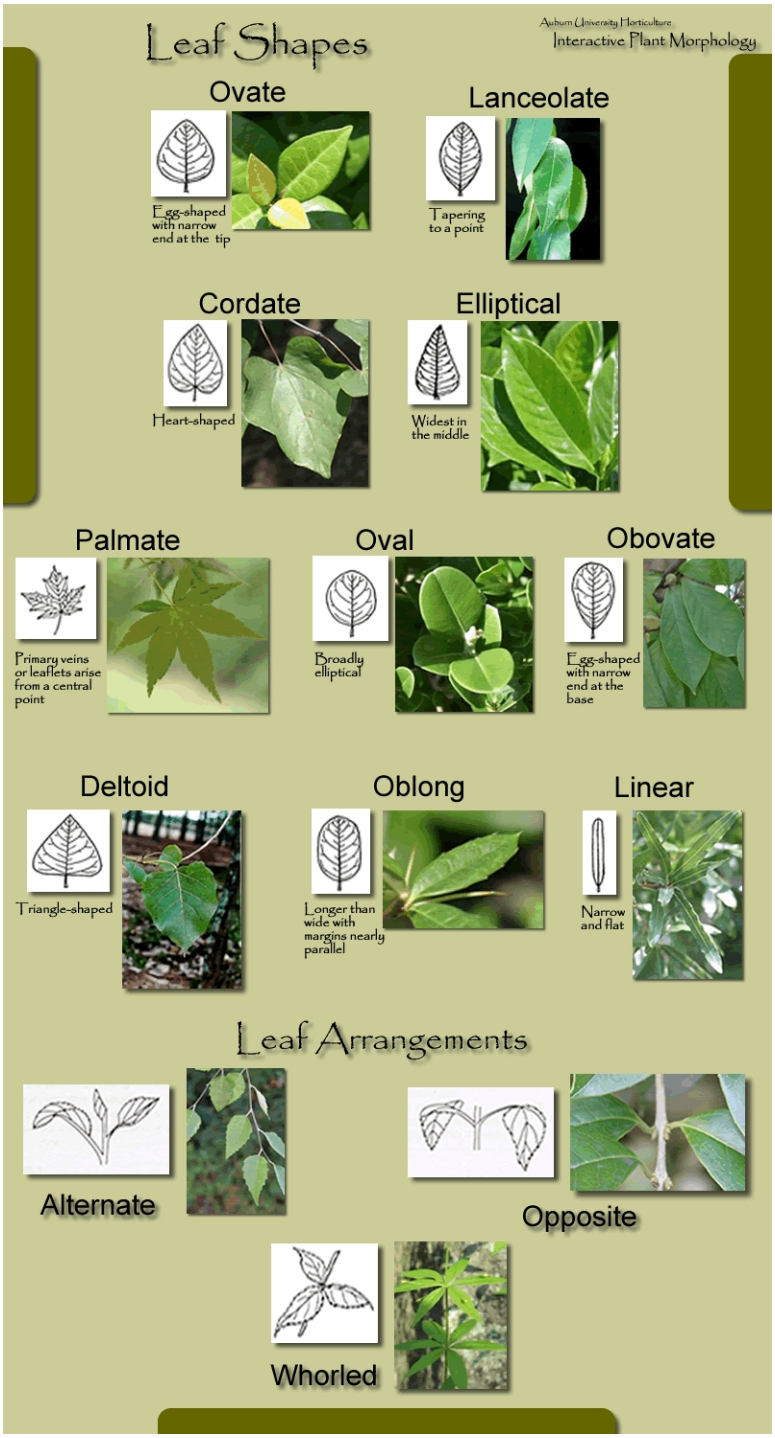
TUTORIAL - HTML VERSION



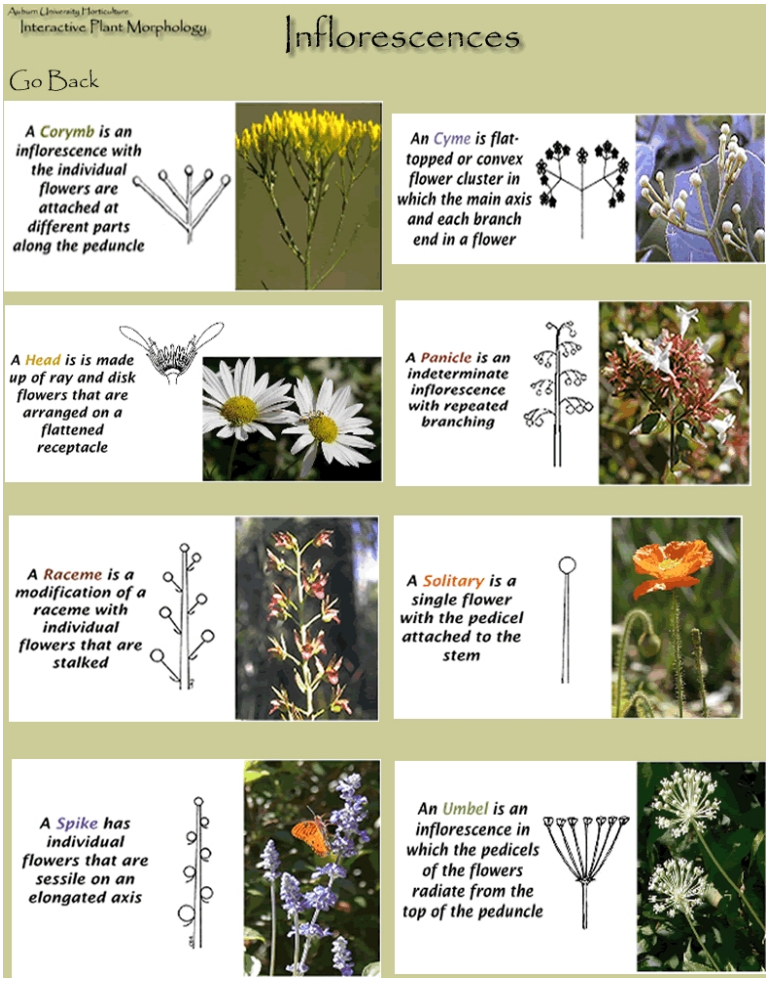
HTML VERSION - OPENING MENU



HTML VERSION - FLOWER PARTS



HTML VERSION - LEAF SHAPES AND ARRANGEMENT



HTML VERSION - INFLORESCENCES

APPENDIX C

DEMOGRAPHIC SURVEY

Demographic Info.

Number of questions: 7

Finish Help

Question 1
On a scale of 1-5, (5 being the best, 1 the worst) how would you rate the helpfulness of this tutorial? (put an X in the appropriate # box)
Save answer

Question 2

Choose your age group

a. 18-25
b. 26-30
c. 31-40
d. 41-50
e. 51-60
f. 61-70
g. 71+
Save answer

Question 3
On a scale of 1-5, (5 being the best, 1 the worst) how would you rate the ease of use of this tutorial? (put an X in the appropriate # box)
Save answer

Question 4
Choose your gender
a. Male
b. Female
Save answer

Question 5
On a scale of 1-5, (5 being the best, 1 the worst) how would you rate the organization and layout of this tutorial? (put an X in the appropriate # box)
Save answer

Question 6
Choose your class
a. Undergraduate
b. Master Gardener
Save answer

Question 7
Please add any additional comments you may have.

Save answer
Finish Help

APPENDIX D

PRETEST

Pretest
Name: AUBURN STUDENT
Start time: June 13, 2005 2:49pm
Number of questions: 10

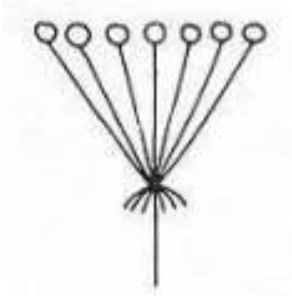
Finish Help

Question 1 (10 points)
The leaf arrangement seen here is called:

a. Opposite
b. Alternate
c. Whorled
d. Complex
e Undulate

Save Answer

Question 2 (10 points)
What type of inflorescence is this?



a. Spike
b. Umbel
c. Corymb
d. Head
e. Panicle

Save Answer

Question 3 (10 points)
The portion of the pedicel upon which the flowers are borne are called:
a. Filament
b. Stigma
c. Receptacle
d. Anthers
e. Style
Save Answer

Question 4 (10 points)
What is the name of this flower part?

a. Anther
b. Filament
c. Stigma
d. Style
e. Ovule

Save Answer

Question 5 (10 points)
This type of leaf arrangement is known as:

a. Opposite
b. Alternate
c. Whorled
d. Simple
e. Compound

Save Answer

Question 6 (10 points)
The swollen basal portion of the pistil containing ovules.
a. Stigma
b. Receptacle
c. Ovary
d. Sepal
e. Ovule

Save Answer

Question 7 (10 points)
The inflorescence seen here is known as:

a. Cyme
b. Raceme
c. Panicle
d. Head
e. Spadix

Save Answer

Question 8 (10 points)
What type of leaf shape is this?

a. Palmate
b. Cordate
c. Lanceolate
d. Obovate
e. Ovate

Save Answer

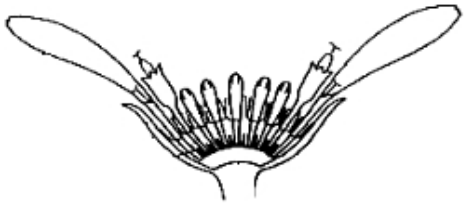
Question 9 (10 points)
What is this type of leaf shape?

a. Palmate
b. Deltoid
c. Cordate
d. Elliptical
e. Oblong

Save Answer

Questio 10 (10 points)
What is this inflorescence called?

a. Umbel
b. Spadix
c. Cyme
d. Corymb
e. Head



Save Answer

Finish Help

APPENDIX E

POSTTEST

Posttest
Name: AUBURN STUDENT
Start time: June 13, 2005 2:49pm
Number of questions: 10

Question 1 (10 points)
What is the name of this flower part?

a. Anther
b. Filament
c. Stigma
d. Style
e. Ovule

Save Answer

Question 2 (10 points)
What type of inflorescence is this?

a. Spike
b. Raceme
c. Corymb
d. Head
e. Panicle

Save Answer

Question 3 (10 points)
The inflorescence seen here is known as:

a. Cyme
b. Ramceme
c. Panicle
d. Head
e. Spadix

Save Answer

Question 4 (10 points)
What is this inflorescence called?

a. Umbel
b. Spadix
c. Cyme
d. Corymb
e. Spike

Save Answer

Question 5 (10 points)
This type of leaf arrangement is known as:

a. Opposite
b. Alternate
c. Whorled
d. Simple
e. Compound

Save Answer

Question 6 (10 points)
The leaf arrangement seen here is:

a. Opposite
b. Alternate
c. Whorled
d. Simple
e. Compound

Save Answer

Question 7 (10 points)
What type of leaf shape is this?

a. Palmate
b. Cordate
c. Lanceolate
d. Obovate
e. Ovate

Save Answer

Question 8 (10 points)
What is this type of leaf shape?

a. Palmate
b. Deltoid
c. Cordate
d. Elliptical
e. Oblong

Save Answer

Question 9 (10 points)
Located inside the ovary; an immature seed.
a. Stigma
b. Receptacle
c. Petal
d. Sepal
e. Ovule

Save Answer

Question 10 (10 points)
The apical portion of the pistil that receives the pollen is called:
a. Filament
b. Stigma
c. Sepals
d. Anthers
e. Style

Save Answer

Finish Help

APPENDIX F
STUDENT COMMENTS - FLASH VERSION

good

Good job.
Great Tutorial.
This tutorial was very informative and helpful.

The test was very easy to take after looking over the tutorial a couple of times. The layout of everything was also easy to use and follow, because nothing was over-complicated. The web design also was a plus, with detailed and color pictures provided for the terms.

I enjoyed doing this and I did learn from the quik and easy layout of the tutorial.

There were a few typos on the tutorial that you might want to correct. Also, on your scale of 1-5 is 5 you might want to state whether 1 or 5 is the highest rating.

The tutorial was great! I know a lot more about plants than I did before!

The tutorial seemed to flow well. It wasn't difficult choosing the topics or knowing what to click on. The images were very clear and the descriptions were easy to understand.

There should be sound along with flash player. If I could have heard the words being pronounced that would have helped me a lot more. Also, in the quiz is one good or bad? I assumed that one was bad.

pictures were very nice and helpful

This was very informative and I wish I could have had something like this when I was taking my biology classes! It was done very well.

It might help if you write in more descriptive comments.

Very well organized.

I think that this tutorial was fairly easy to understand.

My additional comments...very nice design and layout...so easy to understand and operate that a child could do it. Very nicely organized...simple and functional!

very good

APPENDIX G

STUDENT COMMENTS - HTML VERSION

I enjoyed learning and taking the quiz on line.

I hope you were talking about a 1 to 5 scale where 1 was least and 5 was the most

I think the tutorial would have been more helpful had I studied it more, and actually had some kind of education concerning plants and their structures.

Yeah, I don't know where you got all this information, because I didn't read any summary before taking these quizes and for this reason guessed on almost everything except the structures of the flower. However, leaf, petal arrangements, influorecence, etc. I had no idea about.

the tutorial was complete with visual aids and helpful, UNDERSTANDABLE information

The tutorial was very informative by combining very good pictures that were described in simple terms.

Good Layout by dividing the three sections

good job

I am a horticulture major and the quizes were somewhat eazy.

It has been several years since I have reviewed plant material such as this. I found this tutorial to be user friendly, informative, and helpful.

I thought that the quiz was easy to follow, nicely layed out and contained some very helpful information. Good Job!

I had a hard time distinguishing clear cut differences between some of the leaf shapes, but every other part was fine.

APPENDIX H

LETTER TO THE OFFICE OF HUMAN SUBJECTS RESEARCH

Auburn University
Auburn University, AL 36849-5408
College of Agriculture
Department of Horticulture
101 Funchess Hall

Information Letter for Research
Entitled: "Interactive vs. Non-interactive Platforms for Teaching Plant Morphology"

You are invited to participate in a research project that involves learning about plants. This project is being conducted by Brian Wayne Brown, graduate student in Horticulture, under the direction of Dr. Dave Williams, professor in the Department of Horticulture. In this study, we hope to determine the effectiveness of different computer-based delivery methods for learning basic plant morphology. You were selected as a participant because of your interest in horticulture. You must be 19 years old or older to participate in this study.

If you decide to participate, you will need to login to WebCT located under the "Students" section of the main Auburn University Page. A pretest will first be given to determine previous knowledge about the subject. A tutorial (located @ www.auburn.edu/~brownbw/thesis/ will then be given, in which you will have a period of five (5) days to study the subject matter presented. A posttest (also located on WebCT) will then need to be taken to determine the effectiveness of the tutorial. Demographic information will also be collected at that time. This is an out-of-classroom activity. The tests should only take ~10-15 minutes of your time. The tutorial is only for your benefit and it is up to you how much time you spend reviewing it.

The information gained from this project can help in the design of distance education classes in horticulture in the future.

Any information you provide in connection with this study will remain confidential. Information collected through your participation may be published in a professional journal and/or presented at a professional meeting or conference, and only aggregate results will be presented. You may withdraw from your participation at any time, without penalty, however, after you have provided confidential information you will be unable to withdraw your data after participation.

Your decision whether or not to participate will not jeopardize your grade or affect your future relations with Auburn University or the Department of Horticulture in any way. If you have any questions, please feel free to ask them now. If you have any questions, please call or e-mail Dr. Williams or Brian Brown and they will be glad to answer them. You will be provided a copy of this form to keep.

Brian Wayne Brown
(334) 844-3040
brownbw@auburn.edu

Dr. Dave Williams
(334) 844-3032
jdwillia@acesag.auburn.edu

For more information regarding your rights as a research participant you may contact the Office of Human Subjects Research by phone or e-mail. The people to contact there are Executive Director E.N. "Chip" Burson (334) 844-5966 (bursoen@auburn.edu) or IRB Chair Dr. Peter Grandjean at (334) 844-1462 (grandpw@auburn.edu) .

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_____ _____
Participant's signature Investigator's signature

_____ _____
Print Name Print Name