Longitudinal Study of the Attitudes and Behaviors of Environmental Education Program Participants.

Kasie R. Dugas
Louisiana State University and Agricultural and Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_theses

Part of the Other Environmental Sciences Commons

Recommended Citation
https://digitalcommons.lsu.edu/gradschool_theses/4837

This Thesis is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Master's Theses by an authorized graduate school editor of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.
LONGITUDINAL STUDY OF THE ATTITUDES AND BEHAVIORS OF ENVIRONMENTAL EDUCATION PROGRAM PARTICIPANTS.

A Thesis

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Master of Science

In

The School of Renewable Natural Resources

By
Kasie Rene Dugas
B.S., Louisiana State University and Agricultural Mechanical College, 2014
December 2018
Acknowledgments

I would like to take this opportunity to thank those who helped me complete this project. Thank you to my major professor, Dr. Julie Lively for her constant guidance and support. Thank you to the other members of my committee Dr. Michael Kaller and Dr. Hallie Dozier for your knowledge and direction throughout this endeavor. I would like to thank my parents and friends for their support and encouragement. Lastly, I would like to thank Mark Shirley for starting an amazing program that has lasted for over 25 years educating the 4-H members of Louisiana.
# Table of Contents

Acknowledgments........................................................................................................... ii

Abstract.............................................................................................................................. iv

Chapter 1. Introduction......................................................................................................... 1

Chapter 2. Methods................................................................................................................ 8

Chapter 3. Results.................................................................................................................. 14

Chapter 4. Discussion........................................................................................................... 38

Literature Cited.................................................................................................................... 46

Appendix 1. Pre Posttest....................................................................................................... 49

Appendix 2. Draft Survey..................................................................................................... 53

Appendix 3. Marsh Maneuvers Curriculum......................................................................... 62

Appendix 4. IRB Approval.................................................................................................. 75

Vita....................................................................................................................................... 76
Abstract

The goal of this longitudinal study was to measure the attitudes and behaviors of participants of the Marsh Maneuvers program over the course of the last 25 years. The goal of the Marsh Maneuvers program is to educate students into becoming environmentally literate adults. Environmental literacy is considered herein to be people possessing knowledge about and positive attitudes and behaviors towards the environment. Although students learn basic science and environmental knowledge in the classroom, true environmental literacy is believed to require more hands-on understanding of the material. To evaluate the effectiveness of the program, the following three objectives were completed. Lesson plans for the Marsh Maneuvers camp were developed in order to identify specific concepts being taught. The short-term knowledge retention of the Marsh Maneuvers participants was analyzed using pre-and posttests. Finally, the long-term impact of the Marsh Maneuvers program over the past 25 years was determined using a survey. When analyzing the short-term retention results, there was a 36% average increase in knowledge between pre and posttests, which was significant. Nontraditional education programs are designed to overcome barriers that can be presented in a traditional classroom setting (gender, age, GPA). All participants, regardless of gender, age, or GPA, saw an increase in knowledge during the program. The long-term survey results showed that Marsh Maneuvers participants had slightly more positive attitudes and behaviors. The Marsh Maneuvers participants demonstrated environmental knowledge similar to the control group with only one question being statistically significant between the two groups. Marsh Maneuvers is an effective informal education program to increase environmental literacy for 4-H members in Louisiana based on short and long term study results.
Chapter 1. Introduction

Faced with challenges of sea level rise and climate change, as well as rapidly advancing technologies, including clean energy, citizens need an understanding of the basic concepts in order to form educated opinions. Science literacy may be defined as “the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity” (National Science Education Standards 2014). Similarly, environmental literacy may be defined as the understanding of Earth as a living system, including humans and their societal landscapes, and their participation as active citizens (New England Environmental Education Alliance 2010).

Science and environmental literacy is a continuous problem in the United States and globally. At their core, science and environmental literacy are the same; they hold responsible citizen behavior paramount (Culen and Mony 2003, Foster and Shiel-Rolle 2011). It has been estimated that by 2030 the population will reach 7 billion and the demand on resources will be double what the Earth can supply (A.J. 2012). Citizens need to be scientifically literate in order to “appreciate the world around them” and “make informed personal choices” that will be necessary for the future (Hazen 2002).

Formal education has not been demonstrated to create scientifically and environmentally literate adults. In September of 2005, the National Environmental Education Foundation (formerly known as National Environmental Education and Training Foundation) published “Environmental Literacy in America: What Ten Years of NEETF/Roper Research and Related Studies Say about Environmental Literacy in the U.S.” The report explains that a small portion of the adult population is environmentally literate, estimating around 1 to 2% in the United States (Coyle 2005). Although the report estimated the environmental literacy, no national
measure of adult environmental literacy has actually been conducted in the United States; however, the NEEF 2015 Environmental Literacy Report published their findings from a benchmark survey on adults’ environmental knowledge, attitudes, and behaviors. In the United States, generally all adults practice some type of positive environmental behaviors. Furthermore, nearly 33% are engaged in environmental issues, and when additionally informed about the environment issues, 60% will take action (NEEF 2015). The 2005 NEEF report suggests that one of the pitfalls of environmental literacy is its lack of integration into school curriculum. Environmental education is typically an elective that students can take, but the information typically does not build to allow students to apply the ideals of the subject (Coyle 2005). Since the 2005 NEEF report, there has been an emphasis on STEM (Science, Technology, Engineering, and Math) in the traditional classroom (NEEF 2015). This is a platform that environmental educators can use to increase environmental and science literacy across the country. Most scientific knowledge is learned outside of the traditional classroom setting (Miller 2006, Williams and Chawla 2016). Formal education is still important as it builds the science foundation that is necessary to comprehend the larger concepts (Miller 2006), but understanding the concepts is not enough to become literate. The core of science and environmental literacy is responsible behavior. This behavior can only occur if citizens have positive attitudes towards gaining scientific and environmental knowledge. Studies confirm the idea that youth generally have positive attitudes in regards to the environment (Smith-Sebasto and Cavern 2006), but they have a small knowledge base. Therefore, targeting this group for increased science literacy is an effective use of resources. Then students can become scientifically literate adults. Currently it is estimated that only 28% of adults are scientifically literate (Miller 2006); thus, any potential programs to increase this percentage should be pursued.
Informal education can offer an atmosphere more conducive for students to become literate adults; youth can gain knowledge through informal environments (NSTA 2012, Stern, Powell, and Hill 2014). In fact, the National Science Teacher Association (NSTA) urges increased participation and support for such programs for all age groups (NSTA 2012). Informal environmental education programs typically offer an atmosphere that combines learning program objectives with outdoor exploration (Williams and Chawla 2016, Stern, Powell, and Hill 2014, Larson, Castleberry, and Green 2010). Science-based informal education programs have shown an increase in scientific knowledge (i.e, Fields 2007, Francovia and Prokop 2011, Watson et al. 2000), a change in attitudes and behaviors (Francovia and Prokop 2011), and an increase in relating science to everyday life (NSTA 2012). Educational, social, and cultural backgrounds vary greatly in youth; informal science education programs can overcome these hurdles to provide a focused educational environment (Foster and Shiele-Rolle 2011) youth engagement, basic science concept reinforcement and encourage youth to look for the science in their daily lives (NSTA 2012).

These goals for science and environment focused education programs are put into practice across the globe. For example, Slovakia is experiencing large rates of deforestation leading to many environmental problems. Policy and management are being created to combat this problem, yet the general public, due to the lack of knowledge, gives little support. An informal education program called ‘Trees’ was created, and the goal was to combat plant blindness in Slovakia starting with students. An evaluation of the program found that ‘Trees’ positively influenced pupil’s attitudes towards and knowledge of plants. (Francovia and Prokop 2011). The Central Bahamas has also used informal education programs to increase scientific literacy. The goal of their education program was to create scientifically literate adults within the
rural communities of the Bahamas by working with the youth in an active research area, which allowed the youth to experience science in their communities. The posttest showed a modest improvement in knowledge of basic science principles and focused island ecosystem topics (Foster and Shiel-Rolle 2011). In the Redwood National Park in northern California, the Wolf Creek Nature Camp was a two-week outdoor program with a goal to promote environmental awareness and to develop campers’ knowledge to solve environmental issues. During the evaluation of the program, researchers found that participants showed an increase in environmental knowledge including interest in the natural world around them, and five participants were pursuing environmental subjects in school (Dresner and Gill 1994). In Louisiana, similar youth-based programs have been used to try to increase environmental literacy. Programs such as Youth Wetlands Program, Coastal Roots, Native Fish in the Classroom, Project Wet, and Marsh Maneuvers all strive to increase students’ environmental knowledge in Louisiana.

Marsh Maneuvers

Marsh Maneuvers is an environmental education program by the Louisiana State University Agricultural Center (LSU AgCenter) 4-H Program in partnership with the Louisiana Sea Grant College Program and Louisiana Department of Wildlife and Fisheries. 4-H is an international youth organization focused on developing citizenship, leadership and life skills through hands-on and experiential learning. Since 1989, over 1,600 youth have participated in Marsh Maneuvers’ informal education program along the coast of Louisiana (LSU AgCenter 2012). The program blends formal education techniques, lecturing and taking notes, with hands-on outdoor learning. Lessons and activities include wetland functions and values, airboat rides,
trawl sampling, and coastal erosion. From 1993 to 2003, Marsh Maneuvers was conducted in the Barataria Bay of the Gulf of Mexico watershed. In 2004 the program moved to Louisiana Department of Wildlife and Fisheries Rockefeller Wildlife Refuge. The curriculum changed to focus on the Chenier plains and the Teche-Vermilion River, Mermentau River, and Calcasieu River watersheds (Shirley 2014). When the program originated in 1989, limited funds were available to create a more permanent opportunity for youth to experience the wetlands. At the time, Mark Shirley, who created the program, looked to Louisiana Sea Grant and LSU AgCenter 4-H. Paul Coreil who worked for Sea Grant at the time, was a supporter of the program and had funds earmarked for wetlands function and values education. Four one-week camps in the month of July were developed, and there is still a lesson entitled Wetlands Function and Values today. Coreil explained that the goal of the program was to encourage youth to resolve problems regarding the disappearing coastline, including the impacts on the ecosystem, jobs, and culture (Coreil 2018).

The accommodations at Rockefeller Wildlife Refuge limit the number of students who can participate each year. Therefore, parishes are on a four-year rotation. Each summer 16 of the 64 Louisiana 4-H parishes are asked to select four youth who have completed high school biology and chemistry to participate in one of four Marsh Maneuvers week-long sessions. 4-H agents from the selected parishes are asked to attend as chaperones and small group leaders. Since the beginning, Mark Shirley with LSU AgCenter and Louisiana Sea Grant has run the program. Employees of the LSU AgCenter Youth Wetlands Program and Wildlife Agents from the Louisiana Department of Wildlife and Fisheries also attend and conduct lessons.

When the youth arrive at the Rockefeller Wildlife Refuge, a pretest is used to gauge their knowledge of basic biology, as well as, environmental concepts specific to Louisiana. The
pretests are used to understand where the lessons will start so that the youth understand each concept. For example, if pretest scores are high, basic biology information may be skipped and more focus may be placed on specific coastal information. On the last day of camp each student takes the test again to measure change in knowledge. Each student completes a journal, which they take back home; it is filled with lecture notes as well as their thoughts on each activity completed. This gives the youth reference material when they go back to their parishes; many of which require the participants to give a presentation or update on what they experienced at Marsh Maneuvers. This increases the number of people who are affected by the program (Shirley 2014).

The goal of Marsh Maneuvers is to increase participants knowledge on environmental issues, particularly those affecting Louisiana. Coastal land loss is the focus of many of the lectures. As of 2010, Louisiana’s coast lost more than 4,600 km² of land in the previous 80 years (CPRA 2017). The vanishing coast affects everyone in the State of Louisiana. Studies have shown that science-focused informal education programs increase knowledge and can potentially affect youths’ attitudes and behaviors; however, few long-term studies have been conducted to understand the lasting effects. This most likely is attributed to the inconsistencies and longevity of programs. Marsh Maneuvers has been consistent and had a 25 year longevity under the leadership of Mark. Shirley. However, much of the material was developed by the leadership and never formalized into a set curriculum. This interferes with evaluating the effectiveness of different activities and harms the longevity of a program if a change in leadership should occur.

The objective of this project is to find out how twenty-five years of environmental education through Marsh Maneuvers has affected environmental literacy and to formalize the curriculum to increase the longevity of the program. To achieve these goals, I had three objectives: 1) to
document the curriculum used in the week-long sessions of Marsh Maneuvers, 2) to evaluate the short-term knowledge retention of Marsh Maneuver participants, and 3) to assess the long-term retention and impacts of the program from 1990 to 2014. By analyzing the learning retention factors of this program, we can see how this and other environmental education programs can become more effective in producing literate adults.
Chapter 2. Methods

2.1. Curriculum documentation:

To assist with the evaluation of the Marsh Maneuvers program, the formal curriculum needed to be documented. Prior to this project, the curriculum included a listing of the activities and lessons to be conducted each day without any instruction that would allow the individual lessons and activities to be evaluated for effectiveness. With the curriculum well documented, it can then be compared to retention of information to determine which activities and lessons are the most effective and if any need to be improved. Additionally, documenting the curriculum increased the likelihood of program longevity, and was requested by the 4-H Youth Wetlands Program Coordinator.

To develop the formal curriculum, the general listings of activities and lesson was used to create an outline. During the summer of 2016, a complete observer was used to develop lessons. A complete observer does not participate in activities and follows the stages of observation (Fitzpatrick, Sanders, and Worthen 2010). Through qualitative observation using field logs, photos, and recordings, the complete observer obtained the objective of the lesson or activity, what concepts and skills were developed, important notes received during the formal education portion, and any specific steps to allow the activity or lesson to be replicated. Alongside the general curriculum, pictures and recordings of each lesson and activity were developed. This was done to ensure curriculum accuracy as well as provide a tool to be used in the continuation of the program both in and outside of the LSU AgCenter.

2.2. Short-term retention

As noted in the introduction, environmental literacy is not fully formed in the formal classroom; however, the formal education is important for the general science knowledge
required to attend programs such as Marsh Maneuvers. Similar to a formal classroom, the knowledge base of the participants was measured through tests. The Mark Shirley designed a pre-posttest to gauge students’ knowledge of the material (Appendix 1). The test included 31 multiple choice questions to measure the students incoming and outgoing knowledge of the material provided at Marsh Maneuvers. When the youth arrive at the Rockefeller Wildlife Refuge they take a pretest to gauge their knowledge of basic biology as well as environmental concepts specific to Louisiana. The pretests were used to determine which lessons can be skipped due to a basic understanding or which lessons need to be focused on to develop understanding. On the last day of camp each student complete the test again to see how his or her knowledge had grown. Demographic information collected included parish, age, grade completed, self-reported grade point average (GPA), and gender. GPA was categorized into one of five categories: 1.0-1.9, 2.0-2.4, 2.5-2.9, 3.0-3.5, and 3.5-4.0. Note: 3.5 GPAs fell into two categories as staff have shifted the categories over the years. The participants were also interviewed on their experiences obtained through the program. Participants were asked what their overall experience was like, what was something new that they learned, and how they felt upon completion of the program.

Prior to this study, Marsh Maneuver staff collected pre- and posttest data beginning in 2004. Usable data and demographic information were available for 2005 to 2007 and 2009 to 2014. It is important to note that all respondents participated in the program while it was located at the Rockefeller Wildlife Refuge as two questions are specific to the region. However, only the basic overall change in score has been calculated and recorded each year. I used the previously collected nine years of information to measure the short-term impacts of the program as well as the impact of demographics of the participants on difference in score between the pre- and
posttest. The data is used to characterize Marsh Maneuver participants. In those nine years, data were available for 463 participants who went through the program. The analysis of the previously collected data falls under Louisiana State University Institutional Review Board # 3692.

The pre-posttest were reevaluated using mixed linear models (PROC MIXED, SAS Version 9.4, SAS Institute, Inc., Cary, NC). Score change from pre- to posttest was evaluated by years, highest grade level completed, grade point average (GPA), age, and gender. The difference in scores was measured with a paired t-test (Sigma Plot 14.0). For all analysis, the p value was set at 0.05 to measure statistical significance.

Participants who supplied responses to open ended questions about their overall experience, something new they learned, and how they felt upon completion of the program were grouped over all years to create a word cloud. Sentence fillers such as “the” and “and,” were removed from the sentences. The information was then placed in an online word cloud generator (Wordcloud Generator). The word cloud generator then took the words that repeated the most and included them in the cloud. Words that are larger in the cloud repeated more times than words that are smaller.

2.3. Long-term impact

Survey Approach:

To measure the impact of the Marsh Maneuvers program over the past 25 years, I compared Marsh Maneuver participants’ (MM) subject knowledge, attitudes and behaviors towards the environment compared to other Louisiana 4-H participants who did not attend Marsh Maneuvers (control group, CG). A survey (LSU IRB #3692) was designed using Program Evaluation: Alternative Approaches and Practical Guidelines (Fitzpatrick et al. 2010). An online survey was
chosen as the best fit to reach former Marsh Maneuver participants (MM) and the control group (CG). The survey was created and distributed on Survey Monkey, an online survey software. The Survey Monkey account is owned by Louisiana Sea Grant, with all data residing with Julie Lively and the Program Manager for the 4-H Youth Wetlands Program. Although there are some problems with online surveys such as validity of data and sample accuracy, there are clear advantages (Fitzpatrick et al. 2010). The online survey allows for this unique group of people to be included in the study. 4-H is for elementary to high school students with Marsh Maneuvers specifically for 8th through 12th graders. The likelihood of their last known contact information on record remaining the same was low. Conducting the survey online allowed for cost to remain low and reduce waste. Additionally, it has been shown that online surveys can collect similar data in comparison to mail surveys for the information the Marsh Maneuvers survey looked to collect (Laborde, Rohwer, Kaller, and Reynolds 2014). The online format also allowed for logic questions so the CG and MM participants only saw relevant questions based on their answers to previous questions. Contact information for MM participants for the last 25 years was minimal, with the aforementioned 9 years being reliable. For the 9 years of reliable Marsh Maneuvers contact information, email addresses were used to send a unique link to participants. Participants in other years of Marsh Maneuvers and 4-H members in the control group were contacted through their 4-H Parish, 4-H member contacts, 4-H alumni information, and through 4-H social media urging participants to contact the investigator to participate in the study. Each participant who contacted the investigator to participate was provided with a link to complete the survey. The active survey period was March-November 2016.

Survey Design:
The entire survey is available in Appendix 2. The first page of the survey included the online consent form. Survey participants must have checked *continue to survey* which acknowledges that they are a former 4-H'er and age 18 or older. The consent form also addressed any concerns the participants may have, the contact information of the investigators, and the IRB (Institutional Review board) approval.

The next page of the survey included 5-point Likert-type statements to understand participants’ attitudes towards the environment. The response options ranged from strongly agree to strongly disagree including a neutral category. Survey participants rated seven statements, adapted from other national surveys, using the 5-point scale.

The third page of the survey asked participants to rate the frequency they perform the statement provided. The response options were frequently, occasionally, never and not sure. This section of the survey measured participants’ behaviors through their responses to the 16 statements. Items in this portion of the survey are similar to statements in the National Environmental Education Foundation (NEEF) Benchmark Survey Report from 2005 and 2013 (Coyle 2005 and NEEF 2013). These statements were created independently of the NEEF survey; however, the goal was to be able to compare some of the behaviors towards a national survey to see how respondents compare.

The fourth page (Questions 4 through 13) began the knowledge-retention portion of this survey. These questions were taken straight from the Marsh Maneuvers pre/posttest. Ten of the 31 Marsh Maneuvers test questions were chosen to gauge participants’ knowledge base while also keeping the survey short to encourage completion. The Marsh Maneuvers pre/posttest had a mixture of general environmental and Louisiana program-specific questions. Of the ten knowledge-based questions, six were general environmental questions and four were Louisiana-
specific. Since some of the questions are now specific to the Rockefeller Wildlife Refuge location, but survey respondents could have attended either location, none of the geographic specific questions were chosen.

Upon completion of the first three portions of the survey, general and demographic information was collected. Participants were asked if they attended Marsh Maneuvers with additional questions if they responded with yes. These questions included the year they attended, where they attended, and overall experience. Participants who selected no skipped those questions of the survey. Once completed, all participants moved on to the general demographic information, including coastal visits, area of college degree and profession.

Results of the survey were analyzed to look at differences between MM participants and the CG using mixed linear models (PROC MIXED). The p value was set at 0.05 to measure statistical difference. For reporting, weighted averages were created for the scale questions by assigning strongly agree a score of 5 and strongly disagree a score of 1 for the attitudinal questions. For the behavior, frequently was assigned a 3, occasionally a 2, and never a 1. Not sure responses were not factored in to the weighted average and reported as average per group.

Similarly to the word cloud generated in the short-term results, word clouds were generated for questions 21 and 25 on the survey. Question 21 asked respondents why they participated in Marsh Maneuvers and question 25 offered an opportunity for additional comments on Marsh Maneuvers. Again, sentence filler words were removed to enhance the word cloud. All responses were then placed in an online word cloud generator.
Chapter 3. Results

3.1. Curriculum documentation

It is important to note that activities are subject to change based on weather conditions, availability of guest speakers and equipment (Table 1). Each activity and lesson has an individual plan. The lesson plans include an overview of the activity, learning objectives, materials list, definitions, background information and activity procedures. The variety of activities are illustrated in Figure 1, 2, and 3. Students are observing plants in the field (Fig. 1), receiving a hands-on lesson (Fig. 2), and dissecting fish heads (Fig. 3). The Marsh Maneuvers lesson plans are organized to feed into the next activity; however, the lessons can be broken up to create a mini Marsh Maneuvers experience. All created lesson plans can be found in the Appendix 3 and are bolded in Table 1. Lessons or activities that are not bolded do not require a lesson plan, already exist with the Youth Wetlands Program (denoted in Table 1 as YWP Binder), or were presentations by other parties and are not included in the Appendix. Additional material including videos, recordings, and pictures are available from Dr. Julie Lively or the 4-H Youth Wetlands Program Coordinator.

Figure 1. Mark Shirley, Marsh Maneuvers director, educating students on beach hike. Photo Credit: Kasie Dugas
<table>
<thead>
<tr>
<th>Activity (Activities with lesson plans bolded)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Day 1</strong></td>
</tr>
<tr>
<td>Travel Time</td>
</tr>
<tr>
<td>Orientation and Pretest</td>
</tr>
<tr>
<td>6:45 pm</td>
</tr>
<tr>
<td>8:00 pm</td>
</tr>
<tr>
<td>9:30 pm</td>
</tr>
<tr>
<td>11:00 pm</td>
</tr>
<tr>
<td><strong>Day 2</strong></td>
</tr>
<tr>
<td>6:00 am</td>
</tr>
<tr>
<td>8:00 am</td>
</tr>
<tr>
<td>10:00 am</td>
</tr>
<tr>
<td>12:30 pm</td>
</tr>
<tr>
<td>1:30 pm</td>
</tr>
<tr>
<td>2:30 pm</td>
</tr>
<tr>
<td>3:15</td>
</tr>
<tr>
<td>4:00 pm</td>
</tr>
<tr>
<td>7:00 pm</td>
</tr>
<tr>
<td>11:00 pm</td>
</tr>
<tr>
<td><strong>Day 3</strong></td>
</tr>
<tr>
<td>5:15 am</td>
</tr>
<tr>
<td>7:30 am</td>
</tr>
<tr>
<td>8:15 am</td>
</tr>
<tr>
<td>9:00 am</td>
</tr>
<tr>
<td>11:30 am</td>
</tr>
<tr>
<td>12:00 pm</td>
</tr>
<tr>
<td>1:15 pm</td>
</tr>
<tr>
<td>2:00 pm</td>
</tr>
<tr>
<td>3:00 pm</td>
</tr>
<tr>
<td>4:00 pm</td>
</tr>
<tr>
<td>7:00 pm</td>
</tr>
</tbody>
</table>

“(table contd.)”
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 pm</td>
<td>Food Chain (YWP Binder)</td>
</tr>
<tr>
<td>9:30 pm</td>
<td>Wetland Metaphors (YWP Binder)</td>
</tr>
<tr>
<td>10:00 pm</td>
<td>Charades</td>
</tr>
<tr>
<td></td>
<td>Journal Time</td>
</tr>
<tr>
<td>12:00 pm</td>
<td>Prep for bed, lights out!</td>
</tr>
<tr>
<td>Day 4</td>
<td></td>
</tr>
<tr>
<td>6:00 am</td>
<td>Breakfast</td>
</tr>
<tr>
<td>6:30 am</td>
<td>Coastal Tour - Leave for Avery Island</td>
</tr>
<tr>
<td>8:00 am</td>
<td>Environmental Stewardship Project – Marsh Grass Planting</td>
</tr>
<tr>
<td>12:00 pm</td>
<td>Lunch</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>Tour of Tabasco Plant and Avery Island</td>
</tr>
<tr>
<td>6:00 pm</td>
<td>Return to Rockefeller Wildlife Refuge</td>
</tr>
<tr>
<td>7:00 pm</td>
<td>Dinner</td>
</tr>
<tr>
<td>10:00 pm</td>
<td>Movie</td>
</tr>
<tr>
<td>12:00 pm</td>
<td>Prep for bed, lights out!</td>
</tr>
<tr>
<td>Day 5</td>
<td></td>
</tr>
<tr>
<td>7:30 am</td>
<td>Wake-up and pack for home</td>
</tr>
<tr>
<td>8:00 am</td>
<td>Breakfast</td>
</tr>
<tr>
<td>9:00 am</td>
<td>Posttest</td>
</tr>
<tr>
<td>10:00 am</td>
<td>Depart from Rockefeller Refuge</td>
</tr>
</tbody>
</table>

Figure 2. Students participating in the Pollution River activity. Students learned how different pollutants such as DDT move through the environment. Photo Credit: Kasie Dugas

Figure 3. Student dissecting fish heads to find the otolith, which can be used to age fish. Photo Credit: Kasie Dugas
3.2. Short-term retention results

3.2.1. Pre and Posttest Data

From 2005 to 2014 (excluding 2008) 463 4-H members attended Marsh Maneuvers. This does not include the participants who attended a mini-Marsh Maneuvers or any of the 4-H agents, adult leaders, or college interns that experienced the program. Most years saw 40 to 60 participants with 2005 and 2009 seeing only 34 and 31, respectively. Each of the 64 parishes were represented over the 10-year period, with many participants coming from Vermilion Parish. This irregularity is due to the program being held in Vermilion Parish, and it being easier to fill empty camp spots with participants from the parish.

Similar numbers of male and female students participated in 2009, 2010, and 2012. In 2005, 2006, 2007, 2011, and in 2013 more male than female students attended. While slightly more female than male students attended in 2010, there were 13 more female than male participants in 2014 (Figure 4).

Figure 4. Marsh Maneuver participants by gender per year.
Marsh Maneuvers organizers recommend that participants have completed biology, but it is not a requirement. Due to the suggestion of subject completion and limited accommodations, participants are typically in 9th thru 11th grade and 15 to 17 years in age (Fig. 5 and 6). The majority of participants are 16 and have completed 10th grade. However, the ages ranged from 12 to 19 having completed 6th-12th grade at the time of attendance (Fig. 5 and 6). The average age was 15.80 ± 1.23 S.D.

Figure 5. Marsh Maneuver participants by age.
Figure 6. Marsh Maneuver participants by grade completed at the summer of attendance.

Marsh Maneuvers staff recorded the data generated each year and placed GPAs into categories. For students with GPAs of 3.5 the categories varied from 3.0-3.5 and 3.5-4.0 through the years. For the sake of analysis, both categories were kept (Fig. 7). During the nine years of data collection, majority of participants had a GPA of 3.0 and above.

Figure 7. Marsh Maneuver participants by self-reported Grade Point Average (GPA).
The pretest scores test the students’ prior knowledge based on what they have learned in school and other programs. When looking at average pretest scores, each year saw average scores over 50%. Participants in 2012 had the highest average of 62.1%, and participants in 2009 the lowest average of 53.8% followed closely by 2010 with 54.8%. Over the 9 years, the overall average pretest score was 57.5% ± 12.37 SD (Fig. 8).

![Figure 8. Average pretest, posttest, and percent change score per year. Error bars represent standard deviation.](image)

By year, the average posttest scores ranged from 69.7% to 78.7% (total average 76% ± 13.64 s.d.). Participants in 2010 had a low average pretest and posttest score with 54.8% and 69.7%, respectfully. Although 2009 saw the lowest average prescores they had the highest percent change in scores (Fig. 9). Participants in 2012 had the lowest percent change, but those participants had the highest pretest score and an average posttest score. All years saw a
significant increase in percent change with a yearly average range of 23.48% to 47.17% (total average 35.55% ± 31.05 s.d) or more from pre to posttest (p<0.001). (Fig. 9).

From 2005 to 2014, there were not significant differences in average percent change by gender (p = 0.5504), but participants in some years did better than others. In 2006, 2010 through 2012, and 2014, males had higher average percent change than females. In 2006 and 2011, Marsh Maneuvers saw more male attendance while 2010 and 2014 saw more females. In 2009, female participants had higher percent change scores than males (Fig. 9). In that year, number of males and females were very similar (Fig. 4).

When looking at grade completion, students below the 9th grade had the highest percent change in 2006, 2010, and 2012 compared to other grade groups of the time. Participants that finished 9th grade had a higher percent change than any other group in 2007 and 2011, and

![Figure 9. Average percent change of Marsh Maneuvers pre posttest scores by gender. Error bars represent standard deviation.](image)
participants finished with 11th had the highest scores in 2009. There was no statistical difference between grade completed and percent change from pre-posttest (p = 0.5708).

Figure 10. Average percent change of Marsh Maneuvers pre to posttest scores by highest grade completed at time of camp. Error bars represent standard deviation.

When comparing GPA category to average percent change between pre- posttest, the 2.0-2.4 and 2.5-2.9 saw the most change over the nine years. This can be observed in 2006, 2007, 2009, 2011, and 2013. GPAs 3.0-3.5 and 3.5-4.0 were more consistent across the nine years. The smallest percent change for all GPA ranges occurred in 2012, but again this could be due to the higher average pre-score for the year. Similar to gender and grade completed, GPA does not significantly affect percent change on the pre-posttest (p = 0.2740).
3.2.2. Interviews

According to the exit interviews, students enjoyed the experience they received during the Marsh Maneuvers program. Students expressed the knowledge gained upon completion of the program. Since many of the participants were not from that region of Louisiana, many experienced the coastal area and its activities for the first time. Overall, interview comments were positive and participants were grateful for the experience.

One student, in the summer of 2004, from Lafayette Parish (approximately two hours from Rockefeller Wildlife Refuge) stated, “...Sure I knew some of the stuff, but by coming here, I built upon the knowledge that I already had. I got to do so many things that I wouldn’t be able to do if I was here on my own...This experience made me more aware of the great resources I have around me and it makes me want to get active…”
A student, in the summer of 2011, from Tensas Parish (approximately four and a half hours from Rockefeller Wildlife Refuge) shared, “Throughout the activities, lectures and tours, my attention and fascination was always on what was being said...Wildlife research and management is something I find very fascinating and fun and I would like to make it a part of my life, be it volunteer work or as a full time job. Marsh Maneuvers has shown me how much fun the coastal regions of Louisiana really are and I would like to learn more and work with more of it.”

The 4-H agents that attended Marsh Maneuvers as chaperones were also interviewed. Overall, the interview comments were positive expressing the idea that students all gained knowledge and experienced new things while participating in the program. All interviews are archived with the 4-H Youth Wetlands Program and Dr. Julie Lively, and they are summarized in the word cloud below (Fig. 12). Besides the name of the program, respondent key words focused on learning about the wetlands and some of the specific lessons like dissecting the alligator eggs.

Figure 12. Word cloud generated from Marsh Maneuvers participant’s interviews.
3.3. Long-term impact

A. Respondent summaries

The study surveyed 123 former 4-H members. Of the 123 respondents, 107 completed the survey with 46 having attended Marsh Maneuvers (MM) while 61 had not attended, making up the control group (CG). When examining the 46 who attended Marsh Maneuvers, 35 went to Rockefeller Wildlife Refuge and 11 went to the Barataria Bay watershed. Survey respondents attended Marsh Maneuvers in 1991, 1995, 1999, 2001, and 2004 through 2015. The majority of the survey respondents were in the age range of 18-24 and 25-34 (Table 3). The 75 plus participant was most likely an agent or adult leader who participated in the program (Table 3). All survey participants were part of the Louisiana 4-H program in their youth, and the majority still live in Louisiana with 19 living outside of the state (Table 2). Half of the MM respondents reported attending other environmental education programs in school while 25 of the 61 CG respondents attended other programs. The Youth Wetlands Program was the most cited as an additional environmental program attended.

Table 2. Location of respondents

<table>
<thead>
<tr>
<th>State</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>2</td>
</tr>
<tr>
<td>California</td>
<td>1</td>
</tr>
<tr>
<td>Georgia</td>
<td>1</td>
</tr>
<tr>
<td>Louisiana</td>
<td>88</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1</td>
</tr>
<tr>
<td>Missouri</td>
<td>2</td>
</tr>
<tr>
<td>New Mexico</td>
<td>1</td>
</tr>
<tr>
<td>New York</td>
<td>1</td>
</tr>
<tr>
<td>North Carolina</td>
<td>1</td>
</tr>
<tr>
<td>Tennessee</td>
<td>5</td>
</tr>
<tr>
<td>Texas</td>
<td>2</td>
</tr>
<tr>
<td>Virginia</td>
<td>2</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3. Age range of survey respondents

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Number of Participants</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>73</td>
<td>68.22%</td>
</tr>
<tr>
<td>25-34</td>
<td>26</td>
<td>24.30%</td>
</tr>
<tr>
<td>35-44</td>
<td>3</td>
<td>2.80%</td>
</tr>
<tr>
<td>45-54</td>
<td>4</td>
<td>3.74%</td>
</tr>
<tr>
<td>55-64</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>65-74</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>75 plus</td>
<td>1</td>
<td>0.93%</td>
</tr>
</tbody>
</table>
B. Comparisons of Control Group and MM

A total of 107 respondents answered Q.18 (Did you participate in MM?) allowing for a comparison of CG and MM responses in the attitudes and behavior questions of the survey.

1. Attitude Questions

In order to test for differences in attitude towards the environment between MM and CG, seven statements were evaluated. Overall, responses between MM and CG were very close (Table 4). The majority (>50%) of respondents agree with the statement “As humans, we have the right to change the environment to support our needs.” Of all of the attitude-based questions, this question saw the most “Neutral” responses (>20%). CG and MM respondents both disagreed with the statement “The earth has enough natural resources to last forever” with 87% of CG and 82% of MM selecting “Disagree” and “Strongly Disagree” (Table 4).

Table 4. Survey respondents’ weighted average in response to attitude statement. A higher score indicates more strongly agrees while a score closer to zero indicates more strongly disagrees. Underlined averages represent more friendly environmental behavior score.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Weighted Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CG</td>
</tr>
<tr>
<td>As humans, we have the right to change the environment to support our needs.</td>
<td>0.70</td>
</tr>
<tr>
<td>The earth has enough natural resources to last forever.</td>
<td>0.33</td>
</tr>
<tr>
<td>I do not have enough time to worry about how my actions affect the environment.</td>
<td>0.37</td>
</tr>
<tr>
<td>I feel good when I help the environment.</td>
<td>0.88</td>
</tr>
<tr>
<td>I consider how my actions will affect the environment.</td>
<td>0.81</td>
</tr>
<tr>
<td>Business and manufacturers who reduce their environmental impacts are making good business decisions.</td>
<td>0.84</td>
</tr>
<tr>
<td>I cannot help solve environmental problems.</td>
<td>0.35</td>
</tr>
</tbody>
</table>
Only 3% of CG and 4% of MM respondents agreed with the statement “I do not have enough time to worry about how my actions affect the environment” (Table 4). The majority of respondents disagreed and strongly disagreed with the statement (87%), suggesting that time does not affect their attitude toward their actions and how they affect the environment. Most of respondents agree that they feel good when they help the environment with 93% of CG and 98% of MM, respectively.

For the statement, “I consider how my actions will affect the environment,” 0% of the CG stated that they strongly disagreed and 3% stated they disagreed while 2% of MM respondents strongly disagreed and 4% disagreed. The majority of respondents agreed with the statement, 53% CG and 57% MM, while a smaller percentage strongly agreed, 28% CG and 22% MM (Table 4).

Regardless of Marsh Maneuvers attendance, on average, respondents agreed that “business and manufacturers who reduce their impacts on the environments are making good business decisions” (>80%). A small percentage of both group felt neutral about the statement, and 11% of CG and 9% of MM respondents disagreed with the statement.

Overall, both the CG and the MM respondents believe that they “cannot help solve environmental problems” with 89% CG and 91% MM responding with disagree or strongly disagree. There was no statistical significance when looking at the attitudes between CG and MM respondents.

2. Environmental Behavior

In order to measure the potential difference in behaviors considered environmentally-friendly between MM and CG, respondents were asked how frequently they did certain activities. For all but one behavior, MM had a higher weighted average than CG, but only
slightly, and no behaviors were statistically significantly different between groups. Respondents in both groups occasionally unplug electronic devices and small appliances when not in use. The majority of CG and MM respondents frequently turn off the lights when leaving a room with only 3% of the CG saying they never do this. (Table 5).

Table 5. Responses to environmental behaviors by Marsh Maneuver attendees (MM) and the Control Group (CG). For the weighted average, the higher the number, the more frequent the behavior. **Not Sure** is the percent of respondents.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Response</th>
<th>CG</th>
<th>MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>I unplug electronic devices when not in use.</td>
<td>Weighted Average</td>
<td>0.71</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>I keep electronic devices and small appliances unplugged when not in use.</td>
<td>Weighted Average</td>
<td>0.66</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>I turn off the light when leaving an empty room.</td>
<td>Weighted Average</td>
<td>0.92</td>
<td>0.94</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>I use compact fluorescent lightbulbs.</td>
<td>Weighted Average</td>
<td>0.52</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>30%</td>
<td>9%</td>
</tr>
<tr>
<td>I use LED light bulbs.</td>
<td>Weighted Average</td>
<td>0.55</td>
<td>0.61</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>26%</td>
<td>9%</td>
</tr>
<tr>
<td>I look for energy efficiency ratings when buying products (i.e. dishwashers, fridges, etc.)</td>
<td>Weighted Average</td>
<td>0.62</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>12%</td>
<td>9%</td>
</tr>
<tr>
<td>I only run the dishwasher with a full load.</td>
<td>Weighted Average</td>
<td>0.91</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>I only run the laundry machine with a full load.</td>
<td>Weighted Average</td>
<td>0.92</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>I turn off the water when brushing my teeth.</td>
<td>Weighted Average</td>
<td>0.80</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>I take short showers</td>
<td>Weighted Average</td>
<td>0.65</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>I wash clothing on cold-water settings.</td>
<td>Weighted Average</td>
<td>0.79</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>I receive and pay bills online (paperless billing).</td>
<td>Weighted Average</td>
<td>0.74</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>I compost my kitchen waste.</td>
<td>Weighted Average</td>
<td>0.36</td>
<td>0.47</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>16%</td>
<td>4%</td>
</tr>
<tr>
<td>I recycle products instead of putting them in the garbage.</td>
<td>Weighted Average</td>
<td>0.68</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>I use recycled products (paper, paper towels, razors, etc.)</td>
<td>Weighted Average</td>
<td>0.62</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td>Not Sure</td>
<td>7%</td>
<td>4%</td>
</tr>
</tbody>
</table>
The next three behaviors can be grouped to measure respondent’s behaviors when using or purchasing environmentally friendly products. Compact fluorescent light bulbs and LED light bulbs are more energy efficient, and therefore, more environmentally friendly. No statistical difference was shown between the CG and MM; however, slightly more MM participants choose “Occasionally” than the CG (Table 5). The highest “Not Sure” selection was seen in these two behaviors for the CG with a very low percentage for MM. For the behavior, “I look for energy efficiency ratings when buying products (i.e. dishwashers, fridges, etc.),” slightly more MM respondents stated they frequently use this tool to purchase a product (Table 5).

Respondents’ behaviors towards water resources were examined through the next five statements (Table 5). There was no statistical significance between CG and MM respondents. Overall, MM respondents selected “Frequently” and “Occasionally” more often than the CG. When asked about respondents’ laundry and dishwasher water usage, the CG saw more occasionally or never responses than the MM respondents. MM respondents saw a higher percentage who “Frequently” turn off the water when brushing their teeth. Equal percentages of CG and MM “Never” turn the water off. Percentages were very similar between the MM and CG respondents when looking at cold water settings when washing clothing.

Over half of MM participants “Frequently” receive and pay bills online and the majority at least “Occasionally.” Only 9% of MM participants never use paperless billing. Slightly less than half of the CG “Frequently” use paperless billing, and the majority “Frequently” or “Occasionally” pay bills online. Of the CG, 11% never use paperless billing.

When asked if respondents compost kitchen waste, the majority selected “Never” for both CG and MM. Similar numbers “Frequently” compost. A large difference was visible in the
“Occasionally” category with CG responding at 8% and MM at 30%. Overall, MM participants compost more often than CG (Table 5).

Survey respondents were asked, “How often do you recycle?” and were given the options “Always,” “Most of the time,” “Half of the time,” and “Never.” The results were then separated into two categories, “Yes” and “No,” based on if they recycled or not. “Always,” “Most of the time,” and “Half of the time” was considered “Yes” and “Never” was considered “No.” There was no statistical difference between the CG versus the MM, but MM show a slight increase in number of people who recycle (Figure 13).

![Figure 13](image.png)

Figure 13. Average percent of Control Group and Marsh Maneuvers respondents in regards to their recycling habits. Error bars represent standard deviation.

We also asked “Are you able to recycle at home?” with the respondents being able to select “Yes, recycling trucks pick up my recycling,” “Yes, but I do not recycle,” or “No, recycling trucks do not pick up at my home.” A majority of respondents were not able to recycle at home with 74% for CG and 78% for MM. Equal percentages of respondents are able to
recycle at home for CG and MM at 20%. The CG saw a slightly higher response of “Yes, but I do not recycle” at 7% to MM respondents at 2%.

3. MM specific test questions

In order to test specific MM knowledge and retention, ten questions from the Marsh Maneuvers pre-posttest were included in the long term effects survey. MM participants had more correct responses than the CG to questions 1, 2, and 5 through 9 (70% of questions). More CG respondents answered correctly to questions 3 and 4 with 100% correct responses on question 3. Question 10 saw a 1% difference with MM at 96% and CG at 97% correct responses. Except for question 6, no statistical significance was present in the questions. For question 6 (If a crab pinches your finger, which bacterial infection should you be most concerned about?), there was a significant difference in the number of MM (59%) that answered the question correctly than CG (25%) (p = 0.0002) (Fig. 14). When looking at the Marsh Maneuvers combined questions based on average score, MM respondents scored slightly higher on average than the CG (Table 6).

![Figure 14. Respondent’s percent correct on Marsh Maneuvers pretest questions within survey. A * indicates statistical difference between the Marsh Maneuver and Control Groups. (p<0.05)]
To see if there was an impact with time since attendance on retention, the MM responses were grouped based on years since attendance. Year 2016 (Year of the survey) was used as Year 0, and I grouped responses in 5-year groupings to also ensure all categories (1-5 years, 6-10 years, 11-15 years, ≥16) had more than 3 respondents. When looking at MM respondents based on years, no year groupings saw average scores lower than the CG (Table 6 and 7). Respondents who attended Marsh Maneuvers ≥16 years before taking the survey showed the highest average scores (92.5%) (Table 7 and Fig. 15). Overall, all year groupings saw high average scores showing high retention values.

Table 6. Average score out of 10 for Marsh Maneuvers survey questions.

<table>
<thead>
<tr>
<th></th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>MM</td>
<td>8.31</td>
</tr>
<tr>
<td>CG</td>
<td>7.46</td>
</tr>
</tbody>
</table>

Table 7. Average score out of 10 for Marsh Maneuvers questions grouped by year since attending the camp. Year 2016 was used as year 0.

<table>
<thead>
<tr>
<th>Years Since Attendance</th>
<th>Number of Respondents</th>
<th>Average Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>23</td>
<td>8.22</td>
</tr>
<tr>
<td>6-10</td>
<td>12</td>
<td>8.25</td>
</tr>
<tr>
<td>11-15</td>
<td>6</td>
<td>8.17</td>
</tr>
<tr>
<td>≥16</td>
<td>4</td>
<td>9.25</td>
</tr>
</tbody>
</table>

Figure 15. Average score on Marsh Maneuvers questions on survey by attendance year.
Each of the 10 Marsh Maneuvers questions can be linked to a lesson or lessons that were taught during the camp. Of the 10 Marsh Maneuvers questions, 6 are general environmental information questions that were taught throughout the camp, and specifically focused on the Wetlands Functions and Values lesson on day 1. The general information was well retained over a long time period as no difference is seen when looking at time since attendance. More specific information retention was tested in questions 6 and 8. About half, 59% and 43% respectively, of MM answered these correctly (Table 8). Questions that saw the highest percent correct were general information questions that were strung throughout multiple lessons during the week (i.e. question 5, Table 8). Detailed information that was brought up during one lesson was not retained as well as others, which was found with question 8.

Table 8. Questions from pre posttest versus lessons taught at Marsh Maneuvers.

<table>
<thead>
<tr>
<th>Question</th>
<th>Lesson Plan</th>
<th>MM % Correct</th>
<th>CG % Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. As human populations increase, natural resources will….</td>
<td>Wetland Functions and Values (Lecture), Alligator Lecture (Lecture)</td>
<td>93%</td>
<td>89%</td>
</tr>
<tr>
<td>2. Who is affected by coastal erosion?</td>
<td>Wetlands Functions and Values Presentation (Lecture)</td>
<td>96%</td>
<td>92%</td>
</tr>
<tr>
<td>3. Which of the following are non-renewable resources?</td>
<td>Alligator Lecture (Lecture), Boat Launch Prep (Lecture, Hands-On)</td>
<td>78%</td>
<td>100%</td>
</tr>
<tr>
<td>4. What role do plants play in an ecosystems?</td>
<td>Wetland Functions and Values (Lecture), Beach Walk (Hands-On), Marsh Grass Planting (Hands-On)</td>
<td>91%</td>
<td>95%</td>
</tr>
<tr>
<td>5. What is the greatest threat to most animal populations?</td>
<td>Wetland Functions and Values (Lecture), Alligator Lecture (Lecture, Hands-On), Wetland Jeopardy (Hands-On), Pollution: Dead Zone (Lecture), Pollution River (Hands-On), Whooping Cranes (Lecture)</td>
<td>96%</td>
<td>93%</td>
</tr>
</tbody>
</table>

“(table contd.)”
6. If a crab pinches your finger, which bacterial infection should you be most concerned about?  
   Crab Lesson (This specific portion is a lecture where he draws a crab, but they then go outside and learn how to catch crabs.)  
<table>
<thead>
<tr>
<th>Crab Lesson</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>59%</td>
</tr>
<tr>
<td></td>
<td>25%</td>
</tr>
</tbody>
</table>

7. What causes coastal land loss in Louisiana?  
   Wetlands Functions and Values (Lecture), Beach Walk (Hands-on), Marsh Grass Planting (Hands-On)  
   | Wetlands Functions and Values (Lecture), Beach Walk (Hands-on), Marsh Grass Planting (Hands-On) | Total |
   |                                                      | 85%   |
   |                                                      | 80%   |

8. The accumulation of DDT in the body tissues of which species caused it to become endangered in Louisiana?  
   Pollution: Dead Zone (Lecture) and Pollution River (Hands-On)  
   | Pollution: Dead Zone (Lecture) and Pollution River (Hands-On) | Total |
   |                                                             | 43%   |
   |                                                             | 33%   |

9. Nonpoint source pollution comes from  
   Pollution: Dead Zone (Lecture) and Pollution River (Hands-On)  
   | Pollution: Dead Zone (Lecture) and Pollution River (Hands-On) | Total |
   |                                                               | 70%   |
   |                                                               | 64%   |

10. What are the functions of wetlands?  
    Wetlands Functions and Values (Lecture)  
    | Wetlands Functions and Values (Lecture) | Total |
    |                                         | 96%   |
    |                                         | 97%   |

4. Outdoor use and coastal visits

In order to measure if attending Marsh Maneuvers had an impact on outdoor activities, a series of questions asked about coastal visits and activities. MM reported more participation in outdoor activities than the CG with fishing and sightseeing as the most popular.

![Survey responses to "What outdoor activities do you participate in?"]

Figure 16. Survey responses to "What outdoor activities do you participate in?"
experience (Fig. 16). When asked how often respondents go to coastal Louisiana, half of both the CG and MM respondents selected 1 to 3 trips per year. More MM than CG respondents said they take 3 or more trips per year (Fig. 17). Along with information on activities and coastal visits, participation in conservation activities was also obtained. On average, MM respondents participate in conservation groups more than members of the CG. Of the 61 CG respondents, 11 (18%) are members of conservation groups while 17 of 46 (37%) MM respondents are members.

Figure 17. Survey responses to number of trips to Coastal Louisiana per year. Error bars represent standard deviation.
Survey respondents were asked what area of interest their college degree(s) were in. Although the results were not significant, MM participants pursued science related degrees more than the CG.

Table 9. Responses to question 21 "Why did you choose to participate in Marsh Maneuvers?"

<table>
<thead>
<tr>
<th>Attendance Reason</th>
<th>Number of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent Assigned</td>
<td>2</td>
</tr>
<tr>
<td>Environment</td>
<td>27</td>
</tr>
<tr>
<td>Fun Experience</td>
<td>11</td>
</tr>
</tbody>
</table>

Respondents were asked to explain why they choose to attend Marsh Maneuvers with an open-ended response. These answers were grouped into three overall categories (Table 9). Overall many 4-H members choose to attend Marsh Maneuvers because they heard it was fun from others and/or they had an interest in the environment. One respondent wrote,

“I chose to go to Marsh Maneuvers the summer after I wrote a research paper on the disappearing wetlands and had developed an interest in learning about it. In my research, I had learned so much about Louisiana’s coast and the future it currently faced that I
hadn't known previously, and I realized how terrible it was that most of Louisiana's population doesn't even know what's going on. So I wanted to attend to learn as much as possible and hopefully share that with others.”

Figure 19 is a word cloud illustration of the open ended responses gathered. The words shown are repeated in responses most often. When looking at the word cloud, it shows how many 4-H members wanted to enjoy the experience while also learning more about the environment.

Figure 19. Word cloud of open-ended responses to survey question 21, describing why 4-H members attended Marsh Maneuvers. Full anonymous responses are archived with Dr. Julie Lively and the Youth Wetlands Program Director.
Chapter 4. Discussion

The goal of this study was to evaluate the effectiveness of Marsh Maneuvers over the past 25 years at educating students into environmentally literate adults. Environmentally literate adults have a strong knowledge base and positive attitudes and behaviors towards the environment. Students gain basic environmental knowledge from traditional education in the classroom, but as considered herein, true environmental literacy requires students to delve deeper into the material. Informal education programs can allow this to occur, and the National Science Teacher Association (NSTA) urges students to participate in such programs to increase their understanding and literacy (NSTA 2012). To evaluate this program's effectiveness three objectives were developed. The first objective required lesson plans for the week-long Marsh Maneuvers camp to be developed. This allowed for specific concepts to be identified and evaluated for long term effectiveness. The second objective evaluated the short term knowledge retention of the Marsh Maneuvers participants based on their pre and posttest scores. When analyzing the increase in short-term retention, there was an average 36% increase in knowledge between the pre-and posttest, which was significant. The third objective was to develop a survey to assess the long term impacts of the Marsh Maneuvers program over the past 25 years. My survey found that generally Marsh Maneuver participants had slightly more positive attitudes and behaviors towards the environment. They also demonstrated more Marsh Maneuvers knowledge and interacted with the environment more, although only one question was actually statistically different from the control group.

In education, students’ backgrounds can vary and potentially affect their learning. Informal education programs can overcome many of the hurdles that affect student learning (Foster and Shiele-Rolle 2011). When looking at nontraditional education programs and their success,
gender should not inhibit the student’s ability to understand and learn the information. For Marsh Maneuvers, gender was not significant when looking at participants’ increase in knowledge. Age, location, and grade point average were also not significant factors when it came to increased knowledge. Each student was able to take their individual prior knowledge and apply it to the concepts learned at camp. Marsh Maneuvers was effective for short-term knowledge retention.

When looking at the grade level completed before Marsh Maneuvers, participants in 9th grade or below saw higher percent change scores a majority of the years. This is likely due to the fact that they have not taken the recommended Biology course in high school; therefore, they are learning more new concepts than older students creating a higher percent change. GPA ranges were also collected during the posttest and compared to average percent change. Participants who were in the range 2.0-2.4 and 2.5-2.9 saw the most overall change over the nine-year period. Overcoming learner differences is important in any education program. Reaching the level of each learner can be difficult in traditional education, but it can be overcome in nontraditional program due to the variety of activities and lessons. Marsh Maneuvers uses a mixture of learning styles including traditional lectures and hands-on activities to ensure all learners needs are met. GPA did not significantly affect percent change showing that Marsh Maneuvers could overcome some of the learning differences of students. Overall, the Marsh Maneuvers program had very positive reviews when looking at interviews. Although some students expressed their discomfort before attending, they all walked away with a fun experience and an increase in environmental knowledge.

The long-term results were not statistically significantly different (expect for question 6 on disease caused by crabs), but overall Marsh Maneuvers participants’ scores were higher than
the control group. This is most likely due to the types of informal education the survey participants have received over time. Over half of the survey respondents reported that they have attended other environmental education programs hosted by the 4-H Youth Wetlands Program, Ocean Commotion, Coastal Roots, Leaders in Environmental Action for the Future, and other general programs. The majority of the respondents stated they had been impacted by the Youth Wetlands Program, which has been estimated to influence over 600,000 students since 2007 (LSU AgCenter S.E.T. Program Impact 2015). Louisiana has experienced frequent natural and environmental disasters (e.g. BP Macando well spill and Bayou Corne sinkhole) during the study period. With many of the respondents having lived through the major hurricanes of 1992, 2005, 2008, and others, the local news has also been a source of information when it comes to coastal Louisiana. The issues with land loss also makes coastal environmental information more prevalent in the news and through information education. Education stations at fairs and festivals are also sources of informal education that the respondents could have received, and many groups across the state have some type of environmental education exhibit. For example, Ocean Commotion hosted by Louisiana Sea Grant, has about 70 coastal, ocean, or general environmental exhibits hosted by different organizations around the state (Ocean Commotion 2017). As of 2018, Louisiana is 46th in education in the United States (State Grades on K-12 Education: Map and Rankings 2018), perhaps the survey scores show that informal environmental education is effective here.

The control group and Marsh Maneuvers respondents were all former Louisiana 4-H members. In 4-H, students pledge “their hands to larger service…” for the betterment of their communities and world. Although there were no significant differences between the CG and MM respondents for the attitude and behavior statements, it is most likely due to similar attitudes and
beliefs of 4-H members. According to the 2014-2015 Louisiana 4-H Enrollment Report, of the 199,997 Louisiana 4-H program participants, 113,972 are involved in science based programs with 91,817 specifically in environmental education and earth science programs; therefore, the control group most likely has more environmental knowledge than the general public (S.E.T. Program Impact 2015). In the future, the programs participants should be analyzed with a control group outside of the 4-H program. Although the differences were not significant, both survey groups had mostly positive attitudes and behaviors towards the environment with Marsh Maneuver participants slightly higher.

The Marsh Maneuvers questions on the survey can be linked to specific lessons where the material was taught. Some questions were touched upon in multiple lessons throughout the camp. The broad environmental questions were well retained over time. This indicates lessons such as Wetland Functions and Values were effective. Question number 3, “Which of the following are non-renewable resources” was answered perfectly by the CG, but only 78% of the MM group answered correctly. No lesson specifically focused on non-renewable resources, but it was brought up in the Gator School lessons and activities, when preparing for the boat launch, and briefly in other lessons. This may have had an impact on the retention over time. It is recommended that more emphasis is placed on this topic during the camp to increase retention. The CG did slightly better on question 4 “What role do plants play in an ecosystem” than the MM respondents. This question had multiple options with the answer being all of the above. With the MM percent correct being 91%, the material was still well retained over time. The general environmental questions were answered correctly over 80% of the time for both the MM and CG. These questions came from a variety of lessons that were lectures and enforced by hands-on activities. The variety of how this information is presented could help with retention,
however, combined with the high scores for CG, this could also relate to the number of sources of informal environmental education across Louisiana (see above).

Questions that were more specific to the program were not as well retained by the MM respondents, but MM respondents got the correct answer more often than the CG. Some questions saw higher scores by the control group, where they could have learned the material in college since many selected that they were science majors. Questions 8 and 9 were both from the Pollution River activity and focused on nonpoint source pollution. For both questions, the MM respondents did better than the CG. Similarly, question 8, which asked about DDT in an endangered Louisiana animal, only 33% of the CG and 43% of the MM respondents answered correctly. This question had the lowest scores of all 10 questions. This could be because DDT is not as talked about in formal environmental education as it was a decade ago when it was a public concern. The Pollution River activity could be observed more closely to see what changes could be made to increase retention. Question 6 is on crab pinches causing a bacterial infection, and the most specific to Marsh Maneuvers. This question was the only one to see a significant difference with MM respondents having 59% correct and the CG having 25% correct. Mark Shirley, Marsh Maneuvers instructor, focuses on this topic with memorable hand signals and drawings. All MM attendees, regardless of years since attendance, saw higher scores (average out of 10) on the Pre/post question than the CG.

For the questions that were not retained well over time, it would be interesting to compare to see if respondents answered the questions correctly on the post-test to see if it an immediate or long-term retention issue. These answers were not available, but would be interesting as we proceed into the future of the camp to see information retention. Since the
majority of the general environment questions saw high percent correctness, more advanced topics could be explored.

The National Environmental Education Foundation (NEEF), did a survey in 2005, which included measuring environmental behaviors to create a benchmark (Coyle 2005). In 2013 another report was published with updated information on more specific behaviors (NEEF 2013). The behavior portion of my survey purposely had similar questions to the NEEF reports in order to be able to compare the respondents’ behaviors to the national rankings from 2005 and 2013. The NEEF report asked respondents to state whether they never do it, sometimes do it, or frequently do it. NEEF reported on respondents who stated they frequently do it (Coyle 2005). In 2005, 85% of Americans frequently turned off lights and electrical appliances when not in use. In the 2013 report, the statement was more focused “Turn lights off when leaving the room” with a frequently response of 77% (NEEF 2013). Three similar questions were included on my survey. CG reported a frequently response of 80% and MM 83% to “I turn off the light when leaving an empty room.” These ratings are very similar to the national percentage in 2005 and are higher than the 2013 response. CG responded a frequently response 24% and MM at 30% to unplugging small appliances when not in use. The third behavior of unplugging electronic devices when not in use was CG at 23% and MM at 26% for frequent responses. This large difference between the national percentages and survey respondents could be for two reasons. The first reason could be splitting of turning off the lights and electrical appliances. For the NEEF 2013 report when the behaviors are split, we see the differences present in the Marsh Maneuvers survey. The second reason is the increase in electronic devices and small appliances from 2005 to today. The increase in use of appliances might attribute to the differences. The next behavior was on conservation of water in the home. In 2000, 61% of Americans stated they
frequently conserved water (Coyle 2005). In comparison, three specific ways of conserving water in the home were measured for the Marsh Maneuvers survey. When looking at frequently only doing laundry when there are full loads the CG responded with 80% and MM with 89%. Both groups have higher percentages when it comes to conserving water in that manner. The MM respondents would frequently turn off the water when brushing teeth at 72%, and the CG slightly lower with 54%. The last behavior was frequently taking shorter showers which had low percentages with CG at 23% and MM at 30%. For the first two water conversation methods, MM and CG both were higher than the national average. In 2013, 65% of Americans stated they “wait for a full load when running the dishwasher” (NEEF 2013), the CG responded to the same question with 77% and MM with 87%. Both the CG and MM respondents were higher than the national average. The next behavior looked asked if the respondents “look for Energy Star Seals on products” with a response of 54% in 2013 (NEEF 2013). In comparison, the CG had 30% and MM with 46%. Both groups had lower percentages, but this could be due to the large majority (68.22%) of survey respondents being between the age of 18-24 and never buying appliances and energy star ratings being more common (Table 3). The last comparison was recycling and using recycled products. In 2000, 59% of American stated they recycle frequently (Coyle 2005). In 2013, 53% of American stated they recycle on a daily basis and 72% on a weekly basis (NEEF 2013). In comparison, the CG stated they frequently recycle 72% and MM 75%. Forty-two percent of Americans frequently buy recycled products while the CG only frequently buy them 21% and MM 35% of the time (Coyle 2005). Although more of the CG and MM respondents recycle more, fewer buy recycled products. It is important to note that many respondents in my survey stated they were unable to recycle at home since it was not available to them. Overall,
survey respondents, and specifically the Marsh Maneuver participants had similar or slightly higher behaviors to the national averages in the 2005 report.

Upon evaluation of the Marsh Maneuvers program over 25 years, it is successful at significantly increasing participant’s environmental knowledge over the course of the one-week camp. Long-term, participants have retained the knowledge gained 5, 10, and even 25 years after attending. Additionally, over the long-term, participants have positive attitudes and behaviors towards the environment. Participants in the Marsh Maneuvers program were also more likely to enter a science degree program when they attended college. Marsh Maneuvers is an effective informal education program to increase environmental literacy for 4-H members in Louisiana.
Literature Cited


Louisiana State University Agricultural Center (LSU AgCenter). (2014). 4-H members Learn Marsh Maneuvers.  
http://www.lsuagcenter.com/profiles/rbogren/articles/page1485791264418

Louisiana State University Agricultural Center (LSU AgCenter). “S.E.T. Program Impact.”  
Louisiana 4-H, 2015,  

http://www.laseagrant.org/education/projects/marsh-maneuvers/


http://www.neeea.org/environmental-literacy/environmental-literacy-defined.html

Shirley, M. June 2014. Personal Interview.


Appendix 1. Pre-Posttest

Created by: Mark Shirley, LSU AgCenter

Marsh Maneuvers 2014

EDUCATIONAL CONCEPTS TEST

Directions: Read all of the questions carefully. Select the one response which you believe provides the best answer. DO NOT WRITE ON THIS TEST! Mark your choice in the appropriate box on the ANSWER SHEET provided.

1. Out of 100 hatchling alligators in the wild, how many can be expected to survive to reach 4 feet in length?
   a) 12
   b) 35
   c) 64
   d) 75

2. As human populations increase, natural resources will be…
   a) depleted faster.
   b) increasing.
   c) at an equilibrium.
   d) more abundant.
   e) wasted

3. Who is affected by coastal erosion?
   a) only people living in the coastal parishes
   b) all citizens in Louisiana
   c) everyone in the United States
   d) just recreational sport fishermen

4. Which of the following are non-renewable resources?
   a) wood and paper products
   b) mink, bobcat and alligators
   c) red fish, speckled trout and shrimp
   d) iron, copper and oil

5. Rockefeller Wildlife Refuge is located in what region of the Louisiana Coast?
   a) Deltaic Plain
   b) Chenier Plain
   c) Pleistocene Plain
   d) Air Plane

6. What determines the sex of reptilian embryos?
   a) X and Y chromosomes
   b) incubation temperature
   c) paternal DNA
   d) maternal DNA

7. Where does most of the oxygen in the atmosphere come from?
   a) algae that live in the oceans
   b) old growth forests around the world
   c) compost
   d) tropical rainforests
   e) oxygen is released from combustion of wood

8. Where is the most economically and biologically productive region of Louisiana?
   a) forested areas
   b) coastal marshes and estuaries
   c) agricultural lands
   d) cities

9. What are the products of photosynthesis?
   a) carbon dioxide
   b) oxygen and nitrogen
c) carbohydrates and oxygen
d) carbon dioxide and water

10. A watershed is ________.
a) a small building in which water is stored.
b) the area of water which is connected to a river.
c) the area of land which drains to the sea.
d) the area of land which drains to a common water body.

11. What role do plants (including trees, grasses and algae) play in an ecosystem?
They…
a) purify the air and protect the water supply
b) provide a cover to hold soil in place
c) shelter wildlife
d) all of the above
e) they have no significant impact

12. The Gulf of Mexico hypoxic zone develops…
a) near the surface.
b) near the bottom.
c) during low tide.
d) only in inland bays.

13. If a crab pinches your finger, which bacterial infection should you be concerned about:
a) Escherichia coli
b) Vibrio vulnificus
c) Myocastor coypu
d) Bacillus anthracis

14. Which fisheries commodity does Louisiana catch the most of by weight?
a) shrimp
b) crabs
c) menhaden
d) red snapper

15. What function does the regulated harvest of fish and wildlife resources have in an ecosystem?
a) a natural way of removing surplus animals
b) provides for the sustainable use of renewable natural resources through population management
c) no longer an acceptable means
d) limits the amount of fish you can catch

16. What is the greatest threat to most animal populations?
a) fossil fuels
b) available mates
c) habitat loss
d) rainfall
e) DNA mutations

17. What causes coastal land loss in Louisiana?
a) subsidence
b) herbivory
c) sea level rise
d) geologic faults
e) all of the above

18. Which fish is more likely to have higher levels of toxins?
a) 14 pound blue catfish
b) 12 inch largemouth bass
c) 6 inch bluegill bream
d) 2 inch bay anchovy

19. What determines the carrying capacity of a habitat?
a) The availability and quality of food, cover, water and space
b) The available materials and conditions necessary for photosynthesis
20. What might affect the amount and quality of fresh water?
   a) pollution
   b) human activities
   c) plant life
   d) all of the above

21. Nutria, muskrats and beavers are
   a) planktivores
   b) carnivores
   c) herbivores
   d) omnivores

22. What are the functions of wetlands?
   a) a filter for pollutants
   b) a valuable habitat
   c) only a and b
   d) a breeding ground for aquatic species
   e) all of the above

23. The accumulation of DDT in the body tissues of which species caused it to become Endangered in Louisiana? (Think biomagnification)
   a) Red Wolf
   b) Bald Eagle
   c) Black Bear
   d) Gopher Tortoise

24. Which of the following causes subsidence?
   a) natural factors
   b) anthropogenic factors
   c) wave action
   d) nutria overpopulation
   e) a & b

25. Which of the following will slow down wetland loss?
   a) the creation of new canals and waterways
   b) building hurricane protection levees
   c) encourage saltwater intrusion
   d) introduction of freshwater with nutrients and sediments
   e) all of the above

26. What can limit the use of outdoor recreational areas?
   a) reduced interests
   b) pollution and litter
   c) space
   d) crime
   e) all of the above

27. The story “Finding Nemo” is a good example of:
   a) Antitheses
   b) Anthropomorphism and protandrous hermaphroditism
   c) Metaphorism
   d) Onomatopoeia
   e) none of the above

28. The disadvantage (bad effects) of diverting the Mississippi river into coastal marshes is:
   a) sediments and nutrients are provided which help the marsh grow
   b) shrimp, fish, and oyster production might be reduced in the short run
   c) only oyster production might be increased in the short run
d) fresh drinking water supplies are provided
e) saltwater intrusion is reduced

29. The chenier plain region of La. is the _____ region of the coast.
   a) oldest
   b) youngest
   c) highest
   d) fastest
   e) hottest

30. Nonpoint source pollution comes from__________.
   a) agriculture
   b) forestry
   c) streets and parking lots
   d) golf courses
   e) all of the above

31. Regular homeowners insurance covers hurricane damage from wind, rain and falling trees but not rising floodwaters.
   True or False

Page 1

1.
Julie A. Lively - Principal Investigator
Louisiana State University
AgCenter, Louisiana Sea Grant School
225-578-0771
janderson@agcenter.lsu.edu

Kasie Dugas - Masters Student
Louisiana State University
Department of Renewable Natural Resources
225-578-2468
kdugas9@lsu.edu

Online Consent Form

You are invited to participate in a survey about Longitudinal study of attitudes and behaviors of environmental education program participants. The purpose of this study is to evaluate the long term effectiveness of environmental education programs and to gauge participants environmental literacy. To participate in this study you must meet the requirements of both inclusion and exclusion. To participate in this study you must have participated in 4-H and age 18 or older. Your participation will require approximately 10 minutes and is completed online at your convenience. There are no known risks connected with this survey. Taking part in this study is completely voluntary. Subjects may choose not to participate or to withdraw from the study at any time without penalty or loss of any benefit to which they might otherwise be entitled. Your personal information and responses will be kept strictly confidential, and digital data will be stored in secure computer files. Only the investigator and co-investigator, listed above, will have access to this information.

If you have questions or want a copy or summary of this study’s results, you can contact the researchers at the phone numbers and email addresses above. Researchers can be reached during the regular business day from 9:00 am to 5:00 pm. This study has been approved by the LSU Institutional Review Board. For questions concerning participants rights, please contact the Institutional Review Board Chair, Dr. Dennis Landin, 225-578-8692, or irb@lsu.edu.

By continuing this survey, you are giving consent to participate in this study.

☑️ continue to survey

53
Attitudes towards the environment.

2. The following page contains a number of statements with which some people agree and others disagree. Please rate how much you personally agree or disagree with these statements.

Please use the following scale:
a) Strongly Agree  
b) Agree  
c) Neutral  
d) Disagree  
e) Strongly Disagree

As humans, we have the right to change the environment to support our needs.
The earth has enough natural resources to last forever.
I do not have enough time to worry about how my actions affect the environment.
I feel good when I help the environment.
I consider how my actions will affect the environment.
Business and manufacturers who reduce their environmental impacts are making good business decisions.
I cannot help solve environmental problems.

Environmental Behavior

3. Please rate the frequency that you perform the following:

Please use the following scale:
 a) Frequently  
 b) Occasionally  
 c) Never  
 d) Not sure

I unplug electronic devices when not in use.
I recycle products instead of putting them in the garbage.
I keep electronic devices and small appliances unplugged when not in use.
I take short showers.
I use recycled products (paper, paper towels, razors etc.)
I use compact fluorescent light bulbs.
I use LED light bulbs

**I only run the dishwasher with a full load.**
I only run the laundry machine with a full load.
I receive and pay bills online (paperless billing).
I turn off the water when brushing my teeth.
I turn off the light when leaving an empty room.
I compost my kitchen waste.
I look for energy efficiency ratings when buying products (i.e. dishwashers, fridges, etc.)
I wash clothing on cold water settings.

---

**Page 4**

4. How often do you recycle?
   a) always
   b) most of the time
   c) half of the time
   d) never

5. Are you able to recycle at home?
   a) Yes, recycling trucks pick up my recycling.
   b) Yes, but I do not recycle.
   c) No, recycling trucks do not pick up at my house.

6. If trucks picked up your recycling, would you recycle at your home?
   a) Yes
   b) No
   c) Not sure

---

**Page 5**

Marsh Maneuvers
Please answer each question to the best of your ability.

7. As human populations increase, natural resources will be…
   a) depleted faster
   b) increasing
   c) at an equilibrium
   d) more abundant
   e) wasted

8. Who is affected by coastal erosion?
9. Which of the following are non-renewable resources?
   a) wood and paper products
   b) mink, bobcat and alligators
   c) redfish, speckled trout and shrimp
   d) iron, copper and oil

10. What role do plants (including trees, grasses, and algae) play in an ecosystem?
    a) They purify the air and protect the water supply.
    b) They provide a cover to hold soil in place.
    c) They shelter wildlife.
    d) All of the above.
    e) They have no significant impact.

11. What is the greatest threat to most animal populations?
    a) fossil fuels
    b) available mates
    c) habitat loss
    d) rainfall
    e) DNA mutations

12. If a crab pinches your finger, which bacterial infection should you be concerned about?
    a) Escherichia coli
    b) Vibrio vulnificus
    c) Myocastor coypu
    d) Bacillus anthracis

13. What causes coastal land loss in Louisiana?
    a) subsidence
    b) herbivory
    c) sea level rise
    d) geologic faults
    e) all of the above

14. The accumulation of DDT in the body tissues of which species caused it to become endangered in Louisiana? (Think biomagnification.)
15. Nonpoint source pollution comes from _____________________.
   a) agriculture
   b) forestry
   c) streets and parking lots
   d) golf courses
   e) all of the above

16. What are the functions of wetlands?
   a) a filter for pollutants
   b) a valuable habitat
   c) only a and b
   d) a breeding ground for aquatic species
   e) all of the above

17. Did you participate in any environmental education programs when you were in school? If yes, please select the program(s) you participated in.
   a) No
   b) 4-H Youth Wetlands Program
   c) Coastal Roots
   d) Ocean Commotion
   e) LEAF (Leaders in Environmental Action for the Future)
   f) Other (please specify)

18. Did you participate in the 4-H Marsh Maneuvers Program?
   a) yes
   b) no

Page 7
(Student who answered “yes” to question 18 will go to Page 7. Students who answered “no” to question 17 will go to page 8.)

19. Where did you attend Marsh Maneuvers?
   a) Rockefeller Wildlife Refuge
   b) Barataria Watershed (Near Grand Isle)
c) I do not remember (please provide any additional location information).

20. What year did you participate in Marsh Maneuvers?
   Drop Down Menu 1989 - 2015
   I do not remember (please provide a general year range).

21. Why did you choose to participate in Marsh Maneuvers?
   Text Box

22. How would you rate your experience at Marsh Maneuvers?
   a) Excellent
   b) Good
   c) Fair
   d) Poor

23. After attending Marsh Maneuvers did you travel to marshes or beaches in Louisiana?
   a) yes
   b) no

24. Before Marsh Maneuvers, how many trips a year did you take to Coastal Louisiana?
   (excluding New Orleans, Louisiana)
   a) None
   b) 1-3 trips per year
   c) 3 or more trips per year

25. If you would like to share any additional comments on your experience at Marsh Maneuvers
   please leave them in the comment box below.
   Text Box

26. Have you ever been to the marshes or beaches of coastal Louisiana?
   a) yes
   b) no

27. How many times a year do you travel to coastal Louisiana?
   a) none
   b) 1-3 trips per year
   c) 3 or more trips per year

28. What outdoor activities do you participate in? (Select all that apply.)
a) hunting  
b) fishing  
c) kayaking  
d) canoeing  
e) bird watching  
f) hiking  
g) camping  
h) motor boating  
i) sightseeing  
j) none  
k) other (please specify)

29. Have you purchased a Louisiana hunting and/or fishing license in the last 5 years?  
a) yes  
b) no

30. Do you participate in conservation groups? If yes, please select all that apply.  
a) no  
b) Louisiana Wildlife Foundation  
c) Sierra Club  
d) The Nature Conservancy  
e) Ducks Unlimited  
f) Audubon Society  
g) National Wild Turkey Federation  
h) Other (please specify)

31. What is your age?  
a) 18 - 24 years old  
b) 25-34 years old  
c) 35-44 years old  
d) 45-54 years old  
e) 55-64 years old  
f) 65-74 years old  
g) 75 years or older

32. What state do you currently live in?  
Drop down menu.
33. What is the highest degree or level of school you have completed? If currently enrolled, highest degree received.
   a) High school graduate, diploma or equivalent (for example: GED)
   b) Some college credit; no degree
   c) trade/technical/vocational training
   d) associates degree
   e) bachelor's degree
   f) master's degree
   g) professional degree
   h) doctorate degree

Page 10
If answered “b-h” on question 33 they are directed to page 10. If answered “a” they are directed to page 11.

34. What area of interest is your college degree in?
   a) agriculture
   b) art and design
   c) landscape architecture
   d) business
   e) education
   f) engineering
   g) human sciences
   h) liberal arts
   i) mass communications
   j) music and dramatic arts
   k) nursing
   l) science
   m) social sciences
   n) other (please specify)

35. While in college, did you take any environmental courses?
   a) yes
   b) no
   c) other (please specify)

36. If yes, were the classes required for your degree program?
   a) yes
   b) no
37. What area of interest is your profession currently in?
   a) agriculture
   b) architecture
   c) art and design
   d) landscape architecture
   e) business and finance
   f) community and social services
   g) computer and mathematics
   h) education
   i) engineering
   j) farming, fishing, and forestry
   k) healthcare
   l) legal occupations
   m) office administration
   n) sales
   o) transportation
   p) other (please specify)

Thank you for completing this survey. If you have any questions regarding the study please contact Kasie Dugas at kdugas9@lsu.edu.
Appendix 3. Marsh Maneuvers Curriculum

Wetland Functions and Values

Focus/Overview
This lesson provides the background information on Louisiana’s wetlands in order for students to be actively engaged in activities during the course of the Marsh Maneuvers program.

Learning Objective(s)
The learner will:
- Develop knowledge on wetlands and understand their purpose.
- Communicate the issues regarding Louisiana wetland loss.
- Discuss factors of coastal erosion.

Materials List
- Explore Coastal Louisiana with Boudreaux and Marie Interactive CD-Rom
- CPRA – What’s at Stake Video (http://coastal.la.gov/whats-at-stake/)
- Flip chart
- For more general information on wetlands, reference the Youth Wetlands Program Coastal Louisiana 2016 lessons binder.
- Computer
- Projector
- Projector Screen

Definitions
- Wetland: "Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support and (that) under normal circumstances do support a prevalence of vegetation typically adapted for life in a saturated soil condition.” (Clean Water Act - U.S. Army Corp of Engineers)
- Subsidence: gradual sinking or caving in of an area of land
- Accretion: the increase of land by natural forces
- Erosion: the destruction of land by wind, water, or other natural causes.

Background Information
Wetlands are at their core, “wet-lands”. The amount of water in the area controls the types of animals and plants that are found. Wetlands are classified based on their unique animal, plant and soil types. The main wetland types include marshes, swamps, bottomland hardwood forest, baygalls, forested seeps, and bogs. For more information on each wetland type, reference the Youth Wetlands Program binder.

Mississippi River has shaped the Louisiana Coastline.

The Louisiana coastline is a result of sediment deposition over time. As the Mississippi River traveled to the Gulf of Mexico, it would release large amounts of freshwater and sediment creating a delta. During this process, shorter routes of the Gulf of Mexico would appear and the river would move over time creating new deltas. When the original delta is abandoned it goes
through compaction, subsidence, and erosion. The deltaic lobe would retreat as the gulfs saltwater would advance. This would result in lakes, bays, sounds and other coastal landforms. This continuous process formed the Louisiana coastline over the past 5,000 years. In total the Mississippi River discharges 41 percent of the contiguous 48 states.

Historic Mississippi River Map (Source http://mississippiriverdelta.org/enough-sediment-mississippi-river-restore-louisianas-coast/)

Wetlands provide a variety of functions and values to the ecosystem in general and to humans.

1. Protection:
   Wetlands provide shoreline protection during hurricanes and other major storms. Many consider wetlands as the first line of defense during these events. Wetlands are a natural barrier of soil and plant roots that reduce wind, wave impact, currents, and storm surges on inland areas. The wetland soil can also act as a sponge absorbing floodwaters.

2. Water Purification
   As previously mentioned, wetlands act as a sponge absorbing excess flood waters; during this process the water is purified. Water flows through the wetlands at a slower pace and drops of excess sediment and nutrients purifying the water. These sediments and nutrients may not be beneficial to the water systems; however, they are beneficial to the plants growing in the wetlands. The wetland plants recycle the nutrients to improve their growth. This process is important to improving the water quality of Louisiana.

3. Wildlife Habitat and Nursery Grounds
A variety of wildlife call wetlands home for all or some of their lives. Many migratory birds use wetlands as a refueling station for their winter migration. Over 400 species of fish and birds require the habitat that wetlands provide. Wetlands are home to a variety of endangered species.

4. Commerce
Not only do wetlands provide many natural functions, they are also of great value commercially to people. Louisiana has 32 port systems that wetlands are a part of. These ports provide thousands of jobs and contribute millions to the Louisiana economy. Without the wetlands providing stabilization these ports would not exist. Around 25% of the US water commerce goes through Louisiana’s largest port located in New Orleans.

5. Oil and Gas
Some of this commerce comes from oil and gas, which is extracted or accessed through wetlands in south Louisiana. The oil and natural gas contributed more than $14 billion dollars annually to the Louisiana economy.

6. Recreation
Not only do wetlands provide environmental and economic benefits, they also have value recreationally. Recreational fishing, hiking, boating, bird watching, water sports and other activities are all enjoyed in the wetlands of Louisiana. These recreation activities are not only enjoyable but contribute around $98 million dollars a year to the Louisiana economy.

Causes of Louisiana Wetland Land Loss

Louisiana wetland land loss can be attributed to a variety of natural and human causes. Tropical storms can damage wetlands and bring salt water into fresh water areas. Salt water in fresh water areas can cause potential damage to the plants and animals that live there. Hurricanes cause significant damage to wetlands as well. Hurricanes Katrina and Rita alone caused over $1 billion dollars in damages to Louisiana’s economy. The natural process of land compaction called subsidence, contributes to wetland land loss each year. Traditionally, subsidence was combated through the process of accretion. Due to human interference through leveeing the Mississippi River, this process does not occur as it should. The result is a consistent decrease in land over time. Leveeing rivers are not the only human impacts that have affected Louisiana wetlands. Canals and channels were developed to access oil and natural gas locations in and around wetlands. The canals and channels turn wetland areas into open water and can allow saltwater to intrude into fresh water systems. All of these reasons attribute to wetland land loss each year. It is estimated that 2,006 square miles of land has been lost from 1932 to 2016.

Advance Preparation
1. Review background information and familiarize yourself with the Explore Coastal Louisiana with Boudreaux and Marie Interactive CD.
2. Load CPRA – What’s at Stake Video (http://coastal.la.gov/whats-at-stake/)
Procedure

Wetlands Functions and Values
1. Place the Explore Coastal Louisiana CD in your computer.
2. Navigate through the different resources and videos on the CD.
3. As you are exploring the CD, use the background information provided to illustrate important functions and values of wetlands. Use the flip chart to write useful terms for the students. The following are categories of the CD that can be explored along with information to expand on.
   b. Coastal Erosion
   c. Animal Trivia (important to review before night hike)
   d. Animal Matching (important to review before night hike)
   e. Functions and Values of Wetlands – wildlife habitat, flood control, water quality, storm buffer, erosion control, recreation, and commercial values.

Depending on time, explore the resources on the CD. Animal Trivia and Animal Matching should be done before leading into the Sights and Sounds of the Night Hike activity.

What's at Stake
2. After watching the video review the listed topics on a flip chart. Ask students to explain what they understand about each topic and clarify any misconceptions.
   a. Development of coastal Louisiana by the Mississippi River
   b. Changes to the Mississippi River
   c. Changes to coastal Louisiana
   d. Louisiana land loss
   e. Flood control structures (can point out some structures on the refuge)
   f. Louisiana Master Plan

For more information reference the Youth Wetlands Program Coastal Louisiana 2016 lesson binder.

Resources
CPRA What's at Stake Video http://coastal.la.gov/whats-at-stake/

Exploring Coastal Louisiana with Boudreaux and Marie Interactive CD

General Wetlands Information – YWP Binder 2016


Sights and Sounds of the Night Hike

Focus/Overview
Students will observe the sights and sounds of the wetlands during a night hike through Rockefeller Wildlife Refuge. This activity allows students to see wetlands during a time of day where a different set of animals and insects are active. It will also help students foster a greater appreciation for Louisiana’s wetlands.

Learning Objective(s)
The learner will:
- Observe the night activity of animals in the wetlands.
- Observe the functions and values of the wetlands.
- Explore the wildlife refuge and document their findings.

Materials List
- Flash light
- Week Journal
- Mosquito Repellent

Definitions
- Crepuscular – animals that are active primarily at twilight.
- Nocturnal – animals that are active at night.
- Diurnal – animals that are active during the day.

Background Information

Rockefeller Wildlife Refuge
The Rockefeller Wildlife Refuge is located in Cameron and Vermillion parishes in South Louisiana. The Rockefeller Foundation deeded the property to the State of Louisiana to be managed as a wildlife refuge. When the transfer occurred, the refuge consisted of 86,000 acres of property. Since then, beach erosion has brought the acreage down to 76,000.

The refuge is home to mottled ducks, nutria, muskrats, rails, raccoons, minks, otters, opossums, white tailed deer, alligators and a variety of waterfowl that winter in the area. There is no recreational hunting on the refuge as expressed in the terms of deed. Recreational fishing is allowed on the property. Thousands of visitors travel to the Rockefeller Wildlife Refuge to fish for red fish, black drum, speckled trout, largemouth bass, and more. Others go to bird watch as the refuge is home to a variety of waterfowl and wintering waterfowl.

The Rockefeller Wildlife Refuge has full time refuge officers to insure the property is maintained and correctly utilized by the public. Biologists from around the world visit the refuge to conduct research on alligators, brown pelicans, bald eagles, the marsh and waterfowl.
Sights and Sounds

The following is information on two animals frequently seen on night hikes at the Rockefeller Wildlife Refuge.

Alligator research and life history studies are being forged at the Rockefeller Wildlife Refuge. Alligators can be found across the state of Louisiana and into other coastal states, but the largest populations are found in the coastal marshes of South Louisiana. Large harvesting of alligators began in the 1800’s to use the skins in a variety of leather goods. By 1962 the demand for alligator skins had reached an all time high and because of that the populations had dwindled down. That year, alligator hunting officially closed due to overharvesting. Through protection efforts, research and management, alligator populations increased to stable levels and by 1981 the harvest season was reopened. Today, over 300,000 alligators are harvested annually. While students are on the hike, they should shine their flashlights into the water and look for shining eyes. **Always stay on the designated path and never step into the water.**

Mottled ducks are brown resident ducks of South Louisiana. Their primary habitats are marshes and coastal areas but they also reside in rice fields. Mottled ducks are the only dabbling ducks specialized for habituating marshes. Large populations reside in the Rockefeller Wildlife Refuge.

Procedure

1. Discuss with the students the Rockefeller Wildlife Refuge and its importance.
2. Introduce the types of animals that the students may encounter on the night hike. Discuss with the students the different types of animals’ activity during the day and night.
3. Show students the map of the Rockefeller facility (located at the refuge bunk units) and where they will be walking. Reference water control structures and how they impact the refuge.
4. Take students on the night hike. Point out sights and sounds along the way.
5. Students should note what they experience in their week journals.

Note: Nature is never stagnant. There is no way to know what animals the group will come across. Above is a general list to start your Sights and Sounds of the Night Hike experience.

Resources

[http://animals.nationalgeographic.com/animals/reptiles/american-alligator/](http://animals.nationalgeographic.com/animals/reptiles/american-alligator/).


Aquatic Sampling

Focus/Overview
This lesson allows students to understand the basics in aquatic sampling. Students will learn how to harvest crabs, mark them, and finally harvest them to estimate the population size.

Learning Objective(s)
The learner will:
- Be able to estimate population size of crabs and other wild animals.

Materials List
- String
- Bait for crabs
- Rubber bands

Definitions
- Population - all the individuals of one species in a given area

Background Information
There are many different ways biologist can estimate the population size of a species. Trees can be marked and counted to create a complete census. A group of migrating birds can be counted as they fly. The most popular and perhaps accurate way is the mark and recapture technique. This technique requires a biologist to capture individuals of a species, mark them with a tag, and then release the individuals. Later the biologist return to recapture the species. The number of recaptured marked individuals then can be used to estimate the population size. This process can be done multiple times during an experiment to achieve highly accurate results. The results of these experiments help biologist to determine population size, which then tells consumers how much they can harvest.

When all data has been collected the information can be put into the following equation to obtain the population size.

\[ N = \frac{M \times T}{R} \]

\( N \) = total population size
\( M \) = marked initially
\( R \) = marked recaptures
\( T \) = total in second sample

In this activity, students will complete this procedure to harvest crabs in the Rockefeller Wildlife Refuge. This activity will take two sessions and two days to complete. The first session should include capturing crabs and marking them and the second session on the second day should be the final harvest. At the end of the activity, all harvested crabs can be kept for dinner.
Advance Preparation
1. Before this activity, the Crab Lesson should be completed.

Procedure
1. Students should be instructed to attach the bait to the string and fasten it to the location they are in.
2. As crabs are harvested during the first sample, rubber bands should be placed around their shells. Each crab should have a rubber band on it before it is released. The number of crabs marked should be noted in each students notebook.
3. During the second harvest on the second day, students should record how many crabs they harvest and how many are marked.
4. Students should then plug this information into the equation to estimate population size. Record information in notebooks.

Resources


Bird’s Eye View and Airboat Tour

Focus/Overview
Students will get a bird’s eye view from Price Lake Tower followed by an airboat tour of marshes on the Rockefeller Wildlife Refuge. This activity allows students to immerse themselves in the environment of the marshes while actively witnessing concepts discussed in lecture.

Learning Objective(s)
The learner will:
- Observe concepts previously discussed in the Wetlands Functions and Values lesson.
- Observe plants and animals of the ecosystem.
- Observe landforms present in the ecosystem.
- Learn to throw a cast net for aquatic sampling.

Materials List
- Airboats
- Flipchart
- Cast Nets
- Notebooks

Definitions
- Barrier Island – an island created from the reworking, by wind and waves, of sediment historically deposited by rivers.
- Chenier Plains – the coastal area of Louisiana west of the Atchafalaya River. It is characterized by chenier, which are inland land ridges vegetated by a variety of trees that run parallel to the Gulf of Mexico.
• Ecosystem – living and nonliving things within an environment, interacting as a system or community.
• Erosion – a process in which land is worn away by water, ice or wind.
• Estuary - the tidal mouth of a large river, where the tide meets the stream.
• Subsidence – sinking or settling of sediment due to compaction and faulting that occurs at a range of spatial and temporal scales

Background Information
Before starting the lesson review the Sights and Sounds of the Night Hike. Go over key vocabulary terms from previous lessons as well as this lesson.

Advance Preparation
1. Insure all airboats and drivers are at location.
2. Prepare any safety equipment that the students may need for the activity.
3. Become familiar with animals and plants that students will discover during the activity.

Procedure
1. Review previous days lessons and key terms.
2. Review vocabulary and explain how these terms will be visible during today’s activity.
3. Separate students into two groups. These groups will rotate through the airboat rides and birds eye view from the tower. Group leader will follow the remaining procedures at the two locations.
4. Bird’s Eye View
   • Bring students to the top of the tower to point out key concepts discussed the previous day.
   • Point out some of the changes to the landscape that humans have done (canals, water control structures, etc.)
   • Take this opportunity for students to observe the natural landscape and ask the instructor questions. Students will be curious about organisms and concepts discussed during earlier lessons.
   • Switch to Airboat Ride.
5. Airboat Ride
   • Review airboat safety with students. Life jackets and earphones must be worn at all times. Do not stand up while boat is in motion. If you do fall out of the boat stand up in the water, it is not deep.
   • Rotate students on and off the boats.
   • Describe some of the habitat and animals that they will see during the airboat ride (wiregrass, three corner grass, green heron, snowy egret, American egret, roseate spoonbill, alligator nest, muskrat beds, otters).
   • When students return from ride, discuss anything interesting they may have seen.
   • Switch to the Bird’s Eye View activity.
6. Cast Netting
   • If time permits, students can learn how to cast net, a technique used by researchers to collect aquatic samples. Students will take aquatic samples in a later lesson.
For complete instruction, watch the video taken at Marsh Maneuvers during the activity.

Resources
Youth Wetlands Program Coastal Louisiana 2016 Binder

Gator School

Focus/Overview
This lesson will provide students with the basic knowledge of Louisiana alligator’s life history, economic value, and conservation.

This lesson will allow students to become familiar with the Louisiana alligator before participating in other lessons and activities.

Learning Objective(s)
The learner will:
- Understand the life history of alligators.
- Understand the current and historical economic history of alligators.
- Understand the conservation of alligators as a renewable natural resource.

Materials List
- Alligator Conservation: A Success Story (Presentation)
- Alligator skull
- Alligator pelts
- Alligator clothing
- Alligator eggs
- Dissecting tools and containers

Background Information
Alligator research and life history studies are being forged at the Rockefeller Wildlife Refuge. Alligators can be found across the state of Louisiana and into other coastal states, but the largest populations are found in the coastal marshes of South Louisiana. Large harvesting of alligators began in the 1800’s to use the skins in a variety of leather goods. By 1962 the demand for alligator skins had reached an all time high and because of that the populations had dwindled down. That year, alligator hunting officially closed due to overharvesting. Through protection efforts, research and management, alligator populations increased to stable levels and by 1981 the harvest season was reopened. Today, over 300,000 alligators are harvested annually.

Alligators are carnivores reptiles that typically live between 35 and 50 years. Scientist believe that the species is over 150 million years old. Male alligators average 10 to 15 feet while females average 9.8 feet in length. As previously stated, alligators are carnivores, feeding on fish, turtles, birds, snakes, and other small mammals they can catch as they are opportunistic predators. As hatchlings, alligators are food for larger predators.
Alligators typically lay their eggs in late March thru May. Females will build nest typically 6 feet around and a few feet high. The female will lay over 35 eggs in the center of the nest. As the vegetation dries and is heated by the sun it will provide heat for the eggs allowing them to incubate for 2 months before hatching.

Researchers at the Rockefeller Wildlife Refuge harvest eggs to be used for research and conservation efforts. When harvesting the eggs, researchers place a line on the top of the egg to denote the egg placement in the nest. Eggs must be kept in the same position in order to survive. Within one day of eggs being laid, the embryo attaches itself to the top of the egg and a chalky white spot can be observed on the outside of the egg. As the incubation process continues, the chalky spot will expand to surrounding the egg to completely covering the egg. Within a few days of laying the egg, observing the white band will tell you if it is fertile and healthy or not.

**Advance Preparation**
1. Review the Alligator Conservation: A Success Story PowerPoint.
2. Review the vocabulary provided in the Alligator Conservation: A Success Story PowerPoint.
3. Gather materials needed for hands-on examples and dissections.

**Procedure**

**Alligator Conservation: A Success Story**
1. At this point students will have seen alligators during the Night Hike and Bird’s Eye View.
2. Give the presentation titled Alligator Conservation: A Success Story while students take notes in their notebooks.
3. Pass around Alligator samples as they come up in the presentation.
4. Proceed outside to Alligator egg dissection activity.

**Alligator Egg Dissection**
Researchers from all over the world come to the Rockefeller Wildlife Refuge to study alligators and embryonic development. Students will dissect the alligator eggs to be used later in embryonic development studies.

1. Select one person from each group to remove alligator embryos from their eggs.
2. Point out to students the mark on top of the egg.
3. Instruct the students to find the “equator” of the egg. We will be dissecting the egg by cutting at the equator of the shell.
4. Using the dissecting scissor, poke a small hole in the equator. Cut around the entire equator of the shell.
5. Remove the top half of the shell.
6. Ask the students to make observations about the embryo. Record in notebook.
   a. heart
   b. eyes
   c. blood vessels
   d. tail
e. legs  
f. yoke  
g. head development  

7. Preserve the embryo in formaldehyde solution with the date to be used for research. 

Recording of the embryo dissection and discussion can be found in the Marsh Maneuvers files.

Resources  
http://animals.nationalgeographic.com/animals/reptiles/american-alligator/.

“American Alligator (Alligator Mississippiensis).” Texas Parks and Wildlife,  
tpwd.texas.gov/huntwild/wild/species/americanalligator/.


Fish Biology

Focus/Overview  
Students will learn how to dissect fish to harvest the otolith

Learning Objective(s)  
The learner will:  
- Understand basic fish ageing.  
- Dissect and remove otoliths from fish.

Materials List  
- Fish heads  
- Dissecting tools

Definitions  
- Otolith - each of three small oval calcareous bodies in the inner ear of vertebrates, involved in sensing gravity and movement

Background Information  
Fisheries Biologist use otoliths to age fish in order to learn more about the populations. Otoliths are calcium carbonate stones located in the brain of boney fish. Depending on the type of fish, the otolith will be different shapes and sizes. When a biologist harvest the otoliths from the fish they can then cut it with a diamond saw to get a fine slice. Then the otoliths rings can be counted just as rings on a tree can be counted to determine age. Fish use their otoliths for balance and hearing. The bone that the otoliths are housed in are lined with nerves that send messages to the brain to determine the direction a fish is traveling.
**Advance Preparation**

1. Prepare enough fish heads for each student to be able to dissect.
2. Prepare dissecting tools for all students.
3. Familiarize yourself with the type of fish your group will be dissecting.

**Procedure**

It is important to do a dissection as a demonstration before allowing students to dissect their own fish. As you conduct the demonstration, explain to the students what is occurring and answer any questions the students may have. Students should write down information in their notebooks during this time. A sound recording and video recordings can be found in the Marsh Maneuvers files.

1. Pass out all fish and dissecting tools.
2. Ask students to make observations about the fish.
   a. What type of fish is it?
   b. What does the fish eat?
3. Instruct the students to remove the gills from their fish. Explain how gills function for fish.
4. Instruct students to put one thumb under the fishes jaw and another on down throat and pull the fishes head apart.
5. Instruct students to cut the membrane to expose the skull where the otoliths are.
6. The bone that is now exposed is where the otoliths are housed. Using your tools, give a slight whack to the bone and then break it apart. The small calcium carbonate stones found inside are the otoliths.

![Picture taken by Kasie Dugas](image)

**Resources**


Appendix 4. IRB Approval Form

ACTION ON PROTOCOL APPROVAL REQUEST

TO: Julie Lively
AgCenter, Louisiana Sea Grant School

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: February 4, 2016

RE: IRB# 3692

TITLE: Longitudinal study of attitudes and behaviors of environmental education program participants


Review type: Full ___ Expedited X ___ Review date: 2/4/2016

Risk Factor: Minimal ___ Uncertain ___ Greater Than Minimal

Approved ___ Disapproved ___

Approval Date: 2/4/2016 Approval Expiration Date: 2/3/2017

Re-review frequency: (annual unless otherwise stated)

Number of subjects approved: 2,000

LSU Proposal Number (if applicable):

Protocol Matches Scope of Work in Grant proposal: (if applicable) ___

By: Dennis Landin, Chairman

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING – Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU’s Assurance of Compliance with DHHS regulations for the protection of human subjects.
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins): notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
8. SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc.

*All investigators and support staff have access to copies of the Belmont Report, LSU’s Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb
Vita

Kasie Dugas graduated with a Bachelor of Science in Forestry with a double major in Wetland Science in the School of Renewable Natural Resources at Louisiana State University in May 2014. She is currently a teacher in Lafayette, Louisiana where she teaches Environmental Science, Chemistry, and Cyber Literacy to high school students.