

Praying Mantis:

A Teacher's Guide

A Senior Project

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Bachelor of Science

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Abstract

This project provides an activity based learning exercise that will teach the ideals of sustainability and biodiversity. The highlight will be the rearing and integration of the praying mantis into the classroom. Through the praying mantis, students will be able to learn about predatory insects and their value to the environment.

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Chapter 1

Introduction

Children have a fascination with bugs but are more likely to hurt them than understand them. Also, finding appropriate and easy to maintain animals in a classroom is difficult. With the knowledge gained from this senior project and comprehensive learning guide, a suitable lesson plan will be made on the rearing and successful implementation of predatory insects, specifically the praying mantis or Mantodea, into the elementary classroom setting. By learning about the praying mantis in the context of the use as a predatory insect as related to agriculture, elementary-aged children will gain a greater understanding of the insect itself as well as a deeper appreciation for a potential alternative to chemical pesticide agriculture.

Not only is the praying mantis interesting, it is also highly valuable to maintaining a biodiverse agricultural environment. The praying mantis only has to be kept in the classroom until maturity, so the length of time needed is shortened compared to other classroom pets that tend to live for several years and require year-round care. Students will be able to focus on a live creature that can be safely held without worries of the insect dying or of praying mantis availability since they birth in such large numbers. On a more general level, students will learn about the use of predatory insects in agriculture, and the use of the praying mantis will allow students to go more into depth on the topic. Having the praying mantis within the classroom will stimulate student engagement and provide an authentic hands-on learning experience.

Statement of the Problem

Classroom pets are sought after and provide valuable education experiences for children, yet there are always problems associated with the conventional ones. Year round care is just one of the many issues with conventional classroom pets. With the praying mantis, this issue would easily be remedied by simply releasing the creature at maturity into the school's gardens. The educational value of the praying mantis as a classroom pet would be amplified with the inclusion of a series of lessons regarding its growth and purpose in an ecosystem. Teaching children to not harm insects is a step towards better understanding of how insects can be good to the world. Handling praying mantis is harmless and fun. Elementary-aged children will be able to overcome their preconceived notions and fear of insects, which will also teach tolerance by helping them understand that there is no danger.

Our world is becoming less natural everyday as humankind expands over the planet. Our next generation needs teaching on natural processes so that they can integrate into the environment rather than strive to change it. With this educational guide to incorporating the praying mantis into the classroom, one will learn that insects have a vital role in the ecosystem and that individuals can help shape that environment by accepting natural predatory insects like the praying mantis.

The Importance of the Problem

Teaching sustainability in an ever-changing world is an issue that rarely integrates real life applications. The amount of times a student hears the words "recycle" is a perfect example of an over-emphasized application simply because there aren't too many things a kid can do to

really shape the environment on his or her own. With this educational program, a teacher can effectively add another option when teaching about environmental stability practices and help shape the future generations so that they are more aware of the world around them. The hope is that through hands-on learning and proper teaching of the benefits of the addition of a predatory species to an ecosystem, students will be better educated on the natural balance of the world and be more inclined to change current practices through use of these more sustainable practices.

Purpose of the Project

To make a teaching plan that will allow for effective integration of learning and action that will allow for students to be excited about an educative topic.

Objectives of the Project

1. To develop guidelines that introduces the rearing and successful implementation of predatory insects, specifically the praying mantis into the classroom.
2. To create a lesson plan that can be followed as a guideline for the correct implementation of the material into a classroom.

Definition of Important Terms

- Praying mantis: A European mantis (*Mantis religiosa*) that has been introduced into the United States —called also praying mantid (Merriam Webster, 2012)
- Sustainable: Of, relating to, or being a method of harvesting or using a resource so that the resource is not depleted or permanently damaged (Merriam Webster, 2012)
- Biodiverse: Biological diversity in an environment as indicated by numbers of different species of plants and animals (Merriam Webster, 2012)

Summary

Teaching about real life applications of sustainability practices is difficult to show in the classroom. Most instances are hypothetical and essentially students are told what to do and not shown. With this program, the goal is to have the materials (background information and lesson plan) that will illustrate the viability of this type of lesson with the ultimate goal of teaching students about predatory insects' impact on the environment and how they can utilize their lessons in a real-life situation.

Chapter 2

Literature Review

This chapter will include a background on the praying mantis, an overview of the benefits of biodiversity relating to the praying mantis, the life cycles and rearing of the praying mantis, the benefits to the classroom as told by a practicing teacher, and a segment on proper care.

Background

A simple biography of the praying mantis is needed to begin:

Praying mantis form an order of exclusively carnivorous insects. Living solitarily in the vegetation - or, more rarely, on the ground - they ambush insects, spiders and occasionally even small vertebrates. Praying mantises belong to the top predators of the arthropod community. Some species wear cryptic colors and resemble leaves, flowers, sticks or bark. Praying mantises are characterized by their highly specialized raptorial forelegs and a mobile head with powerful compound eyes that allow for binocular sight. (M.E. Helmkamp, 2007, pgs. 1-2).

Beneficial Biodiversity

The praying mantis will positively affect the environment where it is released by eating pest insects. “The praying mantis enjoys crickets, grasshoppers and other larger insects as it gets

bigger. Crickets and grasshoppers can do lots of damage to plant leaves because after one feeding, they can practically strip an entire plant of its leaves causing the plant to die” (Priddy, 2007. Pg. 3).

Farms can also benefit from praying mantis and seem to be the most widely benefitted by praying mantis, “Species richness, within-habitat diversity (expressed as Fisher's ex) and estimated "true" species richness were highest on the farmland site, followed by the primary forest site and the secondary forest site” (M.E. Helmkampf, 2007. Pg. 1).

Life Cycles and Rearing

The first cycle is the egg or ootheca and will begin your rearing of the praying mantis. “Eggs are laid in groups surrounded by a protective foam, this mass is called an ootheca. An ootheca is produced as a froth which hardens on contact with the air, building up the ootheca can take an hour or more. The ootheca can contain as few as ten or over 200 eggs depending on the species. A female will lay 5-20 ootheca depending on the species. The ootheca can be incubated at the normal rearing temperature, a light spraying with water about once a week helps to ensure the ootheca does not dehydrate. The time between laying and hatching varies greatly, and is strongly influenced by temperature. Some species hatch after only a few weeks, some may take several months. Usually all the nymphs hatch within the space of a few hours although in some species it may be several days before they all emerge” (Mantis Study Groups. Pg. 1).

The second cycle of the praying mantis is the nymph stage. “On hatching, the nymphs of even large species are about the size of ants, but with legs which may be longer than the body. In the wild some species stay with their ootheca, standing, or lying over it: others just leave it.

Those that protect the ootheca are probably trying to defend it from attack by parasitic wasps and flies; these parasites are not a problem in captivity” (Mantis Study Groups. Pg. 1). Full-grown praying mantises are hardier and will be able to be handled by students so simply waiting until they are the size of a student’s palm will ensure they do not get crushed.

Proper Care

There is certain information necessary to the successful rearing of the praying mantis in the classroom. Building the right enclosure for the praying mantis is step one. “Keep the praying mantis in a tall container. There is sufficient air in the container, but provide some ventilation to prevent stale air. Provide twigs, which are almost the height of the jar for the praying mantis to climb up on; this is essential for it to be able to molt successfully” (Metamorphosis. Pg. 1).

Container requirements are extremely important to the survival of the praying mantis. “The ideal [temperature] range is 18° - 30°C, (The lower the temperature the slower the growth rate), with a regular fine water spray in the cage, without making the cage wet as mold is a potential insect killer. Feed on live foods e.g. flies, maggots, crickets, locusts, and grasshoppers. etc. in fact they will eat just about anything they can grab, but as a rule try feed things that are less than half the size of the praying mantis” (Metamorphosis. Pg. 1).

Feeding the praying mantis is also important and there are some basic requirements. “Praying mantises are carnivorous, they feed on a wide variety of insects but prefer soft-bodied insects such as flies, crickets and moths. Fast moving insects are more easily seen by praying mantises, but they can learn to spot and eat slower moving prey. Praying mantises can tackle

surprisingly large prey, but as a rough guide aim to feed them nothing which is more than a quarter of their own body mass. Traditionally praying mantises are fed on fruit flies (*Drosophila* spp.) when small, and on crickets when larger” (Mantis Study Groups. Pg. 1).

If you are planning on making a future generation of praying mantises for next year, the option is possible since breeding is relatively simple.

Introduce the male to the female in a large cage, or aquarium after feeding her all she can eat. Mating (pairing) may last some hours and only occasionally results in the male being eaten. The female should lay an egg mass (ootheca) 2 - 4 weeks after mating, which will be attached to a twig or stick. This can produce between 10 - 300 young, depending on the species and will hatch about 4 - 6 weeks after being laid. Young praying mantises should be fed on fruit flies, green /black flies or again anything they can grab, micro crickets suit quite a few species shortly after hatching. (Metamorphosis. Pg. 1).

Benefits to the Classroom

Having hands-on learning integrated into a lesson will aid students in helping them retain information because they will be using critical thinking while enjoying themselves. According to a study by Otis (2010), “students who practice what they're learning in a hands-on environment can often retain three and half times as much as opposed to just sitting in a lecture room and listening intently” (Pg. 1). By allowing students to have hands-on experiences with a praying mantis, students are able to engage with the material rather than passively absorb it, which will impact retention of the information.

“Incorporating the use of a praying mantis into my science curriculum would significantly impact the effectiveness of my instruction. Students find hands-on learning the most engaging and would certainly be highly motivated by the presence of a classroom pet! In the fifth grade, students learn about the varied structures and systems inside plants and animals. By using the praying mantis, my students would be able to observe and study an animal and how a single animal can make a large impact on the surrounding environment. The concept of biodiversity and sustainable living is abstract and difficult for students of this age to grasp, but utilizing hands-on learning experiences helps to make the content more accessible. When we are through housing the praying mantis in the classroom, the students would enjoy keeping an eye on them in our classroom garden. I particularly appreciate the practicality of the praying mantis, such as its affordability and ease of care. I would highly consider utilizing this method of instruction to bring my science content to life!”

-Fifth Grade Teacher, Almond Elementary School, Los Altos, CA

Other Predatory Insects

Of course there are other predatory insects to choose from that benefit the garden just as much as the praying mantis. The most well-known is the lady beetle or Coccinellidae, “Overwhelmingly, habits of lady beetles are highly beneficial to human interests. Both the adult lady beetles and the grub-stage larvae have chewing mouthparts and are voracious predators of other insects. Although each type of lady beetle has preferences for what they will eat (e.g., aphids, scales, spider mites, mealybugs, etc.), they tend to have fairly broad tastes and feed on

almost any small arthropods (insects, mites) or insect eggs that they can successfully attack and ingest” (Cranshaw, 2006. Pg. 1).

Another highly beneficial predatory insect is the green lacewing or *Chrysoperla rufilabris*. The adult green lacewing does not act as a predatory insect in the garden but its’ offspring does. The green lacewing larvae, “feed on many different pest insects. In general, they attack the eggs and the immature stages of most soft-bodied pests such as: aphids, thrips, spider mites, sweet potato & greenhouse whitefly, mealybugs, leafhoppers, and the eggs and caterpillars of most pest moths” (Better Pest Management. Pg. 1, Green Lacewing).

Chapter 3

Methods and Materials

Various materials are required to successfully integrate the praying mantis into the classroom and sustain its living. These items will be relatively inexpensive when compared to other classroom pet supplies and can be easily disposed of after the praying mantis is released.

Praying Mantis Egg Sack

Purchase one or two praying mantis egg sacks, which will be relatively inexpensive. Each egg sack can produce from 25 to 200 baby mantises, but only a few will survive to adulthood. Refrigerate the egg sack until you are ready to hatch them, which once exposed to normal temperatures will take about two weeks to hatch. The egg sack should be placed on a leaf or twig so that it is above the terrarium floor. Also, a light misting of the egg sack would be ideal to prevent it from drying out.



Figure 1 – The egg sack should be placed above ground, preferably on a twig.

A Terrarium

The housing of these friendly bugs will require a standard terrarium of about 20 inches by 20 inches or larger. Add a few plants and a few twigs then place the egg sack onto a twig or on a leaf. To prevent the escape of nymphs will require that the plants and twigs inside the terrarium do not touch the screened lid.



Figure 2 – The terrarium is designed to be visually pleasing as well as provide a natural habitat for the praying mantis.

A Food Source

Many bugs can be used to feed your growing praying mantises. While they are young you must feed them tiny insects like fruit flies or pinhead crickets. As they grow it would be appropriate to begin feeding them crickets or larger worms. However, if you do not wish to use live bugs as a food source it is possible to feed them small pieces of raw meat however it is not an ideal alternative to live bugs. Also, a water source will be necessary which can consist of nothing more than a small, shallow pet bowl. Also, light misting of the plants can provide water for the praying mantis.

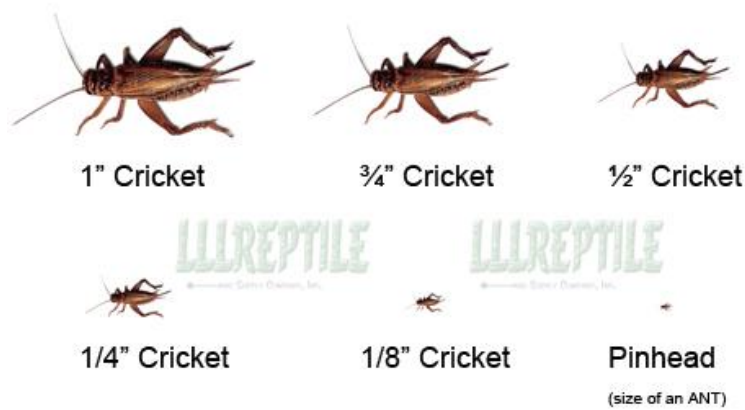


Figure 3 – The size of the cricket provided for the praying mantis will increase alongside the growth of the praying mantis itself.

Plants

Some options for live plant material to be added to the terrarium include *Peperomia caperata* common name Variegata, *Selaginella kraussiana* common name Aurea, and *Pilea glauca* common name Aquamarine. These plants are gentle on the bugs and small enough for a terrarium. Another option is to simply add fake foliage, which will lower maintenance of the cage but loses the natural habitat that helps praying mantis camouflage while hunting.



Figure 4 - *Peperomia caperata* common name Variegata



Figure 5 - *Selaginella kraussiana* common name Aurea



Figure 6 - *Pilea glauca* common name Aquamarine

Summary

It will be necessary to obtain all these items as well as correctly integrate them with each other so as to create a livable area for the praying mantis to thrive. The important items needed for successfully building a home for you praying mantis will include a terrarium, a food source, and some plants. In all, these items will be inexpensive and result in a healthier atmosphere for the praying mantises to thrive in. Also, a fully functional terrarium with praying mantises living in it will be the highlight of students in all grades bringing interest to a class pet unheard of in normal circumstances.

Chapter 4

Guidelines and Lesson Plan

The goal of this project is to create a suitable lesson plan that will encompass necessary information regarding sciences. A guideline to the proper raising of the praying mantis will be discussed at length. As well as the inclusion of a lesson plan that will discuss the proper teaching topics and information regarding sustainability and benefits of praying mantis in an ecosystem.

Preparing the Terrarium



Figure 7 – The egg sack added to the terrarium attached to a twig.

A 20 inch by 20 inch or larger terrarium will be needed. Once you have this, simply place a readily available material, such as paper or cardboard, into the terrarium so that it covers the bottom. Plants and twigs will be added to make the terrarium comfortable for the praying mantis. Decorate the inside with whatever else you wish, but now would be an ideal time as once the praying mantis are introduced it will be more difficult to make changes to the terrarium. Add the praying mantis egg sack that you have

purchased which will hatch in about twenty days so be prepared with food for the newborns as well as misting the plants to allow for them to get adequate water.

Allowing the Praying Mantis to Grow



Figure 8 – Praying mantises will emerge from the egg sack without any assistance needed.

The praying mantises will be numerous as they emerge from the egg sack over the next few days. Do not attempt to allow students to touch the praying mantis until it has molted a few times so that it is large enough to be handled properly. The praying mantis will molt and continue to grow over the next few weeks but as they become larger they will gain the ability to fly

and caution should be exercised when removing them for classroom exercises to prevent escape.

Food and Water

For a nymph praying mantis, feed with fruit flies, micro crickets, gnats, aphids, and other mini bugs. For a praying mantis that has grown and is molting or shedding (the instar stage), start to increase the insect size. Maintain a consistent amount of prey in the terrarium, but if there are still a few in the tank do not constantly add more. In other words, allow the praying



Figure 9 – Praying mantises will eat anything put into the terrarium.

mantises to eat at their own pace and once they have consumed all the prey then it would be appropriate to add more. The praying mantis will benefit from having a steady water source in the form of a bowl in the terrarium, but also misting the plants regularly will help them find the water.

Teaching through Touching

Having students handle the praying mantis will be a fun way to teach students that there is nothing to fear from these alien looking creatures. Make sure students are careful when playing with them and that they are not accidentally crushing them with an overenthusiastic grip. The praying mantis is usually very friendly to humans but when afraid they will pinch with their claws but there is no real harm that can come from this.



Figure 10 – A friendly neighborhood bug.

One of the big issues in today's world is the fear of insects that stems from a lack of contact people have with them. Simply having students observe these bugs while they crawl around them will make the children more open to the possibility of friendly bugs.

The ideal outcome of student interaction with

the praying mantis will take the form of students learning that bugs are not to be feared but are friendly. Also, this interaction will teach students to be gentle and less likely to harm animals or insects in the future.

The Release

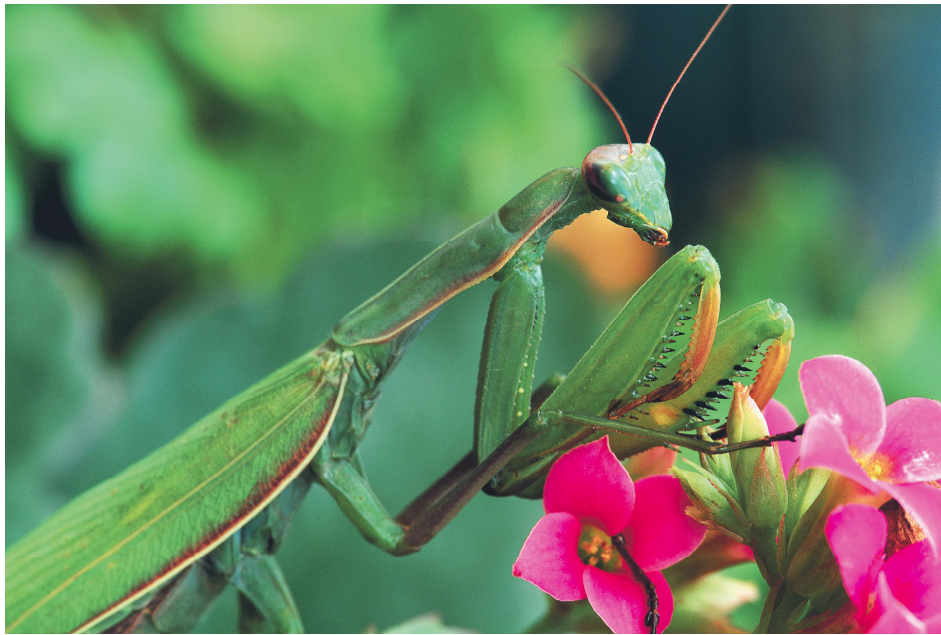


Figure 11 – Releasing the praying mantis can be fun and educational.

Take an hour to go outside and release the praying mantis with the class. A school garden would be ideal so that the students can see their classroom's pet in the wild as an

active participant in the surrounding ecosystem. Students could take a praying mantis each and find a hiding spot for where the praying mantis can be easily camouflaged from predators and prey and release them.

Lesson Plan

Subject: Science--Investigation and Experimentation

Topic: Praying Mantis

Time: 45 minutes

Overview:

Students will have the opportunity to see the life cycles of the praying mantis. They will also be able to handle the praying mantis and observe the behavior of the bug. Feeding behavior can be simulated with the inclusion of a prey insect. Ultimately, the release of the bug will teach the students about incorporation of a predatory insect into the environment.

Purpose:

Students will feel more open to predatory bugs and see their usefulness in the garden they are released into. They will be able to interact with the bug and view the habits of the praying mantis. Students will also be taught about the environment and how predatory bugs are useful and important. Also, sustainability and proper application of environmental management can be discussed.

Standards:

Science Content Standards for California Public Schools: Grade 5

Investigation and Experimentation

6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

- a. Classify objects (e.g., rocks, plants, leaves) in accordance with appropriate criteria.
- b. Develop a testable question.
- c. Plan and conduct a simple investigation based on a student-developed question and write instructions others can follow to carry out the procedure.
- d. Identify the dependent and controlled variables in an investigation.
- e. Identify a single independent variable in a scientific investigation and explain how this variable can be used to collect information to answer a question about the results of the experiment.
- f. Select appropriate tools (e.g., thermometers, meter sticks, balances, and graduated cylinders) and make quantitative observations.
- g. Record data by using appropriate graphic representations (including charts, graphs, and labeled diagrams) and make inferences based on those data.

h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.

i. Write a report of an investigation that includes conducting tests, collecting data or examining evidence, and drawing conclusions.

Objectives:

Given a topic about sustainability, students will discuss how using chemicals to spray for unwanted bugs is no more than a symptom of not having enough predatory insects in an area.

Given a topic on environmental management, the students will discuss and point out that introducing predatory praying mantis will be helpful to an environment in the long run.

Students will demonstrate their understanding of praying mantis life cycles and benefits to a garden through investigation of common misunderstandings about them.

Students will be required to write a paper on the importance of bugs and on how their feelings and understanding towards praying mantises has changed since introduction of the bug into the classroom.

Materials:

Terrarium

Praying Mantis

Evidence of Learning:

Informal assessment will take place during student investigations. Teacher will walk around with clipboard noting common misunderstandings and/or successes, as well as student interactions. Paper will be evaluated based on understanding of the material presented in class.

Cautionary Note:

1. Do not allow students free reign of the praying mantises because they may abuse them.
2. Do not force students to handle the bugs if they are not willing.
3. Attempt raising praying mantises before introduction in the classroom as there is a slight learning curve to maintaining survival of the bugs.

Instructional Strategies and Sequence

Anticipatory Set:

Ask students if they are afraid of bugs or not? What makes them so scary? Brainstorm a list of characteristics of bugs and student ideas of why they are commonly feared creatures on chart paper.

Today we will discuss how praying mantises are not harmful to people and how they are beneficial to the world around us.

Instruction:

Remove praying mantis from the terrarium. Students can participate in the handling of the praying mantis. Demonstrate how the praying mantis should be held and invite students to take turns holding one.

“Handle with care. These little guys are more afraid of you than you are of them. Notice how they move; is that not the coolest thing ever?”

Students will observe the feeding habits of the praying mantis. Inform students that the praying mantis is a carnivorous insect, meaning that it eats other animals. Place one small cricket in front of the praying mantis. Have students observe how the praying mantis inspects its prey. Discuss other possible meals for a praying mantis and review the predator-prey relationship. Have students brainstorm a list of food that they could prepare for the praying mantis.

“The praying mantis is invaluable to the health of a garden. Picture a garden that is overrun with bugs and all your plants and vegetables are being eaten by unwanted pests. With the addition of

a natural predator of these bugs it is simply a matter of time until the balance between pests and the predator is formed resulting in a healthier garden.”

Ask students to think about where a praying mantis might want to live? If it is a predatory insect, does it want to live near its prey? Would a praying mantis rather live near a large outdoor park or on the side of a freeway?

Inform students that the praying mantis uses camouflage to hunt its prey. This camouflage is also needed to protect the praying mantis from its own predators. Ask students what a potential predator of a praying mantis may be.

Based on class discussion, students will develop an investigation to determine the best location to release a praying mantis. This investigation will allow an opportunity for students to continue practicing with the scientific method, but will also ultimately allow them to better support the ecosystem at their school. By doing this, students will become conservationists.

“Have you ever heard of a conservationist? They introduce new things to areas that are without them due to human impact. How would you like to be a conservationist?” Provide students with examples of real-life conservationists. Introduce the challenge to students: “At our school, where would the best place to release a praying mantis be if we wanted to be a conservationist and support the ecosystem?”

Guided Practice:

Guide students through the first steps of the scientific method. Students will record their responses on paper, which will be evaluated at the conclusion of the lesson. Divide students into groups of four and distribute one praying mantis to each group.

“What is the question we are trying to answer? The question we are trying to answer is where is the ideal place to release a praying mantis so that it can successfully fit into an ecosystem.”

As a class, walk around campus and take note of possible locations to release the praying mantis. Where are the best places a praying mantis can camouflage itself with like-colored plants? Are their food sources around? Would the praying mantis be protected from predators, like birds?

Have students develop a hypothesis about where an ideal location at school would be. Provide an example, “I predict that the best place to release a praying mantis would be in the flower box at the front of school because it is covered with lots of green bushes that would provide lots of camouflage for the praying mantis and the praying mantis could eat all of the spiders that have been making webs on the flowers.”

Send each group of students outside with their praying mantis. Allow students to release the praying mantis into the location that they have chosen as their hypothesis. For five minutes, have students take notes about their observations (What is the praying mantis doing? Is it moving around or staying in one spot?). Remind students to be very detailed in their observations. Inform students that conservationists make careful observations when they are introducing new elements to an ecosystem to help them decide whether or not their solution is working.

Independent Practice:

Send each group of students outside with their praying mantis. Allow students to release the praying mantis into the location that they have chosen as their hypothesis. For five minutes, have students take notes about their observations (What is the praying mantis doing? Is it moving around or staying in one spot?). Remind students to be very detailed in their observations. Inform students that conservationists make careful observations when they are introducing new elements to an ecosystem to help them decide whether or not their solution is working.

Ask each group to share the release location that they have chosen and the observations that they have made about their praying mantis's transition into its new ecosystem. Record each location on a class chart and record student observations. After a few minutes of discussion, send students back outside to continue observing their praying mantis. Students will then record additional observations onto the class chart. Remind students to pay particular attention to how the praying mantis is able to interact with the surrounding ecosystem.

Return to the scientific method and ask students to begin thinking about the results of their experiment. Did their chosen location end up being a suitable release location? What problems did they encounter? Did they discover that parts of the ecosystem, such as other animals or types of plants detract from the success of the transition into a new ecosystem? Students will write a paragraph outlining the results of their experiment and draw conclusions from their observations.

Closure:

Students will discuss what they liked about the praying mantis and how their views on the bug have changed after having observed the animal. Refer to the chart made at the start of the lesson about why insects are feared and discuss how students can teach others to not fear this insect.

Students can discuss what it means to be a conservationist and what sustainability is. Suggest that students continue to “check-in” on their praying mantis over the next few weeks.

Chapter 5

Summary, Conclusion, and Recommendations

This chapter acts as a conclusion as well as providing a summary and relevant recommendations in regards to the praying mantis project. The set-up of the terrarium, the rearing and correct keeping of the praying mantis, and the benefits and usefulness to the environment has been discussed. The goal of the project is to give teachers an alternative option when discussing sustainable practices in regards to pest management that relies on natural predatory insects. Students will gain knowledge on the praying mantis, the natural order surrounding the insect, and its beneficial impact on the environment.

Summary:

This project focuses on positive ways in which students can learn about the environment and the relationships insects have with it. The main focus is to teach students to not fear predatory bugs but instead be able to see the usefulness of the insect and their role in the greater world. This project gives students hands on learning that will increase their interest in insects that they can utilize in their own home yards and know that spraying for pests is a less than ideal practice compared to the introduction of a new predatory insect. Also, the addition of praying mantises as the classroom pet will be exciting to students and show them something they wouldn't be privy to otherwise.

Recommendations:

As a follow-up, students may examine an additional predatory insect as a comparison experience and go into more detail. Or even possibly look at mammalian predators and cite similarities with a focus on the environmental impact they have and their benefits to the ecosystems they belong to. Another option is to have students brainstorm ideas on how to improve the terrarium the praying mantis is living in. Students could talk about what inputs are needed to keep life sustained specifically about the praying mantis or speak generally on topics about scenarios that life flourishes in.

Conclusion:

The fun of the project and the perspective change for students will be rewarding. Students will gain knowledge about environmental topics and will be ready for talks on sustainability and biodiversity.

Bibliography

- Helmkamp, M.E., Schwarz, C.J., Beck, J. (2007).
A first look at the biodiversity of praying mantis. Sepilok Bulletin, 7 (13).
Retrieved from
<http://mantodea.myspecies.info/sites/mantodea.myspecies.info/files/Helmkamp,Schwarz,Beck%282007%29Sepilok%20Bulletin,%207,%20p.1-13.pdf>.
- (n.d.) Metamorphosis. Retrieved from
<http://www.metamorphosis.gb.com/mantisCS.html>.
- Mantis Study Group. (n.d.) Rearing praying mantid. Retrieved from
<http://mantodea.myspecies.info/rearing-praying-mantids>.
- Priddy, J. (2007). Benefits of helpful garden insects. Retrieved from
http://www.lifescript.com/life/timeout/at-home/benefits_of_helpful_garden_insects.aspx.
- Gilmer, M. (n.d.) Control pests with praying mantis. HGTV. Retrieved from
<http://www.hgtv.com/landscaping/control-pests-with-praying-mantis/index.html>.
- The praying mantis life cycles in pictures. (n.d.) Retrieved from
<http://www.environmentalgraffiti.com/news-incredible-life-cycle-praying-mantis-pictures?image=3>.
- Cranshaw, W.S. (2006). Lady Beetles. Retrieved from
<http://www.ext.colostate.edu/pubs/insect/05594.html>.
- Better Pest Management. (n.d.). Green Lacewing. Retrieved from
<http://www.insectary.com/lw/lacewing.htm>.
- Otis, K. (2006) Top 5 – Benefits of a hands-on learning environment. Retrieved from
<http://news.everest.edu/post/2010/01/top-5-benefits-of-a-hands-on-learning-environment>.
- Opiola, J. (Photographer). *Peperomia caperata* [Photograph], Retrieved March 13, 2013, from:
http://commons.wikimedia.org/wiki/File:Peperomia_caperata_1-OB9.jpg
- LLLReptile and Supply Co., Inc. (Photographer). (2012). *Crickets Pinhead* [Photograph], Retrieved March 13, 2013, from:
<http://lllreptile.com/store/catalog/feeder-crickets-worms-rodents-roaches-and-more/crickets/-/crickets-pinhead/>
- [Untitled photograph of an Aurea]. Retrieved March 13, 2013, from:
http://www.nortplantas.com/documents/mysql_catalog.php?action=item&page=1&cat=2&subcat=&iid=430

[Untitled photograph of a *Pilea glauca*]. Retrieved March 13, 2013, from:
<http://www.firstclassart.com/tropicals.html>

The Pure Gardener. (2009). *Our Praying Mantids Have Hatched!* [Photograph], Retrieved March 13, 2013, from:
<http://thepuregardener.blogspot.com/2009/07/our-praying-mantids-have-hatched.html>

A Piggyback Ride [Photograph]. (2012). Retrived March 13, 2013, from:
<http://www.jmeacham.info/?tag=terrarium>

[Untitled photograph of a praying mantis egg sack]. Retrieved March 13, 2013, from
<http://www.pbase.com/mkpower/image/27900095>

[Untitled photograph of a terrarium]. Retrieved March 13, 2013, from:
http://zoomed.com/Library/1_AmeergaPepperiTank.jpg?1271281674343

[Untitled photograph of a terrarium]. Retrieved March 13, 2013, from:
http://www.frogforum.net/attachments/vivarium-terrarium-enclosure-discussion/44896d1357525041-whites-tree-frogs-set-up-show-me-yours-img_2860.jpg