

Inquiry into Butterflies

Lesson 1: Butterfly Field Guide and Dichotomous Key

Created for SPICE by Julian Resasco and May Steward

January 2009

KEY QUESTION(S): Which butterfly species are found in our area? What do they look like? What do they eat? What type of habitat do they prefer? How can we tell them apart?

SCIENCE SUBJECT: Biology

GRADE LEVEL: 7th grade

SCIENCE CONCEPTS: Pollination, herbivory, biodiversity, food webs, dichotomous key

OVERALL TIME ESTIMATE: Three 50 minute class periods

LEARNING STYLES: Visual and kinesthetic

VOCABULARY:

Lepidoptera- An Order in Class Insecta that includes Butterflies and Moths. Lepidoptera is derived from the Greek words for "scale" and "wing."

Wingspan- Distance between wings

Habitat- Where an organism lives

Pollination- Refers to the transfer of pollen from male parts (anther) of a flower to female parts of a flower (stigma). Pollination is an important part of plant reproduction.

Herbivory- Refers to the consumption of plant tissue by animals

Mutualism- A jointly beneficial interaction between two species

Host plants- Plants that caterpillars feed on

Nectar plants- Plants that have flowers that butterflies use for nectar.

Specialist- Species with a narrow diet and/or tolerance to environmental conditions

Generalist- Species with a broad diet and/or tolerance to environmental conditions.

Predator- An organism that eats another organism (prey)

Prey- An organism that is eaten by another organism (predator)

Dichotomous key- A series of steps that lead to the identification of an object- typically this is done to identify an organism to a taxonomic level (e.g., species).

LESSON SUMMARY: This lesson will cover diversity of butterflies and the ecological concepts of pollination, herbivory, and habitat. These concepts will be covered by students who will work in small groups to investigate a butterfly species of their choice. Students will then create a dichotomous key based on morphological characters of butterflies.

STUDENT LEARNING OBJECTIVES:

The student will be able to...

1. Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
2. Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.
3. Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.
4. Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.
5. The student understands that the classification of living things is based on a given set of criteria and is a tool for understanding biodiversity and interrelationships.

MATERIALS:

Per set of 2-4 students:

- Set of colored pencils
- Set of markers
- Printer paper
- Field guide of local butterflies
- Computers with internet access and MS Word
- Images or specimens of butterflies

For instructor:

- Computer

- Scanner
- Color printer
- Binding material

BACKGROUND INFORMATION:

Butterflies

Butterflies are a diverse and ecologically important group of insects. They are among the most colorful and strikingly beautiful organisms on the planet. Florida has a high diversity of butterflies, many can be observed year-round. Aside from this beauty, however, they perform important ecological roles such as **pollination** and **herbivory**. **Pollination** is a **mutualistic** interaction in which an animal transfers pollen from one flower to another. Pollinators receive a reward (e.g., nectar) in exchange for their service. Some butterflies are **specialists** and only feed on the nectar of one or a few species of plants, **nectar plants**. Others are **generalist** and feed from a variety of flowers. In their larval form butterflies are caterpillars. Caterpillars are important herbivores that feed on the leaves of plants. Like adult butterflies some are **specialists**- they feed on one or few species of **host plants**- while others, **generalists**, have a more catholic diet. Butterflies and caterpillars can also be important **prey** for **predators** such as birds.

Dichotomous keys

Dichotomous keys can help us identify the species (or other taxonomic level) of an organism by following sequential, objective, and dichotomous statements (yes or no) about the organism. It is a series of statements leading one to the identification of organisms. Biologists use dichotomous keys to identify a variety of organisms ranging from microbes to trees.

ADVANCE PREPARATION:

Obtain materials listed above.

PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES

Field guide

Begin class by asking students if they have heard of nature field guides, provide examples to pass around.

Ask what type of field guides they have seen. Ask what kind of information is found in a field guide. Explain that as a class they will make a field guide of their own. (10 min.)

Students assemble into groups of 2-4. Each group is assigned to a computer with internet access. (5 min.)

Assist each group in selecting a butterfly native to Florida. (10min.)

Once each group has decided on a species they will begin to gather information and record information (e.g., on habitat, diet, distribution... etc). Remind students to keep a record of the sources of their information. Provide a template for a field guide entry on the blackboard for the students to enter into an MS Word document. Template contains Butterfly common name, scientific name, group members, description, distribution, habitat, host plants, nectar plants and fun facts. Provide paper, colored pencils, and markers for students to sketch and color their butterfly (remaining 25min. of the period and 50 min. of following period).

Collect drawings and ask students to save their entries on their computers.

Scan drawings and insert them into MS Word Documents

Print and bind entries

Dichotomous key

Explain what a dichotomous key is and what it is used for (see background information). (10 min.)

Students assemble into groups of 2-4. Each group needs pictures or specimens of native butterflies. These should be correctly identified and labeled. (5 min.)

Students will then create their own dichotomous keys on a sheet of paper or lab notebook. (25min)

Students may then rotate through groups and use their keys to identify butterflies. It is important to cover up the labels for this part until the

student has decided on the identity of the butterfly based on the key. (10 min)

ASSESSMENT SUGGESTIONS:

Grade entries and dichotomous key based on apparent effort that went into making them.

EXTENSIONS:

LITERATURE:

- Florida Butterfly Gardening: A Complete Guide to Attracting, Identifying, and Enjoying Butterflies of the Lower South by Marc C. Minno and Maria Minno (1999).
- Florida Butterfly Caterpillars and Their Host Plants by Marc C. Minno, Jerry F. Butler, Donald W. Hall (2005).

RESOURCES/REFERENCES:

Butterflies and moths of North America
(<http://www.butterfliesandmoths.org/>)

University of Florida Natural History Museum- Butterfly Rainforest
(<http://www.flmnh.ufl.edu/butterflies/>)

Dichotomous Keys

(<http://nerds.unl.edu/Pages/preser/sec/skills/dkeys.html>)

SUNSHINE STATE STANDARDS:

1. SC.7.L.17.1 Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
2. SC.7.L.17.2 Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.
3. SC.7.L.17.3 Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.

4. *SC.7.L.15.3* Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.
5. *SC.G.1.3.3* The student understands that the classification of living things is based on a given set of criteria and is a tool for understanding biodiversity and interrelationships.

Inquiry into Butterflies
Lesson 2: Designing a Native Butterfly Garden
Created for SPICE by Julian Resasco and May Steward
April 2009

KEY QUESTION(S): How can I attract a high diversity of butterflies?
What is the most economic way to attract these butterflies?

SCIENCE SUBJECT: Biology

GRADE LEVEL: 7th grade

SCIENCE CONCEPTS: Pollination, herbivory, biodiversity, invasive species, native species

OVERALL TIME ESTIMATE: Three 50-minute class periods

LEARNING STYLES: Visual and Kinesthetic

VOCABULARY:

Native species- A species indigenous to a region

Invasive species- An introduced species that has negative ecological impacts on native species.

Lepidoptera- An Order in Class Insecta that includes Butterflies and Moths. Lepidoptera is derived from the Greek words for "scale" and "wing."

Pollination- Refers to the transfer of pollen from male parts (anther) of a flower to female parts of a flower (stigma). Pollination is an important part of plant reproduction.

Herbivory- Refers to the consumption of plant tissue by animals.

Mutualism- A jointly beneficial interaction between two species

Host plants- Plants that caterpillars feed on.

Nectar plants- Plants that have flowers that butterflies use for nectar.

LESSON SUMMARY: In this lesson students will design a butterfly garden using MS PowerPoint and MS Excel (optional). The goal of the design will be not only aesthetics but also a design that will attract a high diversity of butterflies using native host and nectar plants. Students may use the field guide from lesson 1 or other references to acquire information on attracting

specific butterflies. Balancing diversity, aesthetics, and budget will be key. Students will present their design to the class. Concepts of native and invasive species will be discussed throughout the lesson.

STUDENT LEARNING OBJECTIVE:

The student will be able to...

6. Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
7. Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.
8. Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.
9. Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.

MATERIALS:

Per set of 2-4 students:

Computer with MS Excel and MS PowerPoint OR
Paper
Colored pencils, crayons, and markers
Handouts with plant prices from a local nursery

Shared among students in classroom:

Field Guides for Butterflies
Native Plant Guides
Gardening books (optional)

BACKGROUND INFORMATION:

Butterflies

Butterflies are a diverse and ecologically important group of insects. They are among the most colorful and strikingly beautiful organisms on the planet. Florida has a high diversity of butterflies, many can be observed year-round. Aside from this beauty, however, they perform important ecological roles such as **pollination** and **herbivory**. **Pollination** is a **mutualistic** interaction in which an animal transfers pollen from one flower to another. Pollinators receive a reward (e.g., nectar) in exchange for their service. Some

butterflies are **specialist** and only feed on the nectar of one or a few species of plants, **nectar plants**. Others are generalist and feed from a variety of flowers. In their larval form butterflies are caterpillars. Caterpillars are important herbivores that feed on the leaves of plants. Like adult butterflies some are specialists- they feed on one or few species of host plants- while others, generalists, have a more catholic diet. Butterflies and caterpillars can also be important prey for predators such as birds.

Native/Invasive species

Invasive species are defined as introduced species that have negative ecological impacts on native species. Some invasive species are quite aggressive and pose a threat to biodiversity around the world. Some of the most notorious invasive species are plants that have been planted extensively in gardens as ornamental plants (e.g., Brazilian pepper tree, Japanese Honeysuckle, and Chinese Privet). Many gardeners are turning to natural landscaping or native gardening. Native gardens contain native species- species indigenous to a region. These gardens not only prevent the naturalization of invasive species but can also provide habitat for wildlife (e.g., butterflies). In addition planting native species can require less watering maintenance because native plants are have evolved to the natural rainfall patterns of the region.

Designing a native garden requires knowledge of the natural history of the local wildlife (e.g., host plants and nectar plants preferences of caterpillars). Balancing the aesthetics of the garden, quality of habitat for wildlife, and budget is an essential component of the design process.

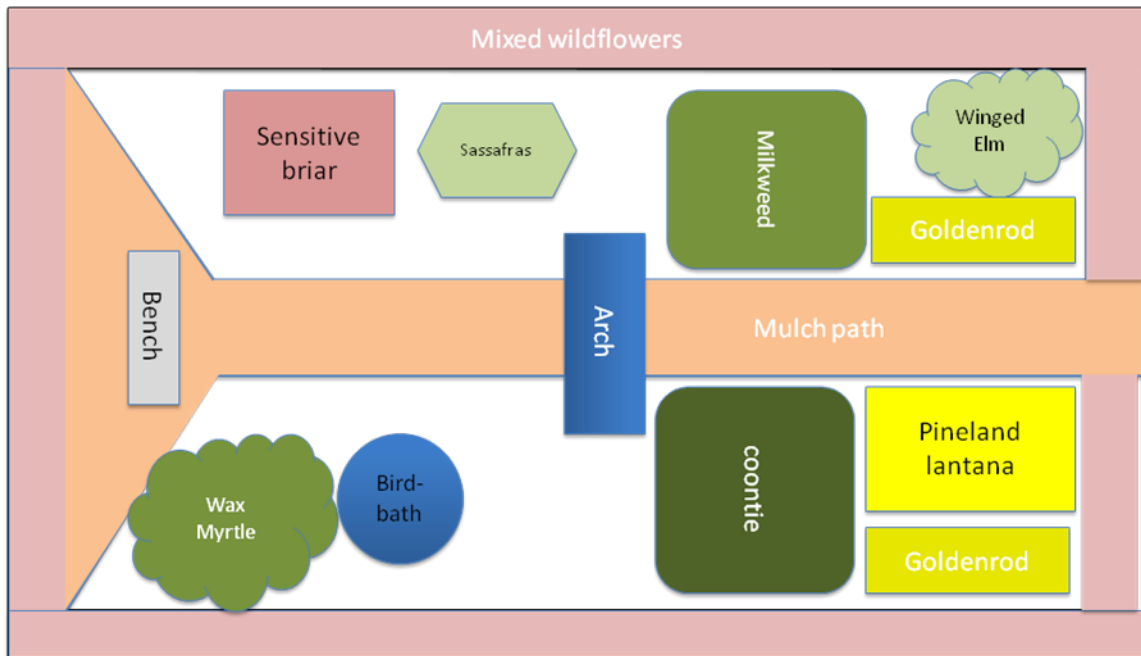
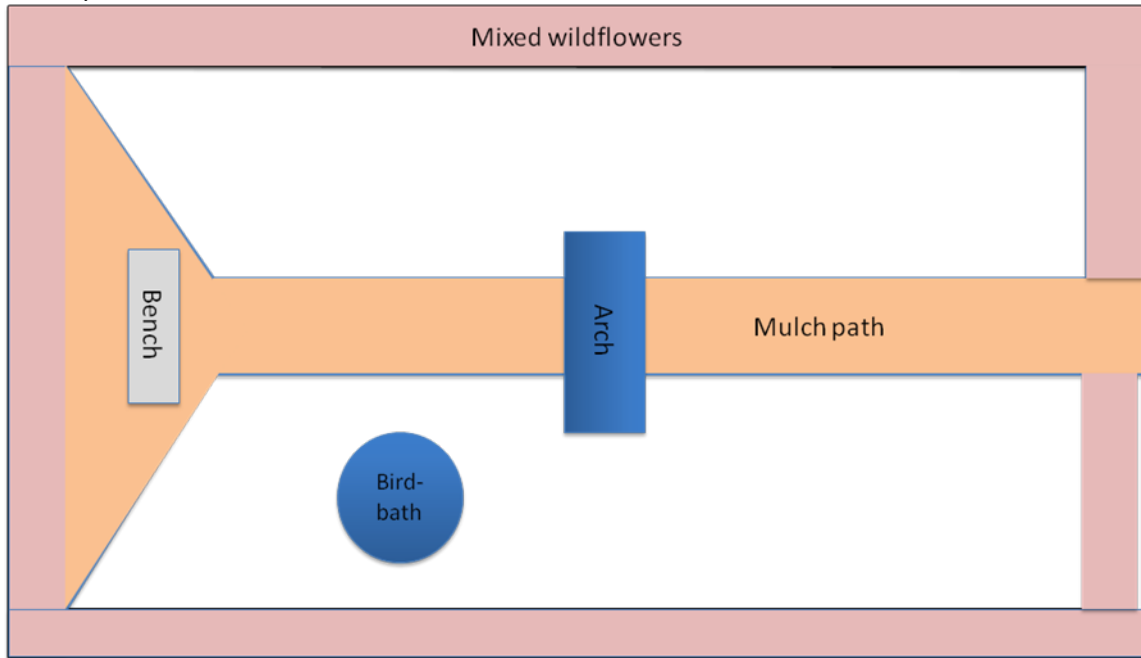
ADVANCE PREPARATION:

Obtain materials listed above.

Obtain prices for native plants at a local nursery, preferably a nursery that specializes on butterfly and/or native gardening and create handouts.

Prepare a layout of existing garden space in MS PowerPoint format and create and download copies onto each computer that students will be using.

Example



PROCEDURE AND DISCUSSION QUESTIONS WITH TIME ESTIMATES

Period 1

Have a discussion about native and invasive species (see background and invasives.ppt). Bring in local native and invasive plants or pictures. Encourage discussion on the dangers of invasive and the value of native plants. (15 min.)

Allow students to assemble into groups of 2-4. Each group is assigned to a computer with MSExcel and MSPowepoint and internet access. Pass out handout with plant prices (this can be obtained from a local nursery) (5 min.)

Explain the objective of the lesson- to design a beautiful garden using native plants and a budget of \$200 dollars. Explain that students must provide 1) a powerpoint slide of the layout of the garden and an excel spreadsheet of the costs of the plants in their design (not exceeding \$200 dollars) and caterpillars and butterflies that use the plants. (5min)

Assist students in creating their layout and spreadsheet. Ask students to save their design on their computers. (25min.)

Period 2

Allow students to continue working on their designs and budgets. (30 min)

Period 3

Display designs and budgets for each group (10 min)

Students groups share why their design is appealing (25 min)

Allow students to judge and vote on the best design (15 min)

ASSESSMENT SUGGESTIONS:

Grade designs and budgets based on following guidelines and apparent effort that went into making them.

EXTENSIONS:

LITERATURE:

-Florida Butterfly Gardening: A Complete Guide to Attracting, Identifying, and Enjoying Butterflies of the Lower South by Marc C. Minno and Maria Minno (1999).

-Florida Butterfly Caterpillars and Their Host Plants by Marc C. Minno, Jerry F. Butler, Donald W. Hall (2005).

RESOURCES/REFERENCES:

Butterflies and moths of North America

(<http://www.butterfliesandmoths.org/>)

University of Florida Natural History Museum- Butterfly Rainforest

(<http://www.flmnh.ufl.edu/butterflies/>)

USDA National Invasive Species Information Center (NISIC)

(<http://www.invasivespeciesinfo.gov/>)

Ecological Society of America- Invasion!

(<http://www.esa.org/education/edupdfs/invasion.pdf>)

SUNSHINE STATE STANDARDS:

6. SC.7.L.17.1 Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
7. SC.7.L.17.2 Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.
8. SC.7.L.17.3 Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.
9. SC.7.L.15.3 Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.

Inquiry into Butterflies
Lesson 3: What Are Pollinators Attracted To?
Created for SPICE by Julian Resasco and May Steward
April 2009

KEY QUESTION (S): How do plants attract good pollinators and deter bad pollinators? What are the cues flowers give to pollinators and how do pollinators respond?

SCIENCE SUBJECT: Biology

GRADE LEVEL: 7th grade

SCIENCE CONCEPTS: Pollination, evolution

OVERALL TIME ESTIMATE: Two 50-minute class periods

VOCABULARY:

Pollination- refers to the transfer of pollen from male parts (anther) of a flower to female parts of a flower (stigma). Pollination is an important part of plant reproduction.

Mutualism- a jointly beneficial interaction between two species

Nectar plants- plants that have flowers that butterflies use for nectar

Angiosperms- flowering plants that are a diverse and widespread group of terrestrial plants characterized in part by flowers

Pollinator- an animal that moves pollen from flower to flower

Abiotic - refers to nonliving factors

Biotic - refers to living factors

LESSON SUMMARY: In this lesson students will 1) observe the patterns of pollinator visitation to different types of flowers and 2) manipulate floral cues (e.g., color, size of inflorescence, shape) and compare visitation frequency to control flowers. This lesson will cover diversity of butterflies and flowers and the ecological concepts pollination and mutualism.

STUDENT LEARNING OBJECTIVE:

The student will be able to conduct an experiment on floral preferences of different pollinators by manipulating floral cues. These

observations will help the student to understand the effects of floral traits on pollinator visitation.

1. Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.
2. Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.
3. Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.
4. Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.

MATERIALS:

Part 1

Clipboards

Stopwatches

Access to a garden or natural area with plants in flower

Part 2

Clipboards

Stopwatches

Scissors

Perfume

Magic markers

Food coloring

Butterflies

Butterflies are a diverse and ecologically important group of insects. They are among the most colorful and strikingly beautiful organisms on the planet. Florida has a high diversity of butterflies, many can be observed year-round. Aside from this beauty, however, they perform important ecological roles such as **pollination** and **herbivory**. **Pollination** is a **mutualistic** interaction in which an animal transfers pollen from one flower to another. Pollinators receive a reward (e.g., nectar) in exchange for their service. Some butterflies are **specialist** and only feed on the nectar of one or a few species

of plants, **nectar plants**. Others are **generalist** and feed from a variety of flowers. In their larval form butterflies are caterpillars. Caterpillars are important herbivores that feed on the leaves of plants. Like adult butterflies some are **specialists**- they feed on one or few species of **host plants**- while others, **generalists**, have a more catholic diet. Butterflies and caterpillars can also be important prey for predators such as bird.

Flowers

Flowers are the reproductive structures of **angiosperms**. The function of flower is to allow for **pollination** to occur. **Pollination** refers to the transfer of pollen from male parts (anther) of a flower to female parts of a flower (stigma). **Pollination** is necessary for the production of viable seeds. Pollination may occur via **abiotic** factors (e.g., wind) or **biotic** factors or **pollinators** (e.g., bees).

ADVANCE PREPARATION:

Obtain materials listed above. Plan accordingly for an outdoor activity either in a natural area or a school garden. Contact director of natural area or groundskeeper of the school for permission to conduct manipulations in part 2 of this lesson.

PROCEDURE AND DISCUSSION QUESTIONS WITH TIME

ESTIMATES

Part I

Hand out the worksheet for Part I. Present MS PowerPoint presentation on pollination to students. Allow for discussion with students. Questions in the MS PowerPoint presentation will facilitate the discussion. (15 min)

Hand out clipboards and stopwatches and explain the assignment- to observe flowers characteristics and record pollinator visitation for 3-5 min/plant

Walk out to butterfly garden or a site on the school grounds with different types of flowers (10min)

Help students find and identify flowers. Assist with questions students may have about filling out the back of their worksheet. (25min)

Collect worksheets and materials.

Part II

Hand out the worksheet for Part II and ask students to take out their worksheet from part 1. Allow students to assemble into groups of 2-4. (5 min)

Ask the groups to discuss their findings from Part I and design an experiment to test the effect of a floral characteristic on attracting pollinators (e.g., bees are attracted to yellow flowers.) Help students with formulating a hypothesis and experimental design (25 min)

Once students have a hypothesis and have designed an experiment, hand out clipboards and stopwatches and escort them outside to conduct their experiments. (20 min)

ASSESSMENT SUGGESTIONS:

Grade designs and budgets based on worksheets for Parts I and II.

EXTENSIONS:

LITERATURE:

-Florida Butterfly Gardening: A Complete Guide to Attracting, Identifying, and Enjoying Butterflies of the Lower South by Marc C. Minno and Maria Minno (1999).

-Florida Butterfly Caterpillars and Their Host Plants by Marc C. Minno, Jerry F. Butler, Donald W. Hall (2005).

- Pollination by Mary King Hoff (2003).

RESOURCES/REFERENCES:

Butterflies and moths of North America

(<http://www.butterfliesandmoths.org/>)

University of Florida Natural History Museum- Butterfly Rainforest

(<http://www.flmnh.ufl.edu/butterflies/>)



Names of group members _____

What are pollinators attracted to?

Part I

1) What is pollination?

2) Why is pollination important?

-
-
-

3) Give examples of abiotic pollination

4) Give examples of biotic pollinators

5) Why do some plants need animal pollinators?

6) Why do these pollinators pollinate plants?

7) Do you think that some pollinators are better than others?
Why?

Flower	Color	Shape (sketch)	Pollinators observed

Conclusions:



Names of group members _____

What are pollinators attracted to? Part II

Recall your **observations** from Part I of *What are Pollinators Attracted To?* What floral characteristics that attracted pollinators did you observe ?

Hypothesis: If I change _____ on the flower of species _____, then the number of pollinator visitations will _____ because _____.

Experiment

To test my hypothesis I will (procedure):

Independent variable:

Dependent variable:

Control:

Results (data):

Conclusions:

Does your data support your hypothesis?

What did you find out by doing this experiment?