

Insects

Encourage Beneficials, Deter Pests

Overview

There are hundreds of thousands of species of insects (there are more known species of beetles than there are known species of flowering plants!) and insects play many roles in the world's diverse ecosystems. In agriculture, there are small number of species that can cause damage and are therefore unwanted (called pest insects) and a much larger number of species that are valuable and therefore wanted (called beneficial insects). In a given crop, a pest species might have the potential to cause catastrophic losses, while a beneficial insect species may be able to feed on the pest species and keep its population so low that it causes no discernable damage. Another beneficial species may be essential to the crop's pollination and thus its productivity.

The goal of this activity is to introduce the idea that in many cases pests can be managed effectively by employing ecological processes that occur commonly in nature and on the farm. However, farmers need to monitor their crops for pest and beneficial insect activity to make efficient use of these processes. Effective monitoring takes time, keen observational skills, and knowledge about insects. This activity will engage students in the ecological principles and practices integrated pest management (IPM). The activity also explores some of the human health and environmental consequences of chemically based pest control. The following resource references are provided to improve your familiarity with the topic.

Resource References

University of California Integrated Pest Management Guidelines: How To Manage Pests of Agriculture

<http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html>

Bio-intensive Integrated Pest Management, ATTRA

Part 1. <http://attra.ncat.org/attra-pub/ipm.html>

Part 2. <http://attra.ncat.org/attra-pub/ipm2.html>

Organic IPM Field Guide, ATTRA

http://attra.org/attra-pub/summaries/organic_ipm.html

MacGowan, C., 2000. Mac's Field Guide: California Garden Bugs. The Mountaineers Books. Seattle WA

<http://www.mountaineersbooks.org/productdetails.cfm?PC=322>

Pests of the Garden and Small Farm. A Growers Guide to Using Less Pesticides. Mary Louise Flint. 1998. University of California, DANR Publication 3332, Oakland CA.

Common Sense Pest Control. 1991. Olkowski, William, Sheila Daar, and Helga Olkowski. Taunton Press, Newtown CT.

Insect Exploration (p.36-38). French Fries and the Food System: A Year-Round Curriculum Connecting Youth With Farming And Food, by Sara Coblyn. Lincoln and Roxbury: A publication of the Food Project.

The Death of Ramon Gonzales: The Modern Agricultural Dilemma, by Angus Wright 1990. University of Texas Press.

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Introduction

This activity is designed to show students that farms are complex ecosystems where insects can be more than just pests. Students will learn about the wide diversity of insects that play important and beneficial roles on the farm as pollinators, predators, parasites, and decomposers. They will also learn that pests and beneficial insects often exist in interdependent food webs, and that when we attempt to eliminate pests, we may end up hurting the beneficial insects that help us. Students will see that Integrated Pest Management (IPM) requires farmers to be knowledgeable about the life cycles of pests and their natural enemies. They will also learn that there are many effective non-chemical methods that farmers and gardeners use to control pests. By minimizing or eliminating the use of hazardous materials these methods reduce or avoid harm to beneficial organisms, farm workers, consumers, natural ecosystems and wildlife.

To Lead This Activity You Need to Know

Facilitators of this activity need to have the following basic understandings in order to effectively lead students through this activity:

- How to identify beneficial insects in their different life cycle stages
- How to identify pests in their different life cycle stages
- How to recognize pest damage to crops
- How to monitor pest and beneficial insect populations
- What differences exist between different pest management practices such as biological, cultural and chemical controls

Key Concepts

- Food webs
- Pests
- Beneficial insects, including predators, parasites and pollinators
- Insect habitat, including insectary plants
- Pest monitoring
- Biological control
- Chemical pest control
- Cultural controls
- Integrated Pest Management (IPM)

Objectives

- See a farm or garden as a complex food web
- Recognize different insects and what roles they play in the food web
- Understand the importance of insect habitat
- Monitor for pest and beneficial insects

- Understand pest management decision making

Materials

- A farm or garden where IPM is practiced
- Clipboards (1 for every 3-4 students)
- Insect I.D. sheets. Single page sheets with pictures of pest and beneficial insects common to the farm, in the various stages of their life cycles. (At the end of this activity guide are several sample I.D. sheets, a blank I.D. sheet template to use in making additional sheets for some of the important insects found on your farm and information on how to easily access images to use in your I.D. sheets.)
- Sweep nets (one for every 2-3 students)
- Light colored cloths large enough to catch insects that fall off of shaken plants
- Clear plastic containers with lids for capturing and viewing insects
- Magnifying glasses, hand lens or other tools to observe insects in the field (at least 1 for every 3-4 students)
- Food web insect picture cards (sheets with pictures of insects included in this activity guide)
- A large piece of poster paper or a display board
- Tape and markers for use with the poster or display board

A day or so beforehand, identify the crop(s) and pest(s) that will be the main focal points of the activity. Diagnostic symptoms of insect damage that are often easiest to study include the following: holes in leaves and other plant parts caused by pests with chewing mouthparts such as caterpillars and beetles, puckering or curling of leaves caused by insects with piercing-sucking mouthparts such as aphids, and leaf tunneling damage caused by insects such as leafminers. In addition, frass or excrement can be a helpful diagnostic sign of some insects.

Activity (45-50 minutes)

The Farm as a Food Web (10 minutes)

1. After welcoming the students to the farm or garden and describing it briefly, tell them that the focus of the day's visit is going to be learning about some of the insects that live on the farm. Ask them if they think that most insects are good or bad for the farm. Ask them to explain their answers – how are the insects good or bad. Fill in the missing parts if they don't explain how many insects are helpful or beneficial, but others can be damaging pests on crops. Give them examples to consider such as honeybees (beneficial – pollinators), lady beetles, (beneficial – predators) and aphids (pests – herbivores, disease transmitters).
2. Show the students a crop that has insect damage. Explain that farmers can tolerate some pests but need to limit crop damage so that they sell enough produce to stay in business. To protect their crops, some farmers use chemicals called insecticides to kill insect pests. Explain that these pesticides can be expensive and can harm farmers, farm workers, consumers, beneficial insects and the environment. However, farmers can also use other measures to control pests and limit their impacts. These

include rotating their crops, growing a diversity of crops instead of a monoculture, timing crop plantings and harvests to avoid likely periods of high pest numbers and maintaining healthy soil.

3. Explain that in a healthy farm all the insects are part of a complex food web. Ask the students to describe a food web. Explain that a food web is a way of describing the feeding relationships between organisms in a certain place. Explain what carnivores, herbivores, primary producers, and decomposers are, and how they interact. There are food webs in all ecosystems, including tropical rain forests, arid deserts and temperate grasslands as well as in rivers, lakes and oceans. Food webs exist in “man made” environments too, not only farms and gardens but also in and around our homes and neighborhoods. Ask students to name some pests and predators of those pests in or around their homes. These might be mice, rats, birds, cats and dogs. Ask how these creatures interact. What are some of the reasons people might have cats around? Do they include catching mice and rats?
4. Draw on butcher paper a basic food web diagram with simple drawings of common organisms students could easily recognize. Represent primary producers (crop or pasture plants), herbivores (cows, deer), omnivores (humans), predator carnivores (hawks), parasites (fleas, intestinal worms) and decomposers (fungi, centipedes). This drawing will serve as a visual concept model to demonstrate and remind students of the functional relationships between organisms.

Monitoring (35-40 minutes)

1. Explain that farmers need to make a regular accounting of the pest and beneficial insects on their farms to know if pest populations are at or near damaging levels. They also need to know if there are predators and parasites present that can help keep the pest damage down. Regular observations of crops for pests, their damage, and signs of beneficial insect activity enable farmers to make informed and effective crop protection decisions. Making these observations and keeping records of them is referred to as the monitoring part of pest management. It is the collecting and recording of information on the condition of the farm’s dynamic food web.
2. Have the students break into groups of about five (ideally with one facilitator per group), and give each group a copy of the Insect I.D. Sheets with pictures of the pests, predators, and parasites that they will encounter. Have each group work in at least one crop. Instruct them on how to look for and identify the pests and natural enemies in the crop; facilitators may need to help them figure out good ways to look for insects and their impacts.
3. Show students what healthy crop plants with no pest damage look like. Ask the students to find something that could be insect damage or an insect pest. Let them look around on their own. Use insect nets or other methods to catch samples of the insects. One way to gather and observe the insects is to place a white cloth on the ground below the plant and brush against and beat the plant to shake some of the insects free. If necessary, transfer the insects to small jars or clear plastic boxes for observation. Magnifying lenses and plastic boxes with built-in magnifying lenses work well for up close viewing of insects. If one student finds something s/he thinks might be damage or a pest, call everyone’s attention to it. Let the student tear off a

leaf or plant part that has the damage or pest. Ask the student to pass it around to show other students up close. Ask the student to describe what it looks like and if it matches any of the insect I.D. sheets. Have the students try to figure out which insect is causing the damage. Do this process repeatedly until several clear examples of pest damage and pests are found. Ask all the students to successfully find an example of the damage or pest in the crop. Give the students about 10-15 minutes per crop. If time allows, have each student look at more than one crop.

4. Monitoring also involves searching for the presence of natural enemies. Introduce the students to the presence of beneficial insects through the procedure similar to the one use with the pest insects. Let the students search for beneficial insects or evidence of them in locations you have previously determined to have some good examples. Some examples, such as mummies of parasitized aphids, may be present on the same samples the students found pests. Some examples may need to be visited away from the crop or collected beforehand. Common examples include lady beetles, lacewing larvae and parasitic wasps which may be caught in sweep nets.
5. Farmers may also work to maintain beneficial insects and natural enemies by growing plants that provide shelter, nectar and/or pollen. If such insectary plants are nearby, show them to the students and explain how these plants can provide food and habitat for many types of parasites and predators. Let students observe the insect activity around the plants for a little while. Explain that creating habitat that attracts predators and parasites is one way to encourage biological control, or “bio-control,” of pests. Ask the students if they know about the life cycle of these beneficial insects and why planting flowers may promote the control of pests in crops. If necessary, explain these concepts to the students.

Discussion and Reflection (10-15 minutes)

Food web

1. Pass out insect and plant picture cards and identify the insects that play the various roles, such as crop, pest, predator, and parasite.
2. Help the students create an example of a food web that exists on the farm by posting the different insect and plant cards on a display board or large poster paper and drawing the arrows showing the feeding relationships.
3. Ask them what would happen if all the predators or parasites were removed? If necessary, you can help them to understand by physically removing the cards that represent the predators and parasite and explaining that pest populations will likely increase. You can also ask the students what they think might happen if people’s cats disappeared. What would happen to the rodent population?
4. Explain that a healthy farm will probably have a low population of certain pests such as aphids and these may help maintain the population of beneficial insects that use them as food or hosts.

Food and farm worker safety

1. How can you know what pest management practices were used to grow the food you eat? Ask the students if they think about how the food they eat is grown. Is it grown in a way that is safe for the consumer, the farmers and farm workers who grew it and for the environment? Ask if they have ever seen signs in grocery stores about how the food was grown and whether or not the farmer used pesticides?
2. Ask the students if they have heard of organic food? Ask them what they think might be some of the differences is between organic food and the other food sold in the grocery store? What might be some of the benefits of growing organically for the farmer and farm workers? What might be some of the disadvantages of organic farming? What might be the benefits to the consumer? Ask the students if they have ever had a vegetable garden at home or in their community, or if they have considered it. Might this be a good way to know whether their food was grown with pesticides or not? You might suggest that they can purchase food directly from the farmer, such as at a farmer's market, where they can ask the farmer how they grew the food.

The following pages are examples of Insect I.D. sheets that can be made with images from the University of California, Integrated Pest Management Program web site (<http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html>). The examples contain pictures of a few common pest and beneficial insects in the various stages of their life cycles. The last page is a template you can use to make additional Insect I.D. sheets with images from this website for students to use in this activity.

Insect photos were sourced from the University of California, Integrated Pest Management Guidelines: How To Manage Pests of Agriculture <http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html>.

Crop photos were sourced from Damian Parr.