BIOLOGICAL CONTROL

eGENTS

elementary. Guest Entomologists & Newly Trained Scientists

This workbook is part of a project that was initiated in 1993 by Dr. Tony Shelton and originally funded, in part, by the National Biological Control Institute and the Department of Entomology at Cornell's New York State Agricultural Experiment Station (now merged with its Ithaca colleagues into a single department). Additional funding has been provided by Dr. Tony Shelton's program and, most recently, by a grant from Cornell Cooperative Extension. Funding is welcome from other sources who will be recognized for their contributions.

Cornell University

Please visit the Biological Control : A Guide to Natural Enemies in North America website at:

www.biocontrol.entomology.cornell.edu

or The Cornell University Department of Entomology website at:

www.entomology.cornell.edu

for additional Program information.

Introduction: The Goal of this Workbook

You are about to embark on a very interesting journey into the world of Biological Control!

Biological control, or BioControl, is a way for people to protect their plants, animals, and structures from "bad" insect pests that want to eat them or use them for their own benefit. These pests can be common in certain areas, arrive during certain seasons, or be imported accidentally from very, very, far away (even other countries!). Although biological control can be used to control many different kinds of pests (insects, weeds, and disease-causing organisms), we'll focus on insects. BioControl uses "good" insects (also called Natural Enemies) to get rid of the "bad" pests, usually by eating them.

Use this workbook along with your community garden to learn how to identify "good guys" and "bad guys". If you find out what to look for, you might even be able to save your plant if "bad guys" get in!

At the end of this project there is a reward for you to unlock, so pay close attention and most importantly, HAVE FUN!

What to Look For: Plants and Pests

Here is a list of some typical plants in your garden and what pests you might find on them. If your plant isn't in this book, use the website ***web.entomology.cornell.edu/shelton/veg-insects-ne*** (it also has bigger pictures).

TOMATO

EGGPLANT

BROCCOLI

SUNFLOWER

PEPPERS

BEANS

SWEET CORN

Identification: What is On and Around Your Plant

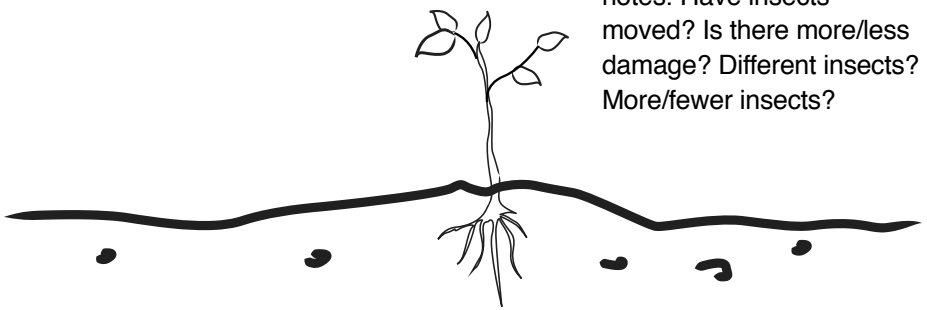
In this section you are going to check your plant and make notes about what insects are on or around it. If you don't know what the insect is, make a few notes (so you don't forget) and look it up later.

Key:

Make the marks below on the drawings. This will help you identify and locate anything living on your plant.

1	DAMAGE	2	PESTS	3	BIO CONTROL AGENTS
1a	Holes in Leaves	2a	Caterpillars	3a	Spiders
1b	Leaf Deformity	2b	Aphids	3b	Ladybird Beetles (Ladybugs)
1c	Holes in Stem	2c	Plant-Eating Beetles	3c	Other Beetles
1d	Damaged Fruit	2d	Maggots	3d	Lacewings
1e	Chewing on Roots	2e	Thrips	3e	Praying Mantis
		2f	Mites	3f	Wasps
		2g	Other Insects	3g	Other Bio Agents

WEEK 1

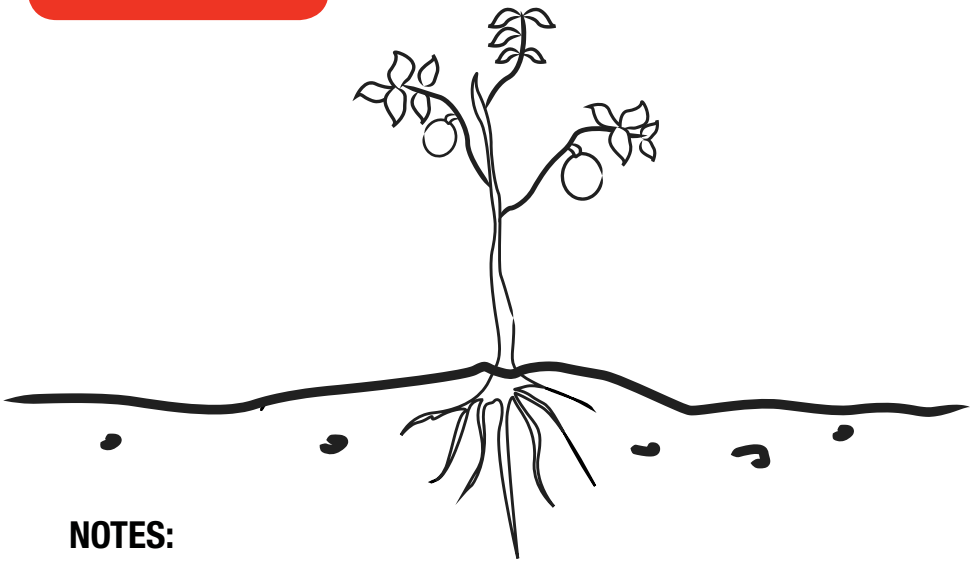


Your plant will change from week to week.

Be sure to make detailed notes. Have insects moved? Is there more/less damage? Different insects? More/fewer insects?

NOTES:

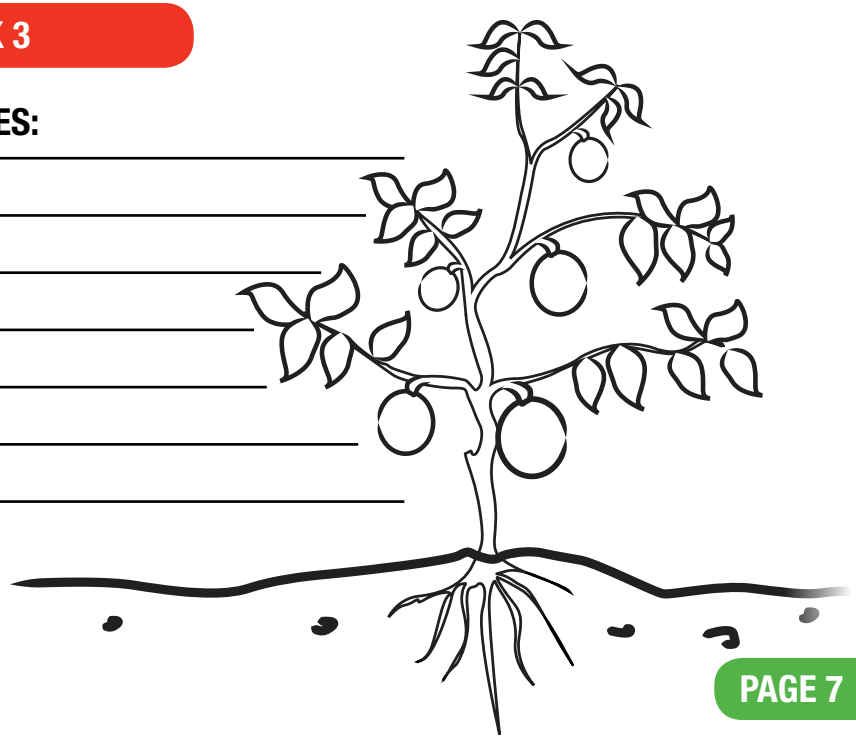
WEEK 2



NOTES:

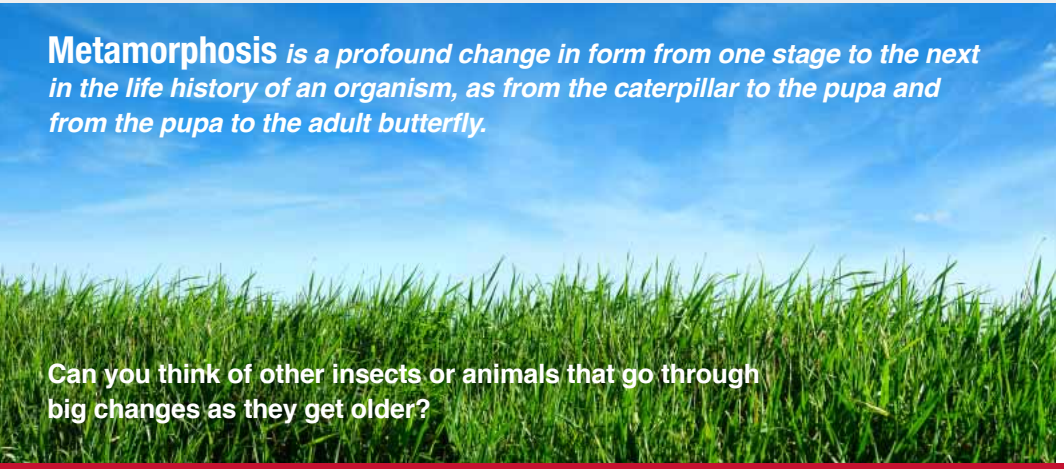
WEEK 3

NOTES:



Identification: Life Cycles

Insects have different stages in their life cycles and many look VERY different in the end than they do in the beginning. The major changes that insects go through sometimes makes it difficult to identify them. Here are life cycle diagrams of three common insects that you might find in your garden. Look carefully!

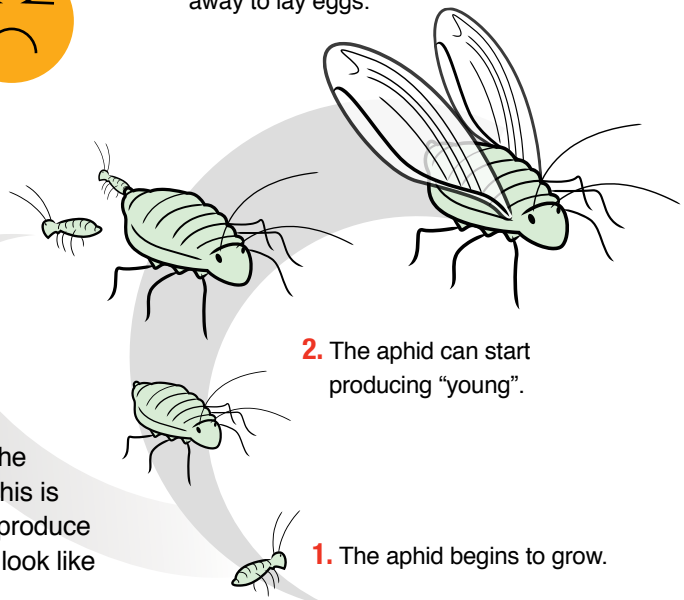


Metamorphosis ***is a profound change in form from one stage to the next in the life history of an organism, as from the caterpillar to the pupa and from the pupa to the adult butterfly.***

Can you think of other insects or animals that go through big changes as they get older?

APHID - PEST

Aphids are very interesting insects. You will not likely find any aphid eggs because adult aphids grow wings at a certain stage of their life cycle and fly away to lay them. However, you may see small aphids coming out of the rear of a bigger one. This is because adult aphids produce live young aphids that look like adults but are smaller.



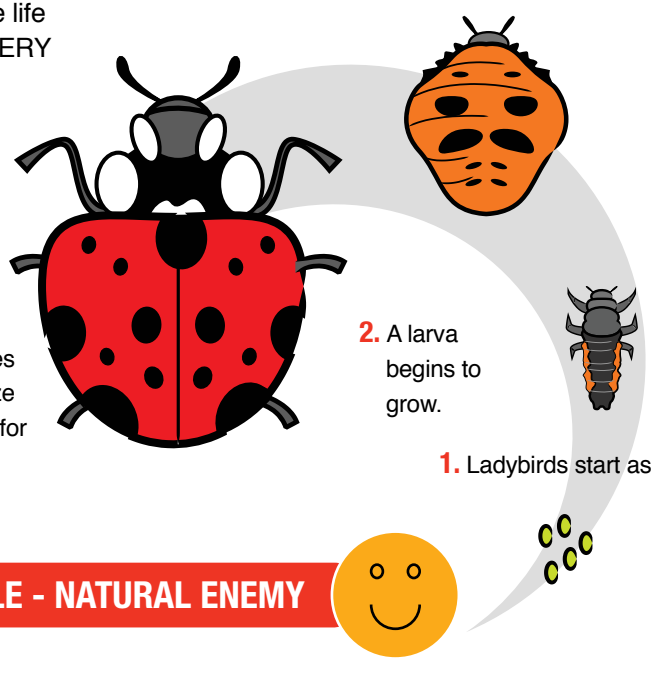
1. The aphid begins to grow.

2. The aphid can start producing "young".

3. The aphid grows wings and flies away to lay eggs.

LADYBIRD BEETLE - NATURAL ENEMY

Look for all of these stages of the ladybird beetle life cycle. They are all VERY different-looking and interesting.



1. Ladybirds start as eggs.

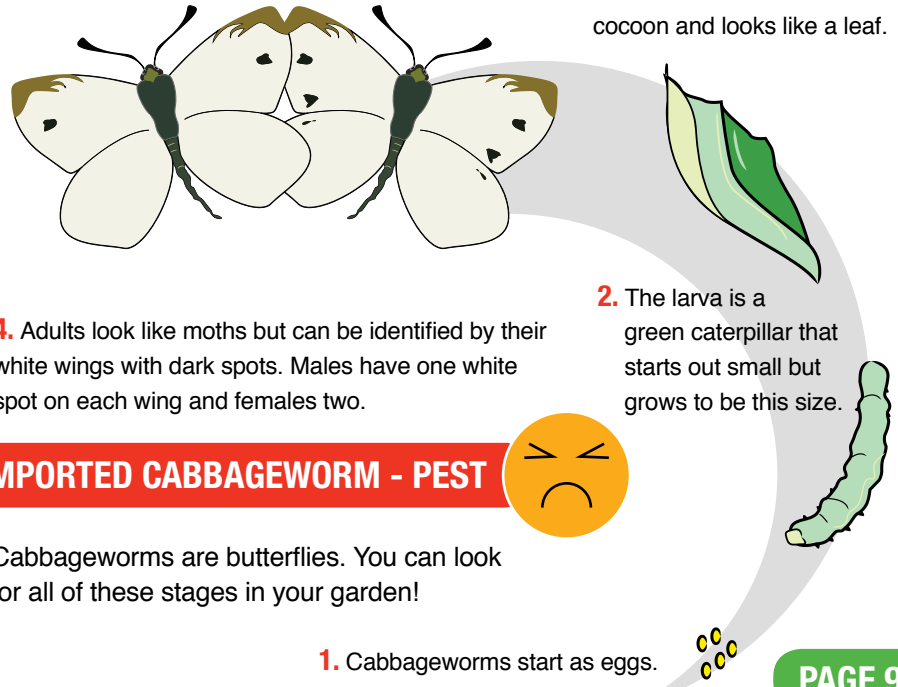
2. A larva begins to grow.

3. The next stage is a pupa.

4. Adult ladybird beetles are easy to recognize and many are good for your garden!

IMPORTED CABBAGEWORM - PEST

Cabbageworms are butterflies. You can look for all of these stages in your garden!



1. Cabbageworms start as eggs.

2. The larva is a green caterpillar that starts out small but grows to be this size.

3. The larva turns into a cocoon and looks like a leaf.

4. Adults look like moths but can be identified by their white wings with dark spots. Males have one white spot on each wing and females two.

Meet Some Natural Enemies: The “Good Guys”

Natural Enemies are good because they can stop major damage from spreading to many habitats, including farmers’ crops and your own garden. But using these “good guys” is a science and you have to be careful when using them. If you introduce one insect to control another, you have to make sure it doesn’t have bad effects. This is why BioControl insects are studied VERY closely, so they don’t stop one pest and then become a pest themselves!

There are four different kinds of Natural Enemies; 1. **Predators, 2. Pathogens, 3. Weed-feeders, and 4. Parasitoids**.

Predators of insects and mites include beetles, true bugs, lacewings, flies, midges, spiders, wasps and predatory mites. Some are extremely useful natural enemies of insect pests. Unfortunately, some prey on other beneficial insects as well as pests.

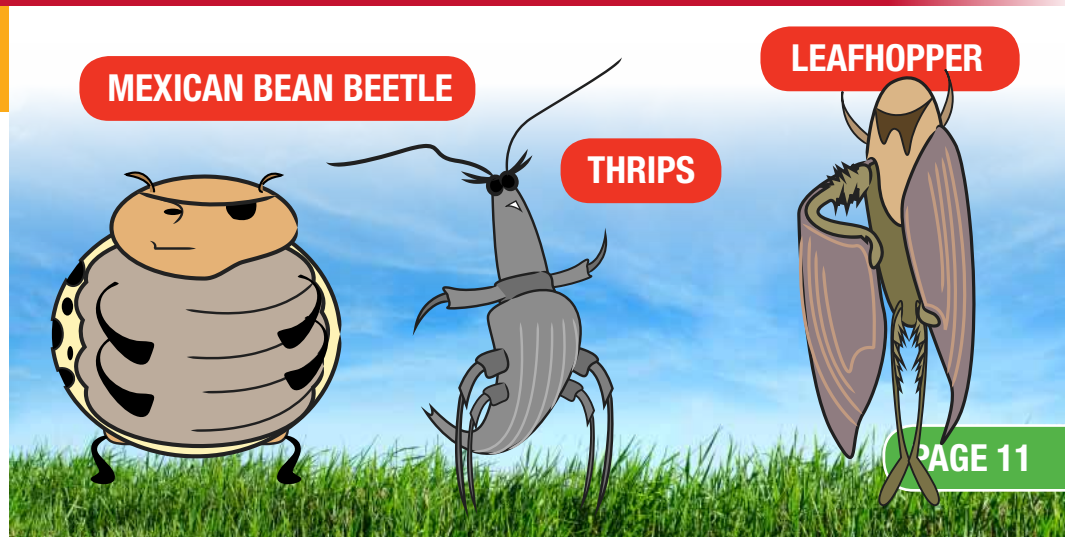
Insects and mites, like plants, humans and other animals, can be infected by disease-causing organisms such as bacteria, viruses, and fungi, called **Pathogens.**

Weeds can be carried to far away places by animals and the wind. **Weed-feeders** can control these foreign weeds by feeding on seeds, flowers, leaves, stems, roots, or by transmitting plant pathogens, which will infect plants.

The young of **Parasitoids** grow on or within an insect pest (called the host). The young eats the host and kills it. Bye-bye “bad guy”!

Meet Some Pests: The “Bad Guys”

You might think of your little brother or sister as a pest but they are nothing compared to these guys. Insect pests can destroy golf courses, forests and even your garden! Biological Control is a great way to stop them and can be used in place of, or even alongside insecticides. If you can learn to identify these “bad guys”, you can research what “good guys” can stop them and maybe save a garden or even a whole farm!

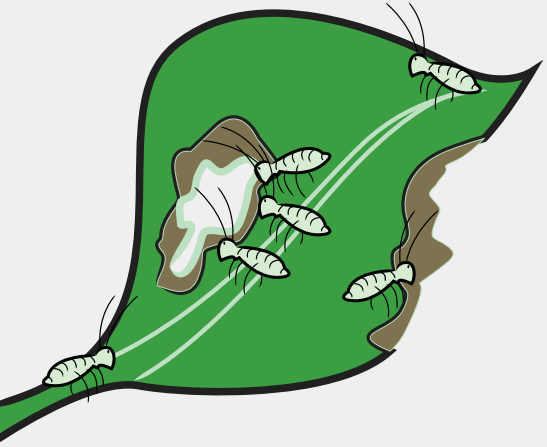


Experiment #1: The Disappearing Aphid

Are ladybird beetles (ladybugs) magicians? Try the experiment below if you can capture a leaf full of aphids and a ladybird beetle.

STEP 1

Find a ladybird beetle and a leaf infested with aphids. Capture the ladybird and pick the leaf off the plant.



STEP 2

Place the leaf in a jar with all the aphids still on it along with the ladybird. Then place a piece of cloth on top (so the insects can breathe) and put a rubberband on the rim of the jar.

STEP 3

Observe the aphids and answer the questions below. Be sure to release the ladybird when you are done.

How many aphids are in the jar to start?

2 hours later how many aphids are in the jar?

6 hours later how many aphids are in the jar?

1 day later how many aphids are in the jar?

3 days later how many aphids are in the jar?

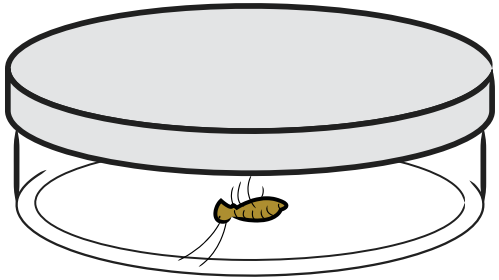
What do you think happened?

Experiment #2: The "Popping" Brown Aphid

If you find a brown aphid on your plant(s) use the instructions below to see some really cool Biological Control in action!

STEP 1

Collect the brown Aphid(s) and put it in a container with a lid (make sure the lid has holes or use a cloth like in experiment #1.



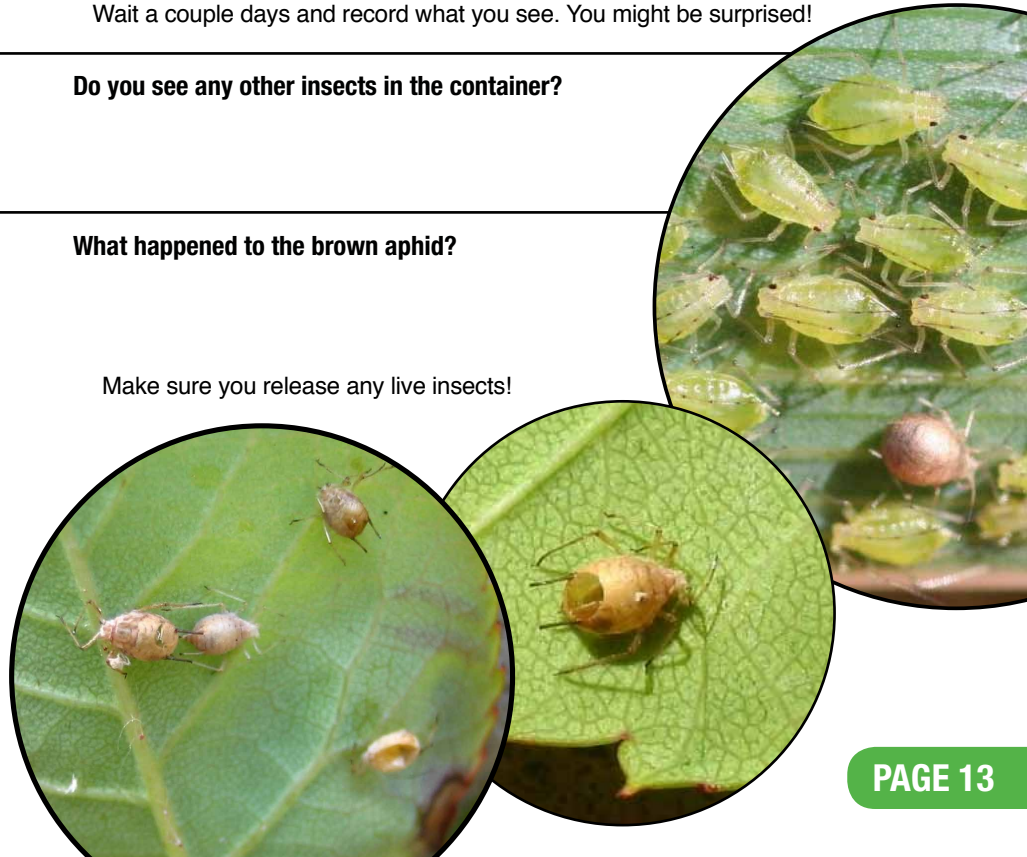
STEP 2

Wait a couple days and record what you see. You might be surprised!

Do you see any other insects in the container?

What happened to the brown aphid?

Make sure you release any live insects!



Summary: Journal

Now it's time to find out what you learned!

What is Biological Control?

What does a parasitoid do?

What does a predator do?

What does a pathogen do?

How many stages are there in the life cycle of a ladybird beetle?

What is the most interesting thing you observed in the "disappearing aphid" experiment?

What is the most interesting thing you learned in the "disappearing aphid" experiment?

What is the most interesting thing you observed in the "popping brown aphid" experiment?

What is the most interesting thing you learned in the "popping brown aphid" experiment?

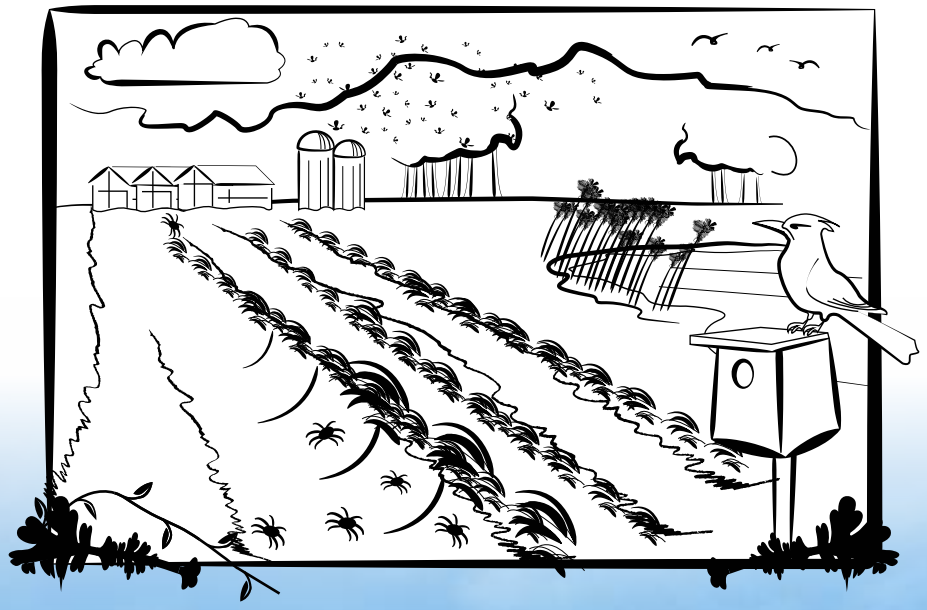
Nice work e.GENT! Here is a reward for completing the program. Have some fun and do some coloring if you like! Here are a couple games to try.

If you have access to the internet you can play the e.GENTS Biological Control game online! Ask your teacher for the website address.

Some insects (called **Parasitoids**) use others to help their young grow and get strong. This usually makes the other insect (called the **Host**) feel very sick.

Can you find the missing images in the picture below?

While you are looking try to find some examples of Biological Control.



ANSWERS/CLUES: Spiders, Bird's Leg/Meal/Hole in bird House, Vine, Tree Trunk, Right Swarm, Greenhouse, Pond Plants

Credits and Resources

If you'd like more information on Biological Control, check out these websites.

A Guide to Natural Enemies in North America: ***www.biocontrol.entomology.cornell.edu***

Cornell University Department of Entomology: ***www.entomology.cornell.edu***

Pests in the Northeastern United States: ***web.entomology.cornell.edu/shelton/veg-insects-ne***

Biology Teaching Resources. Insect Life-Cycles: ***www.biology-resources.com/insects-01.html***

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