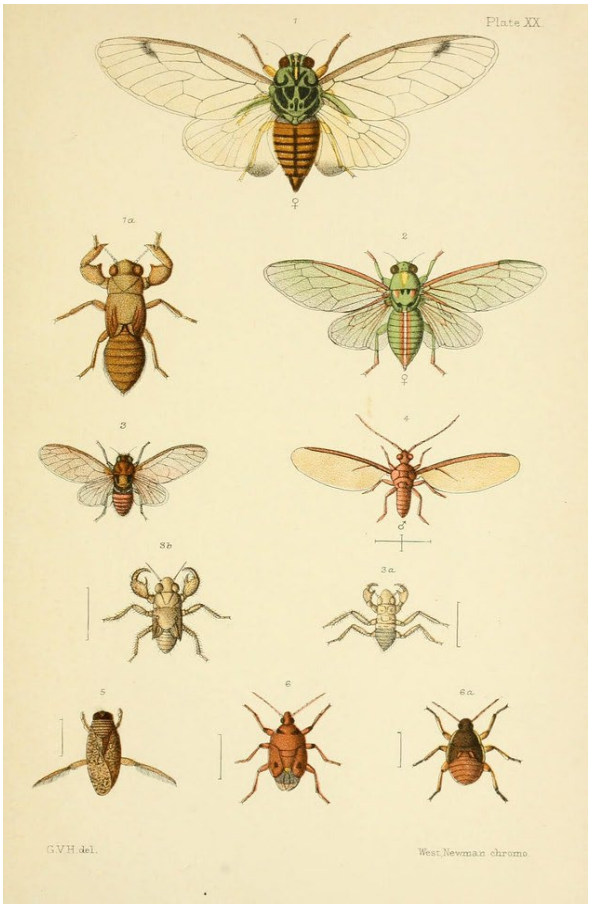
W 1174
1-2 YEARS IN PROJECT

Entomology and Beekeeping Project Area Guide



Beginner Level

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Activity 1 – Insect Basics

Project Outcomes:

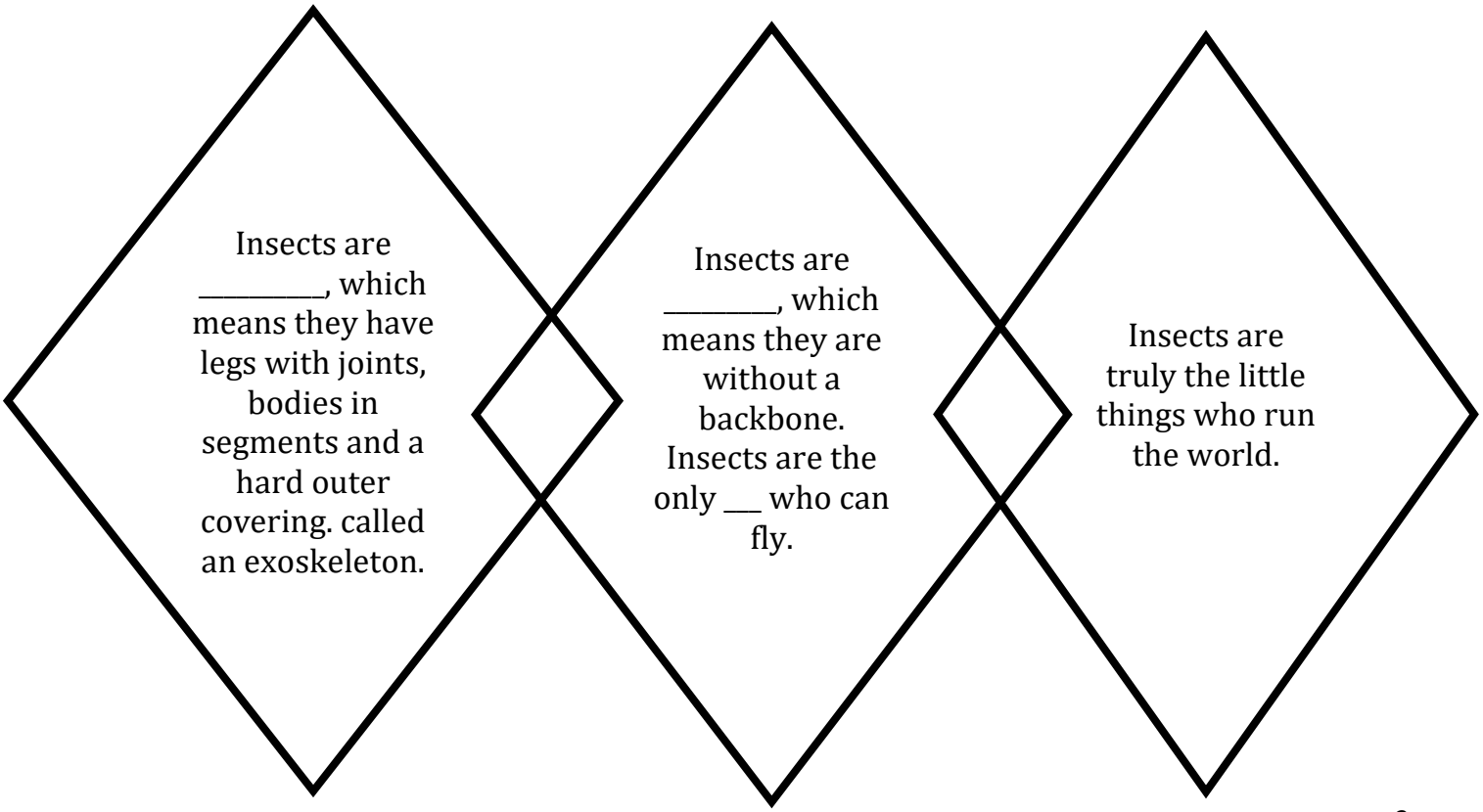
- Define entomology, entomologist, insect, arthropod and exoskeleton
- Explain the importance of entomology
- Describe the phylum Arthropoda
- Explain how insects differ from other arthropods
- List examples of insects (class Insecta) and spiders and other arachnids (class Arachnida)
- Define exotic species and invasive species
- Compare and contrast the differences between exotic and invasive species

Entomology is the study of insects and dates to the time of Aristotle (about 2,400 years ago), when biology became a formal field of study. However, humans worked with insects before then. More than 4,000 years earlier, people living in China used insects as part of their daily lives when growing silkworms. Entomology also looks at the relationship of insects to humans, the environment and other organisms. Studying insects leads to discoveries in biological and chemical pest control, food and fiber production, biological diversity, pharmaceuticals (medicines), epidemiology (occurrence of disease), and other fields of science. Using the information above, describe in your own words what you think an entomologist might do.

_____

_____

Watch this short video, youtu.be/YjOFjzLgY0M, and fill out this infographic.



Type equation here.

Why do you think entomology is important to humans?

_____

_____

_____

Watch these two videos and answer the following questions:

- youtu.be/cTZcBG8Hs8A
- youtu.be/TZj3MOlke8A

1. What surprised you the most about the entomology collection exhibited in the video?

_____

_____

2. From these videos, why do you think entomology is important?

_____

_____

3. Why is pin placement of insects important?

_____

_____

4. How does entomology play a role in our economy?

_____

_____

5. What impact do insects have on our lives?

_____

_____

Learn what an entomologist does by watching this video: youtu.be/Q-38ocCB0ss

Record three things you learned.

1. _____
2. _____
3. _____

Who needs an entomologist?

1. _____
2. _____

Name where you might find an entomologist working.

1. _____

Find a credible source to verify your responses above. Be sure to use a website that ends in __.edu, __.org or __.gov.

Research and name six animals that are arthropods.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

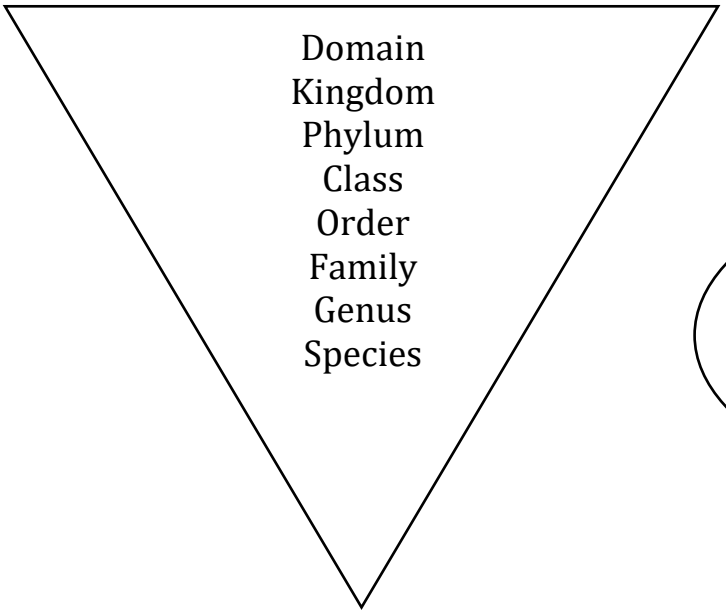
Name some distinguishing features of an arthropod.

- _____
- _____
- _____
- _____
- _____

Insects are a part of the phylum Arthropoda. Research four different insects and fill out the taxonomy classification for each insect you list.

1. _____
2. _____
3. _____
4. _____

Taxonomy classification is the organized classification of living and extinct organisms by naming, defining and classifying groups of organisms by shared characteristics. The taxonomy works by listing it from the most generic to the most specific.



Arthropods fall under the phylum classification. Arthropoda is the largest phylum in the animal kingdom.

Insect 1

_____

Domain:
Kingdom:
Phylum:
Class:
Order:
Family:
Genus:
Species:

Insect 2

_____

Domain:
Kingdom:
Phylum:
Class:
Order:
Family:
Genus:
Species:

Insect 3

_____

Domain:
Kingdom:
Phylum:
Class:
Order:
Family:
Genus:
Species:

Insect 4

_____

Domain:
Kingdom:
Phylum:
Class:
Order:
Family:
Genus:
Species:

Watch this video, youtu.be/puKoq5fzyAg, from the Smithsonian where Dan Babbitt, manager of the Smithsonian's Insect Zoo, shows why the name of the zoo is a little imprecise. The Insect Zoo is home to all five major groups of arthropods – insects, arachnids, crustaceans, millipedes and centipedes – all of which Babbitt defines. This video is less than three minutes long. After you watch it, answer the following items..

1. Explain how insects differ from other arthropods.

_____

_____

_____

_____

_____

2. List examples of insects, as well as spiders and other arachnids.

_____

_____

_____

_____

_____

Watch these videos:

- youtu.be/f7JY4-ZsRDw
- youtu.be/7KSVqGaXhGw
- youtu.be/spTWwqVP_2s

Create your own definitions for the following:

- Non-native species

_____

_____

_____

_____

_____

- Invasive species

_____

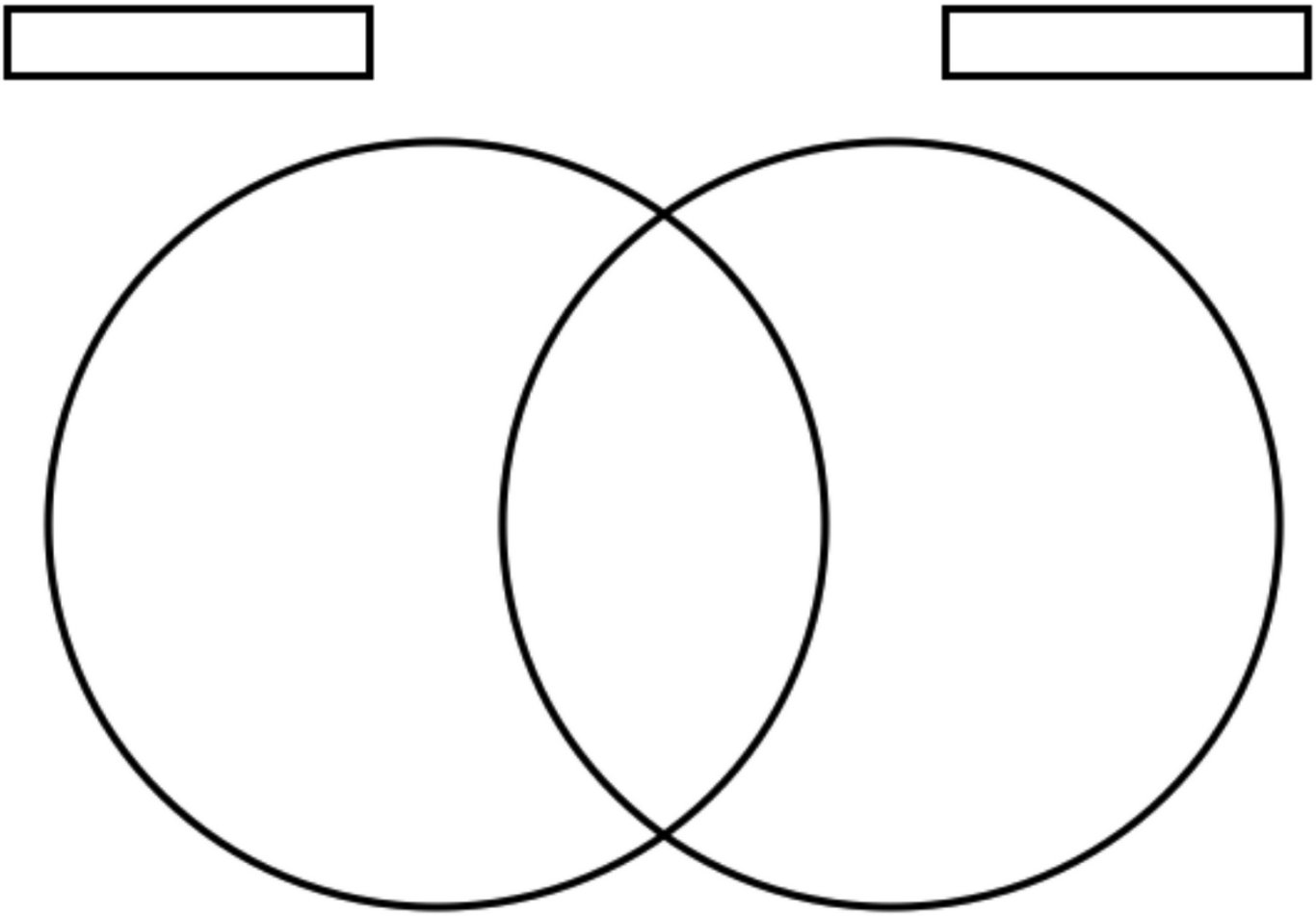
_____

_____

_____

_____

Complete the Venn diagram to understand the differences and similarities of non-native and invasive species.



Sources:

entomology.wsu.edu/prospective-students/the-what-why-of-entomology
entomology.unl.edu/scilit/what-insect
environmentalscience.org/entomology
britannica.com/science/taxonomy

Investigate invasive beneficial and pest insects in Tennessee.

The chart below has a list of insects in each category. Research each species, then insert a picture and add a description of why the insect is in this category. Not all the invasives listed are in Tennessee yet.

Beneficial insects in Tennessee	Invasive pest insects in Tennessee
Ladybug	Imported fire ant
Damsel bug	Emerald ash borer
Lacewing	Hemlock woolly adelgid
Honeybee	Spotted lanternfly
Dragonfly	Africanized honeybee

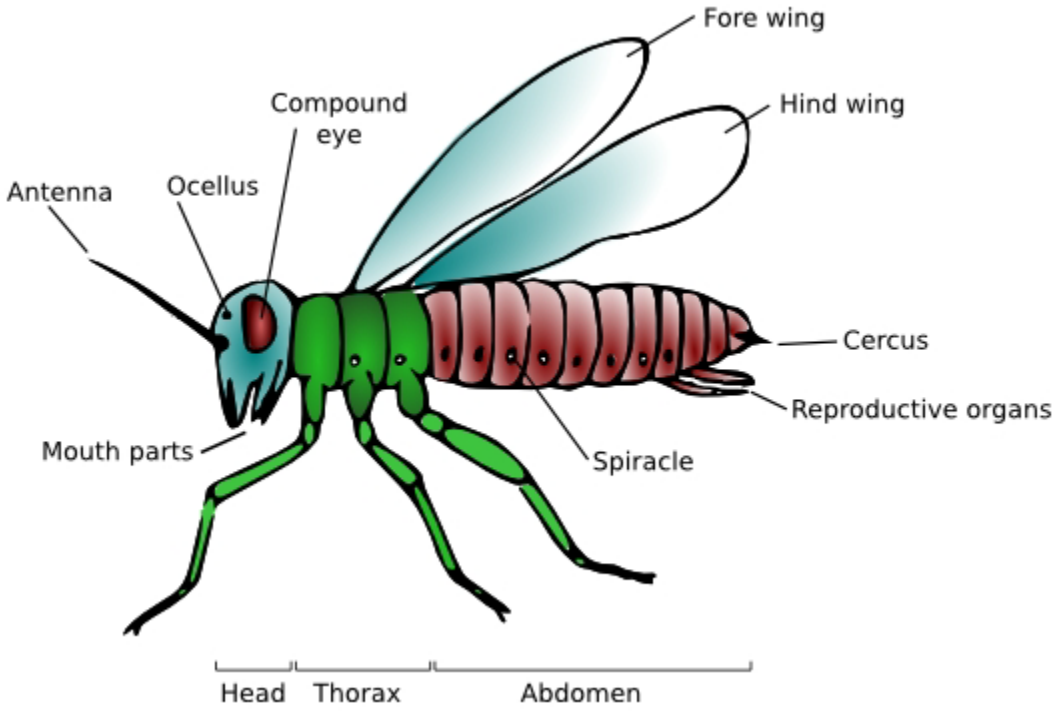
Activity 2 – Insect Body Parts

Project Outcome:

- Identify the major insect body parts, including the head, thorax, abdomen, antenna, compound eye, leg, spiracle and wing, and explain their functions.

Let's get crafty:
Create two different insects using materials you have at home. Use the examples below or use your imagination to mimic an insect.

Below is a labeled insect. Take your homemade craft and label the different parts of your insect. Feel free to research other sources to be as accurate as you can.



Watch this video, youtu.be/ZVVWDUVSVhk, to learn more about the parts of the insect. Then complete the note graphic below.

What are the three regions of the insect?

1.

2.

3.

What are the parts of the head?

1.

2.

3.

4.

The top of the prothorax is called the _____.

What are the three segments of the thorax?

1.
2.
3.

What are the four mouth parts?
1.
2.
3.
4.

Name the parts of an insect leg and their functions.
1.
2.
3.
4.
5.

On which two segments of the thorax can you locate the insect's wings?

1.

2.

Where is each pair of legs found?

What can you find at the end of the abdomen?

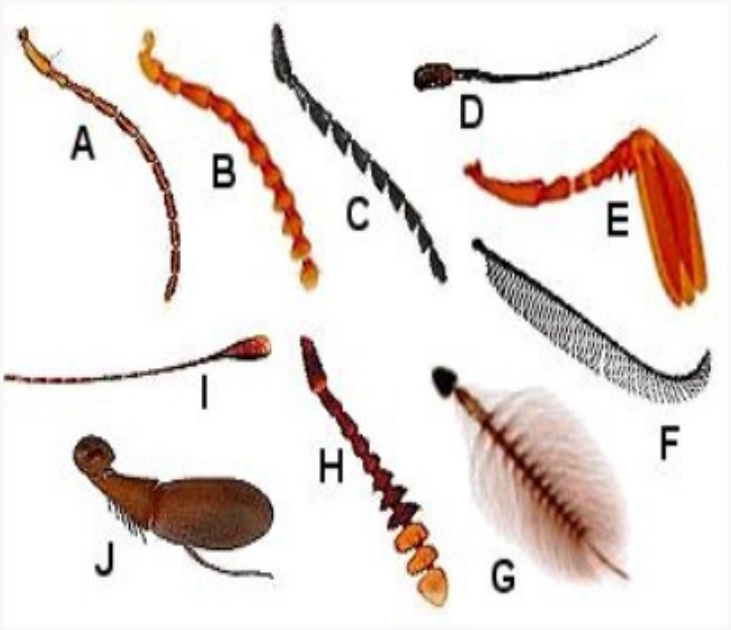
Conduct research using a credible source to name three interesting facts about the usage of any insect's body part listed above.

1._____

2._____

3._____

Antennae (singular antenna) are paired sensory organs on the heads of insects. Antennae are sensitive to touch, smell and, in some species, sound. Antennae are made up of several segments, and different groups of insects have different forms of antennae.



Conduct research using credible sites and identify the forms of antennae pictured at left.

A. _____

B. _____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

Pectinate
- sawfly
- spring fishfly
- spongy moth

Aristate
- flesh fly
- tachinid fly
- leaf predator fly

Capitate
- picnic beetle
- red flour beetle

Clavate
- carrion beetle
- butterfly
- clavate tortoise beetle

Geniculate
- reddish brown stag beetle
- ant
- clown beetle

Filiform
- black blister beetle
- gray fishfly
- camel cricket

Setaceous
- cockroach
- dragonfly
- damselfly
- bark lice

Plumose
- glowworm (Phengodes)
- midge
- mosquito

Serrate
- black firefly
- fishfly
- darkling beetle

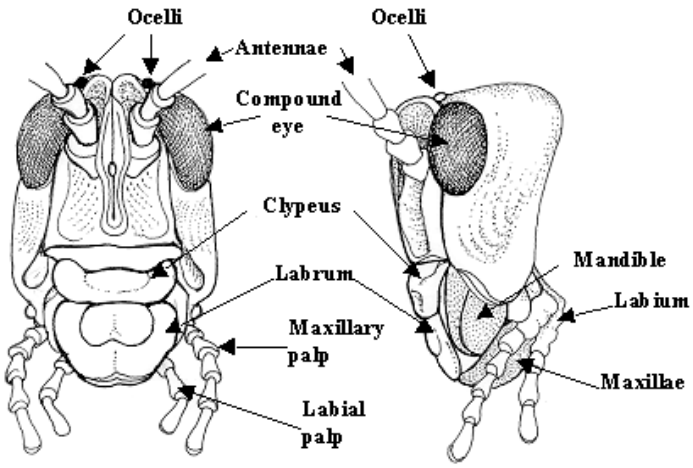
Stylate
- robber fly

Moniliform
- termite
- blister beetle
- bronzed blister beetle
- wrinkled bark beetle

Lamellate
- dung roller
- rhinoceros beetle
- northern masked chafer
- earth borer

The head includes the brain, mouth parts and organs like the antennae, compound eye and ocelli, which help the insect sense things. The head is a sturdy structure.

Use credible sources to learn more about the different parts of the head that are not mentioned in this activity packet.



Compound eye:
Learn more about an insect's eye by watching these videos.

- youtu.be/Lpt0XN_G8Tc
- youtu.be/QLzyW9MFSlI
- youtu.be/0XxCrDVqvMQ

Name three parts of the insect eye.

1. _____
2. _____
3. _____

Name two things you did not know about the eye before watching the videos.

1.

2.

What is the difference between apposition eye, superposition eye and ocelli?

Sources:
amentsoc.org/insects/glossary/terms/thorax
amentsoc.org/insects/glossary/terms/abdomen
genent.cals.ncsu.edu/students/lab-schedule/1455-2
bugguide.net/node/view/142285
bugguide.net/node/view/110592
bugguide.net/node/view/110596
bugguide.net/node/view/110597
bugguide.net/node/view/124693
bugguide.net/node/view/110600
bugguide.net/node/view/111808
bugguide.net/node/view/110549
bugguide.net/node/view/110594
bugguide.net/node/view/110593
bugguide.net/node/view/110590
blogs.evergreen.edu/fieldstudy-weacol19/types-of-antennae
geol.umd.edu/~tholtz/G331/lectures/331arthr3.html

Activity 3 – Importance of Recordkeeping

Project Outcome:
- Describe the importance of careful observation and recordkeeping.

Describe why an entomologist should be efficient at recordkeeping.

_____

_____

_____

Use credible resources to explore how entomologists need recordkeeping skills and what type of data entomologists may keep.

What types of records should entomologists keep?

_____

_____

_____

_____

_____

_____

_____

What kind of equipment helps entomologists properly observe their specimens?

_____

_____

_____

_____

_____

_____

_____

List your sources:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

When collecting insects, what information should entomologists include on their labels?

_____

_____

_____

_____

_____

When entomologists are conducting fieldwork, what type of information do they collect in the field?

_____

_____

_____

_____

_____

How can detailed recordkeeping skills help an entomologist with an integrated pest management (IPM)?

_____

_____

_____

_____

_____

_____

_____

_____

What other information did you find?

_____

_____

_____

_____

_____

_____

Observation and recordkeeping label activity

Objective: Make an insect trap, leave it out overnight and examine your catch the following day.

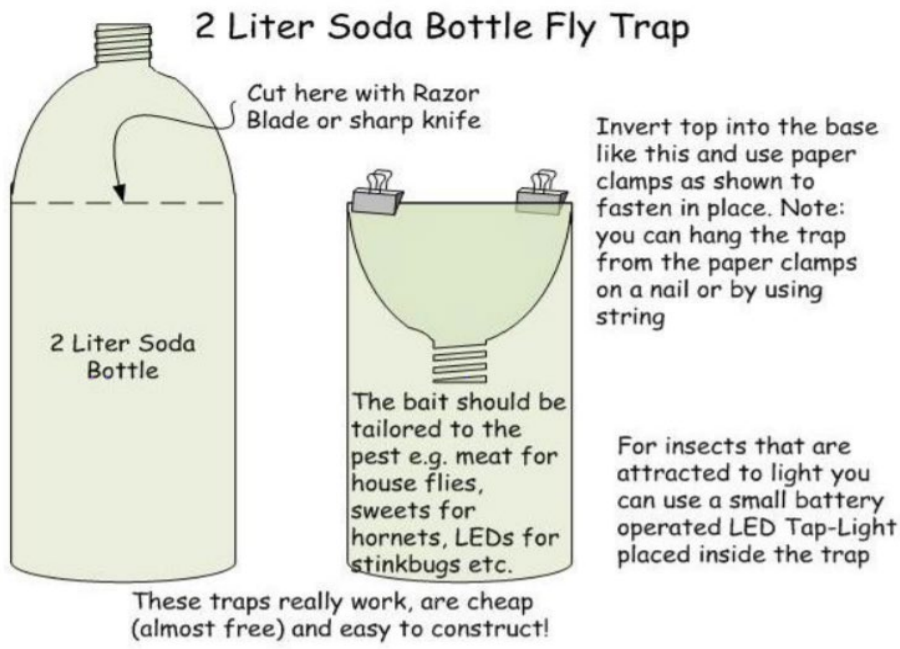
Materials for making traps (recycled where possible!):

- Bottles
- Bowls
- Old sheets
- Wooden dowels
- Tape
- Scissors
- Bait to attract insects will vary depending on species, but can include meat, fruit or even a small light.

Build an insect trap to be placed outside overnight. You can design your own, or use the design below. We recommend using non-lethal traps so that insects remain alive. This allows for observation of insect behavior and teaches that all life is valuable and should be treated with respect.

Once the trap is built and left out overnight, complete the observation report and take pictures to include in your portfolio.

Bottle Traps: Follow the instructions in the diagram below.



Source:
ecolearninghive.org/sites/default/files/Lesson%20Plan%20-%20Introduction%20to%20Entomology%20-%20Collection%20and%20Observation%20of%20Insects.pdf

Observation report completed by: _____

Insect trap type: _____

Date trap was set out: _____

How long trap was left out: _____

How many different insects were collected? _____

Insect name (Conduct research to properly identify your insects.)	Describe what this insect looks like. (Number of legs, size of the insect, type of antennae, wings, etc.)	What is a potential predator of this insect?	What adaptations do you think this insect has?	Are you afraid of this insect? If so, why?	Why do you think this insect was attracted to your trap?	Other details or information you want to share

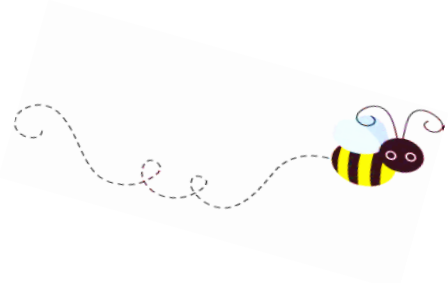
Activity 4 – Pollinators

Project Outcomes:

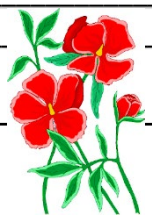
- Explain the importance of honeybees and other types of bees.
- List five non-bee insects that are pollinators.
- List five food crops that need pollinators.
- List five plants in Tennessee pollinated by honeybees and five plants pollinated by other types of bees.

Importance of honeybees:
Watch these vides and learn about pollinators to answer the questions below.

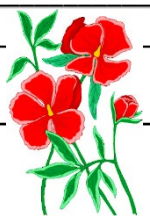
- youtu.be/ZBVVLTz4xuQ
- youtu.be/x0USvv6oeME
- youtu.be/6CxCTyxRFh0



Why are pollinators important?



What plants attract pollinators?



How can we help pollinators?

List five non-bee insects that are pollinators.

List five food crops that need pollinators.

Use these sources to fill in the charts below:

- extension.tennessee.edu/publications/Documents/W1095.pdf
- gardenia.net/guide/great-pollinator-plants-for-tennessee
- nrcs.usda.gov/wps/portal/nrcs/detail/tn/plantsanimals/?cid=stelprdb1142997
- tectn.org/generatesomebuzz.html
- pollinator.org/PDFs/Guides/SoutheastMixedForestrx5FINAL.pdf

Using the sources above, list five plants in Tennessee pollinated by honeybees.	Conduct research and find a picture of the plant to help you identify it.
1.	
2.	
3.	
4.	
5.	
Using the sources above, list five plants pollinated by other types of bees.	Conduct research and find a picture of the plant to help you identify it.
1.	
2.	
3.	
4.	
5.	

Activity 5 – Castes

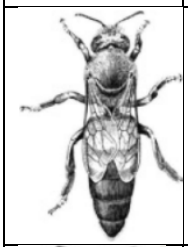
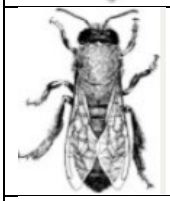
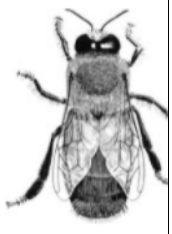
Project Outcomes:

- Define caste, worker, queen, drone and pollinator.
- Describe the castes of honeybees, the races of honeybees, and the honey and wax they produce.

Fun fact from the University of Georgia: Honeybees, like ants, termites and some wasps, are social insects. Unlike ants and wasps, bees are vegetarians; their protein comes from pollen and their carbohydrate comes from the honey they make from nectar. Social insects live together in groups, cooperate in foraging tasks and the care of their young, and have different types, or castes, of individuals. (Source: University of Georgia Extension – Bees)

Use these websites to identify the different types of bees in a honeybee hive:

- uaex.edu/farm-ranch/special-programs/beekeeping/about-honey-bees.aspx
- pugetsoundbees.org/honeybees-101

	Name of the bee	How can you identify the bee?	How does this bee contribute to the hive/colony?	Other important information to note
				
				
				

Create a list of the equipment that a beekeeper needs and an estimated budget for purchasing or replacing the equipment.

Compile beekeeping records to show a change in profit or loss.

Equipment needs vary with the size of your operation, the number of colonies, and the type of honey you plan to produce. Research the different pieces of equipment listed below and fill out the chart. Using blank boxes or additional paper, feel free to list other equipment you find through your research.

Name of equipment	Picture of equipment	How the equipment is used	Estimated cost of equipment
Bee veils			
Smokers			
Hive tools			
Bee brush			
Frame holder			

Hive lifter			
Hive			
Bee suit			
Honey extraction – uncapping knife			
Honey extraction – capping scratcher			
Honey extraction – comb section cutter			
Wax tube fastener			
Spur wire embedder			
Frame cleaner			

Queen cages			
Hive net			
Pollen traps			

Beekeeping records can be a(n):

- Learning tool
- Management aid
- Evaluation of what practices work and do not work
- Diagnostic tool

Recordkeeping can vary among beekeepers. Use the information provided above and other research findings of your own to start creating your beekeeping records.

Review these beekeeping records:

- sfyl.ifas.ufl.edu/media/sfylifasufledu/osceola/documents/agriculture/Copy-of-KVBA-Hive-Inspection-Sheet.pdf
- nybeewellness.org/wp-content/uploads/2014/04/IPM_workshop_-_monitoring_and_record_keeping-1.pdf
- nybeewellness.org/resources/record-keeping-3

Make a list of important items you would want to record as a beekeeper:

-
-
-
-
-
-
-
-
-

Activity 6 – Diversity of Life

Project Outcomes:

- Define biodiversity and evolution.
- Explain the importance of biodiversity.
- Describe the value of insect diversity.
- Develop a definition of diversity and inclusion.

Watch this video, youtu.be/XTC4qiXd36Q, and use your own words to define biodiversity:

_____

_____

_____

Why is biodiversity important?

_____

_____

_____

_____

Use the space below and create a social media post to share the knowledge you gained about biodiversity. Then create a digital version to share at your 4-H club meeting.

View this video, youtu.be/GhHOjC4oxh8, and this website, yourgenome.org/facts/what-is-evolution. Use your own words to define evolution:

_____

_____

_____

Biodiversity Lab Experiment

Materials needed:

- Three plastic yellow bowls (You can use other bright colors to experiment with but yellow will probably give you the best results.)
- Three plastic containers with lids (can be an old peanut butter jar or an empty restaurant drink cup with a lid)
- Water
- Table salt (2 teaspoons per bowl)
- Dish detergent (a couple of droplets per bowl)

Step-by-step guide

- Prepare your liquid (3 cups of water, 2 teaspoons of salt, and a few drops of dish detergent). The dish detergent decreases surface tension so the insects fall into the liquid and do not escape. The detergent should not make a foam.
- Identify three different locations: one with no or few plants, one with some plants, and one with lots of plants.
- Pour 1 cup of liquid into a yellow bowl and place one bowl at each location.
- Wait for 24 hours and go back to collect your bowls.
- Pour the liquid into labeled containers with lids.
- Count how many different types of plants are within 1 meter of where your bowl is.
- Use a magnifying glass to identify what insects you have and how many of each.
- Try to identify your insects and what orders they belong in.
- Take some photos of what you have collected.
- Use the collection form to list what you have collected.

The following are resources to help identify insect orders:

- A quick way to identify common insect orders: biokeys.berkeley.edu/inverts/insecta.html
- A starting place to help identify insects: insectidentification.org/bugfinder-start.asp
- Here is a step-by-step guide and explanation of this experiment to follow along for extra guidance: youtu.be/VsYRwUbcpes

Biodiversity Lab Worksheet

Prediction:

What do you think will occur within your experiment? Do you think you will collect a variety of insects or no insects? Which location will have the most insects?

_____

_____

_____

Where are you going to place your bowls?

_____

_____

Were you surprised by your lab results? Why or why not?

_____

_____

_____

_____

_____

How do plants contribute to insect diversity?

_____

_____

_____

_____

Why would insect diversity be important? Why would insect diversity be of value to an area?

_____

_____

_____

What would you recommend to someone who is wanting to increase the diversity of insects within an area?

_____

_____

_____

_____

Sample 1 – Low plant diversity
Number of different types of plants within 1 meter of test site:

Name of insect	Number in sample	Characteristics

Sample 2 – Medium plant diversity
Number of different types of plants within 1 meter of test site:

Name of insect	Number in sample	Characteristics

Sample 3 – High plant diversity
Number of different types of plants within 1 meter of test site:

Name of insect	Number in sample	Characteristics

Activity 7 – Communication Among Insects

Project Outcome:

- Describe various ways that different insects communicate.

Each individual is born with a distinctive vocabulary that is only shared with other members of its own species. It's an essential part of all social interactions.

Why would insects need to communicate?

_____

_____

_____

How do insects communicate?				
	Visual communication	**Tactile communication**	**Acoustic communication**	**Chemical communication**
Overview	Colored markings or patterns on insects to insects producing light dance-like movements Most of these signals are effective only as long as they are visible in daylight.	Related to touch or physical contact between insects	Sounds are produced by vibrations. Insects produce various sounds by making vibrations with different parts of their bodies.	Using smell, insects release pheromones, which are the odors released from the special scent glands in their bodies.
Advantages	• Effective over long distances • Can be used while moving fast – speed of light • Effective in all directions (independent of wind) • Passive signals require no expenditure of energy	• Instantaneous feedback • Localized area • Individual recipient • Effective in the dark (e.g., caves, wood galleries)	• Not limited by environmental barriers • Effective over distances and around corners • Highly variable, fast change – high information content	• Not limited by environmental barriers • Effective over distances and around corners • Effective either day or night • Longer lasting than visual or auditory signals • Metabolically inexpensive because only small quantities are needed
Disadvantages	• Requires a clear line of sight • Visual signals may be intercepted by predators • Only effective in daylight (in fireflies, only at night) • Active signals may be metabolically expensive to produce	• Not effective over distance • Organisms must stay in direct contact • Message must be repeated to each recipient • Vibration signals can be intercepted by predators	• May reveal location of sender to a potential predator • Less effective in noisy environments (e.g., seashore) • May be metabolically expensive to produce • Attenuation – intensity falls rapidly with distance from source	• Low information content (presence/absence) • Not effective in an upwind direction
Conduct research and note other insect communication methods				

Conduct a study of a variety of insects to determine how they communicate. Below is a list to get you started, but feel free to add to the list.

Name of insect	Communication method (maybe more than one type)	Communication in action	Other findings	Source
Blister beetle (family Meloidae)	*Tactile*	*Courtship begins with a series of antennal taps by the male on each side of the female's body.*	*Male must continue tapping, alternating from side to side at just the right frequency, until the female is stimulated to extend her genitalia and begin mating.*	*genent.cals.ncsu.edu/bug-bytes/communication/tactile-communication*
A parasitic fly				
Mosquito				
Red admiral butterfly				
Mole cricket				
Whirligig beetle				
Treehopper				
Dog-day cicada				
Deathwatch beetle				
Cabbage butterfly				
Silk moth				

Aphid				
Madagascar hissing cockroach				
Blister beetle				

- Fireflies communicating
  - Fireflies communicate through flashes, mostly to attract mates. Each firefly species has a unique pattern of flashes.
  - Become a firefly:
    - Work with glow-in-the-dark paint to create firefly patterns to explore later in the dark.
    - Get creative with glow sticks and have your group make a unique firefly pattern in the dark. Work with your group on replicating unique patterns.
  - Use flashlights to play a game of firefly tag. Make up your own rules!

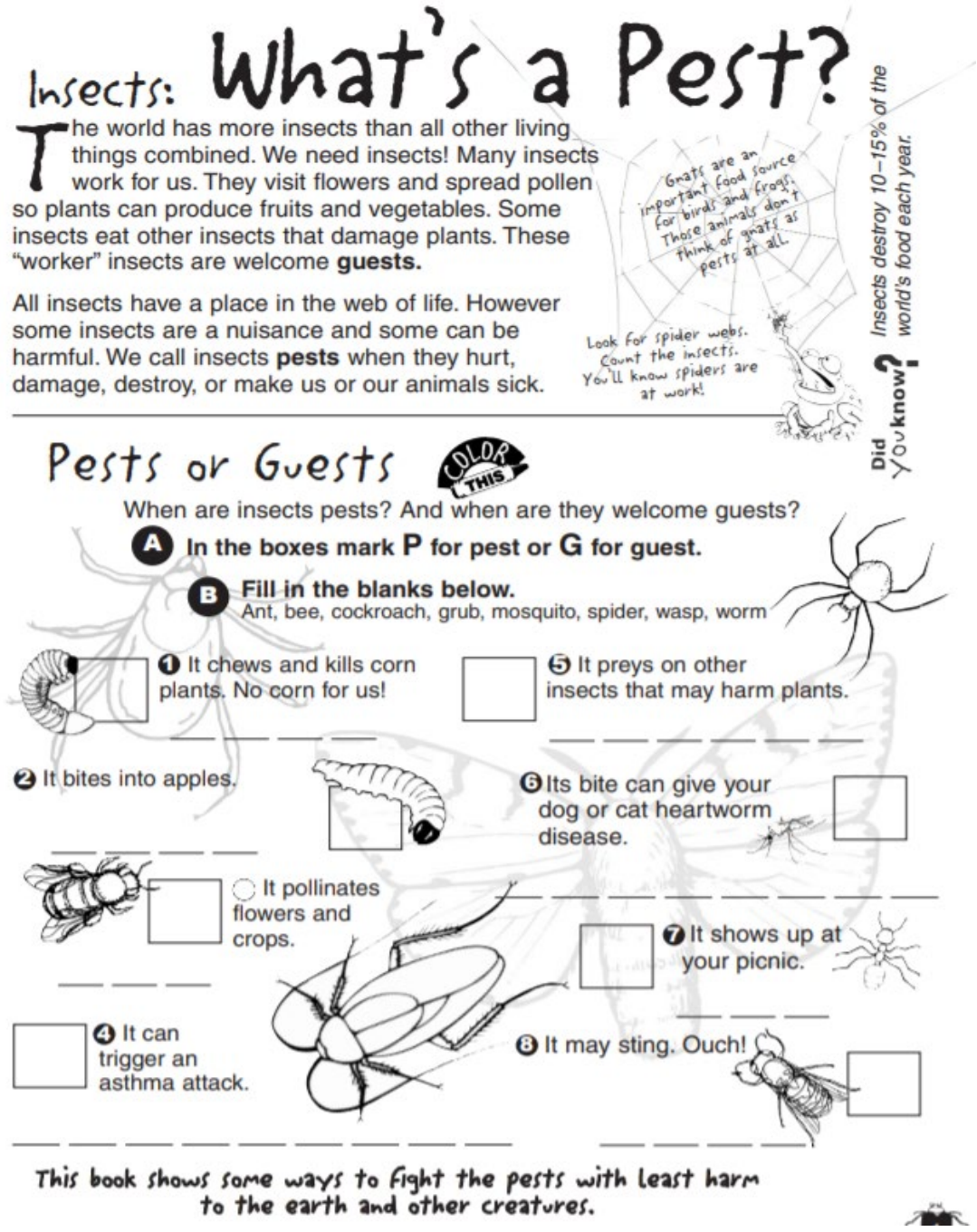
Sources:
genent.cals.ncsu.edu/bug-bytes/communication/tactile-communication
genent.cals.ncsu.edu/bug-bytes/communication/chemical-communication
genent.cals.ncsu.edu/bug-bytes/communication/acoustic-communication
genent.cals.ncsu.edu/bug-bytes/communication/visual-communication
genent.cals.ncsu.edu/bug-bytes/communication
entomology.unl.edu/k12/termites/communication.htm
streaming.discoveryeducation.com/teacherCenter/lessonPlans/pdfs/6-8_Science_HowInsectsCommunicate.pdf
learningwithoutdoors.com/learningactivities/insect-chat

Activity 8 – Harmful and Beneficial Insects

Project Outcomes:

- Define integrated pest management, predator, parasite, pathogen and parasitoid.
- Explain why some insects are pests and some are beneficial.
- Identify pest insects in Tennessee that affect plants, non-humans, animals and humans.
- Identify beneficial insects in Tennessee that affect plants, non-humans, animals and humans.
- Investigate 10 insects found in gardens, crop fields or households in Tennessee (activity).
- Investigate and describe several invasive, beneficial or pest insects in Tennessee

To get started learning about harmful and beneficial insects, complete these worksheets from the U.S. Environmental Protection Agency.



Insects: What's a Pest?

The world has more insects than all other living things combined. We need insects! Many insects work for us. They visit flowers and spread pollen so plants can produce fruits and vegetables. Some insects eat other insects that damage plants. These "worker" insects are welcome **guests.**

All insects have a place in the web of life. However some insects are a nuisance and some can be harmful. We call insects **pests** when they hurt, damage, destroy, or make us or our animals sick.

Gnats are an important food source for birds and frogs. Those animals don't think of gnats as pests at all.

Look for spider webs. Count the insects. You'll know spiders are at work!

Did You know? Insects destroy 10–15% of the world's food each year.

Pests or Guests

COLOR THIS

When are insects pests? And when are they welcome guests?

A In the boxes mark P for pest or G for guest.

B Fill in the blanks below.
Ant, bee, cockroach, grub, mosquito, spider, wasp, worm

1 It chews and kills corn plants. No corn for us!

2 It bites into apples.

3 It pollinates flowers and crops.

4 It can trigger an asthma attack.

5 It preys on other insects that may harm plants.

6 Its bite can give your dog or cat heartworm disease.

7 It shows up at your picnic.

8 It may sting. Ouch!

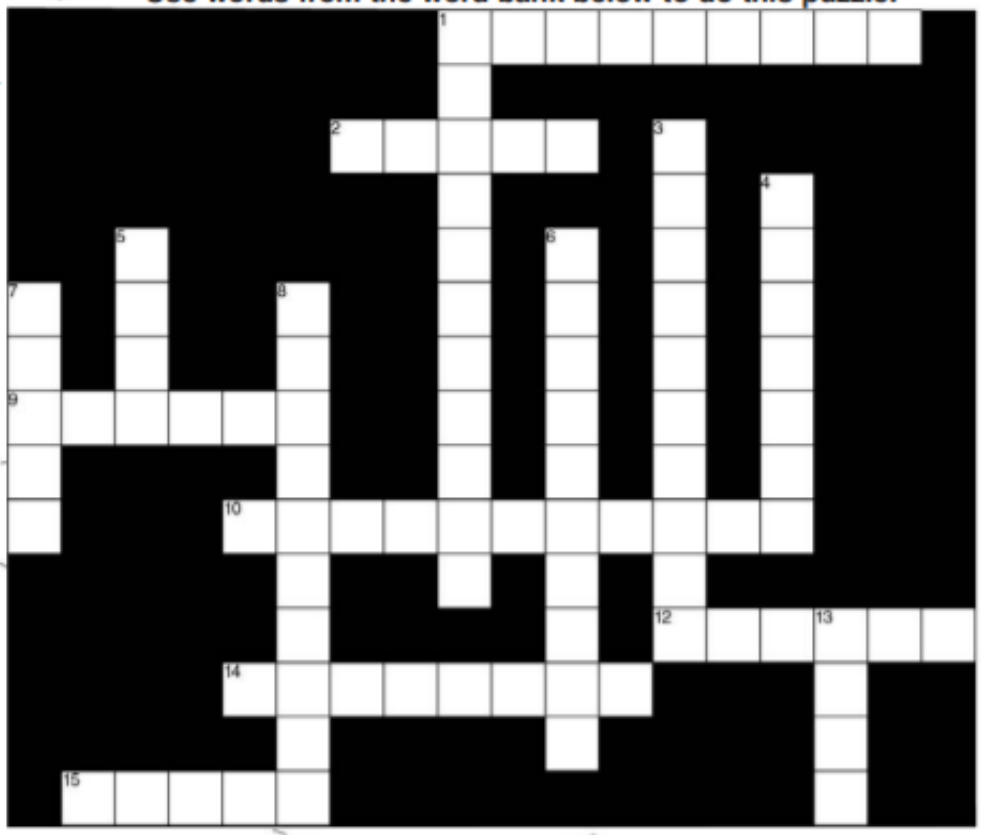
This book shows some ways to fight the pests with least harm to the earth and other creatures.

Insect Pests and Pals

Some bugs help us. Some bugs pester us. All bugs are part of the web of life. If you think all bugs belong in bug zappers, think again!

Use words from the word bank below to do this puzzle.

What's the only insect that makes food humans eat?
See puzzle No. 13!



Word Bank

- Aphids
- Bees
- Boxelder
- Butterflies
- Carpenter
- Cockroaches
- Fruitflies
- Gnats
- Houseflies
- Mosquitoes
- Moth
- Spiders
- Sowbug
- Ticks
- Wasps

Across:

1. Large black ant that nests in wood.
2. They get on you to suck your blood.
9. They harm plants by sucking sap.
10. Beautiful insects that drink nectar.
12. Outdoor creepy-crawly that eats rotten plant matter.
14. Red and black bugs that eat tree leaves and seeds but don't kill trees.
15. They sting, but also kill harmful insects.

Down:

1. They eat almost anything, they like the dark, and they are hard to get rid of.
3. Tiny, flying insects that breed in fruits and vegetables.
4. They have eight legs and eat insects.
5. It eats holes in wool and fur clothing.
6. They spread germs with their feet. Frogs eat them.
7. Small, flying bugs. The female's bite is itchy.
8. They give itchy bites. Bats eat them.
13. They sting, but also make food that humans eat.

What's the difference between a coyote and a flea?

A coyote howls on the prairie. A flea prowls on the hairy.

a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Outsmart those pests!

Do pests bug you? Keep them from getting into your home, yard, or garden in the first place.

Use the code to fill in the blanks. You'll see ways to outsmart pesty insects, weeds, and diseases.

1 Put up _____ _____ _____ _____ _____ _____ _____ _____ _____ _____.
25 18 9 23 19 12 6 8 22 8

Plant _____ _____ _____ _____ _____ _____ _____ _____ _____ _____
8 6 13 21 15 12 4 22 9 8

and plants with berries. These attract birds to feast on insects that harm plants.

2 Welcome _____ _____ _____ _____ _____.
7 12 26 23 8

They eat _____ _____ _____ _____ _____
8 15 6 20 8

that eat and damage plants.

4 Take

_____ _____ _____ _____ _____ _____ _____
20 26 9 25 26 20 22

and recycling outdoors.

3 Clean up

_____ _____ _____ _____ _____ _____.
24 9 6 14 25 8

Wipe up spills. Keep rooms clean.

5 Put _____ _____ _____ _____ _____ _____ _____
8 24 9 22 22 13 8

on doors and windows. Keep insects out!

6 Stake up

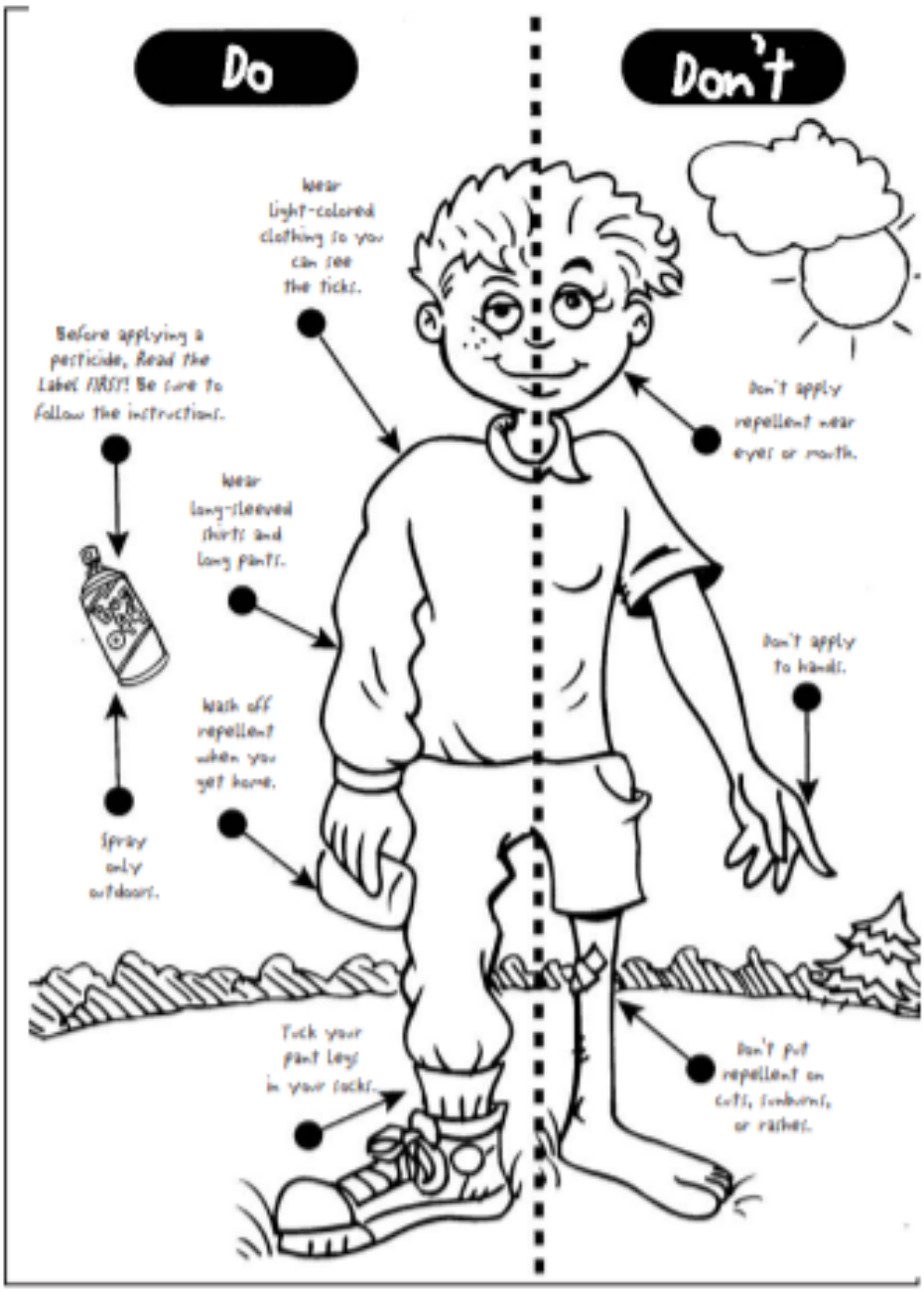
_____ _____ _____ _____ _____ _____ _____ _____to keep
7 12 14 26 7 12 22 8

their leaves off the ground. Water them with a can or bucket, not a spray. Then spores that live in the soil won't splash up on the plants and make them sick.

United States Environmental Protection Agency 2003

Keep Pests from Pestering You Inside and Outside Your House!

Kitchen pests like cereal, flour, oatmeal, crackers, and pancake mix. Travel the maze to see which containers pests can get into.



Tip for Grown-ups:

Think you've got pests? Identify the pest problem before you decide what to do. Some pests (or signs of them) are easy to spot. But sometimes we are fooled. What looks like a plant "disease" may actually be a sign of poor soil or lack of water. To help you identify your pest and learn the most effective ways to control it, use free sources from the library or local nurseries. Or contact your local Cooperative Research, Education, and Extension Service. (http://www.reeusda.gov/1700/statepartners/usa.htm)

United States Environmental Protection Agency 2003

Using the information from the worksheets above, explain why some insects are pests and some are beneficial.

_____

_____

_____

Conduct research and use information already presented on examples of integrated pest management. List examples below:

- _____
- _____
- _____
- _____
- _____

Sources:
epa.gov/sites/default/files/2014-04/documents/insects_-_whats_a_pest.pdf
epa.gov/sites/default/files/2014-04/documents/insect_pests_and_pals.pdf
epa.gov/sites/default/files/2014-04/documents/keep_pests_from_pestering_you_inside_and_outside_your_house.pdf
epa.gov/sites/default/files/2014-04/documents/outsmart_those_pests.pdf

Additional resources on Integrated Pest Management for 4-H beginners include:

- Friend or Foe, An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066A.pdf
- Create an Animal, An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066B.pdf
- What is IPM? An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066C.pdf
- Interviewing, The First Step, An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066D.pdf
- Inspecting the School, An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066E.pdf
- May I Take Your Order? An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066F.pdf
- Preferred Destination, An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066G.pdf

- Wanted Dead or Alive, An Integrated Pest Management Lesson
  extension.tennessee.edu/publications/Documents/W1066H.pdf

Read the information below from the University of Georgia and answer the questions on the next page.

Most animals produce many more young than needed to maintain a stable population. It is a role of predators and parasitoids to maintain a balance in nature and control prey populations. Even usually non-bothersome herbivores such as rabbits or deer become problems if there are not enough predators to limit their populations.

Humans are particularly concerned about keeping the numbers of pest insects low. Pest insects threaten our health and possessions (crops, homes, pets, gardens, forests, etc.).

Predators, pathogens, parasites, parasitoids and pesticides control these pests. An estimated 115,000 kinds of insects are parasites, and more than 300,000 kinds are predators at one of their life stages. Except for disease-causing microbes, these insects are the primary living controllers of insect populations.

Other invertebrates, particularly spiders, are also critical predators in the control of insect populations. Other insect predators are centipedes, daddy long legs and scorpions. Mites may be parasitic or predatory.

How do we know that predators and parasites are important? Numbers of insects accidentally released in alien places have become pests because there were no predators or parasites to keep them in check. A scale insect that was benign in Australia became a major citrus pest in the United States. The fire ant is not a great pest in South America, but it is in the United States.

In contrast to predators that kill their prey, parasites seek animals for blood or body fluids, but one parasite does not take enough blood to kill the animal. Biting flies and mosquitoes are examples of external parasites. Ticks and bedbugs are parasites that stay on animals just long enough to fill up with blood and then fall off.

External parasites, in general, live on the body of the animal they feed upon. In fact, their hosts are generally animals with permanent dens, nests or homes where the parasite may deposit its eggs. Parasites also include mites (arachnids) and several orders of tiny insects. The chewing and biting lice, fleas and mites all live on the surface of a host animal for most, if not all, of their lives, and suck blood from it. However, these animals do not kill their hosts because survival of the host benefits parasite populations.

On the other hand, parasitoids enter their host, feed upon it and usually kill it. Parasitoid insects include wasps, a few flies, beetles and the twisted-wing insects. Typically, the female wasp deposits her eggs near, on or in the larva of another insect or arthropod. The wasp larva feeds on the host larva, eventually killing it. Usually, the larva emerges before the insect dies or pupates. Some wasps insert their eggs into the eggs or pupae of other insects.

Some wasps (e.g., mud daubers) paralyze insects and seal them in a nest with an egg. The emerging larva then feeds on the paralyzed victim. The wasp usually seeks a specific prey, which might be a kind of spider, weevil, cricket or long-horned grasshopper.

Female tachinid flies lay their eggs on the bodies of other insects. The larvae burrow inside and live as internal parasitoids, eventually killing the host. Different species of these stocky flies prefer different hosts, but their most common victims are true bugs and caterpillars. Like parasitoid wasps, they are used by farmers for insect control.

Twisted-wing insects enter their hosts as larvae and females may never leave the external skin.

Pathogens are agents that cause disease in organisms. Examples include fungi, bacteria, viruses and, sometimes, nematodes.

Source:
gen.uga.edu/documents/pest/Predators,%20Parasites,%20Parasitoids%20and%20Pathogens.pdf

Define predator using your own words.

_____

_____

_____

What is an example of a predator not listed above?

_____

Define parasite using your own words.

_____

_____

_____

What is an example of a parasite not listed above?

_____

Define parasitoid using your own words.

_____

_____

_____

What is an example of a parasitoid not listed above?

_____

How do predators, parasites, parasitoids, pathogens and integrated pest management work together? What would happen if there were no predators, parasites or pathogens?

_____

_____

_____

_____

Below is a chart started for you about insects that may be located within Tennessee. Conduct research to determine if each insect listed is a benefit or if it's a pest, how it affects plants, non-human animals or humans, and if it occurs in Tennessee. Feel free to add to this list.

Resources to use:
tn.gov/agriculture/businesses/plants/plant-pests-and-quarantines/insects.html
insectidentification.org/insects-by-state.php?thisState=Tennessee

Name of insect	**Picture of insect**	**Beneficial or pest?**	**Does it affect plants, non-human animals or humans? Can be more than one or all three.**	**Found in Tennessee?**	**Source**
Emerald ash borer beetle					
Imported fire ant					
Asian long-horned beetle					
Ground beetle					
Soybean aphid					
Spotted lanternfly					

Name of insect	Picture of insect	Beneficial or pest?	Does it affect plants, non-human animals, or humans? Can be more than one or all three.	Found in Tennessee?	Source
Multicolored Asian lady beetle					
Spotted wing drosophila					
Odorous house ant					
Green lacewing					

Discuss why some insects found in Tennessee are not native.

Conduct research and list seven discussion points on why insects found in Tennessee or anywhere else are not all native.

1

2

3

4

5

6

7

Investigate insects found in gardens, crop fields, schools and households in Tennessee.

Use the model below and conduct research to identify insects we can locate in Tennessee in our gardens, crop fields, schools and/or in our households. Include a picture of the insect, the name of the insect, and where we can find the insect, as demonstrated in the example below.

1

Japanese beetle
Can be found in nursery, turf and horticulture crops throughout the eastern United States.
Feeds on leaves, flowers or fruit of more than 300 species of plants.
Metallic green head and thorax with copper-brown wing covers.

2

3

4

5

Congratulations!

You have completed the Beginner Entomology and Beekeeping Project Area Guide!

By completing this project book, you have learned about the basics of entomology and beekeeping near you and around Tennessee. Continue to seek opportunities to apply what you have learned to your project work so far and learn new things along the way. Make sure to upload any figures to your digital 4-H portfolio.

You can find more information on entomology and beekeeping, including the project outcomes and curriculum for the intermediate level, at the following website: 4h.tennessee.edu/beekeeping-and-entomology.

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