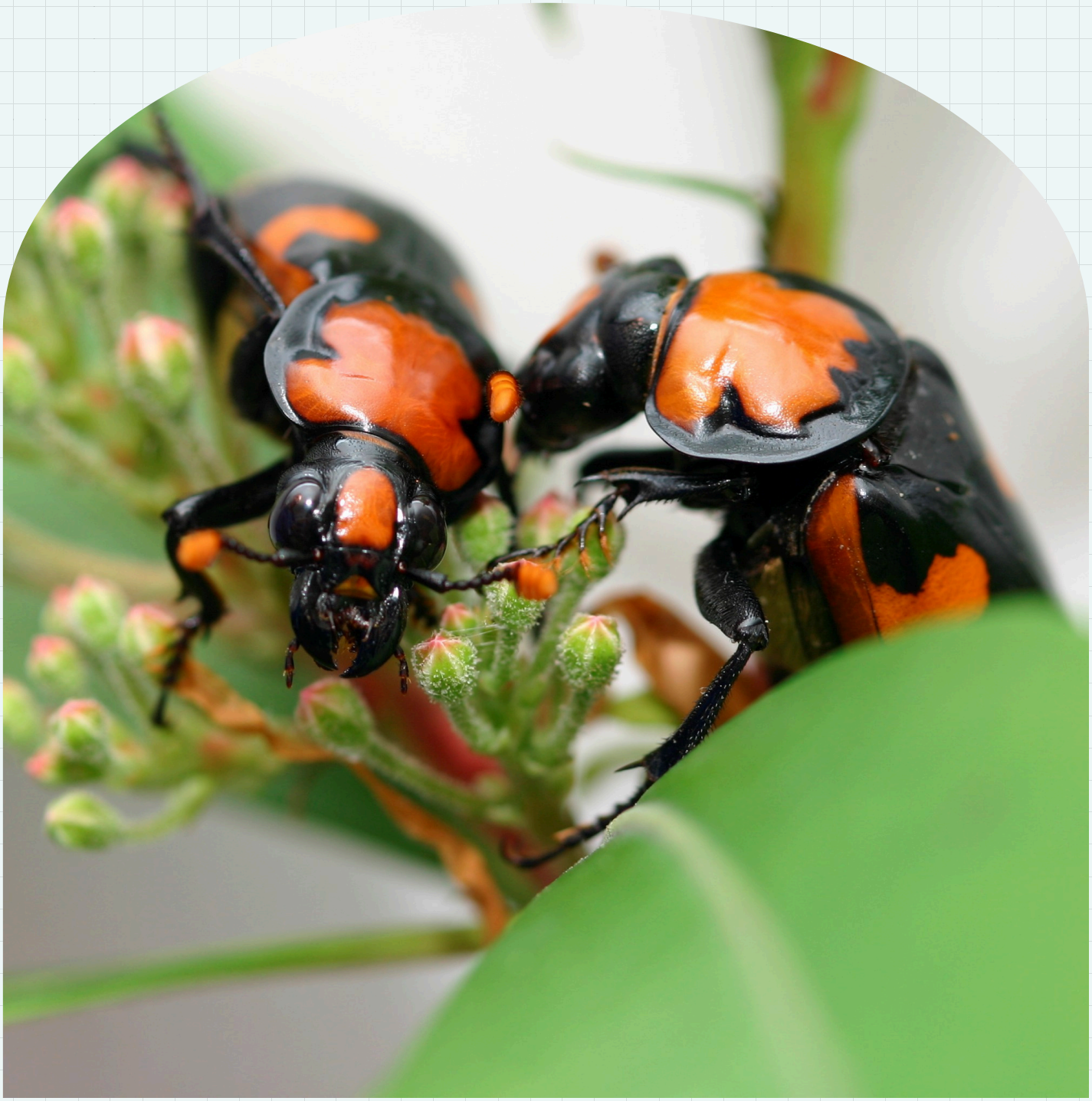


Insect Self-Guided Activities

A BUG'S WORLD

ROGER WILLIAMS PARK ZOO

Table of contents:

Welcome to The Roger Williams Park Zoo!

Dear Educators,

Field trips are a great way for students to use their science knowledge outside of the classroom. A trip to the zoo allows students to make real world connections to their classroom curriculum. Students will remember field trips for years and will gain new information that will strengthen concepts they already know and get them excited to learn more.

From young children, who are naturally curious about their surroundings and are always ready to explore, to high school students, who are starting their own exploration into their future careers, Roger Williams Park Zoo offers countless opportunities to learn about the world around them and how they can positively impact animals and their environments throughout the globe.

The activities in this guide will help your students learn to be focused observers on your field trip. The goal of these activities is to ensure that every school group visiting the zoo has a positive educational experience. We want students to make connections and discoveries about the world around them and for chaperones to feel prepared and ready to help guide the learning of students in their care. The activities are filled with questions that will get your students thinking and making connections among the animals and themselves.

We hope these activities are beneficial to your visit and we look forward to seeing you at Roger Williams Park Zoo.

Sincerely,
The Education Staff at Roger Williams Park Zoo

Next Generation Science Standards

Kindergarten-Second Grade Activities

Next Generation Science Standards Disciplinary Core Ideas

- LS1.C: Organization for Matter and Energy Flow in Organisms: All animals need food in order to live and grow. They obtain their food from plants or from other animals.
- ESS2.E Biogeology: Plants and animals can change their environment
- ESS3.A: Natural Resources: Living things need water, air, and resources from the land, and they live in places that have the things they need.
- LS1.A: Structure and Function: All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air.
- LS2.A: Interdependent Relationships in Ecosystems: Plants depend on animals for pollination or to move their seeds around.
- LS4.D Biodiversity and Humans: There are many different kinds of living things in any area, and they exist in different places on land and in water.

Third-Fifth Grade Activities

Next Generation Science Standards Disciplinary Core Ideas

- LS1.B: Growth and Development of Organisms: Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.
- LS2.D: Social Interactions and Group Behavior: Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different function and vary dramatically in size.
- LS3.A: Inheritance of Traits: Other characteristics result from individuals' interactions with the environment, which can range from diet to learning. Many characteristics involve both inheritance and environment.
- LS3.B: Variation of Traits: The environment also affects the traits that an organism develops.
- LS4.D: Biodiversity and Humans: Populations live in a variety of habitats, and change in those habitats affects the organisms living there.
- LS1.A: Structure and Function: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Next Generation Science Standards

Sixth-Eight Grade Activities

Next Generation Science Standards Disciplinary Core Ideas

- LS1.B Growth and Development of Organisms: Animals engage in characteristic behaviors that increase the odds of reproduction
- LS2.A: Interdependent Relationships in Ecosystems: Organisms and populations of organisms are dependent on their environmental interactions both with other living things and with nonliving factors.
- LS2.B: Cycle of Matter and Energy Transfer in Ecosystems- Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. Transfers of matter into and out of the physical environment occur at every level. Decomposers recycle nutrients from dead plant or animal matter back to the soil in terrestrial environments or to the water in aquatic environments. The atoms that make up the organisms in an ecosystem are cycled repeatedly between the living and nonliving parts of the ecosystem.
- LS2.C: Ecosystem Dynamics, Functioning, and Resilience- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations
- PS3.D Energy in Chemical Processes and Everyday Life- The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6)

Nineth-Twelfth Grade Activities

Next Generation Science Standards Disciplinary Core Ideas

- ·LS2.C Ecosystem Dynamics, Functioning, and Resilience- Anthropogenic changes in the environment can disrupt an ecosystem and threaten the survival of some species
- ·LS4.D Biodiversity and Humans- Sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth.
- ·ETS1.B Developing Possible Solutions-When evaluating solutions, it is important to take into account a range of constraints including cost, safety, reliability, and aesthetics and to consider social, cultural, and environmental impacts.
- ·ESS3.C Human Impacts on Earth Systems-The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources

Background information

Insects are the most diverse group of animals on the planet, 900 thousand different kinds of living insects are known, with many still estimated to be undiscovered. This group of organisms potentially represents over 80% of all life forms, with the number of existing species estimated to be between 2-30 million. Insects also probably have the largest biomass of the terrestrial animals. At any time, it is estimated that there are some 10 quintillion (10,000,000,000,000,000,000) individual insects alive.

Insects can be found in every biome, though only one species is known to be found in marine environments (sea skaters). Within their respective biomes, insects play many crucial roles. While many insects are food to other organisms, including humans (an estimated 2,000 species are known to be consumed by humans), other species assist in the creation of food such as fruits and seeds through pollination. Approximately 35% of the world's crops rely on pollinators to be successful. While some insects create food, others break down nature's waste through a process called decomposition. Decomposition is critically important as it releases key nutrients back into the ecosystems through dirt, air, and water.

To accomplish these various roles, some insects live in large, well-organized colonies such as ants, bees, and termites. However, most insect species are primarily solitary. Some insects even take care of their young, such as the American Burying Beetle.

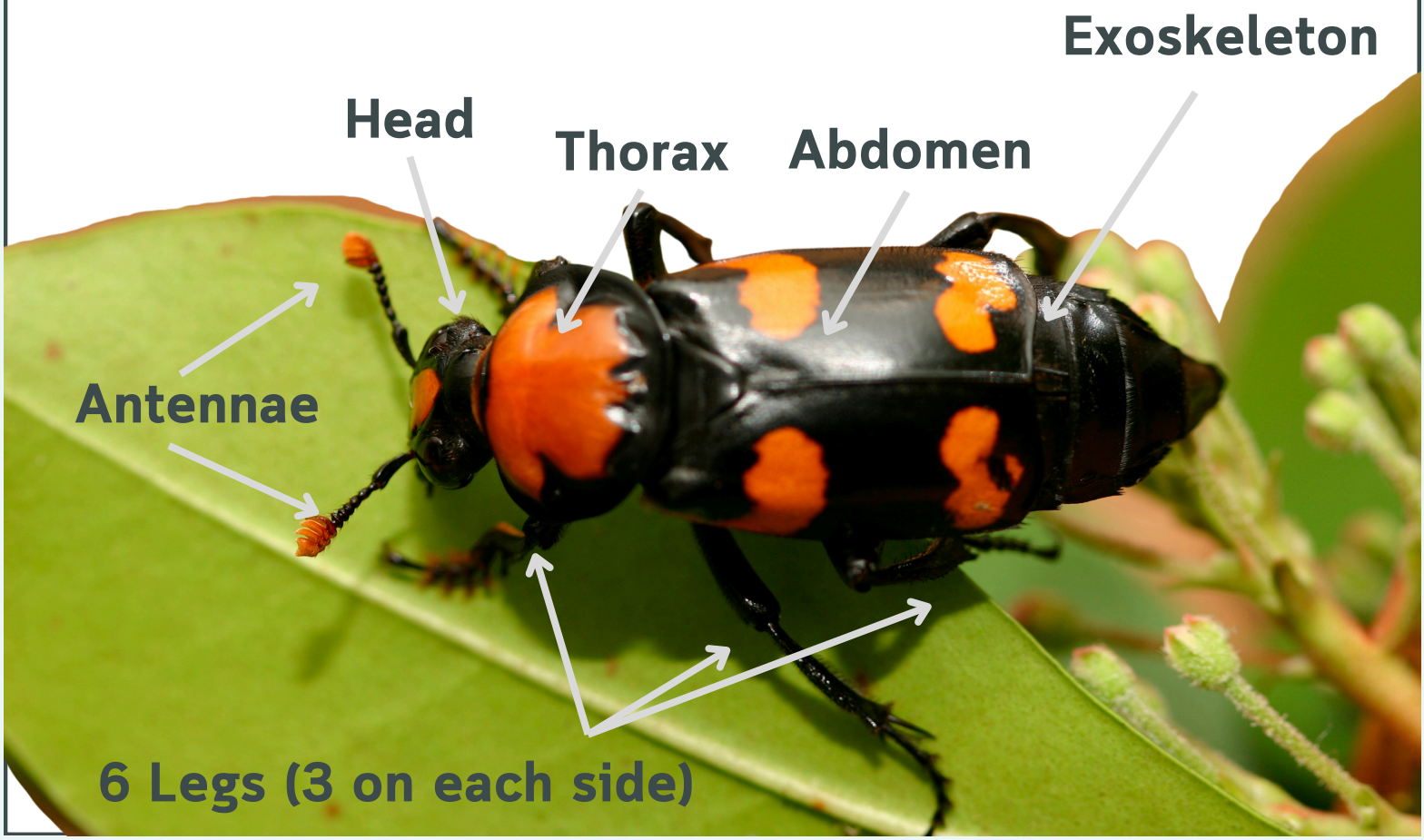
The Structure of an Insect

Insects (Class Insecta) are a type of **arthropod**, though not all arthropods are insects. To be classified as an insect, an organism must have:

- An **exoskeleton** for part of their lifespan (a hard outer covering)
- Three body parts (**head, thorax, abdomen**)
- **Three pairs of jointed legs** (6 legs attached to the thorax)
- **Compound eyes**
- **Two antennae**

-Some insects have wings, though there are many species that do not. An organism does not have to have wings to be classified as an insect.

Diagram of an American burying beetle



Name: Date:

The Structure of an Insect

A diagram is a model that scientists use that features a drawing or image with arrows or labels. Can you make a diagram of an insect? Find one around the zoo or pick your favorite from the trail. Draw it here and make sure you add the labels!

Diagram of _____

Labels:

Head Exoskeleton Thorax Abdomen 6 Legs

Antennae Wings (if your insect has them)

Name: Date:

The Structure of an Insect

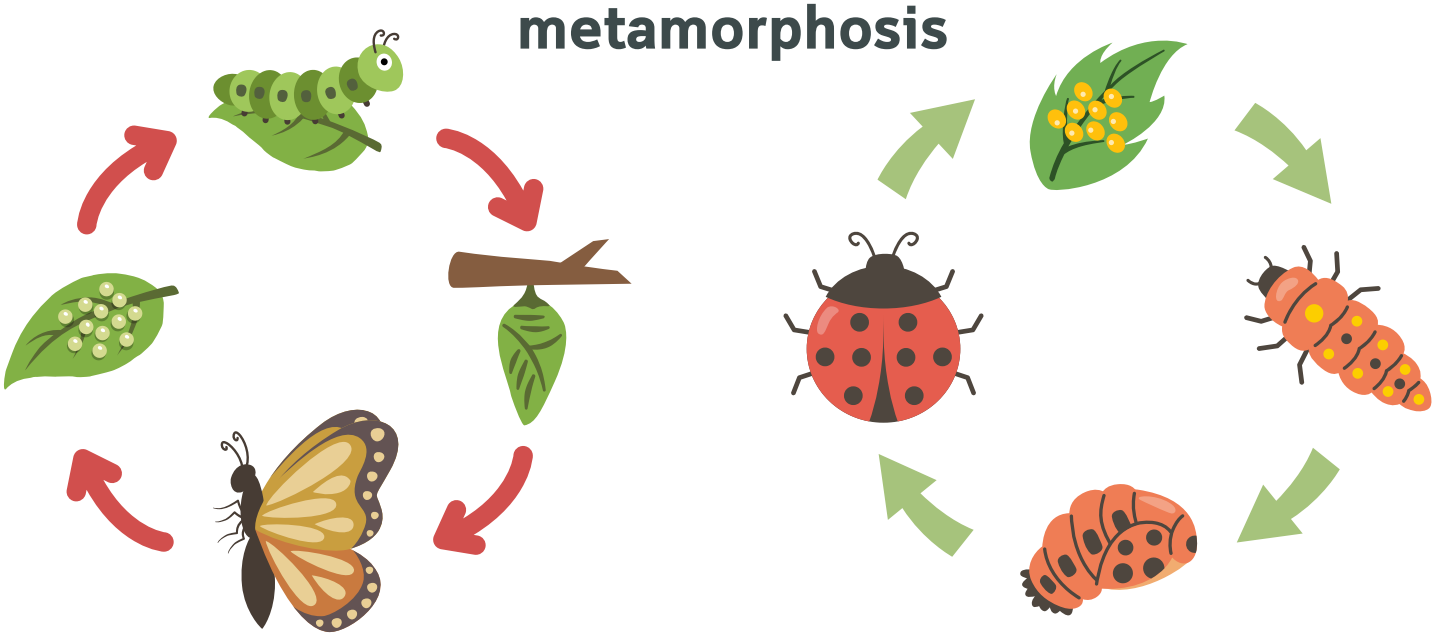
There are animals on the trail that are not insects. Can you find one and draw it below?

What makes you think this animal is NOT an insect?

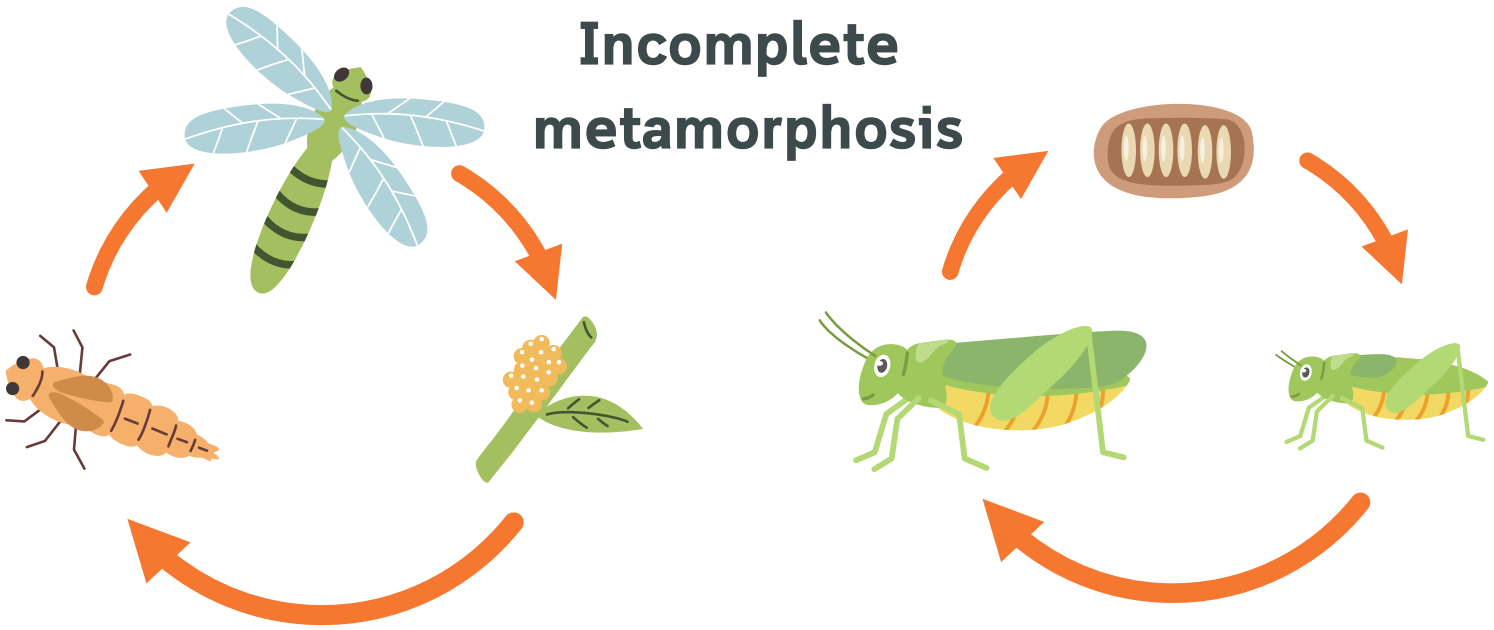
Metamorphosis

All insects undergo a series of **molts** and go through either incomplete or complete metamorphosis. Incomplete metamorphosis has three stages (egg, nymph, adult-no pupal stage) and can be seen in insects such as grasshoppers, cockroaches, dragonflies, aphids, and cicadas. Complete metamorphosis has four stages (egg, larva, pupa, adult) and can be seen in insects such as beetles, ants, bees, wasps, and flies.

Complete metamorphosis



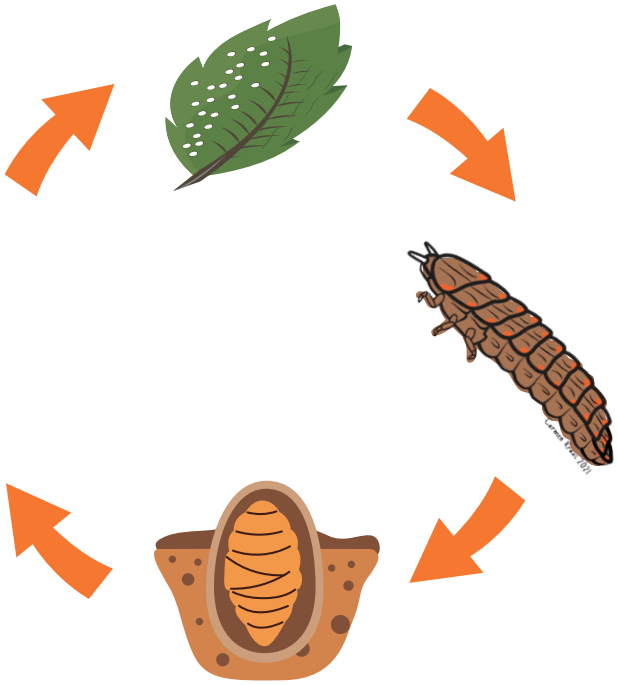
Incomplete metamorphosis



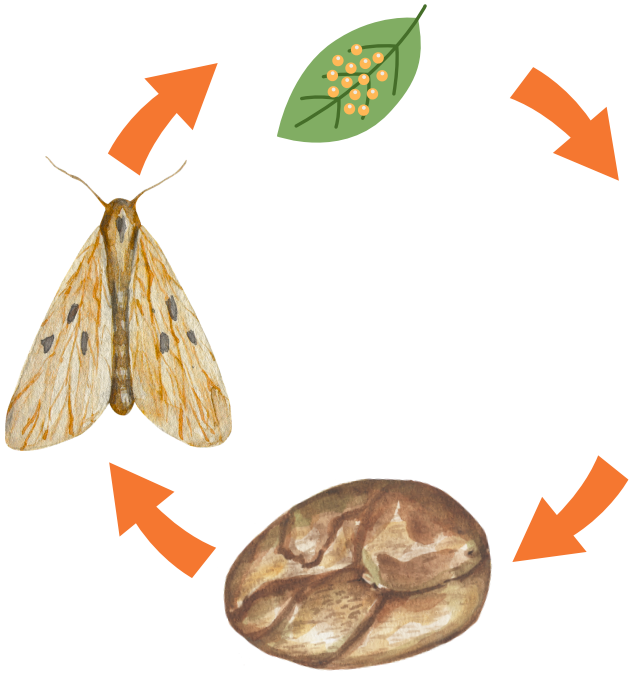
Metamorphosis

Can you draw in the missing stage in these charts? Need a reference? All the missing stages are on the trail!

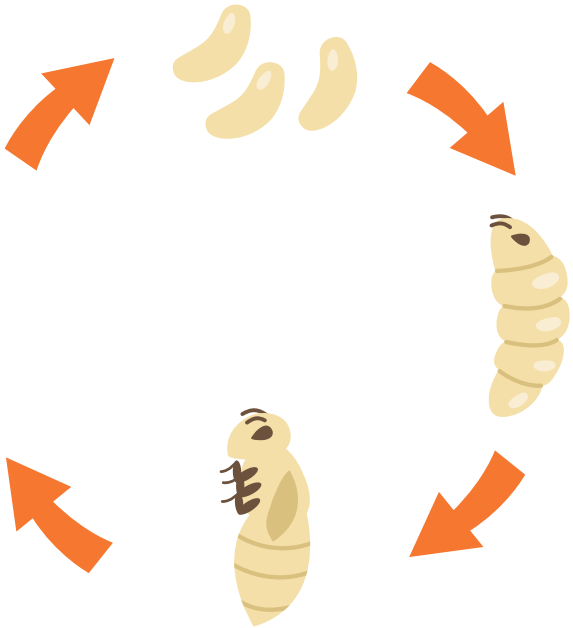
Firefly



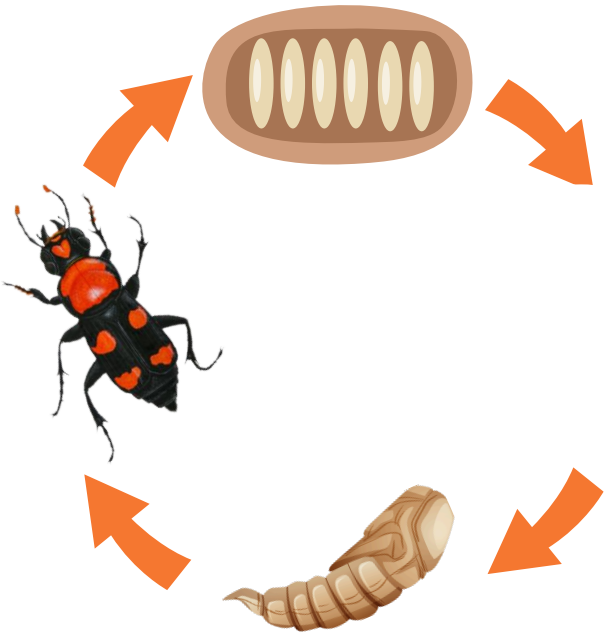
Wooly Bear



Bumblebee



America Burying Beetle



ECOSYSTEM RELATIONSHIPS

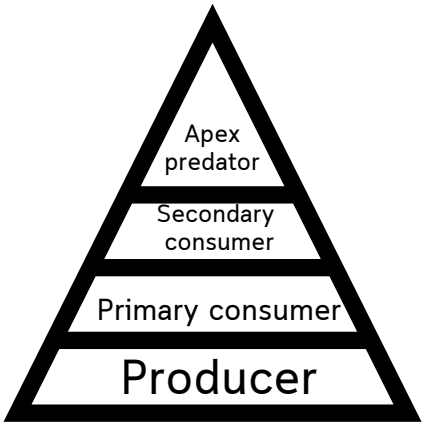
All organisms within an ecosystem have roles. These roles keep the ecosystem in balance. Organisms can have more than one role, or act in different roles depending on the situation.

Predator/Prey

Predators are animals that eat other animals. **Prey** are animals that are eaten by other animals.

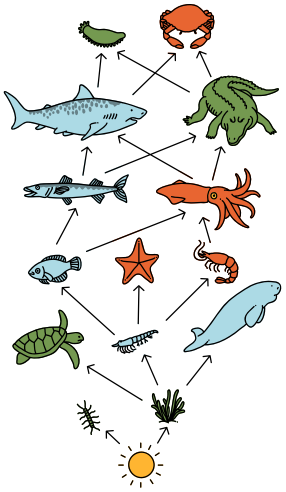
Scavenger/Decomposer

Decomposers and **scavengers** are organisms that feed on dead and decaying organic matter.

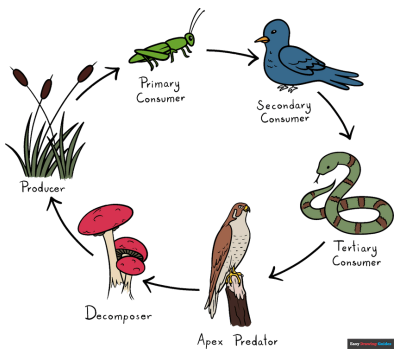


What is a food web?

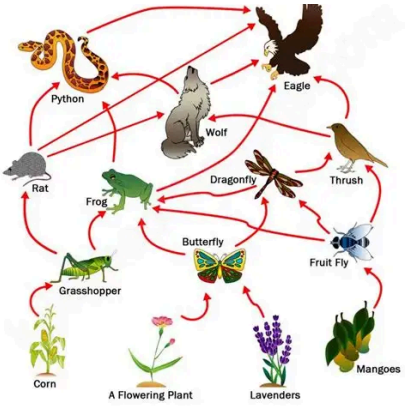
Food webs show how energy moves through an ecosystem; they use arrows to show energy moving from one **trophic level** to another. A **trophic level** represents the position of an organism in relation to the primary energy source (usually the sun).



How do we structure a food web?



We organize food webs by trophic level and use arrows to show the direction the energy is going. Almost all food webs start with the sun, and end with decomposers recycling nutrients back into the soil for producers to use. However, these relationships are not always linear, and organisms can fit into different trophic levels at different times and have many connections.



ECOSYSTEM RELATIONSHIPS

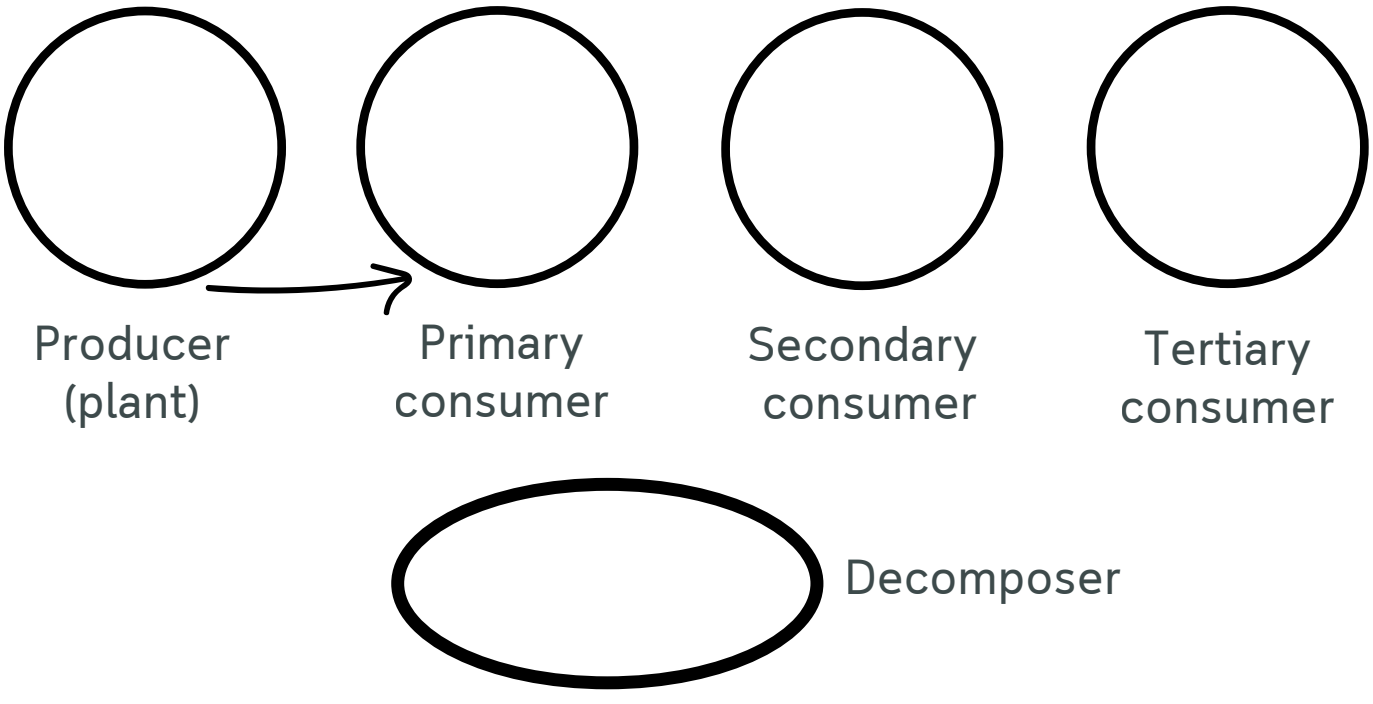
Can you find examples of these roles while on the trail?

	Prey		Predator
1		→	
2		→	
3		→	
4		→	

Decomposers

1		3	
2		4	

Can you make a simple food web with animals from the trail?
(Don't forget to draw in your arrows-they should point in the direction the energy is moving!)

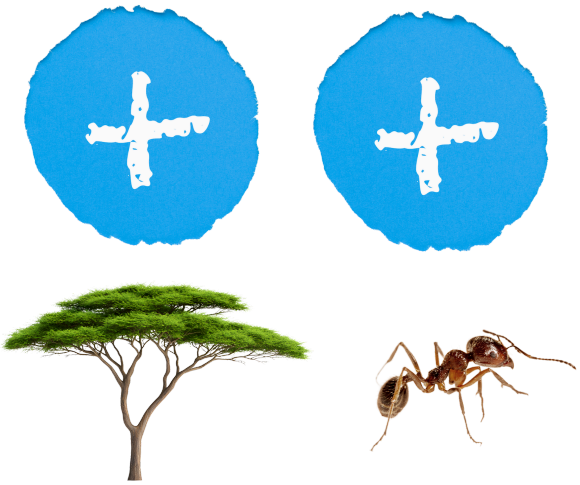


SYMBIOTIC RELATIONSHIPS

Symbiotic relationships occur when two species live in close proximity to each other and interact regularly in such a way as to benefit one or both of the organisms.

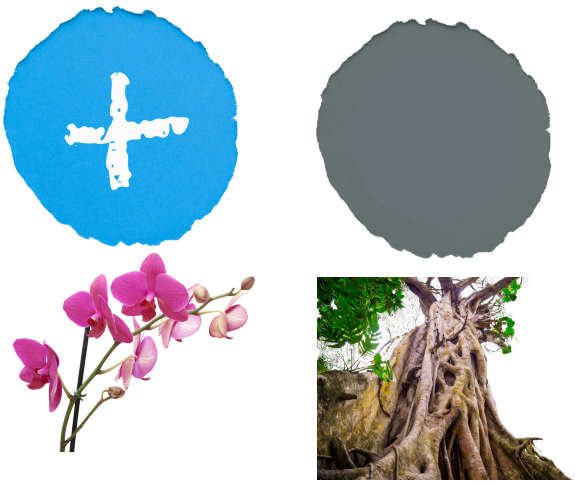
Mutualism is when both organisms benefit from their interactions.

For example, ants and acacia trees have a mutualistic relationship where the ants protect the acacia tree from being eaten by herbivores such as elephants and giraffes. In return, the tree provides the ants with shelter and a source of food in the form of nectar.



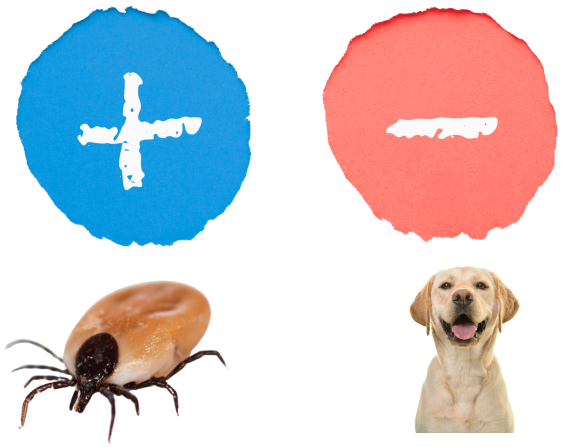
Commensalism is when one organism benefits and the other is not affected.

For example, orchids attach themselves to larger trees in order to gain access to sunlight in dense rainforests. They do not steal nutrients or grow to sizes that would negatively affect the host tree, but the tree also does not benefit from the orchid's presence.



Parasitism is when one organism benefits, but the other is negatively impacted.

For example, ticks and dogs are a parasitic relationship, because the tick benefits (gains food), while the dog is injured (loss of blood, possible disease transfer)



SYMBIOTIC RELATIONSHIPS

Name: Date:

Find the animal along the trail that completes the symbiotic relationship.

Human and _____

This is Parasitism because the insect gains the proteins they need to lay their eggs, but the human is injured through loss of blood and potential transfer of diseases.

Milkweed and _____

This is Mutualism because the milkweed gets pollinated by the insect which lays its eggs on the plant. As adults, the insect also acquires a bitter taste from the milkweed it eats as a larva-making it unappetizing to predators.

Cattle and _____

This is Commensalism because the cattle are not affected by this insect using its fecal matter to house and feed its larva.

Cicada and _____

This is Parasitism because the cicada is killed to provide food for this insect's larva.

Fruit trees and _____

This is Parasitism because the fruit trees are damaged by this insect feeding on their sap, while the insect benefits by gaining a place to lay their eggs and food to eat.

Native flowers and _____

This is Mutualism because the insect gains food to last their colony through the winter, and the flowers get help with pollination.

Tree branches and _____

This is Commensalism because the tree branches do not gain anything from the interaction, but the other organism is protected from predation.

ARTHROPODA: THE LARGEST ANIMAL GROUP ON EARTH

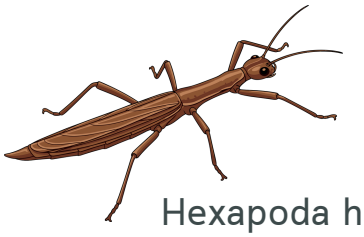
What is an arthropod?

Arthropods are **invertebrates** (animals with no backbone) who for at least part of their lives have a hard outer shell made of chitin called an exoskeleton. Arthro- meaning “jointed” and -poda meaning “foot”.

Count the feet!

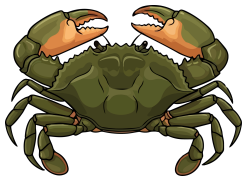
Arthropods are separated into a few different groups, the easiest way to tell them apart is by counting feet!

Hexapoda (insects)



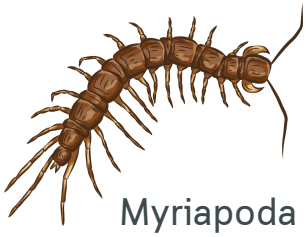
Hexapoda have 6 legs

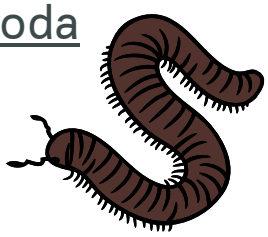
Crustacea



Crustaceans have 10 legs

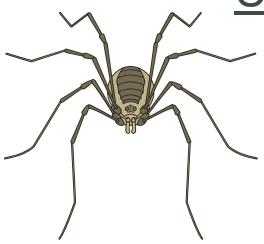
Myriapoda





Myriapoda have MANY legs

Chelicerata



Chelicerata (usually) have 8 legs

Yes, they are animals.

Arthropods make up approximately 80% to 85% of all known animal species on Earth. To put that in context, there are about 2.5 million ants for every individual human. Arthropods have been around for over 500 million years; more than 200 million years before the first known dinosaur!

ARTHROPODA: THE LARGEST ANIMAL GROUP ON EARTH

Name: Date:

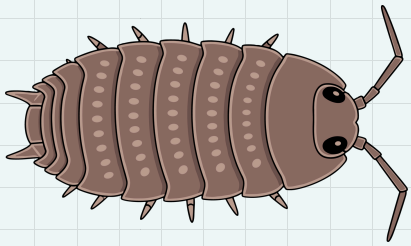
Can you find examples of arthropods on the trail?

Hexapoda (insects)

1.
2.
3.
4.

Crustacea

1.



Myriapoda

1.
2.

Chelicerata

1.
2.

Can you find two animals on the trail that are NOT arthropods?

1.
2.

Explain why they are not arthropods:

FRIEND OR FOE?

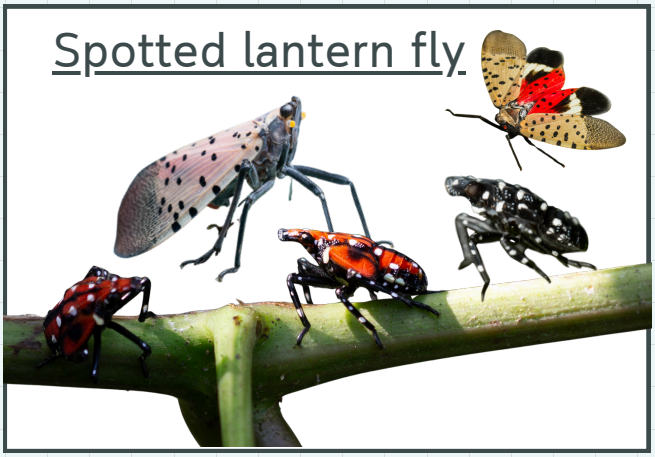
Insect conservation and ecosystem management

Both of these insects are a big deal in Rhode Island, but for very different reasons.

American Burying Beatle

American Burying Beatles (ABB for short) are Rhode Island's state insect (did you know we have a state insect?). The last known naturally occurring population of American burying beetles east of the Mississippi River is on Block Island. Roger William's Park Zoo is heavily involved in the breeding and reintroduction of ABBs to Block Island as well as trying to create supplemental populations. ABBS are **carrion** beetles and need a dead animal of appropriate size to rear their young. They are also one of the few insects which provide dedicated parental care to their larva.

Spotted lantern fly



Spotted Lanternflies (SLF for short) are **native** to parts of China and Vietnam, where populations are controlled by parasitic wasps. The lanternflies have become **invasive** here in the US and in Japan and South Korea. They are sap feeders (and true bugs) and the piercing wounds caused by their mouthparts are harmful to the health of host plants. SLPs main host plant is the tree of heaven (also an invasive species here in the US), but they will also utilize crops like stone fruit, apple trees, soy, and grapes. They make egg cases on trees that overwinter and hatch in spring.

The way we are managing populations of these two insects couldn't be more different- we are actively breeding, supplementing, and hoping to increase the population of ABBs, while trying to exterminate the SLFs completely. What make one species a "bad bug" and one species a "good bug"?

What makes something invasive?

"An invasive species is an introduced, nonnative organism (disease, parasite, plant, or animal) that begins to spread or expand its range from the site of its original introduction and that has the potential to cause harm to the environment, the economy, or to human health." -USGS

The biggest problem with SLFs is the negative effect on agriculture, and the lack of a main predator here in the US. Damage done by SLPs to crop trees like apples can have a negative economic impact for farmers, as well as the impact on native trees like black walnut and maples. Scientists hope that native predators like birds, predatory wasps, praying mantises and spiders will learn to eat the SLPs and that will help control the population.

Not all introduced species negatively impact their new ecosystem. The European hornet was introduced to the US and Canada around 1840; it is the only true hornet species in North America. These hornets have naturalized and do not pose a threat to humans or native species.

FRIEND OR FOE?

Insect conservation and ecosystem management

This is you

Congratulations, you have been magically turned into a bird - a grey catbird to be exact. Catbirds are omnivores, and a large amount of their diet is insects and other invertebrates. Eating new foods can be risky, but an empty stomach is risky too. Can you find enough safe food?

Your job is to identify and “eat” as many invertebrates as possible. As you are walking the trail try to identify the insects you see without looking at the signs.

Give yourself **2 points** if you identify the animal correctly. If you do not identify it correctly you can either eat it anyway and give yourself **1 point**, or not eat it and get **0 points**.

If the animal is venomous, stings, or has another way of defending itself, find a friend to play rock, paper, scissors with. If you win you successfully eat- give yourself **1 point,** if you lose the defense works and you go hungry- **take 2 points away**.

You need at least 10 points to survive.

Keep track of your points here:

Animal name:	Points	Animal name:	Points

Total points:

FRIEND OR FOE?

Insect conservation and ecosystem management

Name: Date:

Pick a species on the trail and complete the trail guide page below. You may have to do additional research to complete the prompts.

Species name:

Sketch:

Range and habitat description:

Diet:

Reproductive cycle:

Role and impact on native ecosystem:

FRIEND OR FOE?

Insect conservation and ecosystem management

Name: Date:

Your chosen species has been transported by you to a new ecosystem; this can be any ecosystem of your choice as long as it is not already native there.

Where was your organism transported to?

What is this ecosystem like? Compare it to the one your organism is used to living in.

What would your species eat in this new ecosystem?

How would it complete its reproductive cycle?

What role would your species play in this new ecosystem? What impacts, positive or negative, would it have on this new environment?