Invertebrate Defenses

LESSON OBJECTIVE
- Understand defense mechanisms of invertebrates

GRADE
- 4

STANDARDS
- Life Science

TIME REQUIRED
- 60-90 min

VOCABULARY
- Invertebrate
- Exoskeleton
- Arthropod
- Appendages
- Antennae
- Metamorphosis
- Insect
- Millipede

MATERIALS
- Defense Type Necklaces (laminated paper, hole punch, string)
- Optional: potatoes, magnifying glasses

RECOMMENDED ASSESSMENT
- Participation in the games and class discussion

introduction

Invertebrates make up about 98% of all animal life and they have interesting ways they defend themselves from predators. This lesson is designed to help students understand invertebrates and their defenses through a series of activities that will have kids running around outside.

State Standards

4-LS1-1: Students learn about internal and external structures that function to support survival, growth, behavior, and reproduction.
4.RC.11: Identify relationships among words, including more complex homographs, homonyms, synonyms, antonyms, and multiple meanings.

Lesson Plan

Background Knowledge –

- *Invertebrate:* an animal with no internal skeleton (no backbone)
- *Exoskeleton*: a rigid external covering for the body in some invertebrate animals, providing support and protection.
- *Arthropod*: the most common type of invertebrate, consisting of animals like *insects*, spiders, and *crustaceans* (crabs, lobsters). Arthropods have segmented bodies (each body segment usually has a pair of *appendages* that can be *antennae*, wings, or legs), hard *exoskeletons* they shed (or *molt*), undergo *metamorphosis* (like a *larva* into a bee or a caterpillar into a butterfly), and have bilateral symmetry.
- *Insect*: a small arthropod animal that has 6 legs, a 3 part body, 3 pairs of legs, and one or two pairs of wings
- *Millipede:* a long, worm-like invertebrate with 4 pairs of legs on each segment, resulting in hundreds of legs.

Invertebrates are often categorized into 8 major groups but the biggest group (about 80% of all animals) is called arthropods. All insects are arthropods and all arthropods are invertebrates, so insects will be the easiest type of invertebrate for students to observe and study for this lesson.

Activity –

1. Ask students: what is an invertebrate? *(an animal with no backbone)* How many different invertebrates can they think of? *(flies, bees, spiders, butterflies, cockroaches, beetles, centipedes)*

Some invertebrates form large colonies, where each member remains together for the duration of their life cycle and each has a specific job like

feeding or reproducing. Can anyone think of an invertebrate that lives in a colony? *(ants, bees, wasps, termites)*

2. Go on a bug hunt and see what invertebrates the students can find. Try pulling up a few weeds, lifting up a fallen log or rock, or looking around on the ground near flowers, in the dirt, or in a leaf pile. Students will probably see insects everywhere, and possibly see some snails or worms. Pay attention to how those insects act when you move the log, try to pick them up, or tap on the ground near them. We'll discuss that later. Did anyone find a colony?

3. Ask: what do invertebrates eat? Some of them scavenge for food, some are parasites that live in or on other animals, and many use camouflage to help them hunt their prey. We're going to try all 3 methods to get food:

    a. First, students are going to scavenge for food. Give students 60 seconds to bring you a stick, a dead leaf, a rock, a pinecone, and a blade of grass (or make up your own list of several natural items you might find outside your school). Were all students successful at surviving as a scavenger or will some be going hungry? What if we worked together as a colony to collect food? Does that help some animals survive?

    b. Some invertebrates are parasites that get their food from other animals by living on or in them. Can anyone think of an example? *[Ticks, fleas, roundworms, leeches.]* Set up a small boundary to play Parasite Tag (Blob Tag). In this game, one student will be a type of invertebrate called a stylopid. Stylopids attach themselves to a bee and feed off of them to multiply. The bees then become a bit like zombies and will act how the stylopid wants it to. The student who is the stylopid is "it" and when they tag someone, they link arms and continue to try and tag others together (with the stylopid telling everyone where to go and leading the charge). Eventually, the mass of linked people should be able to corner whoever is left until everyone is taken over by the parasite (depending on how big of a boundary you set in the beginning). How did it feel for students to be controlled by the parasite?

    c. Next, students will be testing their ability to camouflage and sneak up on prey. In this game, students will be dragonflies trying to hunt you, a fly. Dragonflies can camouflage themselves, even when flying, to try and catch prey. Start with yourself somewhere in the middle of the playground. Everyone runs and tries to hide somewhere, but they have to be within earshot and able to SEE you. Your job as a fly is to catch students before they can sneak up on you. You can turn around but can't move from your spot. If you call out a student because you can see them, they have to come and sit by you and help you watch for predator dragonflies. If you don't see any students, call out "Nighttime!" to let them know you are going to "sleep" for 5 seconds (count 5 seconds out loud while your eyes are closed). During this time, they should try their best to find a hiding spot closer to you (every student should move). The goal for them is to get to you without you seeing them so they can eat you! You can call "Nighttime" as many

times as needed until all of the students are out or you have been tagged. The winner is whoever manages to tag you during your 5 second sleep time.

4. During the last game, the dragonfly students had the goal of getting to the fly without being seen so that they could eat the fly. Ask students: is there any way for an invertebrate like a fly to defend itself against predators like a dragonfly?

    a. When you found insects earlier, how did they defend themselves? Did any curl up into a ball? Try to run away? Do invertebrates have a defense mechanism? How many can the students come up with?

    b. Invertebrates have a variety of defensive strategies against predators. Many of these are similar to those used by other animals, including humans.

        - Running, jumping, or flying away (grasshoppers leap away, moths will fly)
        - Playing dead (click beetles and stick insects will fall of perch and play dead)
        - Hiding (social insects like ants will hide in their colony's shelter and station guards)
        - Camouflage (This is probably the chief defense of insects and other invertebrates. Many are colored to match their habitats. There are countless examples: mantids and stick insects look like stems or twigs or leaves. Butterflies, such as the tortoiseshell and comma, look like dead leaves with their wings closed. Many caterpillars match the leaves they feed upon. A variation of this camouflage strategy is masking. The larvae of geometrid moths fasten bits of flowers or leaves to themselves as a disguise. Another approach is to look like an undesirable object. Some swallowtail butterfly caterpillars look like bird droppings.)
        - Warning (some moths flash bright red color to distract birds or make clicking noises)
        - Mimicking fierce or distasteful insects (longhorn beetles mimic wasps, snakeflies have snake-like heads that deter predators)
        - Armor or spikes for attacking (scarab beetles have rhino-like horns, wasps have stingers)
        - Chemical warfare (some caterpillars have venomous spines, stinkbugs squirt out irritating and smelly substances)

5. Invertebrate Defense Tag: the premise of the game is a simple game of tag.

    a. Use the list below to introduce various defense strategies and how they will be performed during the game of tag.

        i. Playing Dead: stick insect (freeze and drop to the ground for 5 seconds)
        ii. Color Warning: peacock butterfly (flash neck sign to show colorful display)
        iii. Noise Warning: hissing cockroaches (freeze and make hissing sounds)
        iv. Hiding: roly-poly (bend down and cover self with arms)
        v. Attacking: ants (make chomp/biting motion with arms to simulate mandibles)
        vi. Camouflage: praying mantis (pick up a leaf or some grass and "hide" behind it)

b. Give each student a sign (to be worn around the neck) that distinguishes which type of defensive strategy they will use against predators. Make sure they know how to perform their defensive strategy.

c. One or more students will be birds trying to snag an invertebrate meal. Birds will chase the invertebrates and try to tag them. To avoid being tagged, the invertebrates must perform their defense strategy before the predator is able to tag them. They may continue their defense for 5 seconds, then keep moving. The predator birds must keep moving (no waiting around for prey to finish their defense time). If an invertebrate is tagged, they will become another predator bird. This shows how increased food supply helps increase the predator population levels. Have students remove their sign (they may hold in their hand or give to you) to signify that they are now predators. Play until the predator/prey levels are about equal. Discuss what may happen if the predator level continued to grow and the prey decreased (overpopulation, disease, etc.).

6. Wrap-up discussion: Why do we need invertebrates? Why are they important to the ecosystem? *(pollination, dispersing seeds, being food for wildlife like birds and amphibians, recycling nutrients, cleaning water)*

Post Activity –

Insect Potato Home/Invertebrate Empathy

1. Prepare a potato home for insects by cutting a potato in half lengthwise. (For younger students you may want to have this already done.) With a spoon, hollow out the center of each potato half to form a cavity. On each end of these cavities make indentations or entrances to your potato home. You will want to make sure that the indentations are about halfway above the center of each end. Place the potato halves back together (you can wrap the halves together with masking tape) to complete the home. Locate the spot you would like to use to collect and, with a trowel, dig a depression in the soil. The area should be deep enough so that the potato home's entrance is level with the ground surface. Place the potato home in position. Soil from the depression can be left to one side to fill in after you are through with your collecting.




2. Check your potato daily to record the kinds and number of critters in your potato home. Transfer your critters to a petri dish or glass jar. Observe your critters with a hand lens and record your observations. Note any interesting features on your critters. Be sure to release your critters back into their potato home after you are done!

3. Possible discussion questions:
   - Which animals are attracted to the potato for food?
   - Which animals are there because they are attracted to its moisture, a water source?
   - Which could be there just for shelter?
   - What is something unique you have noticed about the invertebrates you found in your potato? Do any of them have a cool feature?
   - Imagine: what might life be like to be one of the invertebrates you found? Make up a 60 second story about your life as an insect.
   - Could any of the animals be there to prey upon the other animals in your potato home?
   - How might the critters you caught defend themselves against predators?
   - Predict what might happen if we buried the potato deeper in the ground.

4. Have students complete the Arthropod Poetry on the next page.

   Answer Key to Arthropod Poetry:

   1. Millipede
   2. Molting
   3. Larva
   4. Arthropods
   5. Appendages
   6. Abdomen
   7. Insects
   8. Crustaceans
   9. Antennae
   10. Metamorphosis

Discover Further

Learn More –

Did you know? The Fort Wayne Children's Zoo has more invertebrates than any other type of animal. Most of the Zoo's invertebrates millipedes and hissing cockroaches that we use for our Zoo Scientific Inquiry and Zoomobile programs in classrooms across the region. If you're interested in having the zoo come to your school, check out the zoo's website: https://kidszoo.org/programs/schools-program-guide/.

Resources

Invertebrate defense signs (last page): print out as many sheets as you need for your class. Cut them out, laminate them, add two holes with a hole punch, and attach a string to make a necklace.

Invertebrate Defenses

millipede	arthropods	insect	appendages
larva	molting	metamorphosis	
crustaceans	abdomen	antennae	

1. When I'm scurrying, fast and fleet,
   I seem to have a thousand feet.
   When I slow down, it's evident
   I have just four on each segment.

   Who am I? _____

2. My exoskeleton never grows
   Even though I do.
   And so I have to take it off
   To grow one bigger and new.

   What is this process?
   _____

3. When I come out of an egg
   I look like a worm with legs.
   But someday – wait and see –
   An adult insect I'll be.

   What am I? _____

4. We're crustaceans, arachnids, and millipedes.
   We're also insects and centipedes.
   We're famous for our legs that are jointed.
   Guess who we are, or we'll be disappointed.

   Who are we? _____

5. Feelers, mouth parts, legs, or wings.
   We can be any of these things.

   What are we? _____

6. I'm body part number three
   If you start from the head.
   Though belly's a common name for me,
   There's a fancier name instead.

   What is the fancier name?
   _____

7. My body has three main parts,
   An abdomen, thorax, and head.
   I often fly to get around
   Or I use my 6 legs instead.

   Who am I? _____

8. Lobsters, crabs, and crayfish are we,
   We often make our homes in the sea.
   We have five pairs of legs to walk
   And eye often perched atop a stalk.

   Who are we? _____

9. We're long and thin
   We're used so much
   When arthropods taste, hear, or touch.

   What are we? _____

10. First egg, then larva, then pupa –
    Everything gets rearranged.
    As step by step, I become an adult
    And my body's completely changed.

    What is this process?
    _____

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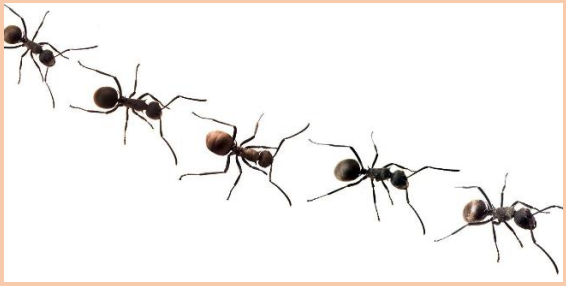
Invertebrate Defenses

COLOR WARNING

CAMOUFLAGE

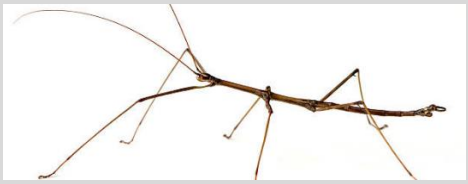
NOISE WARNING

ATTACKING



HIDING

PLAYING DEAD



Connecting kids and animals, strengthening families, and inspiring people to care.