

Who Wants to be Eaten? Invertebrate Defenses

Essential Question:

How does an invertebrate defend itself?

Background Information:

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

RUNNING OR JUMPING AWAY - Grasshoppers and fleas leap away. Primitive springtails spring. Water striders can leap about 8 inches to avoid fish. Many insects, e.g., ground beetles, cockroaches (which can move quite fast), will run away when threatened by a predator.

FLYING AWAY - Moths, butterflies, almost any species with wings, will fly away.

PLAYING DEAD - Click beetles drop to the ground when disturbed and play dead. Stick insects may fall off their perches and play dead.

HIDING - Cockroaches seek cover. Some moths dive into vegetation when pursued by bats. Undersides of low leaves, stems, and leaf litter, can hide insects and invertebrates from some predators.

MAKING A COVER TO HIDE IN - Bagworm caterpillars live in camouflaged tubes. When disturbed, they seal off the opening. Spittlebug larvae make froth to hide beneath, and few birds will dip into it. Tent caterpillars spin a silk web as protection. Roly-polies roll themselves into balls for protection. Land snails withdraw within their shells. Slugs coat themselves with a repellent slime.

FORTS (COLONIES) - Social insects –ants, bees, wasps, and termites–find shelter in colonies and station ‘soldiers’ to guard them. They will attack intruders en masse.

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.

STARTLING - Startling an attacker may provide time to get away. Peacock butterflies, with eyespots on wings, open wings suddenly to display spots, startling birds. Moths may flash red or black hindwings to distract birds. Green grasshoppers may display black and yellow hindwings as they dart away. Some insects make noises. Some cockroaches hiss. Tiger moths make clicking sounds.

WARNING: ‘I AM DANGEROUS’ - Bright colors on an insect or other invertebrate usually mean ‘Don’t bother me because I taste bad’, ‘I’ll make you sick’, or ‘I can sting or bite’. For example, stink bugs (nymphs and some adults) are often warning colored. Stink bugs produce a noxious smelling fluid that can be given off when disturbed. Yellow jackets and red and black velvet ants (actually wasps) are examples of warning colored insects with stings or powerful bites. Some warning colored insects obtain their noxious substances by feeding upon plants containing distasteful or poisonous substances. This is true of the caterpillars of monarch, some swallowtail, and cabbage butterflies.

Location: Classroom/Outdoors

Objectives: *Learners will*

- 1) name five predators of insects and invertebrates.
- 2) describe five ways invertebrates defend themselves against predators.

Skills: communication, observation, listening, analysis

Supplies:

- Invertebrate Defense Tag signs (procedure 1)
- Hole punch (procedure 1)
- Yarn (procedure 1)
- Cones (procedure 1)
- chalkboard or large piece of paper for brainstorm activity (procedure 2)
- slips of colored paper with words (procedure 2)
- Match Defenses and Animals Worksheet (procedure 4)
- invertebrate GEN Eco-service ID cards

Subjects: science

Time: 30-45 min

MIMICKING FIERCE OR DISTASTEFUL INSECTS - This is fairly common in the insect world, making identifications difficult. Stinging insects are often mimicked. For example, some moths mimic wasps or bees; hover flies look and sound like bees, some longhorn beetles mimic wasps. Insects also mimic insects that are distasteful or noxious. The viceroy butterfly has been considered a mimic of the bad-tasting, noxious monarch. However, it has been found that viceroys themselves are somewhat distasteful to birds, probably because they also contain distasteful plant material.

MIMICKING PARTS OF FIERCER ANIMALS - Snakeflies have snake-like heads that may deter some predators. A large South American hawkmoth caterpillar looks like a snake when disturbed. Big eyespots are found on the hind wings or bodies of some moths and butterflies. When a predator appears, the insect reveals the eyespot to startle it. Tests indicated that birds were, indeed, startled enough by the eyespots to draw back, giving the insect time to escape.

ARMOR OR SPIKES - Snails make and wear their own protective armor. Many caterpillars have sharp spines or hairs that emit pain-producing substances. Some adult insects have formidable mandibles. The mandibles of the stag beetle may be almost one half as long as he is (although they are mostly used in wrestling matches for mates). Some scarab beetles have formidable, rhino-like horns; more dangerous may be leg spines. Some insects have cutting-edge spines on their forelegs (e.g., mantids) or spines on their back legs (e.g., grasshoppers) with which they can effectively kick small attackers.

ATTACK WEAPONS - Biting with mandibles, pinching, and stinging can be quite deterring. Earwigs menace and can pinch with their cerci.

UNITED ATTACK - Social insects, ants, bees, wasps, and termites, will attack intruders en masse.

CHEMICAL WARFARE - Insects and invertebrates make and discharge chemicals that are noxious or toxic in one way or another. The stinging insects, many of which can cause painful reactions, inject a variety of chemicals. The hairs or spines of caterpillars can be venomous. The bite of many spiders is venomous. Other examples of chemical warfare include:

- When disturbed, the Eastern lubber grasshopper can emit a white froth from glands under its wings.
- Blister beetles 'bleed' a blood-like distasteful and toxic substance.
- Stinkbugs, formicine ants, and bombardier beetles squirt out irritating substances. That of the bombardier beetle comes out like a puff of hot smoke, blocking the enemy's view while the beetle escapes.
- Nasute termite soldiers emit noxious substances through snout-like organs.
- Some millipedes discharge noxious substances that include cyanide.

Getting Ready:

For Procedure 1:

1. Print 'Invertebrate Defense' Tag signs, double-sided. The picture should be on the front and the explanation of the defense on the back. (Laminating will help them last through multiple games)
2. Punch two holes on either side and thread a piece of yarn through to make a 'necklace'. Signs will be worn around learners' necks in the activity.
3. Prior to playing the tag game, set up the parameters of the playing field or indoor gymnasium using cones.

Procedures:

PREDATOR/PREY TAG

1. Use the 'Invertebrate Defense' Tag signs (see attached) to introduce the defense strategies discussed in the background section of the activity.
2. The premise of the game is a simple game of tag. Use the list below to introduce the various defense strategies and how they will be performed during the game of tag. Also mention the specific invertebrates that use these defense strategies to protect themselves against predation (may use Eco-Service cards as visual aids).

3. 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.
4. Choose one student to be the predator or “It” and give them the Predator sign. A bird is an example of a predator that would go after these types of prey. The predator will chase its prey and try to tag them. The predator must keep moving (i.e. they may NOT wait around until prey is done performing its defense strategy, then tag immediately).
5. The prey must perform their defense strategy before the predator is able to tag them. They may continue their defense for 5 seconds, then must keep moving. If the prey is tagged, they will become another predator. This shows how increased food supply helps increase the predator population levels. Have learners remove their sign (may hold in hand) to signify that they are now predators.
6. 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.).
 - **Playing Dead:** Click beetles, Stick insects (freeze for 5 seconds)
 - **Color Startling:** Peacock butterflies, Green grasshoppers (flash sign to show colorful display)
 - **Noise Startling:** Hissing cockroaches, Tiger moths (freeze and make hissing sounds)
 - **Cover to Hide in:** Bagworm caterpillars, Roly-poly (bend down and cover self with arms)
 - **Attack Weapons:** Earwigs, Ants (make chomp/biting motion with arms – mandibles)

FOOD CHAIN GAME: (Optional: Use if no other ‘food chain’ activity precedes this activity)

1. With learners, brainstorm a list of animals that eat insects and other invertebrates. (Birds, reptiles, spiders, amphibians, fish, other insects, other invertebrates such as spiders, small mammals and larger ones like ant eaters.) Every insect is eaten by something else. In that sense, they are important to the survival of many animals and part of many **food chains**.
2. Explain food chains and then distribute pieces of colored paper with names of organisms written on them, as given below:
 - (Green paper) Plant - seed - ant - frog - bird - alligator
 - (Yellow paper) River algae - insect larvae - small fish - big fish - person
 - (White paper) Tree - termite - anteater - jaguar
 - (Pink paper) Leaf - caterpillar - mantid - bird - hunter (person)
3. Ask children to make a food chain with others holding the same colored-paper assignments. After getting their food chain into the proper order, they should join hands. Each member of the chain should then identify himself or herself. Then, one by one, remove the insect from the each chain. What will happen to the animals that ate the insects? What will happen to the animals that ate them?

INSECT DEFENSE IDENTIFICATION: Distribute insect and invertebrate GEN Eco-service ID cards, so that each student has at least one. Let the learners decide what defense their invertebrate uses.

1. Distribute **MATCH DEFENSES AND ANIMALS Worksheets**. Learners have two tasks. First, they should match each defense with examples of insects or invertebrates using it. There may be more than one animal for some of the defenses, and some of the defenses show two methods of defense, e.g., a sting that injects venom. Second, if it is a defense that people use, they should put a check after the defense.
2. When learners are finished, review the defenses and student responses. Are all equally effective? Why?

Answer Key:

- j_____ 1. RUN AWAY
- h n__ 2. JUMP AWAY
- u_____ 3. FLY AWAY
- b_____ 4. PLAY DEAD
- j o r d_ 5. HIDE /MAKE 'FORTS'
- l v__ 6. CAMOUFLAGE
- c x__ 7. STARTLE
- s y__ 8. WARNING: 'I AM DANGEROUS'
- g _____ 9. MIMIC FIERCE INSECTS
- m_____ 10. MIMIC DISTASTEFUL INSECTS
- c f x__ 11. MIMIC PARTS OF FIERCER ANIMALS
- a p w_ 12. ARMOR OR SPIKES
- p e w_ 13. ATTACK WEAPONS
- d_____ 14. UNITED ATTACK
- a e i k t z (y s) 15. CHEMICAL WARFARE

Discussion/Assessment:

Take learners outside to discover insect defenses. Ask learners to observe insects' defense behaviors as you approach them. Many will leave or hide as you get near. To elicit defense behaviors from some animals such as caterpillars, you may need to tap the area before it with a straw.