

Predators, Parasites, Parasitoids and Pathogens

Essential Question:

What are predators, parasites, parasitoids and pathogens?

Background Information: Predation and Parasitism

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. Imagine if there were no predators on mosquitoes! 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 numbers of ‘pest’ insects under control. Pest insects are those who threaten our health and possessions (crops, homes, pets, gardens, forests, etc.)

Predators, pathogens, parasites, and parasitoids 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. With the possible exception of disease-causing microbes, these insects are the main 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 U.S. The fire ant is not a great pest in South America, but it is in the United States.

Predators: Who They Are:

- Dragonflies and Damselflies (adults and aquatic nymphs)
- Praying Mantids
- Some True Bugs (Hemiptera) are very effective predators. Examples are: ambush bugs, damsel bugs, leaf bugs, leaf-footed bugs, stink bugs (particularly spined soldier bugs), assassin bugs, and water striders.
- Dobsonfly larvae (in water)
- Snake flies
- Lacewings and ant lions (immatures)
- Many beetles, such as ladybugs, fireflies, ground, tiger, and rove beetles. In some species, the larvae are also predatory.
- Scorpion and hanging flies

Location: Classroom

Objectives: *Learners will:*

- 1) explain why predators are important to ecosystems.
- 2) define the terms: predator, parasite, parasitoid and pathogen
- 3) give one example of a predator, parasite, parasitoid and pathogen

Skills: communication, observation, listening, analysis

Supplies:

- chalkboard or large piece of paper for brainstorm activity of procedure 1
- Predators, Parasites, Parasitoids and Pathogens Worksheet
- invertebrate GEN Eco-service ID cards

Subjects: science

Time: 30 min

- Flies (some species)
- Ants
- Invertebrate predators include: spiders, centipedes, scorpions, some daddy long- legs, and predatory mites.

Predation Methods: Insect and invertebrate predators get their meals in several different ways:

❖ **Hunters, Chasers:**

- On the ground, long-legged tiger beetles run down prey (sometimes interspersing short bursts of flight) and snatch it in their strong, curved jaws.
- In the air, dragonflies with excellent eyesight, shape their spiny legs into basket nets and snare their prey on the wing. Dragonflies are very fast flyers.
- In the water, a number of beetles (e.g., diving, whirligig) and water striders (true bugs) seek and seize insect larvae, small aquatic insects, and mites. Giant diving beetle larvae are ferocious predators. They have sickle-shaped jaws and will attack small fish and tadpoles.

❖ **Hunters, Waiters:**

- Slow moving praying mantids, slow-moving, get most of their meals by waiting. Their shape and coloring acts as camouflage. They are attracted by movement. When prey comes near, they reach out with their spiny forelegs.
- Dragonfly naiads (juveniles) hide in the bottoms of ponds. Their lower lips are tipped with a fang. When prey comes near, they try to snag it with their fangs, and pull it into their jaws.
- Some spiders (jumping, trap door) spring or dart out from hiding places to snag prey.

❖ **Hunters, Collective Attack:**

- Ants work collectively and will use chemical signals to call other workers to the attack.

❖ **Trappers:**

- The spiders are well known for their use of traps. Almost everyone has encountered their webs, occupied or discarded.
- Some caddisfly larvae spin nets fixed to a rock in flowing water. Nets may resemble a thimble, trumpet, or finger of a glove. The larva lurks nearby and eats the organic matter that is caught in the net.
- Hanging flies (related to scorpion flies) become live traps by hanging by their front legs and grabbing victims with the back ones.
- Ant lions (lacewings) dig steep-sided conical pits in sandy soil. They usually also seek a place protected from rain. They hide in the sand and wait for ants and other small insects to fall into the trap. There, they wait with sickle-shaped jaws. If a victim tries to climb out, an ant lion will pelt it with little scoops of sand dug out with its flat, shovel-shaped head.

Finding Prey: How do they find their prey? Dragonflies, as noted, use vision, and predatory animals often have better vision than their prey. Movement alerts many predators, including trappers and lurkers such as praying mantids. Predators also use odor. This is particularly important to non-flyers such as ants and other invertebrates. No doubt, sounds and vibrations also signals for some predators, e.g., spiders.

What Are Parasitoids, Parasites and Pathogens?

In contrast to predators that kill their prey parasites seek out animals for blood or body fluids, but one individual does not take enough blood to kill it. Biting flies and mosquitoes are examples. Ticks might also be put in this category in that they stay on animals just long enough to fill up with blood and then fall off.

There have been a number of theories as to how these blood-seekers find food (and discussion of why some people are preferred hosts). Body temperature (warm-blooded animals) and carbon dioxide emission are probably factors.

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 include mites (arachnids) and a number of 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. But, 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 it, eventually killing it. Usually the larva emerges before the insect dies or pupates. Some wasps insert their own 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 out a specific prey, which might be a kind of spider, weevil, or long-horned grasshopper.

Female tachinid flies lay their eggs on the bodies of other insects. The larvae burrow inside and live as internal parasites, 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.

Procedure:

1. Explain the terms predator, parasite, parasitoid, and pathogen. Ask the students to give examples of each. Why are all these organisms important? What would happen if there were no predators/parasites/pathogens? Explain the difference between parasites that live on organisms and parasitoids, which usually kill their host. Use the Eco-service ID cards to show some examples.
2. Drawing Predators and Parasitoids in action. After seeing pictures of some of the predators and parasitoids, and learning how they find and catch prey, learners will be asked to draw a picture or cartoon-panel showing how one of these gets their prey. Be sure you have at least one example from categories listed below. Use the GEN Eco-service ID cards (Insect guidebooks can provide more information). In discussing, consider how hunters and parasitoids find their meals. Compare tactics with those of people.

SOLITARY HUNTER-CHASERS

GROUND – Tiger beetles, ground beetles, centipedes,

AIR - Dragonflies, damselflies, lacewings, robber flies

WATER - Diving beetles, beetle larvae, water striders

LURKER-WAITER – Praying mantid, dragonfly naiad, jumping spider

COLLECTIVE ATTACKS - Ants. (Note that some bees will attack other bee colonies for food.)

TRAPPERS: spiders, ant lions

PARASITOIDS - Wasps, tachinid flies

After discussion, learners can choose a predator or parasitoid to draw. They can create a cartoon-like sequence showing, say, a hunter tracking, catching, and eating prey or a parasitoid laying eggs in prey with ovipositor, the larvae emerging inside the caterpillar or grasshopper, and adults emerging from dead victim.

3. Have the students complete the Predator, Parasite, Parasitoid and Pathogen Worksheet. The students decide whether the numbered boxes show predators, parasites, parasitoids, or pathogens.

Answer Key:

1. Predator
2. Pathogen
3. Parasite
4. Parasite
5. Parasitoid
6. Predator
7. Parasitoid
8. Parasite
9. Pathogen
10. Pathogen
11. Predator
12. Parasitoid

Related Games: BEETLE AND BUG GAME

Played similarly to 'Bat and Moth' except that the beetle is using odors to find its prey. After being blindfolded, the 'Beetle' gets a whiff of a strong and familiar smell (e.g. cinnamon, lemon). The Bug, holding a cup with that odor, joins the circle. The Beetle must find the bug in the circle. The group may need to tell the beetle if it is getting close.

SEEK AND STAY STILL

Explain that motion is often a signal to predators. In this game, played like 'Statue', 1 to 3 children are predators and the rest are prey. The prey runs around in a defined area until whistle is blown. The whistle indicates a Predator is near. When they hear the whistle, all the prey/children must freeze. 'Predator' players watch for motion – and anyone who moves can be tagged and are out and 'eaten'.

ESCAPING THE WEB GAME

Lay out a web on the floor or in the grass with rope or tape, making it challenging to cross without touching any of the strands. Activity will be done with pairs of learners. One will be a spider. One will be an insect that must cross the web trying to avoid the strands. Before the 'insect' student starts, give him or her a card (but he or she is not to look at it unless he or she gets stuck touching a strand.) As the student crosses, the 'spider' must watch to see if he or she touches any strand and signal if they do. Once a touch is signaled, the 'insect' learner must stop. The learner can then examine the card they drew. It will tell them whether it can escape the spider. If it is a butterfly or moth it may escape because it can shake off scales and escape. If it is a toxic insect, it may escape because the spider may not want to eat it and will want to cut it free. Repeat until all who wish to play have turns.

Discussion/Assessment:

Review the importance of predators. Point out that some predators are recruited by people to help them control 'pest' insects.

What is the difference between a parasite and parasitoid?

What is a pathogen?