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Ant Zombies and Other Mind Control Parasites

Crystal Risko
Product Developer

Add interest to your discussion of parasites and their relationships with hosts with these examples of parasites that change the behavior of the host organism.

Example 1

Host: carpenter ants (*Camponotus leonardi*)
Parasite: fungi (*Ophiocordyceps unilateralis*)

The fungus infects the ant, causing it to move to the forest floor and latch on to the underside of a leaf. This brings the ant into the fungus's preferred habitat, where the fungus then kills the ant and sprouts.

This species of carpenter ant is native to tropical rainforest trees in which they build their nests. The ants go to the forest floor only to find necessary resources, such as food. When a spore from the *Ophiocordyceps unilateralis* fungus lands on an ant, it infiltrates the ant's body. The fungus then secretes chemicals that cause a secondary phenotype. This causes the ant to go to the forest floor, select a leaf in a particular type of habitat (about 25 cm off the forest floor and in very high humidity), and grasp the main leaf vein between its mandibles. The ant continues to hold on to the leaf while the fungus grows in the ant's body, killing the ant. The fungus then emerges from the back of the ant's head where it continues to grow. The fungus reproduces by releasing spores.



Example 2

Host: amber snail (*Succinea*)
Parasite: green-banded broodsac (*Leucochloridium paradoxum*)

When the amber snail is infested with the green-banded broodsac, a flatworm, the snail is prompted to move to bright areas (as opposed to its normal dark habitat), where it is more likely to be eaten.

When the snail ingests bird droppings infected with the flatworm's eggs, the flatworms hatch in the digestive tract. The larvae produce sporocysts, tube-like structures that contain several hundred larvae. These tubes stretch up into the snail's eyestalks, rendering the snail blind. Once the snail is blind, it no longer avoids sunlit areas. When it reaches a sunny area, the parasite causes the snail's eyestalks to twitch, which makes them resemble caterpillars. As the snail is unable to retract its eyestalks due to the presences of the sporocysts, birds attack the snail and are able eat the snail or to rip off its eyestalks and eat them. The flatworm then continues its life cycle, transforming into an adult and reproducing in the bird.

Example 3

Host: mice and other rodents
Parasite: protozoan (*Toxoplasma gondii*)

Upon infection with *Toxoplasma*, mice lose their innate fear of cats, making the mice more likely to be eaten and allowing the *Toxoplasma* to complete its life cycle.

Toxoplasma gondii is an intercellular parasite that requires the digestive system of cats (*Felis*) in order to complete its life cycle. *Toxoplasma* can infect other warm-blooded organisms as an intermediate host, including mice. When cats are infected with *Toxoplasma* parasites, they shed oocytes (eggs) of the protist in their fecal matter. These eggs are then consumed during grazing by animals such as sheep or mice. When mice consume the eggs, the protozoans form cysts in the mice brains. Instead of the mice having an aversion to the scent of cats, the cysts make it so that mice are actually slightly attracted to this scent. Because the mice no longer fear cats, the cats are able to get an easy meal. When the cat eats the mouse, it puts the *Toxoplasma* in the digestive tract where it can complete its reproductive cycle.

Example 4

Host: orbweaver spider (*Plesiometa argyra*)
Parasite: wasp (*Hymenoepimecis argyraphaga*)

The wasp uses the spider as a host for its larva. When the larva is ready to form a cocoon, it forces the spider to build a modified web that will hold the cocoon, and the larva kills the spider.

An adult wasp stings the orbweaver spider, temporarily paralyzing the spider. While the spider is paralyzed, the wasp lays an egg on the spider. The spider then resumes its normal activities; however, it's now carrying the wasp egg. When the larva hatches, it begins to suck hemolymph, internal fluid, from the spider, but otherwise the spider continues its normal activities. When the larva is ready to pupate (form its cocoon), the larva injects the spider with a chemical that causes the spider to build a modified web. This web is able to support the weight of the wasp

cocoon, while the normal web would not be able to do this. The wasp larva kills the spider and drains it of any remaining nutrients and forms its cocoon. The wasp then emerges from the cocoon and continues its life cycle.

Example 5

Host: grasshoppers and crickets (*Orthoptera*)

Parasite: hairworm (*Spinochordodes tellinii*)

The hairworm causes grasshoppers and crickets that are infected to jump into water, which will kill the grasshoppers and crickets but allow the hairworm to complete the aquatic phase of its life cycle.

When the larvae of hairworms are in the body of a grasshopper (or cricket), the hairworms live inside them, growing and developing. While living inside the grasshopper, the hairworm absorbs nutrients from the insect. After several weeks or months, the larva is ready to become an adult. Adult hairworms are free living in aquatic environments. The hairworm produces chemicals that cause the grasshopper to seek out a source of water. The grasshopper will then jump into the water and drown itself. This brings the hairworm to the water source needed to live as an adult and reproduce.

Example 6

Host: green crab (*Carcinus maenas*)

Parasite: barnacle (*Sacculina carcini*)

The female barnacle injects itself into the crab and takes over the crab, causing the crab to care for the barnacle eggs as its own.

The larval female barnacle finds a joint in the crab's body and sheds the barnacle's hard outer layer. The female barnacle then injects itself into the crab's body, where it takes over. The female barnacle produces tendrils that go various places in the crab. The barnacle also produces a sac-like structure at the back of the crab where the crab would normally have its eggs. The barnacle takes over the digestive system to take nutrients from the crab, and it also takes over the nervous system of the crab. The barnacle causes the crab to cease molting or regenerating limbs and causes infertility. If it infects a male crab, it causes the crab to release hormones that make it act and look like a female crab. When a male barnacle encounters a crab infested with the female barnacle, the male injects itself into the sac where it fertilizes the egg. The female crab or male crab acting like a female now cares for the eggs until they are ready to hatch and larvae are dispersed.

The following is a list of other examples that you may wish to have your students investigate.

Host	Parasite
Ant	Lancet liver fluke (<i>Dicrocoelium dendriticum</i>)
Ant (<i>Cephalotes atratus</i>)	Nematode (<i>Myrmeconema neotropicum</i>)
Caterpillar (<i>Thyrinteina leucocerae</i>)	Wasp (<i>Glyptapanteles</i>)
Sticklebacks	Tapeworm (<i>Schistocephalus solidus</i>)
Killifish	Worm (<i>Euhaplorchis californiensis</i>)
Pillbugs (<i>Armadillidium</i>)	Ancanthocephalan worms (<i>Plagiorhynchus clindraceus</i>)
Grasshopper (female) and Ants (male)	Fly (order Strepsiptera, family Myrmecolacidae)
Bees	Phorid flies (<i>Apocephalus borealis</i>)
Ladybugs	Wasp (<i>Dinocampus coccinellae</i>)

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