

THE ZOMBIE ANT EXPERIENCE

INSTRUCTIONS

1. Print this document with the following settings:
 - 11"x8.5" paper
 - Full color
 - Single-sided
 - One page per sheet
 - Landscape mode
2. Affix pages 2 - 6 to wall.
3. Download and install the "Zombie Ants" app on your phone or tablet.
4. Launch the app and follow the on-screen prompts.

Download links coming soon.

Enjoy!

LEARNING OBJECTIVE I:

ANT COLONY

Welcome to the Zombie Ant Experience.

The ant nest is a society, in many ways like our own. Ants have invented agriculture, antibiotics, war, slavery, and even air conditioning. An ant's society can be anywhere from 100 ants to 15 million, and they're all one family. The worker ants are all female, all sister, and all the daughters of a single queen. It is these workers that emerge each night from the nest to travel along trails that snake out into the forest, so that they can find food. The carpenter ants, that are the preferred host of the zombie-ant fungi, depend heavily on sugar for food. The healthy ants get this sugar by milking the bodies of living insects feeding high up in the canopy. To get to the sugar source, the red legged Brazilian carpenter ant moves rapidly along the trails of fallen branches. These trails can be used by the same colony for months on end. The first ants lay down chemical trails for the others to follow, which ensures that none get lost along the way. It is in this way that the colony grows and thrives, but, it must also reckon with the zombie-ant fungi.



LEARNING OBJECTIVE 2:

INFECTION PHASE I

For a species of zombie ant fungus that is specialized to attack and kill the red-legged Brazilian carpenter ant, the trails are key. It is on the trails that each night, thousands of ants run. And so, it is on these trails the fungus lays its spores at dawn. Hundreds of dead ants hang from the leaves of plants that surround the colony. Each evening, the unaffected ants emerge into the forest to run through a sniper's alley made up of their dead sisters clamped to leaves.



LEARNING OBJECTIVE 3:

INFECTION PHASE 2

The infected spore attaches like Velcro to the body of the ant whose unaware that her life will soon be over. The first step for the fungus is getting through the thick armor of the ant which it does by using a combination of corrosive chemicals and mechanical pressure to push through the defenses. Once inside, the spore multiplies and multiplies and multiplies until it builds up the force that's needed for next stage, which is manipulation of the ant host. To manipulate the ant so that it acts like a puppet on a string, the fungus needs to take control. This means controlling the muscles that move the ant. It first slowly separates the densely packed muscle fibers so it can squeeze in between them, then, and quite remarkably, the fungal cells join together and cooperate. What were previously individual cells now connect to form a three dimensional structure of fungal cells surrounding the muscles.



LEARNING OBJECTIVE 4:

LEAF BITE

On the evening that it will die, the infected ant really isn't much of an ant anymore. Its body is filled up with fungal cells, and as much as 40% of the creature we look at is fungus. What happens next shows that 100% of its behavior is that of the fungus. It needs its ant host to climb up a plant that is near the trail. On this plant it finds a leaf and bites deeply into the tissue. The biting is important because the next stage is death, as the fungus releases chemicals that kill the ant. Since the ant is upside down, the death grip the fungus induces, ensures the ant cadaver doesn't fall down to the forest floor. And now this once important member of the colony lies dead above the trails her sisters are still walking on. Over the following days, the fungus rapidly converts all the muscle and tissue of the ant into fungal material that grows explosively from the ant's body. Some of this growth are the long strands that stitch the ant's body to the leaf as it will stay in place for as long as a year and a half. But most of the growth is to form the stalk that emerges from the ant's head. It is on this stalk that we find the spore factory, the ascoma.



LEARNING OBJECTIVE 5:

ASCOMA

The ascoma is the most important part of the fungus. It takes weeks to grow. And when complete, it has over 100 little sacs in which spores mature. The end of each sac is a whole called an ostiole, through which spores emerge.

Since fungal spores are microscopic, they face distinct aerodynamic challenges and the fungus must rapidly shoot them out to break through a thin layer of air called a 'boundary layer'. Without gunpowder, this is a challenge, as you might imagine. The fungus uses the sac-like structure the spores are in, together with the changing humidity that naturally occurs in the forest, to create localized high and low pressure environments. As the pressure changes, the spores are shot out to break

through the boundary layer, and once in flight are propelled by the wind. Although the forest's understory is still and humid, there is enough wind to carry the spores. Since the target are the foraging trails, the spores must hit them. Many don't make it, and fall uselessly to the ground, or hit branches the ants are not walking on. But

by manipulating the ants to bite the leaves near the trails, the fungus has ensured that enough spores hit the nearby trails and the cycle continues. The circle of life, or in this case, the circle of death, goes on.

