

TEACHER'S GUIDE TO

The Wasp That Brainwashed the Caterpillar

EVOLUTION'S MOST UNBELIEVABLE SOLUTIONS
TO LIFE'S BIGGEST PROBLEMS

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DISCUSSION QUESTIONS

- The most important thing an animal must do at all costs is what?
- There's no such thing as "progress" in evolution. Just because you have a big brain doesn't mean you're any more evolved than any other animal. Choose a creature from the book and explain how they're just as suited to their environment as you are.
- What makes a creature qualified to be a worm?
- The males of some species are far more extravagant than the females. And some males wield weapons while females don't. Why is that?
- Lots of parasites can mind-control their hosts, like the wasp does to the caterpillar. It seems too complex to be true, so how could this have evolved?
- What is plankton, and why is it so important to the ocean ecosystem?
- Madagascar is home to many strange creatures found nowhere else on Earth. Why did they evolve to be so unique?
- Why is it so hard for scientists to determine what exactly a species is? And what causes a species to become a species in the first place?
- All tongue-eating isopods are born male, but some turn into females. Why?
- The pistol shrimp and the mantis shrimp can both create cavitation bubbles with their strikes. What makes these bubbles so destructive?
- Say you're a sociable weaver. Why would it make sense for you to tend to your own chambers instead of helping maintain the nest as a whole? And what happens if someone catches you cheating?
- For most creatures in the animal kingdom, the males are bigger than the females. So why is the diving bell spider different?
- What is social immunity, and how has it helped ants conquer the world?
- The pink fairy armadillo and the naked mole rat are both mammals that live underground, but they have different adaptations to survive down there. Explain how the two species differ.
- The cuttlefish has many uses for its ability to change color. Name three of them.
- The aye-aye plays the role of a woodpecker on Madagascar. But why would a primate assume the role of a bird?
- What has made beetles so wildly successful?
- The bolas spider and the cone snail have both turned chemicals into weapons. How are their strategies different?
- Why is the term "living fossil" so problematic?



ACTIVITIES

- No matter where you live, you too can collect your very own water bears. Just head outside and gather up some dirt, preferably moist. Pile it in a petri dish and add water, then put it under a microscope. More likely than not, you'll see tiny critters that resemble gummy bears milling about. Watch as they use their clawed feet to move around and feed.
- Thought experiment: Dream up your own creature that has evolved to solve a certain problem. Anything goes. Explain what drove the development of such an animal, and why it couldn't actually exist in real life. For instance, a four-legged critter that's evolved wheels instead of feet. But why? Well, it's more energy efficient for one. There's a catch, though: it would only make sense if this animal lived in a very flat environment, since going uphill would be impossible. Again, anything goes, so get wild with it. And sketch it out to bring it to life.
- Choose a spot anywhere on Earth. What's the most unique creature (in your opinion) you can find there? Madagascar has lots of interesting animals, but so too do the deserts of California.
- Check out the book's bibliography. See a scientific paper that looks interesting? Find it online and give it a read. Fear not! Scientific papers are far more entertaining than you'd think. What have the scientists discovered? What were their methods? Can you think of a study that you'd conduct as a follow-up?
- Discover your family tree. I don't mean your great grandparents. I mean your great great great 2,000-times-over grandparents. Research the evolutionary history of human beings. What species are we most closely related to? When did our fish ancestor first crawl up on land? And go back even farther: When did life first appear on Earth? That, after all, is your very, very distant ancestor.
- Your own body consists of a whole lot of brilliant solutions to problems. For instance, your opposable thumbs allow you to manipulate objects. Can you think of another? What does it help you do? And why might it have evolved?
- Take a look around outside for a creature that you find particularly interesting. A beetle, or ant, or even a pigeon. What traits help them survive? What job do they have in the ecosystem? Why can they exist alongside humans so well?

RESOURCES

Evolution is an exceedingly slow process. But sometimes organisms adapt with astonishing speed. Bacteria, for example, evolve right before our eyes. In this fascinating experiment, scientists use a giant petri dish to show how bacteria evolves resistance to antibiotics at a terrifying clip. <https://www.youtube.com/watch?v=plVvk4NVIUh8>

An excellent museum site with interactive games about the colossal squid, which makes an appearance in the cuttlefish chapter: <http://squid.tepapa.govt.nz/>

A great one-stop resource for all things evolution, from UC Berkeley: <http://evolution.berkeley.edu/evolibrary/home.php>

Archive of the author's Absurd Creature of the Week column: <https://www.wired.com/tag/absurd-creature-of-the-week/>

The Absurd Creatures video series: <https://www.wired.com/tag/absurd-creatures/>

Videos of some of the creatures featured in the book:

Lowland streaked tenrec: <https://www.youtube.com/watch?v=W9kJKu4cpXM>

Pearlfish: <https://www.youtube.com/watch?v=dOoZ6wHiSnI>

Pistol shrimp: <https://www.youtube.com/watch?v=QXK2G2AzMTU>

Naked mole rat: <https://www.youtube.com/watch?v=A5DcOEzW1wA>

Pangolin: <http://video.nationalgeographic.com/video/short-film-showcase/the-tragic-tale-of-a-pangolin-the-worlds-most-trafficked-animal>



QUESTION AND ANSWER WITH MATT SIMON

Why is it that the animal kingdom is so very strange?

We humans have the luxury of judging particular animals as particularly “strange,” because we’ve got these great big brains. But really, what’s weird to us is just business as usual in the animal kingdom. It’s all the automatic processes of evolution: those best fitted to their environment survive to pass down their genes. Yes, sometimes that entails invading other creatures’ bodies. I think we find these animals so strange because our lizard brains can’t fathom something so complex or “devious” evolving by mere chance. But then there’s the breaks, as the saying goes.

What’s the biggest misconception about evolution?

That there’s such a thing as “progress” in evolution. Anyone who writes about biology or does biology has to struggle not to fall into this trap. We humans may seem like an advanced species because, among many other things, you’re reading a written language that our big brains thought up. But we’re no more “advanced” than any other species because evolution isn’t about progress. We’re suited to our environment—that’s it. So is a duck and so is a chimp. It’s easy to forget that.

What’s your favorite creature from the book?

I get this a lot, and struggle with it a lot, because it feels like I’m picking a favorite child. But since I have no children, here goes. My favorite is the zombie ant. I think more than any other creature it demonstrates the raw power of evolution. It’s almost impossible to comprehend something so complex evolving, but it actually makes perfect sense. A fungus didn’t just one day start steering ants around the rainforest. It evolved over millennia, adapting step by step to gain total control over an insect. It shouldn’t exist, but there it is.

What inspired you to write the book?

The book actually grew out of a column I used to do for *Wired* called Absurd Creature of the Week. The more critters I covered, though, the more I realized how disconnected they were from each other. With a book, I was able to take those creatures (and some new ones) and tie them all together thematically by their common problems, all under the larger umbrella of the majesty that is evolution.

Do you ever get angry letters from creationists?

Believe it or not, in all the years I’ve been writing about evolution, I’ve never once gotten a letter from an angry creationist. (Though oddly enough I have gotten letters from scientists objecting to my humorous treatment of the animal kingdom, but that’s a whole different story.) I think this may be because I don’t go out of my way to prod people who don’t accept the idea of evolution. I like to think that I’ve at least convinced a handful of people to accept the fact, but if that’s happened, I haven’t heard from them. Really, there’s nothing to say you can’t believe in a higher power and be onboard with evolution. You just have to accept the fact that natural selection creates species, not a god.

What’s next for you as a writer?

I’m actually working on a second book at the moment, which Penguin will publish in 2018. It’s a dive into the surreal science of the zombifiers among parasites. So you know the wasp that brainwashes the caterpillar and the fungus that hijacks the ant’s brain? Well, it turns out they’re just two of many, many parasites that can manipulate the behavior of their hosts. It’s a phenomenon that’s evolved independently perhaps hundreds of times across the animal kingdom. And scientists are just beginning to understand the mechanisms involved here, because each zombifier employs a different strategy—for instance, physically manipulating the brain or instead using chemicals. In my humble opinion, the work that’ll come out of this field in the next decade or so will be the most intriguing research in all of biology.

Are you optimistic about the future of nature, what with global warming and all?

I’ll be the first to admit I’m not the most optimistic of people, but I think what we’ll see happening in the natural world over the next few decades as the planet warms will be fascinating. I mean, ideally we’d stop throwing ecosystems into chaos, but we’ll actually see animals evolving in unique ways. Corals could adapt to warmer, more acidic oceans, for instance. Life, as I demonstrate in the book, doesn’t like being told “no.” Some species will perish but some will persist, despite our best efforts to destroy them.

