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### MIND AND MATTER

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## See Jane Evolve: Picture Books Explain Darwin

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*Peter Oumanski*

Evolution by natural selection is one of the best ideas in all of science. It predicts and explains an incredibly wide range of biological facts. But only 60% of Americans believe evolution is true. This may partly be due to religious ideology, of course, but studies show that many secular people who say they believe in evolution still don't really understand it. Why is natural selection so hard to understand and accept? What can we do to make it easier?

A new study in *Psychological Science* by Deborah Kelemen of Boston University and colleagues helps to explain why evolution is hard to grasp. It also suggests that we should teach children the theory of natural selection while they are still in kindergarten instead of waiting, as we do now, until they are teenagers.

Scientific ideas always challenge our common sense. But some ideas, such as the heliocentric solar system, require only small tweaks to our everyday knowledge. We can easily understand what it would mean for the Earth to go around the sun, even though it looks as if the sun is going around the Earth. Other ideas, such as relativity or quantum mechanics, are so wildly counterintuitive that we shrug our shoulders, accept that only the mathematicians will really get it and fall back on vague metaphors.

But evolution by natural selection occupies a not-so-sweet spot between the intuitive and the counterintuitive. The trouble is that it's almost, but not really, like intentional design, and that's confusing. Adaptation through natural selection, like intentional design, makes things work better. But the mechanism that leads to that result is very different.

Intentional design is an excellent everyday theory of human artifacts. If you wanted to explain most of the complicated objects in my living room, you would say that somebody intentionally designed them to provide light or warmth or a place to put your drink—and you'd be right. Even babies understand that human actions are "teleological"—designed to accomplish particular goals. In earlier work, Dr. Kelemen showed that preschoolers begin to apply this kind of design thinking more generally, an attitude she calls "promiscuous teleology."

By elementary-school age, children start to invoke an ultimate God-like designer to explain the complexity of the world around them—even children brought up as atheists. Kids aged 6 to 10 have developed their own coherent "folk biological" theories. They explain biological facts in terms of intention and design, such as the idea that giraffes develop long necks because they are trying to reach the high leaves.

Dr. Kelemen and her colleagues thought that they might be able to get young children to understand the mechanism of natural selection before the alternative intentional-design theory had become too entrenched. They gave 5- to 8-year-olds 10-page picture books that illustrated an example of natural selection. The "pilosas," for example, are fictional mammals who eat insects. Some of them had thick trunks, and some had thin ones. A sudden change in the climate drove the insects into narrow underground tunnels. The thin-trunked pilosas could still eat the insects, but the ones with thick trunks died. So the next generation all had thin trunks.

Before the children heard the story, the experimenters asked them to explain why a different group of fictional animals had a particular trait. Most of the children gave explanations based on intentional design. But after the children heard the story, they answered similar questions very differently: They had genuinely begun to understand evolution by natural selection. That understanding persisted when the experimenters went back three months later.

One picture book, of course, won't solve all the problems of science education. But these results do suggest that simple story books like these could be powerful intellectual tools. The secret may be to reach children with the right theory before the wrong one is too firmly in place.

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