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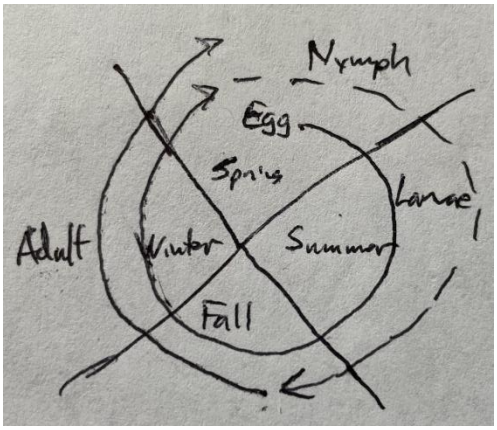
McNeil-Ticks and Lyme Disease: An Argument for why Biodiversity Matters

I value using real-world examples where I don't necessarily know what the outcome of an activity is going to be in my teaching. One of the best ways to do this is to add games into my classes that allow students to literally play with concepts. I've developed several of these, but one of my favorites revolves around showing students the value of biodiversity using the example of how ticks transmit Lyme disease, not just to people, but to other organisms.

One of the fundamental questions in environmental conservation is why should we care. Helping people and students see why having a lot of different kinds of organisms around is a good thing is a big challenge but is so important to getting support for conservation initiatives. One of the most concrete ways to connect people with their environment is through health concerns, and ticks are an ever-present threat that many students are familiar with.

I begin this activity by asking the students what they think when they hear "biodiversity". Based on their answers, we come to a definition that usually encompasses the technical definition (i.e. all the living organisms on earth). I then emphasize that biodiversity is in decline and that most of the threats are human influenced, which may seem disheartening at first, but also means that we have the power to change outcomes if the threats are mostly created by people's actions. This setup grounds the activity and helps pull the specific example back out to a larger message at the end.

From here I poll the group, asking how many have every encountered ticks (usually most of them) and if any of them have ever had a tick-borne disease (sometimes a few, though most have at least heard of them). Lyme disease is the most common disease people have heard of and provides a good case study for the activity. I introduce the tick life cycle (see the sketch to the right from my class notes), which provides the context for the game: students will act as ticks and mammalian hosts to simulate how Lyme disease moves through communities of animals with very little diversity versus those with a lot of biodiversity.



In the first round of the game, I ask for six volunteers to be black-legged ticks (the species most known for transmitting Lyme disease), five volunteers to be chipmunks, four volunteers to be humans, and ten volunteers to be mice, two of which are "infected" with Lyme disease, indicated by an orange piece of construction paper they carry with them. I adjust these numbers proportionally based on the size of the group so that everyone who wants to can be involved. The numbers are actually based on published literature and should be maintained for the activity to function well.

The game works as a series of tag sessions; the ticks try to catch a mammalian host at each stage of their development (larva, nymph, and adult, so we play three sessions of tag per generation). If a tick catches a mammal with Lyme disease, they contract the disease and any further hosts they catch become infected (they get to carry orange cards). We go through the whole tick life cycle twice, which mimics essentially two years of disease spread in this environment. What usually happens is that most of the mammals have Lyme disease by the end of two years, including the humans.

In the second round of the game, I re-assort the mammalian hosts. There are still six ticks and four humans, but now the mammals are broken up into three mice (still two with infections), three chipmunks, two squirrels, two deer, two skunks, one rabbit, one raccoon, and one opossum. We go through the same sessions of tag for each

life stage of the tick, but with some changes. For one, deer, skunks, raccoons and possums can't contract Lyme disease, so even if they're bitten by an infected tick, they don't carry the disease with them in successive tag sessions. The other change is the opossum. In addition to being resistant to Lyme disease, opossums eat ticks, so the student who is the possum runs around trying to tag ticks, even as they're trying to tag mammals. Ticks that are "eaten" by the possum are out of the game until the next generation. We run the simulation for the same two years, but in contrast to the first round there are usually many fewer infected mammals and the possum has greatly reduced the tick population. It's actually quite rare for a human to become infected in this scenario.

After these rounds of gaming, which I try to do outside whenever possible, I emphasize to the students that there is a clear difference in the outcomes in these two scenarios: the world with many different species is impacted much less by the disease. This difference is the value of biodiversity. Simply by having more diversity the ability of pathogens like Lyme disease to spread is greatly reduced. This phenomenon has been documented in the literature and is a clear example of why biodiversity is worth preserving.

The reason this activity is one of my favorites is because it has such a solid impact on the students. They have a lot of fun pretending to be the different animals (and avoiding each other!), but the distinction between the two scenarios hits home very strongly. I also appreciate it because although I have a general sense of how the two rounds will play out, I can't predict the specifics. There are always variations in the outcome that require me to adjust my explanations, but also serve to highlight that the real world is messy and data is often not cut-and-dry. Playing with real data this way is my favorite way to teach!