Chapter 9
Spiders, Rats, and Education

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When I visit environmental learning centers involved with wildlife rehabilitation, I can observe injured crows in small outdoor cages "sentenced to life" as teaching props. "Otherwise in the wild," it is explained, "they will be dinner." I watch the birds circling endlessly around and around in their small cages all daylong and I say to myself, "That is not crow." I feel the same way at a New England zoo when watching a polar bear circumnavigate its concrete enclosure. I say to myself, "That is not polar bear."

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I cringe for the countless laboratory rats when I hear about cosmetic, health, and food companies using rats to test for the harmful effects of their products. And I say to myself, "Those aren't rats."

And yet I continue to ask my teacher education students to consider how and why they challenge their middle and high school science students to confine and manipulate rats and spiders in the name of education and scientific progress.

"So what are you?" I ask myself. "A specieist or altruist?" How can I justify claiming empathy for the millions of animals used in scientific research and education every year *and* at the same time recommend to my science education students that they should have their students trap spiders and teach rats something they would never otherwise learn?

To consider the moral dimensions of these projects, let's first examine what students are being asked to do with the spiders and rats.

9.1 Sustaining Spiders and Teaching Rats

9.1.1 TheBiosphere Challenge

"Create whatever you think has to happen so that multiple generations of spiders can live inside a sealed five-gallon container for as long as possible." Hundreds of students, middle through graduate school, have been captivated by this challenge. The Biosphere Challenge as it has come to be known, is an "inquiry-based, hands-on, minds-on, problem-solving, student centered curriculum that can help students of any age deepen their understanding of ecology… It is about challenging students to reflect on, to test and to rethink their most fundamental ideas about nature" (Karlan 2000, p. 13).

With shovels, trowels, and a 5-gallon container in hand, students between ages 12 and 50 are presented with this challenge. Most, with the right facilitation, are still designing after an hour and bargain for more time to debate and decide with their partner what else they can do before sealing their container. As teachers follow their students through the schoolyard, and fields and forest when available, they elicit their students' ideas about what they're collecting and why.

Intermittently, teachers ask their students to clarify, elaborate and respond to alternative suggestions. The first phase of the Biosphere Challenge invites students to reveal their theories about big questions like: Is nature a verb or noun; an object or a process; cyclical or linear; diverse or monochrome; cooperative or competitive; dynamic or steady; open or closed; inclusive or exclusive of humans; male or female? "Ultimately the story manifested in their biosphere constructions and accompanying explanations, reflects their conceptual 'thumbprint' – their most fundamental ideas about nature" (Karlan 2000, p. 14).

The second phase of the Biosphere Challenge presents discrepant events that challenge students' initial theories about the nature of nature. These discrepant events lead to opportunities for students to open and modify their biospheres. Discrepant events come from readings about ecology, a guest ecologist sharing why she thinks the amount of soil and water they included can lead to their biosphere's collapse, films about the lessons learned from Biosphere II's two attempts to sustain people in a completely sealed container (biosphere2.org), and ongoing observations of their own biospheres. These discrepant events can motivate students to rethink and redesign what they think has to happen to sustain nonhuman life. Every ecological principle from cycling to biodiversity, from carrying capacity to evolution, and from exponential growth to entropy is contained within the students' efforts at creating a working model for sustaining life in a closed system.

The Biosphere Challenge involves creating working models of very complex systems. Thus, it can involve the collection and containment of a diversity of organ-

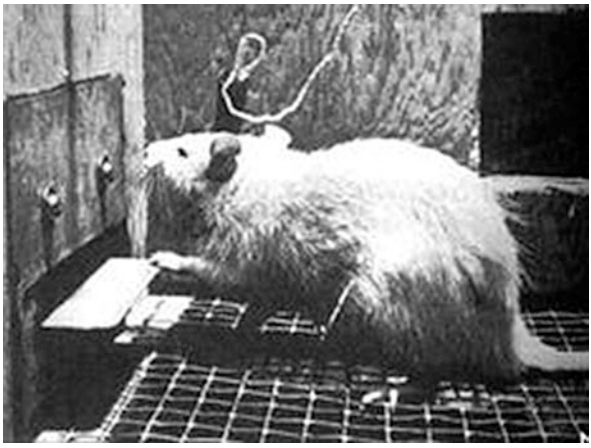
isms including spiders, earthworms, beetles, flying insects, ants, and countless microorganisms. My desire to use animals in classroom settings began about 34 years ago when I was a middle school science teacher. With my students' help, we turned our classroom into a museum with observation beehives and ant colonies, earthworm farms, snakes, and rats. Lots of rats!

9.1.2 Teach a Rat

Back then I challenged pairs of 7th graders to prove that they can teach a rat something new. This was the opening challenge to a unit on Learning. I chose rats because they are very friendly, rarely bite, and have the capacity to learn lots of behaviors like how to ride on someone's shoulder, jump through hoops, ride in a belly bag, come to its name, sit, stand up on hind legs, play with a ball, barrel race, open a gift, navigate a maze, step on a lever, and I'm sure much more.

Since every two students shared their own rat, we had some 14 white rats contained in 5–10 gallon terraria. I bought the rats from a local pet store that raises them primarily for snake food, and as pets. The pet store agreed to take back any rats that my students didn't take home at the end of the unit; consequently, all rats either became a student's pet, food for a student's pet snake, or were returned to the pet store for similar outcomes.

We discussed, debated, and decided on the parameters of the challenge like only using positive reinforcement to teach the rat something that would do it no harm. Of course we played with the meaning of positive reinforcement and what they would consider as causing no harm to other than human animals. While teaching their rats, students also learned about learning through readings, films, reflecting on their own learning abilities, and talking with guests about their various learning challenges.



9.2 Moral Objections Welcomed

Both the Biosphere Challenge and Teach a Rat activities invite students to discuss and debate the moral issues around using animals, including humans, in the name of education and science. One of my science teacher certification alumni reported back, "I set my students out on the Biosphere Challenge last week and it has been awesome in garnering active interest, genuine curiosity and today a passionate discussion on the ethics of keeping insects/ arachnids."

Inevitably, some students will raise moral issues on their own and assert that they'd like to decide whether or not to participate. I challenge my students to literally take a stand to indicate their position along a continuum of values and beliefs for why they should or should not participate in activities using domesticated or wild animals. This "Taking-a-Stand" exercise is orchestrated to bring out as many voices and values around the issues and is a prerequisite to deciding how to participate. Asking students to do a two-minute free-write on their initial position before

taking a stand, literally, can help reduce the influence of peer pressure. And the activity often leads to students asking each other for what evidence they have to support their respective positions.

During "Taking-a-Stand," 7th grade students like Amy on the opposing side of the continuum exclaims, "It's not fair to make the spiders suffer!" All names are pseudonyms.

Ruth on the continuum's side "in favor of participating" responds in defense, "How do you know it's suffering? You're not a spider. And Mr. K (the teacher), anyway, asked us to keep the spider alive and well, not hurt it."

Bob (standing next to Amy): "If you were plucked from your house and locked up somewhere else, I bet you'd be feeling pain."

I interject to the class that this is the same position taken by the American Psychological Association's (APA) "Guidelines for Ethical Conduct in the Care and Use of Nonhuman Animals in Research" Their guidelines assume "that procedures that are likely to produce pain in humans may also do so in other animals, unless there is species-specific evidence of pain or stress to the contrary."

Ruth: "That's not fair. I don't think there's any reason to believe that spiders feel the same pain as humans."

Amy: "Certainly the humans who were sealed into Biosphere II say they felt a lot of pain and stress while confined inside their 3-acre globe. And they volunteered. The spiders and whatever else we trap did not."

Ruth: "It's not fair to think that putting spiders in a sealed container for just a month or so in a way that will help them thrive causes the same kind of suffering experienced by some of the Biosphere II inhabitants."

Bob: "Since we'll never know, we shouldn't risk harming them. I'm sure there are other ways we can learn about ecology."

Kristen (standing between Ruth and Steve): "That might be true, but I know I learn better when I'm using my hands and mind together. I'd rather create a working model of how to keep something alive than read about how to do that in a textbook."

Niki (near the middle): "I'm OK about reading a book to learn about this stuff."

I interrupt to remind folks that they each get to decide if they want to participate and that our goal is to understand each other's values and beliefs behind their decision.

Ruth: You know it's likely you killed or harmed dozens of spiders and insects on your ride to school this morning. Just check your windshield and tires. And even if you didn't, one blue jay alone ate more spiders than all of us are at risk of killing during this exercise.

Amy: "Yeah but the bus didn't kill them on purpose. And it's natural for a blue jay to eat spiders."

Kristen: "So why should choosing to trap a spider for the sake of learning have any less value than the accidental or natural killing of them?"

Amy: "Because accidents and predation are the natural order of things. They are not choices. We can choose to do something else to learn about the same thing."

Ruth: “I’m going to try and keep the spider alive. If it dies during this activity, I’m trusting that what we learn about sustaining life is as worthy as spiders dying from the bus’ windshield, or by hungry chickadees.”

Rob (near the middle): “I wonder if any of our positions would change if instead of trying to sustain a spider we were trying to sustain an earthworm, a frog, or a mouse.”

Amy: “Yeah Kristen. What if we were trying to sustain multiple generations of mice in a completely sealed container?”

Kristen: “I’d probably not be in favor of the activity. For even though I don’t like to admit it I probably value a mouse’s life over an earthworms or a fruit fly.”

Amy: “And I’d probably be OK with sustaining multiple generations of earthworms in a sealed container.’

Mr. K (teacher): “In this regard, the two of you sound like you’re in agreement. You both believe that different kinds of animals have different life values. Invertebrates are not legislated in Massachusetts, however, the Center for Laboratory Animal Welfare (CLAW) advocates that invertebrates be treated the same as vertebrates. Specieism is a great issue to ponder and I promise we’ll do so throughout this project.”

Kristen: “I plan to be very careful and respectful with everything we put into our terrarium. And you already told us that we could release the spiders and other organisms at any time. So I’m not worried about harming the spider.”

Kathryn (near the opposing side): “A captive spider sealed inside even the best-made biospheres is no more a spider than a caged fox at a zoo is a fox.”

The values and beliefs around the use of the spiders in the Biosphere Challenge are similar to those when deciding whether or not to participate in the Teach a Rat project. The rat-based lesson, however, opens up new issues around the use of vertebrates versus invertebrates in education and research, as well as the rights and protections of domesticated animals.

During the first ½-hour of either the Biosphere or Teach a Rat challenge, my students articulate a wide range of values and beliefs around using invertebrate wildlife like spiders or domesticated vertebrates like rats, for education and research. “This multiplicity blooms dissonance, which in turn increases students’ moral breadth. Since students can return everything they collect at any time, they are faced continually with determining their own evolving moral responsibility. Students who oppose the exercise on moral grounds are invited to collaborate with their teacher in designing alternative ways to meet their curriculum goals without compromising their moral position” (Karlan 2000, p. 17).

Throughout both projects, students are introduced to ethical guidelines for using nonhuman animals for education and research by organizations like the American Psychological Association (APA) and the BBC. And with the current 1979 animal protection laws protecting vertebrates from suffering at school or at school-related functions as well as protecting classroom pets students are periodically asked to

reconsider if and how their values and beliefs have changed during the course of the project. No matter what my students decide, we've come a long way since the early 1800's when rats were used in Rat-Baiting, a sport where people bet on which terrier would kill the most rats trapped in a rat-infested pit.

As soon as most students are clear about how they want to participate, they begin collecting materials for their biospheres or figuring out what they want to teach their rat. This is when you hear them buzzing away with their partners trying to figure out where they can find food for the spider or brainstorming how they are going to teach a rat to press a lever when it hears a bell. This is when I can walk out of my middle school science or graduate school classes and no one notices. These are the beginnings of very engaging, constructivist-based, student-centered and directed inquiries into ecology and learning.

9.3 Learning Goals

Knowing the learning potential from these projects can help one determine whether they believe the benefits of using these animals in education outweigh any risks of suffering.

9.3.1 Biosphere Challenge

With a dozen Biosphere's surrounding their classrooms, students have opportunities to observe intimately a close approximation of the ecological dynamics necessary for sustaining life. It allows teachers to facilitate deeper investigations into the meaning of balance, cycles, relationships, biodiversity, adaptation and evolution. And perhaps as importantly, these small terraria in concert with direct experiences in nature can help create a more process-oriented worldview. We need to help students celebrate and understand that while the spider is an individual, the spider is actually "both manifestation and raison d'être innumerable processes – air, water, and inorganic and organic cycling – whose interactions with one another are the meaning of life." (Karlan 2000, p. 18) I am an advocate for any curriculum that helps create a paradigm shift toward a more process-centered view of nature.

Here's what one of my students wrote when reflecting on how the Biosphere Challenge engaged her:

> I found that the biosphere activity opened the doors for a plethora of lessons and discussion beyond the obvious challenge and experience. First and foremost, as a student I was entertained, my attention was held, and my brain was cooking trying to figure out what we needed. I was thinking critically, trying to think ahead and sequence our actions, and trying to think of all the important biological factors that we may have been overlooking. Julia and I were raking through our stores of scientific knowledge and applying it to the situation and trying to prevent a potential arachnid catastrophe. (Science Teacher Certification Alumni, October 2006)

With the vivaria as backdrop to all classroom activity, students can learn about any ecological principle: carrying capacity, feedback loops, cycling, exponential growth, adaptation, evolution, living soils, symbiosis, waste, and entropy. It's a great opportunity to teach about the role of microorganisms for I've often been struck by their general absence in the development of students' biospheres. Since invertebrates represent "more than 90% of the planet's biological diversity, they perform most of the critical ecological functions of pollination, seed dispersal, parasitism, predation, decomposition, energy and nutrient transfer, the provision of edible materials for adjacent tropic levels, and the maintenance of biotic communities through mutualism, host-restricted food webs, and a variety of other functions and processes. (Kellert and Wilson 1993) Understanding the role of microorganisms is a prerequisite to understanding sustainability.

Ecologist Tom Wessels participated in the Biosphere Challenge as a thought experiment. Toward the end of his explanation of what he would create to sustain multiple generations of spiders he indicated that

> a domed football stadium would be the minimum size necessary in which to create a stable, self-sustaining system for the spider. The size of this space would allow for the greater complexity and therefore greater stability. In a large system a lot of nutrients can get tied up in different parts of the ecosystem without catastrophic consequences, because there would be plenty of available nutrients left in the soil. The dome would also help resolve the water problem." (Karlan 1995, p. 463)

Explanations like these from professional ecologists help create additional cognitive dissonance and motivate students to 'challenge the expert' by trying to create self-sustaining systems within their small contained environments.

9.3.2 Teach a Rat

With a dozen terraria surrounding their classrooms, each containing a couple of white rats, the Teach a Rat project can help students learn about the science of learning. Behaviorism, cognitivism, constructivism, educational neuroscience, and learning styles are just a few of the arenas students can explore while teaching their rats to learn something new. Like the Biosphere Challenge, Teach a Rat is a living, vibrant constructivist-based, student-centered, and student-directed inquiry.

Inevitably students' investigations into what and how to teach their rats lead to energetic discussions about what and how they are taught. Discussions can become quite animated as they reflect on their personal experiences of schools using behaviorist approaches to motivate their learning. This is when I hear students comparing how they taught their rats to teachers giving them good grades in response to them

doing well on a test or assignment. This comparison often leads to more debates about whether traditional grading systems are the most effective motivators for student learning.

When students notice that their rats seem to have different capacities to learn and learn at different rates, they reflect on their own learning styles and processing speeds. These questions can often lead them to further investigations on learning styles, multiple intelligences, and learning differences.

I often close the unit by challenging the entire class to work together to use a positive behaviorist approach to change my own classroom behavior. It isn't long before I am only writing on the left side of the board or smiling throughout most of the class – without me ever knowing these were behaviors they intentionally tried to teach me. Of course all this becomes more grist for the mill of morality.

9.4 5-Gallons of Powerful Learning

It's extraordinary what one can learn from what's inside a 5-gallon container. One could argue the triteness of the moral question on whether or not it is right for dozens of spiders or rats to be put at risk of dying at the hands of innocent school children. At a quick glance, it seems defensible that everyone's travel, diets, and other product choices have far greater impact on the health of wildlife and their ecosystems than the risks of what might happen to a classroom of spiders and rats. What doesn't make the use of the spiders or rats trite is that the exercise puts a lot of power into students' hands by inviting them to reflect on what it means to control or take another life other than for sustenance. Inevitably the students at some point turn the activity itself inward when they discuss how the very premise of these exercises may inadvertently send messages condoning human control over other species. And

these discussions lead to interesting questions concerning the "rights" of nonhuman animals.

One could argue there's nothing better than learning about wildlife in nature. There are however, millions of children worldwide in schools surrounded by miles of asphalt. The opportunity to experience first-hand the meaning of ecology in ecosystems relatively untouched by the human hand is extremely challenging, if not impossible. The Biosphere Challenge and Teach A Rat are two compelling examples among many others that can bring a variety of life into science classrooms so students can learn more about themselves, the meaning of life, along with the principles of sustainability and ecology.

Using wild and domesticated animals in the classroom in ways that challenge students to discover big ideas about how the world works is undeniably engaging. I encourage all science educators to figure out how to engage their students with learning scientific concepts and processes, along with their moral corollaries, through student-centered, student-directed, hands-on, minds-on, relevant problem solving based lessons which use wild or domesticated animals in ways that are compassionate, mindful, and learning-full like the Biosphere Challenge and Teach A Rat.

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