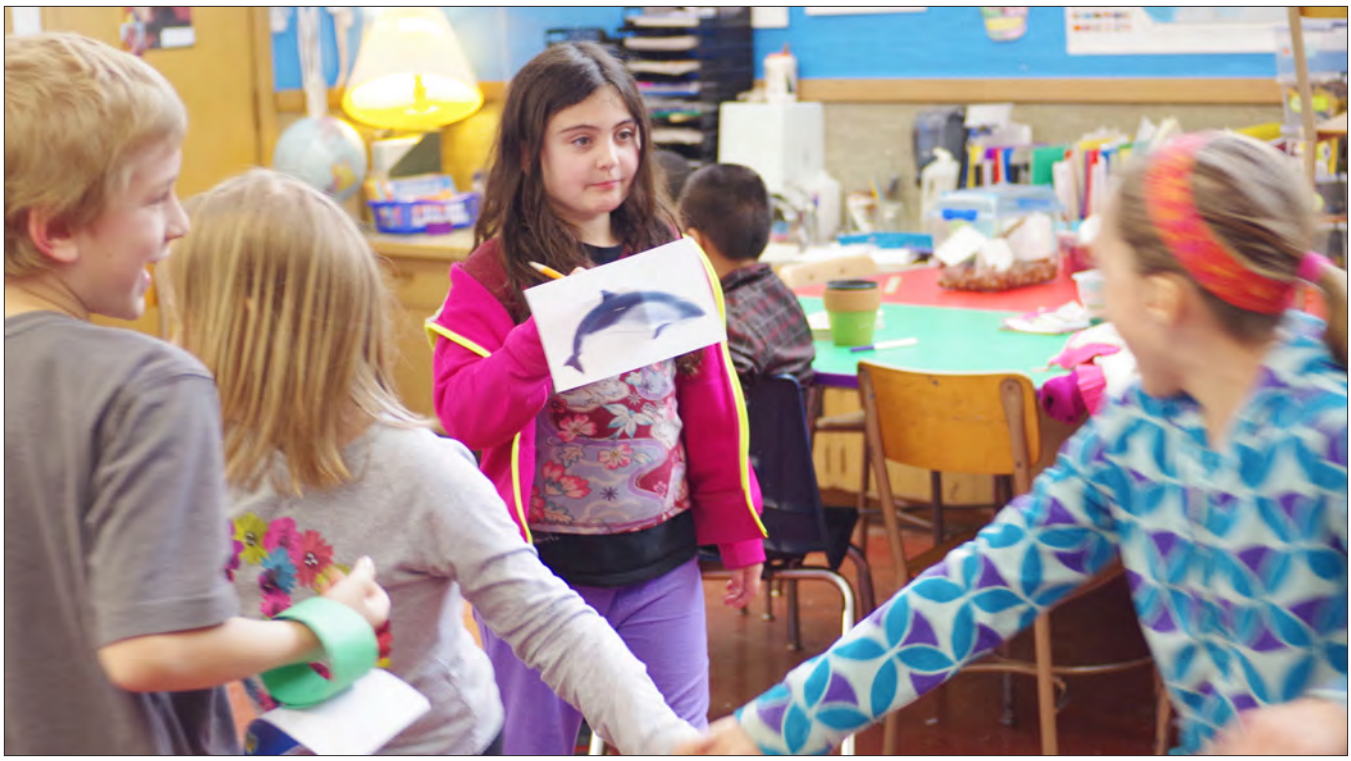


Photographs: Autumn Doss

Role-Playing, Inquiry and Food Chains

Integrating drama to encourage elementary students' engagement in environmental science

By **Autumn Doss**

It's spring in an urban neighborhood in Seattle and I am attempting to organize 25 very energetic 3rd grade students into an environmental role-playing game. For many of the students English is a second language and they are also primarily from low-income households. "So! Yusur, Ahmed, Lacy and Tyler, you guys are the Phytoplankton!," I smile and give them their bright green pictures. "Don't move!" The rest of the class clamors for their roles, several are disappointed at not getting to be the Phytoplankton at first, so we negotiate. The students who were willing to be a bit more patient for this round are the scientific observers. They are busy recording sounds, taking pictures and writing notes about their observations of our simulated North Pacific ecosystem.

AT THE ELEMENTARY SCHOOL where I teach, the majority of students are from low-income households in which half are learning English as a second language. I created a game to solidify scientific concepts using inquiry improvisation and theater. Many of my students have very little exposure to science and by integrating two subject areas, I am able to allow students to play and learn. Students can role-play different organisms in an ecosystem and act out their interconnectedness through theater and improvisation. It is a fun, engaging and effective way to increase understanding and can be adapted for all age ranges.

Climate change is gaining traction in the mainstream media and is a central focus of world energy policy. Changing attitudes and practices are becoming increasingly urgent. As a result, it is essential to teach students about climate change and particularly those from disadvantaged backgrounds. Many of my students do not have access to recycling bins, healthy non-packaged food and state parks. Bradford & Schleich[1] found that families were more likely to adopt energy conservation practices if there were younger children in the household. They also found that the higher the level of parental education, the more likely families were to adopt conservation practices. This highlights the need for educators to focus on environmental education, particularly student understanding of human impacts on biodiversity and climate change. India, for example, has implemented a widespread environmental education curriculum to increase teacher and student awareness of the intricacies of ecosystems and human-caused disruptions in local environments and it has been very successful.[2]

Science education, particularly inquiry-based activities, have been found to effectively engage students and improve student learning. This is why I chose improvisation and play-acting to guide my students to a stronger understanding of the food chains in various ecosystems. Students who participate in inquiry science have a stronger understanding of the concepts, particularly when paired with literacy.[3] Unfortunately, North America's focus on standardized test scores has significantly reduced inquiry science instruction, art and other non-tested subject areas in the classroom.[4] Many educators struggle with implementing inquiry into science curriculum.[5] This challenge, however, does not mean inquiry science is not worth teaching. In fact, many teacher preparation programs are now including inquiry teaching methods in their curriculum to better prepare teachers for effective science instruction.[6]

I intentionally use inquiry methods to demonstrate important science concepts to students who have very little or no experience with science and, in some cases, the English language. Ecosystem connectivity, human-caused disruptions and the potential consequences of those disruptions are the focus for my students but I am certain this game could be modified to teach anything from chemical bonds to Newton's Laws of physics. Having a direct experience and connection to the environment may make people more willing to implement conservation actions.[7] As a result, this project focuses on third grade students participating in an inquiry ecosystem game meant to demonstrate the interconnectedness of the species in two different ecosystems. Their knowledge and understanding of the concepts are assessed both formally with a short questionnaire, and informally with observations and an ecosystem poster.

> *Everyone is racing around, the Salmon are trying to eat Shrimp and the Shrimp are diving and weaving to avoid their untimely deaths at the mercy of the food chain. Children are laughing and screaming things like, "Watch out for the Salmon Shark! She's at the top of the food chain!" When it's over, we sit and discuss what happened. Did every Salmon Shark survive? Were there enough Phytoplankton left to continue the cycle? They smile and chat with one another eagerly about whether it's better or more important to be this species or that species and then, eagerly beg for another round. We switch roles and go again!*

Implementation

My goal is for students to be able to identify a healthy food chain in the North Pacific Ocean. I want them to predict and confirm, through play-acting, potential consequences of invasive species and human interference, such as overfishing. I also emphasize teamwork and social skills to further our scientific objectives. For this lesson, students are focused on the food chain of different species (each species can only eat one target species). Later in the year when students have grasped the basic concepts of species interactions, I will introduce a more complex version of the game that includes the food web (some species can eat multiple other species).

The standards of performance include students' ability to play the food chain game under control (no running or grabbing of other students), listen to and express ideas about the causes and effects of different stressors within a food chain, and complete a post assessment that asks students several questions about the scientific content of the North Pacific ecosystem. To replicate this game, you will need color-coded bracelets for five different species with pictures attached, a large space to play the game, paper for the post assessment, and a clip of Planet Earth's Shallow Seas episode.[8]

> *The students were wiggly and they could not seem to settle down. They knew I had a new project for them but no one could figure out what it was. Several kids had tried to peek under my notebook to find clues but to no avail. "What are we going to do?! I saw you had pictures of sharks!"*

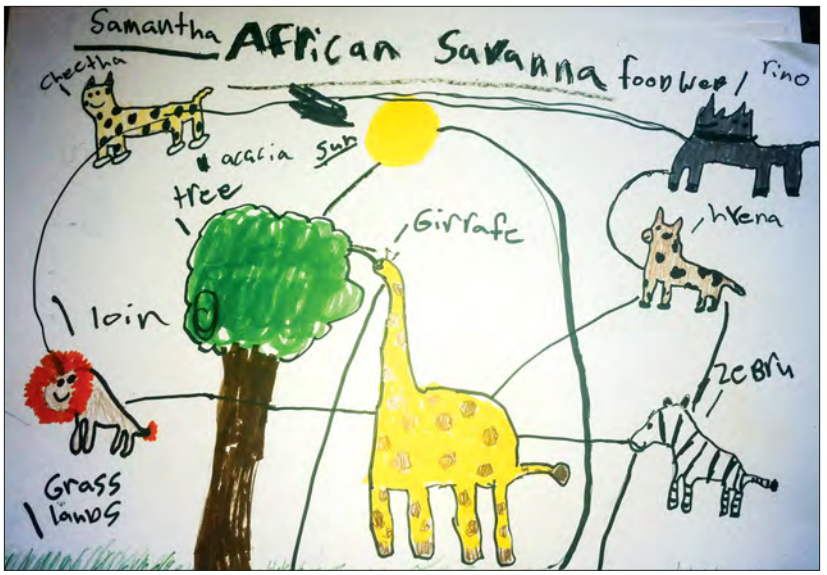
Once settled, introduce students to the images of five species found in the North Pacific Ocean (or whichever body of water you choose to work with). For my session I used phytoplankton, shrimp, salmon, porpoise and Salmon sharks. After a brief discussion about the photos, students spend time identifying which species are producers, primary consumers and secondary consumers.

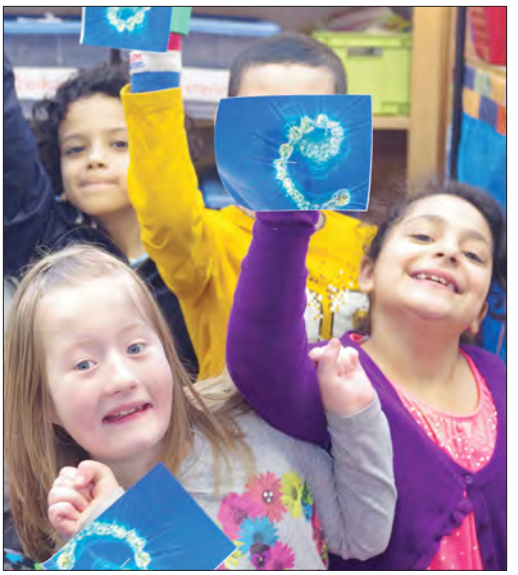
Demonstrate one simplified round of the food chain game with only three species and a group of prepared volunteers. Explain that you will play the game two different times and the second time, you will discuss observations and watch a section of Planet Earth. During each session of the game, there should be six scientists carefully observing the interactions of the organisms. They present what they see to the class during the discussion. The scientist role is designed to include students who may need a break from the activity due to overstimulation or for students who may not want to participate. Everyone gets a chance to be a few different species and a scientist.

There are typically two to four sessions (two to three games played per session) depending on the complexity of

Food Chain Game Rules

1. Try to find your food. Phytoplankton (green) just hang out, shrimp (yellow) eats the phytoplankton, salmon (orange) eats the shrimp, porpoises (blue) eat the salmon, salmon shark (red) eats the porpoises.
2. When you eat your food, you and your food are attached. You have to stay together.
3. If you can't find any food, sit on the floor. You are hungry.
4. You can only eat your type of food.
5. No running. Be safe. Be honest. Nearly everyone will get eaten. That's the way it's supposed to work.
6. If you are a scientist studying the food chain. Observe carefully. What do you see?





the ecosystem or science content you are teaching. During the first session, students play the game with a healthy ecosystem. As a group, practice several times, reviewing rules and noticing what is going well and what needs to change. During the second session, students observe an ecosystem that is disturbed, first by invasive species and second by humans overfishing the salmon. Students who can't find food sit down signaling that they are too hungry and can't be eaten by other predators. The scientists debrief their observations and once the game has been played several times, students gather for a conversation. The teacher should provide a basic question such as, "How did it feel to you each time we played the game?" and then more complex questions like, "What did you notice about the differences and similarities between each version of the game?" After the conversation, have students watch the Planet Earth video clip and work in partners to illustrate the food chain you worked with and write three new things they learned about our world's ecosystems.

> *"Ms. Doss! I want a chance to be a salmon shark!" a previously uninterested student demanded. He had been living in a homeless shelter for the majority of the year and had been incredibly withdrawn from any collaborative activity. "Ok Leo! Next round and you're up!" I replied with a smile. My heart was thumping and I couldn't' help but think, "This is awesome! Please, please, please! Let it go well!"*

Teacher Reflection

The Food Chain Game was a success at my school! We played the game six different times over two days and besides having a really entertaining time, we got to experience science in a very different way. Students enjoyed trying out different strategies to survive and practiced being either stealthy predators or more aggressive ones. Prey attempted hiding in groups versus running away individually. All these factors contributed to the improvisational theater goals. The repeated game plays decreased the "newness" enough to eventually allow students to think about exactly what was happening to the ecosystem during the game.

Our whole class conversation was productive. I facilitated by asking questions and keeping a record of student ideas and questions on the board:

- Why did we play the Food Chain Game?
- What are you wondering about now?
- What are some things you learned from the game?
- What do you think people could do to help ecosystems in danger?
- Are predators important to an ecosystem?
- Can invasive species be a good thing?

An extension activity, after watching the Planet Earth segment on the North Pacific ecosystem, can help further solidify student understanding of ecosystems while allowing children with different learning styles an opportunity to more fully participate. For example, students are given a choice to illustrate their own ecosystem individually or with a partner. Their ecosystem choices could include the African Savanna, the Arctic, the North Pacific and the Desert. Resource materials such as books on those ecosystems and various species are given as reference so the students can research and create their posters. These posters allow another opportunity to illustrate students' understanding of the connectedness of species within an ecosystem and engage all students, particularly those with learning disabilities and those learning English as a second language. Inquiry activities, such as posters, art and play-acting, can significantly increase student science understanding and can give all students a chance to show their learning in an alternate way.[9]

Finally, students are given a written assessment to further determine individual comprehension. Questions might include:

- What happens when the food chain is balanced?
- What might happen if one of the animals, like the salmon, disappears from the food chain?
- Put the animals in the order they eat each other by putting a number next to each one.

Students are graded on complete explanations in their answers, using vocabulary words (e.g. species, individual species' names, ecosystems, overpopulation, and invasive species) and accuracy.

Leo nailed it! He found food and during our discussion tentatively raised his hand to share how hard it had been to find food in the disturbed food chain scenario. His voice was barely a whisper but it was a start! Other students wanted to try over and over again and began asking questions like, "How would the species be effected if there was an oil spill?" and "What would happen if all the sharks disappeared?"

Student Learning

Once the students understood the rules, they enjoyed the game immensely. Their engagement enhanced their academic understanding and encouraged improvisational techniques, including working collaboratively to survive. They took on more elaborate roles in the first two games, imitating the species they were assigned to and trying different ways to "work the system." The third game focused on the overfishing of salmon so there were very few individual salmon in the ecosystem and it ended with the majority of the participants sitting on the ground. The children realized that without food for the predators, they would die off. The fourth game was the Arctic ecosystem version and we played one round of the healthy ecosystem, one round of an ecosystem with a reduced population of arctic hares and one round with an invasive plant species that killed the moss and grasses the arctic hares feed on.

The Grand Conversation took place the third day of the lesson. I posed questions to the whole class and students would then turn and talk about the question to an assigned partner. Turn and talks are a strategy for providing processing time and support for students with disabilities and students learning English. Lastly, they were asked to share out to the class and build on one another's ideas through conversation. Students were able to express their understanding and questions in a whole class setting and synthesize their learning.

The next steps in the sequence are to continue teaching about ecosystems and the interrelated aspects by beginning to study smaller systems. For example, growing and observing plants, labeling the different parts of the system and predicting what might happen if parts of the system were missing or if new variables were introduced. My students even created a podcast explaining conservation values. People involved in inquiry science often have a stronger commitment to implementing conservation methods in their own lives and that was the goal of integrating theater arts into science comprehension.[10]

The children were exhausted. They had spent the last 50 minutes chasing one another, eating their prey, being observed and observing. "Can we do this again tomorrow?" one student asked enthusiastically. "Maybe, we'll see," I replied. The assessments weren't in yet and I wasn't completely certain everyone understood but they were thrilled and learned about topics that will significantly influence their lives. I felt overwhelmed, happily worn out and extremely hopeful.

Autumn Doss is a National BoardCertified teacher in Seattle, Washington working primarily in elementary schools with low-income populations. She has 10 years of experience and absolutely loves her job as an educator.

Notes

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