From Mystery Seed to Mangrove Island

By Virginia Frissell

Find a box, hide a local natural resource inside, and let your students solve scientific mysteries!

Have you ever walked into a classroom with a critter container or mystery box before? What is the first thing children ask? Whether they are kindergarteners or fifth graders, they almost always inquire, "What do you have in that box?" or "Can I see?" Even if I walk by inconspicuously trying to disguise the mystery box, soon I have a following of curious footsteps. Immediately, I've hooked that audience into finding out more about my mystery. Students begin to wonder naturally without my prompting.

Introducing a mystery object is an easy strategy to implement and allows teachers to preassess students' knowledge about local natural resources. Misconceptions can be noted as teachers record initial inquiries and wonderings on charts. Using the constructivist approach, students can explore and construct their learning as they continue to use the process skills to solve their mystery. I'll show you how to use a local natural resource—in this case, seed pods—for an entire unit of study.

The Mystery Begins

My own stumbling upon a mystery seed led me to incorporate my treasure into a plant adaptation lesson for my students. As I strolled along the beach on Sanibel Island after a storm one morning collecting univalve sea shells, I found numerous mysterious green pencil-shaped seed pods and wondered where they traveled from. As a frequent beach explorer on this island, I didn't remember seeing these seeds here before. I did recognize the red mangrove seed propagules from living near Cockroach Bay and wondered how they ended up at Sanibel Island. I began collecting them to study further. In previous years we visited parks along the protected bays with students to observe how the red mangrove's unique multibranched root systems trap sediment and keep wind and water from eroding shorelines. I inferred that the propagules must have traveled from Florida's west coast to the barrier island along with the ocean's driftwood, seaweed, and shells that all ended up as beach wrack. I wondered how I could incorporate these mystery propagules with my students for further wetland and plant studies.

Start With a Box

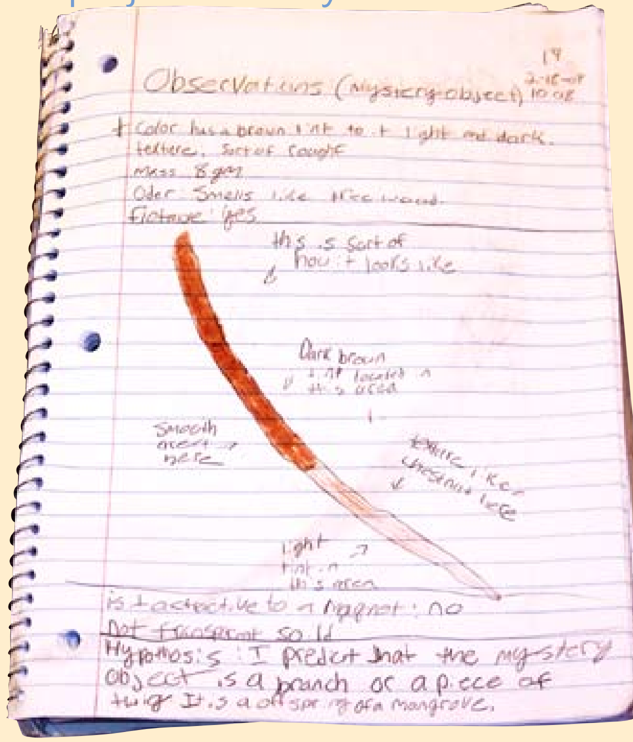
Because I could not take my fourth- and fifth-grade classes to the same location I encountered the seed propagules, a three-hour drive away, I looked around the community to find destinations where they could explore and help solve the mystery locally. These excursions were scheduled for later in the year, and I did not know how long the seeds would be viable, so I initially engaged my fifth-grade students by passing a mystery box around so they could reach in and feel the object first. Using their sense of touch, they recorded their observations. After I hooked them in wondering about the contents in the mystery box, I passed seed propagules around while students made further sensory observations. Students recorded qualitative properties such as color, shape, texture, and odor in their science journals. Students then measured length and mass and recorded this quantitative data along with a labeled diagram (Figure 1). Students were learning how to use the tools scientists use to compare objects; this was a way to incorporate measurement using centimeter rulers and balance scales. Later, if seed propagules changed, students would be able to calculate the differences. They curiously compared one propagule with another. One student replied, "I've seen these at the beach sticking up from the sand."

Where did I find the seed pods? How did they get there? Why is the top skinny part green and the bottom brown? Will these seed pods grow if we plant them? Do we have these same seed pods in our area? Why are they so long? These were some of their wonderings recorded in their journals.

We then put the seeds in transparent containers of water to test their ability to float (Figure 2). This confirmed that the seeds could float and travel to other destinations. One student inferred that the seeds stuck in the sand vertically because when they were in water we observed some of the propagules floating vertically with the larger root end-down and the narrow end just above the water's surface. Before the end of this class period, another student said she always saw the propagules at her grandmother's house near the shore. Another said, "I saw those when I went fishing." Finally, I heard, "Are they from a mangrove tree?" The science period came to a close, so I asked where the student had seen a mangrove tree before and explained that the next day we would continue researching.

The next day I passed out more propagules, but these noticeably had another plant structure growing from the

Figure 1.
Sample journal entry.



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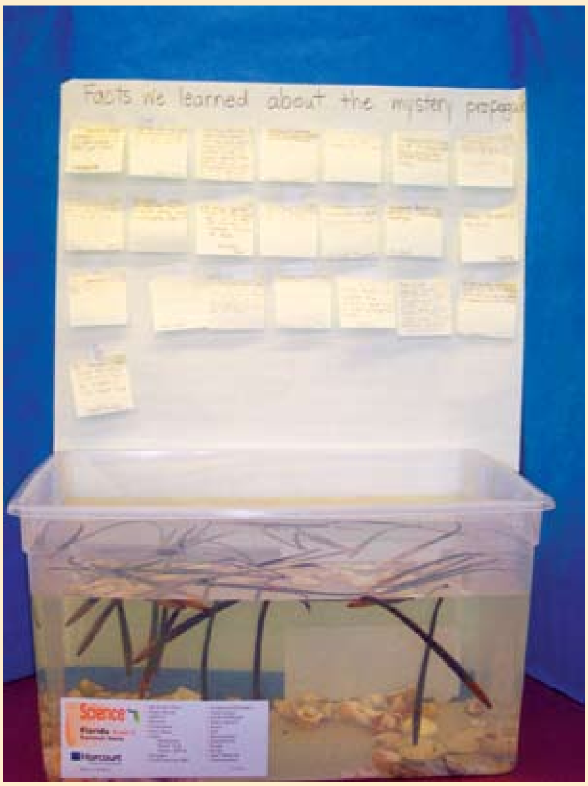
large end of the seed. Students identified the roots and noted short hairlike roots in their drawings and diagrams. How can such long seeds grow in dry sand with these short roots? How do these root structures help its function to take in water and support the propagule to stand if it grows in water? What about the salt? How does the mangrove keep from falling over when it is exposed to constant wave action? Some of these questions were prompted to initiate students' testable questions to experiment further. Students in small groups also recorded questions they wondered about and did follow-up by writing steps for further investigations. They gathered their own materials to proceed with a long-term investigation to test how the different soils, water, or germination chambers affected the seedlings' growth.

Incorporate Literature

Students' many wonderings and inquiries led me to introduce a book to help them find answers to their researchable questions while learning more about the mangrove seed's life cycle. Lynne Cherry's (2004) *The Sea, the Storm, and the Mangrove Tangle* explained how the mangrove tree is important in sustaining life along our shoreline communities. Students either designed a *mind map* (a detailed illustration to show visual thinking, including important information) while I read the story or they used a strategy called *stop and jot* (a comprehension strategy in which learners stop and think about the reading and jot down a thought) to make notes to help them learn more about the mangrove propagules.

Figure 2.
Testing the mangrove seeds' ability to float and travel.



Students continued to research further using online resources and books about wetlands, and we took a field trip to our local aquarium. One exhibit allows students to follow a water drop as it journeys through Florida's freshwater aquifer, lakes, and rivers, ending up in bays and beaches. Our fifth graders learned how freshwater mixes with salt water to form brackish water environments in our estuaries—where mangrove trees grow and survive. Students also saw the prop roots supporting the red mangrove trees. The *National Audubon Society Field Guide to Florida* by Peter Alden (2008) verified much information we had found in other sources. Students learned that mangrove trees are uniquely adapted to flooded coastal banks and that their roots don't just absorb water for the plant, but also act as the structural support system, much like our skeletal system.

In the Field

Finally, we ventured on another field trip to our local bay so students could observe the flora and fauna in our community. Follow district guidelines for field trips (obtain parent permission, follow student: adult ratios, pack cell phones and first aid kits, and bring student allergy or medical alert information). Make sure students are properly dressed and use sun protection.

Teachers were knee high in the water alongside the students to ensure safety. All students wore sneakers so that their feet did not slide out of protective foot coverings. When we took a boat to Snake Key, an island in Cockroach Bay, we all wore life preservers. (Students should wear life preservers when in water more than one foot deep.) Two environmental biologists accompanied our class, and all teachers had training for safety measures, to learn how to use the benthic sieves and seine nets, and to become familiar with the sea grass beds so we would not trample them.

Because the mangrove trees are cyclical, we did not find any seed propagules on the red mangrove trees, nor did students observe many seed propagules left from last season's dispersal in the sand. The few seed propagules that were found were dried up. So again students wondered—where did the seeds travel to? While in the field, students also observed how the mangrove leaves fell into the water by using an aqua-scope. They looked underwater at the decomposed muck that allows tender sea grass beds to grow and support the juvenile fish, shrimp, and sea horses living there. Students peered between the prop roots while they stood in the shallow brackish water. Here they saw why the estuary is called a *nursery* for marine life and how animal life is dependent on plant life not only for food but for shelter.

One afternoon when we visited a park along the shoreline where there was more development, students saw how mangroves and other plants and animals were affected by changes in the environment. Developers were getting variances to develop land areas and destroying mangroves and other wetlands for development. These changes not only destroyed food source and habitat for our plants and animals, but also reduced natural areas that provided enjoyment for people in the community. This development destroyed the buffer that mangroves provided from strong storm winds and waves that aid in keeping our shorelines from eroding along with rising tides and hurricanes. Our students learned more about the balance among plant, animal, and human interactions. Connecting our science standards to real-world issues in our local community stimulated students to wonder more, ask questions, take action, and share their learning with the community.

Our students planted the germinated mangrove seedlings on Snake Key to give back to the community. The environmental biologists permitted us to bring any germinated mangrove seedlings with us on our scheduled trip to plant (and later on for other returning classes to monitor). Southwest Florida water management district helped fund a portion of the transportation cost so students could boat out into the bay to observe the importance of mangroves in our geographic region. Upon returning from their trip, students published their own experiences in a book to communicate like real scientists with parents, students, and funding providers. Students interacted with other schools and teachers in a sharing day and prepared small exhibits or activities.

As a result of their experiences with the mystery seed, students improved the schoolyard habitats by planting native species to attract wildlife at the end of the school year. When students ventured outside to bird watch or observe the gopher tortoise on our campus, they would always notice the lack of shade or native plant species. They were encouraged to act and engage in real-world service learning projects. A local nursery and native grower visited our campus and assisted with placing and providing the right plant to guarantee food, shelter, and space for wildlife. This will provide mystery seeds for future generations of students to investigate in our own backyard.

Formative Assessment

I used formative assessments throughout these activities. Students shared their learning by creating charts to list how different plant structures function and compared and contrasted these with animal structures, functions, and adaptations. Murals depicted how plants and ani-

Figure 3.

Sample mural of habitat depicting how plants and animals are interdependent.

mals are interdependent and share habitats (Figure 3). Students contrasted mangroves in freshwater, brackish water estuaries, and saltwater oceans dotted with mangrove islands in their science journals. Students observed mangrove trees growing along riverbanks leading to the bay that were freshwater ecosystems. Many trees also shared this habitat so the mangrove tree had to compete for space. In brackish water habitats, however, mangrove trees had fewer trees to compete with for space, so they were more abundant along the shores of bays. When students went boating farther out in the bay, they observed how few species shared the space with the mangrove trees. Evidence was gathered from firsthand experiences.

Students created PowerPoint presentations using their photographs. They also wrote a classroom newsletter to share with others the importance in protecting our natural areas. I used first word–last word acrostics from *Science Formative Assessment* (Keeley 2008) to check their understanding of photosynthesis before and after instruction. Seamless formative assessments occurred throughout this mystery seed study with various checkpoints. Students mostly recorded data, wonderings, and learning in their science notebooks. I used an inquiry rubric from *Assessments for Science Process Skills of Inquiry* (Ostlund and Mercier 2006) to grade their experiments. I also used rubrics from IIM—Independent Investigation Method—to score research reports (see Internet Resource). Because this topic segues naturally into others—and students' notebooks contain information about life cycles of trees, photosynthesis, and the interdependence between plants and animals—target sheets with the main benchmarks are kept in science notebooks for students to document the completion of work. This allows them to connect their mystery seed project to the standards throughout the year while covering other content.

Students communicated verbally when they inquired about the mystery seed. They drew diagrams with labels to mark their understanding of plant parts and functions. Students researched questions of their own to propel them in seeking new information about mangrove trees. They documented evidence in their science notebooks when they experimented to test whether the seed propagules would grow in freshwater and different substrates.

Students listed the benefits of mangrove trees for a formative assessment in which I had them stand as each student read an item from their lists. As they checked off the items discussed, I could see what information was missing and elaborated on the benefits they neglected to mention but were important to revisit again. Students forgot that roots help trap sediment and pollutants entering the bay and filters runoff reducing phosphates from creating algae blooms that kill plant and animal life. I was pleased when one student remembered that the fallen leaves provide a base for leaf litter in a food web that traps sediment allowing sea grass beds to grow amongst the roots for the mangrove tangle.

All in the Seeds

If you do not have a mangrove propagule in your local habitat or an aquarium to visit, there are native seeds in natural places in your neighborhood to explore and investigate. What better way to support students working on the scientific process skills. Put the mystery into your science lessons and listen as student scientists begin to inquire about the world around them. Seek a seed and solve a mystery! ■

References

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Cherry, L. 2004. *The sea, the storm, and the mangrove tangle.* New York: Farrar, Straus, and Giroux.

Keeley, P. 2008. *Science formative assessment.* Thousand Oaks, CA: Corwin Press.

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Virginia Frissell (Virginia.Frissell@sdhc.k12.fl.us) *is a K–5 Gifted and Science Resource Teacher at Twin Lakes Elementary School in Tampa, Florida.*

Internet Resource

Independent Investigation Method
www.iimresearch.com

NSTA Connection

To see how the author extended her lesson the following year, visit *www.nsta.org/SC1002.*

Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Content Standards

Grades 5–8

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Standard C: Life Science

- Structure and function in living systems
- Diversity and adaptations of organisms

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academies Press.