CHAPTER 9

# *Lessons in a Pond: A Year-Long Inquiry Investigation*

## by Lynn Rankin

***Once a teacher has established a foundation for doing inquiry in the classroom, science learning can take some unexpected paths. This essay follows the experiences of a fifth-grade teacher who allowed her class to pursue their questions and interests. The result was a full-year inquiry investigation that gave students insights, knowledge, and experiences that far exceeded their teacher's expectations.***

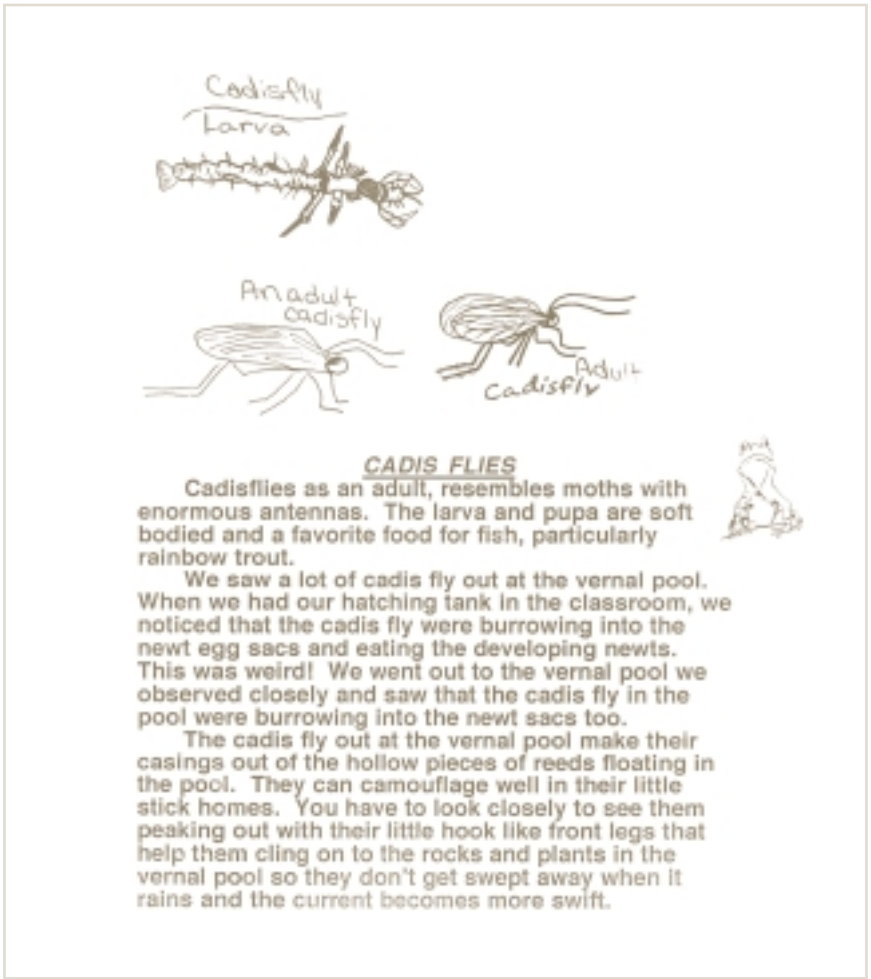
Beth is a fifth-grade teacher in a suburban school in northern California. Over the past 3 years, she has been experimenting with inquiry in her classroom. Beth has moved toward inquiry incrementally, designing lessons and strategies that build a foundation for doing short-term (several-day) student investigations. Last year, Beth decided to embark on a month-long inquiry investigation. Quite by accident, the investigation grew into a year-long study as Beth followed the expanding curiosities and interests of her students.

Beth's regular science curriculum includes a unit on the study of diverse ecosystems and interdependency. As part of this study, she introduces her students to a nearby vernal pool—a seasonal pond that fills with rainfall and attracts amphibians, aquatic insects, and vegetation. Beth hopes to develop her students' appreciation and stewardship of this unique and precious local habitat.

During the first several months of the year, Beth creates a framework from which students develop process and social skills. These skills are designed to allow students to carry out productive investigations in which deep, significant conceptual learning takes place. By the time the vernal pool has filled with winter rain, Beth wants the students to be equipped

with the process skills and previous knowledge that will allow them to investigate in a scientific manner. Beth draws upon her existing curriculum on the environment and uses other topics of study that are required.

Since Beth knows that inquiry begins with looking closely, she focuses considerable time on the skill of observation. Lessons are planned around the use of tools for observing, such as microscopes and hand lenses. Students spend time studying fish in an aquarium, learning to pay attention




**CADIS FLIES**

Cadisflies as an adult, resembles moths with enormous antennas. The larva and pupa are soft bodied and a favorite food for fish, particularly rainbow trout.

We saw a lot of cadis fly out at the vernal pool. When we had our hatching tank in the classroom, we noticed that the cadis fly were burrowing into the newt egg sacs and eating the developing newts. This was weird! We went out to the vernal pool we observed closely and saw that the cadis fly in the pool were burrowing into the newt sacs too.

The cadis fly out at the vernal pool make their casings out of the hollow pieces of reeds floating in the pool. They can camouflage well in their little stick homes. You have to look closely to see them peaking out with their little hook like front legs that help them cling on to the rocks and plants in the vernal pool so they don't get swept away when it rains and the current becomes more swift.

*"Cadis Flies," courtesy Beth Kraft's fifth-grade classroom, Lu Sutton Elementary School, Novato, California.*

to and describe details and differences. Because questioning is a central part of exploring and understanding the environment, specific lessons focus on the art of asking questions.

Beth wants her students to begin recognizing the kinds of questions that lead to experimentation, as opposed to those that cannot be answered, or those that have to be answered by asking experts or reading books. When teaching literature or social studies, Beth takes opportunities to make connections between the way questions are used to develop understanding in these disciplines and how her students can ask useful questions in their own studies.

The students are taught how to keep records through writing, drawing, graphing, and charting. Often, Beth found that similar skills were being used, and relationships made, in math activities. She works with the students on controls, variables, and fair tests. Throughout this period of time, they are also taught the language of science. "I want them to understand what they are practicing," Beth says. "And that they are beginning to think like scientists."

To further prepare for investigations at the vernal pool, the class spends time gathering information about ecosystems and the interdependency of plants and animals in the environment. Beth invites guest speakers to talk about freshwater ecosystems and storm drain systems. The students do research by reading books, looking up information on the Internet, and watching videos. They do a series of focused experiments on water pollution, the water cycle, condensation, evaporation, and soil absorption. Questions and curiosities that emerge from these activities are recorded on a large question board kept where everyone can see it. "The questions kept spiraling," Beth says. "They started to guide the project."

Beth prepares herself by taking workshops offered by environmental education organizations. The class takes field trips to water sewage and treatment plants. They visit various environmental sites with experts from a native plant society and the California Department of Fish and Game. "All along the way," Beth notes, "I am learning with my students. I have to reach out to experts because I don't know all of this stuff."

During the winter and spring, the class visits the vernal pool every other week for about an hour. Before every visit, Beth talks with her students about the purpose of their visit. "I want them to understand why and what they are investigating," she says. For the first several visits, Beth allows the children to experiment on their own. This gives the children

a chance to familiarize themselves with the pond and begin raising questions. They are asked to find out what they can about the vernal pool using their environmental observation tools (hand lenses, nets, collecting buckets, and so on), and to record their questions and observations.

After every visit, the students discuss their discoveries. As usual, questions are listed on the question board. These sessions give Beth an opportunity to assess points of interest and areas that might be fruitful for more study. At this point, Beth either chooses an area of study in which the whole class can participate or has smaller groups form to study particular aspects of the topic.

Over the next several months, the class moves back and forth between investigations at the pond and in the classroom. All along the way, Beth reinforces the children's understanding of the processes they are using to investigate and helps them build their conceptual understanding of the phenomena. She interacts with the student groups, continually assessing their progress and providing suggestions for adjustments when necessary. Periodically, she gives the children pertinent information in the form of a lecture or class discussion. The students regularly report their findings to each other.

This particular year, after several visits to the pond, the students decided to construct a similar environment of their own, so ongoing observations and investigations could take place inside the classroom. They carefully gathered samples of plants and animals, created a miniature hatching pool in the classroom, and watched what happened.

As newt and frog eggs hatched, the children were able to witness the animals' growth and development. After several weeks, some of the students noticed that a number of the aquatic insects were feeding on the amphibians and their eggs. This seemed strange, since the children expected the insects to be herbivores. As they puzzled about why this might be happening, they formed the hypothesis that the insects did not have enough to eat in the artificial environment, and so were being forced to change their diet. They decided to test their idea by observing insects at the vernal pool. After a few sessions, they determined that the eating behavior at the vernal pool was the same as in the hatching pool. It seemed that the insects were, in fact, carnivores.

Even with the evidence before them, the students had a difficult time believing this. "They saw it, but they didn't believe it," says Beth. She encouraged the group to do some research to find out more about the

THE VERNAL POOL

As you come and see the amphibians
at this magnificent vernal pool,
You will see the cycle of life happening
all around you.

Frogs and newts at your feet,
birds singing in a nearby bush.
Many animals,
all struggling to survive
living with their neighbors and enemies alike.

This is not just a vernal pool that you
should just pass by
thinking everything here is dead.
There are mysteries here waiting to be solved.

These are not slimy, ugly creatures,
they are an important part of life
and sadly, millions are dying every year.

Sometimes, if you are patient,
and you look at the grass
and stay very still,
you can see the frogs and butterflies.
So when you come to visit a vernal pool,
step lightly and look very closely,
the mysterious of life are waiting to be solved.

*"The Vernal Pool," courtesy Beth Kraft's fifth-grade classroom, Lu Sutton Elementary School, Novato, California.*

feeding habits of aquatic insects. They called in a high school biology teacher, who was as puzzled as they were. They looked in books. Finally, they found a site on the Internet that gave specific information about the carnivorous behavior of certain aquatic insects and their role in feeding on the weakest amphibians.

This discovery led to a week's investigation on natural selection. The kids wondered if the same relationships existed in other ecosystems. Says Beth: "I certainly never imagined that we would be studying natural

selection as part of this curriculum. It wasn't in my original plan, but it captured the students' interest."

At the pond, one group of students were fascinated by the water striders walking on top of the water. They wondered how this could happen. As children looked more closely, they began to notice that there were tiny depressions in the water at the base of each of the insects' feet. They also noticed similar depressions around floating leaves. This led to a study of surface tension. Beth set up a series of activities in which the students could experiment with floating various objects on the surface of the water (balsa wood blocks, paper clips, and so on). She talked with them about the physical characteristics of water and showed them pictures of the molecular bonds.

After noticing how the pond was diminishing in the late spring, another group of children wondered whether the chemistry of the water was being altered by the environment. They were watching amphibians growing, some plants getting taller, and some plants decomposing, and thought that the acidity of the water, and the oxygen and nitrate levels, would be affected by these changes. This led to a lot of work with water testing and very careful tracking of data. In the end, the children discovered that there were only marginal changes.

The final month of the school year was spent compiling information for presentation in a student book. Committees of student writers, artists, and researchers formed to develop narratives, graphs, diagrams, photographs, and poetry that could represent what they had learned.

After reflecting on the experience, Beth says, "I'm really convinced that one inquiry a year is important. It doesn't have to last a year; it could be a month. But there are things that the kids learn about their own learning that can't happen without it." Beth also talked about the importance of "building" the inquiry experience by developing the children's ability to be good investigators.

"In order to do this, you have to isolate the process skills, so the children learn to be good observers, good at questioning, etc. Of course, when you are investigating, these skills are more intertwined, but it's helpful to know, as a teacher, that you can develop the children's abilities for these skills.

"Doing inquiry is much more structured than you might think. You really have to be organized and think about what you're doing at every

step of the way. But it's worth the effort because you get to know how your students think through this process. It renewed my faith that children of all ages have an innate curiosity. We marvel at how curious young children are and how their excitement for learning drops off as they get older. But I would say that my fifth graders were natural naturalists. They learned more about the environment, and about doing science, than I ever would have imagined."

WATER STRIDER

A water strider is a special insect that uses the small hairs on its feet to hook on to the surface of the water or the water's skin. They resemble tiny black carrots with long, long legs. They eat red water mites, which you will find on the next page.

If you have ever wondered how striders walk on the water here is you answer to the mystery: surface tension. If you put a feather in the water and then push it down, it sinks, but if you leave the feather alone, it floats beautifully. The feather is staying up on the surface of the water. It's the same with water striders.

We learned that staying on top of the surface of the water is different from floating. We learned that things like paper clips and straight pins can stay on the surface of the water and not break through the water's skin. When an object floats, some of it is above the water and some of it is below the surface of the water, thus breaking through the water's skin. TRY IT SOMETIME!! You'll see what I mean.

*"Water Strider," courtesy Beth Kraft's fifth-grade classroom, Lu Sutton Elementary School, Novato, California.*