



The following excerpt is from *Strong Force: The Story of Physicist Shirley Ann Jackson*. This biography is part of the *Women's Adventures in Science* series, sponsored by the National Academy of Sciences and published by Scholastic and Joseph Henry Press.

Shirley Ann Jackson stood in the hot summer sun, patiently staring at a large rosebush in her family's garden. It was still early morning, but already the heat was beginning to build. She could feel a sneeze making its way through her nose. At 10 years old, Shirley was allergic to many things, including the pollen from the flowers she admired so much.

But this day, Shirley wasn't just admiring the garden of her family's home in Washington, D.C. She had important work to do. She was capturing bees.

As a large bumblebee headed for the rosebush, Shirley tensed in anticipation. The bee hovered over the bush, flitting here and there until it found just the right spot. It touched down and nestled itself into the center of a wide-open bloom. Shirley watched its fuzzy body vibrate as it slurped up the flower's nectar.

Carefully — very carefully — she reached down with one hand and closed the petals around the bee. She held her breath slightly, then gently plucked the bloom with her other hand. She could feel the bee's wings beating frantically inside the petals as it tried to escape. But that didn't worry Shirley. She had been capturing bees this way since she was eight years old. By now, she knew exactly what to do.

She dropped the bloom containing the bee into an empty mayonnaise jar. Quickly — before the bee even knew where it was — she screwed on the top, which already had tiny holes punched in it so the bee could breathe.

Shirley carried the jar with her new specimen to the wooden porch in the back of the house. She scooted under the porch where it was dark and cool, a perfect place for her bee collection. When her eyes adjusted to the dim light, she picked out a spot on a ledge where she would put her newest addition. It would sit between two other jars. One held three yellow jackets and a wasp, and the other held a wasp and a bumblebee. The summer was only half over, but she had already collected dozens of bees in jars that her mother had cleaned out for her.

## Bee Behavior

Some people thought it odd that a young girl would want to collect bees. After all, bees sting! And most of the other kids were afraid of them. Amazingly, Shirley had never been stung. But she wasn't just collecting bees the way some people collect dolls or marbles. She had a purpose: to learn about bee behavior and in that way unlock one of the secrets of nature.

To Shirley, the world was full of mysteries, and living creatures provided the clues that could help solve them. She chose bees to study because they were always buzzing about and she would never run out of specimens. Plus, they were easy to keep in captivity.

Shirley had several questions about bees. For example, she wanted to know how they might behave if they were fed certain things. To find out, she had a different way of capturing them. She waited until the bee was at the edge of a flower petal. Then, holding the jar on one side and the top on the other, she closed the bee into the jar without the flower. She added different foods, such as sugar, for the bees to eat. Then she observed their behavior after they ate the different foods.

At first, she kept the bees with their own kind. Then she wondered how they would behave with other species. She decided to mix them all up: bumblebees with yellow jackets, wasps with bumblebees, yellow jackets with wasps. The bumblebees seemed to be the most aggressive at first, but eventually all the species of bees got along pretty well with each other.

Shirley also wondered how the bees would act if they spent more or less time in the dark. In their spot under the eaves the bees were in the dark a lot of the time. Shirley would bring them out during the day to see if their behavior was different when they were in the light.

Like any good scientist, Shirley kept a detailed log of her observations. And when she analyzed her data she discovered some interesting things. For example, she noticed that under normal circumstances, bees have a circadian-type rhythm — or a pattern of behavior that is repeated every 24 hours. Shirley found that she could change this rhythm by changing how long she kept the bees out of the light. If the bees stayed in the dark under the porch until the middle of the day, they tended to behave as though it were the middle of the night.

## **Lessons from the Bees**

Surprisingly, the most important thing the bees taught Shirley was not so much a scientific lesson as a lesson about life itself. Shirley realized that no living thing likes to be in captivity. When the bees were first caught, they would bang against the side of the jar, trying to get out. Over time, they got more and more passive.

That's when Shirley knew it was time to let them go. But by then the bees had become so used to their new environment that sometimes they didn't leave right away, even after Shirley opened the jar. It was as though they had given up. So Shirley would leave the jars open for as long as it took for the bees to fly away.

As she got older, she saw the lesson of the bees repeat itself in the human world around her. Shirley realized that, just like the bees, people can easily become conditioned to having their space and their possibilities limited. And just like the bees in captivity, these people may simply stop trying.