At about the same time that Ashley Smart, PhD, was finishing up her doctoral degree in UC San Francisco’s Neuroscience Program in December, she was also wrapping up another training experience: an internship doing scientific illustration—specifically, drawing botanical specimens at San Francisco’s California Academy of Sciences [1].

On the surface, making pen and ink drawings of plants is a completely different kind of work from doing bench science, but Dr. Smart sees a lot of commonality in both endeavors. In January, as she prepared to begin a postdoctoral position at Stanford in the lab of Tom Clandinin, she took some time to tell the Graduate Division a little more about her internship experience, how it relates to her scientific research, and some thoughts on the intersection of art and science.

What inspired you to do this internship?

A couple years into grad school I started to draw more frequently. I also started to read about other people drawing to get tips, and to see what sorts of things were drawn and what sorts of things I found interesting to draw. Eventually, I realized that there was a whole field of scientific illustration, where illustrators not only make figures for textbooks and journals, but also do illustrations of plants and animals for publications, or museums, or parks, among other places. I began to get more curious about what it was like to do scientific illustration.
professionally, and I figured the best way to see what it was like day-to-day was to do an internship.

Do you have a background in the arts?

I have always liked creating things—painting, building, drawing, inventing, but I don’t have a lot of formal art training. I took some photography classes in high school and one in college. When I got to grad school, I realized that I missed creating things, and so I started drawing. It was a form of stress-relief to be able to create something and to progress in something, especially when things didn’t seem to be going that way in the lab. I could carry around a notebook and sketch anywhere, but I decided I wanted a more structured place to improve, so I took a night class at City College of San Francisco.

Everyone has heard of the "left-brain, right-brain" model. Do you feel like drawing bridges that divide?

Technically, in terms of brain organization, there really isn’t a lot of a left-brain/right-brain division except opposite body motor control and some really specific parts of language processing/speaking. Even as a metaphorical question, I don’t feel there is big difference between science and art. Both are ways of exploring and understanding the world, and both involve an incredible amount of creativity. So, when I am doing science I still feel artistic, and when I am doing art I still feel scientific. I experiment with paints, brushes, pens, and techniques. And I experiment with flies, DNA, bacteria, and microscopes. I create things in both, and I learn things, and I try to find good ways to share that with other people. I feel there is still this notion that science and art are in opposition. But there really are a lot of scientist-artists, and a lot of people who might not think of themselves that way yet, but are.

Actually, I have been thinking about this theoretical split so much and for so long that I ended up naming my art website Questioning Lines, partly to keep questioning the division between science and art.
Now that scientists have access to highly sophisticated imaging tools, where does scientific illustration fit in?

High-tech imaging technologies are incredibly useful for collecting data, which is obviously important, but scientific illustration can summarize information or find a way to express it so that it is more easily understood. It's like comparing data collection to graph creation. Illustration is good at synthesizing information and also for explaining that information to other people. The illustrations I did for the Cal Academy were used to describe and explain specific species of plants, so that botanists can use the information to recognize plants later on. It is a way to easily explain the components that led to the classification of the plants.

Dr. Tom Daniel, the botanist I worked with, sometimes gets questions about why he uses illustrations in his publications rather than focusing entirely on photographs. While he does use photographs, especially for flower color or seeds, there is frequently not a good single specimen that has all of the parts he needs to show?flower, seeds, fruit, leaves, roots, rhizomes, and so on. Additionally, the specimens are pressed flat and dried. Some of the ones I drew from had been kept in a rolling shelf for decades! This does not make easy-to-understand photos. Plants that are very old are usually brown, they are glued down on a paper, their leaves are cracked and broken or folded over, and most of the structures are hard to distinguish. But an illustrator can study multiple specimens with the help of a botanist and use different parts from each plant to represent the whole species, and then draw them so they actually look like a plant instead of dried brown vegetative matter glued to paper. So I think there is still a lot of benefit in scientific illustrations in combination with advanced photography and imaging.

Can you tell us a little about the illustration process?

In my work at the Academy, the process started with Tom, choosing which plant parts needed
to be drawn and which specimens had good versions of those parts. For example, one specimen might have a good quality leaf, and another collected at a different time might have good seeds or a good flower. He’d tell me what qualities were important to the identification of the plant, to make sure I would know what aspects might be specific to the specimen, and what was generalized to the entire species. Some things were artifacts of the collection or storing process, like discoloration, but other things were important, like the irregularity or direction of the hairs. I’d study the specimens and then measure and start to draw them. I’d draw first in pencil to get all of the details precisely accurate? usually while looking at the part under a dissecting scope. Once I had a good pencil drawing, I’d give it to Tom, and he would make sure that it was accurate and proportionate to as fine a measurement as we could get. Once he approved it, I would draw it in pen, using a combination of line-work and stippling.

I repeated this process for each plant part and then scanned and arranged them into a plate with scale bars. Each plate took about two to three weeks, but some plant parts were more difficult than others. The hardest part for me was doing the ?habit? of the plant, where the whole plant is drawn as it would look if someone found it in the field. The dry, flat specimens I was working with looked very little like a plant you might find if you were walking through a forest, so I had to translate this material into something that looked alive. It was definitely a fun challenge and I spent some time studying and sketching plants in the park to try to figure out what the angles of leaves might be for the species I was drawing.

Click on the drawings above to see Ashley’s beautiful full illustrations. See even more on her website [3].

For now, Dr. Smart still considers drawing as a hobby, but we look forward to seeing the fruits of her future scientific and artistic labors. Her graduate research, with advisers Grae Davis and Jim Wells, focused on caspases, protease enzymes that are generally responsible for killing cells, but which have additional, not-very-well-understood roles in neurons. Ashley was able to engineer a light-activated caspase that could be turned on and off to see how different types of fly neurons would respond when caspase was activated. To learn more, see her prize-winning 3-minute talk [5] at UCSF’s 2017 Grad Slam competition. (Photo of Smart above, by Noah Berger, is from Grad Slam.)

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