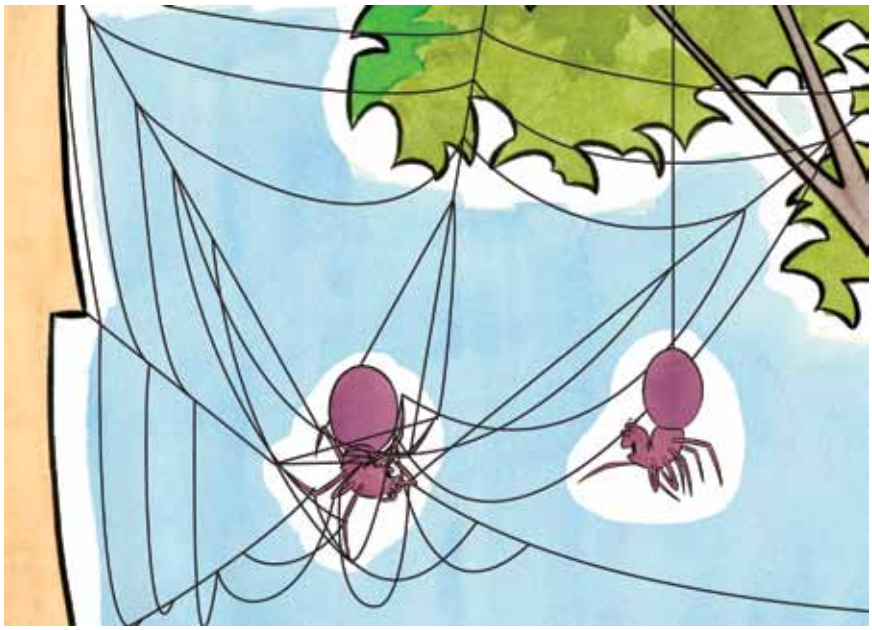
Q: Why don't spiders stick to their own webs?

By Bill Robertson



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"Oh, right, like you've never had an off day."

A: The short answer is that spiders don't stick to their own webs because they're clever. Well, maybe *clever* isn't the right word because spiders don't have much in the way of a brain. But they do have behaviors that are hardwired through evolutionary processes. Because spiders have been around at least since the Jurassic Period, they've had a long time to develop that hardwiring. So let's call it *evolutionary cleverness.*

Anyway, to understand why spiders don't stick to their webs, it will be helpful to go over the entire web construction process. So that's what we'll do.

Spider Anatomy

Spiders produce silk for the construction of webs from openings known as *spinneret glands* that are located in their abdomen. Most spiders have about three pairs of spinnerets, but can have as few as one pair and as many as four. Each type of spinneret produces a different form of silk. Some are thin and some are thicker. Spiders can even use adjoining spinnerets to intertwine the silk threads and make them stronger. Alongside some of the spinnerets are glands that produce an adhesive substance that's basically glue. So, spiders can produce nonsticky silk threads of varying strength and can produce sticky threads that contain droplets of glue.

Scaffolding

If you've ever watched a house or building being constructed, you've no doubt seen the scaffolding they use to construct the house. Scaffolding is basically a structure built around the house or building that allows the construction crew to create the actual structure. There are many different kinds of spider webs, so I'll just pick one kind—the spiral orb—to analyze how spiders use scaffolding and then construct their web. The spiral orb is the prettiest kind of web, and it's the one we usually think of when spider webs come to mind. Nothing like sticking with the classics (a little spider humor there).

To begin their scaffolding structure, spiders first have to bridge a gap between different places such as tree limbs or corners of houses. To do that, they attach one end of a thread where they are and then let the wind carry either the other end of the thread or the spider itself on the end to another place. This process is called *ballooning* or *parachuting*. Aside from the ends of this first thread, called a *dragline*, this thread isn't sticky. The spider can move freely along this thread. From the first dragline, the spider then continues to build a *frame*, which is a set of nonsticky threads that form a crude structure from which to work. Traveling along the frame, the spider

then spins *radial* threads (very strong, also nonsticky), and then the basic spiral structure that crosses over all the radial threads. See Figure 1.

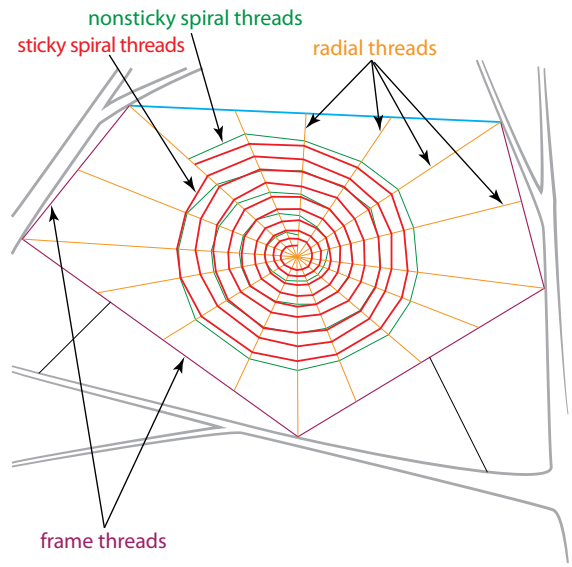
So far nothing is sticky, so the spider can cruise along all the threads without a problem. The entire basic web so far forms the scaffolding from which the spider spins the real web. The real web contains the glue, but here's where the spider is tricky. First, after the main web containing glue is spun, the spider still retains some of the framework so he or she (many times it's she because she killed her male mate—a situation that makes me glad I'm not a spider) can quickly move across the web without getting stuck. The spider actually eats the parts of the scaffolding it doesn't need in order to replenish protein. Second, the glue is put on the threads in droplets so it's not continuous. The spider can negotiate the web without landing on the sticky parts, but the prey are not so fortunate.

Materials

The radial arms of the web are really strong and taut. Your average radial arm of a spider web is about four times stronger than the same thickness of steel. Some webs in Africa have been found that are stronger than Kevlar! The reason for this strength is that the silk is composed of long chain polymers that are tangled together. It's good to have strong radial arms not just for holding the web together, but for detecting prey. Take a moment and get a length of string. Hold the string loosely between your hands and try to send a wave pulse from one end of the string to the other. Doesn't work very well, does it? Now hold the string tight and send a pulse from one end to the other. Works nicely. Many spiders who spin spiral orb webs hide out at the edges of the web and wait for prey to come. Because the radial threads are strong and tight, they transmit the vibrations from the prey to the edge of the web where the spider is waiting.

Figure 1.

The spiral orb.



The spiral threads are much thinner than the radial threads, and they're also more elastic, meaning that they stretch a lot before breaking. If you have a fast-flying insect hit the web, it's not a good thing if the insect just breaks on through. Because the radial threads are so elastic, they bend but don't break, allowing the glue to grab onto the prey. They are also able to deal with the crazy motions of the prey as they try to escape. The threads are sticky enough that they can even break and then reattach themselves.

There's one more thing about the glue that spiders use for catching prey. It actually performs better when it gets wet. That's a good thing if you happen to be a spider in a rain forest. The glue is so special that scientists and engineers have been trying to duplicate the glue (not all that successfully, so far) for industrial use.

So, to go back to the original question, spiders don't get stuck in their own webs (and they aren't immune to their own glue) because they use a combination of sticky and nonsticky threads (different glands for producing those), and the glue is in droplets that the spider can avoid but the prey can't. The spider's nervous system is hardwired so the spider knows how to avoid the sticky threads and how to avoid the droplets. I suppose that doesn't leave much room in the spider brain for philosophizing, but heck, they're pretty much focused full time on catching food. All of this is really amazing, but I still don't like black widows. ■

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