Ari intro: This is Small Matters – the audio series where we sweat the little things. I'm Ari Daniel.

<fade up outdoor ambi>

Our story begins in downtown Atlanta, in a park no bigger than a tennis court.

Dixon: Standing here, you are looking at an uncountable field of daffodils.

Ari: Dabney Dixon works just around the corner.

Dixon: So I was walking by here yesterday and I go, "Whoa! I wonder what specific molecule makes it that beautiful color yellow? Carotenoids!"

Ari: By the way, Dixon's a chemist at Georgia State University.

Dixon: Like music in the background, I can envision the molecules that make the color of our world.

Ari: Knowing how molecules paint color onto the world is deeply gratifying to her. <fade down outdoor ambi> But back in Dixon's office, she says for a while, all she had was the question.

Dixon: When I was a little girl, I would say, "What makes things colors?" And people would say, "Well, Dabney, molecules make things colors." And I would go, "Yes, yes, but what makes a blue molecule a blue molecule, and a green molecule a green molecule?" And I never met the people who knew the answer. And then I got to college and I took freshman chemistry, and I went, "I met the people! The people who know what makes different molecules different colors." And so, I went and became a chemistry major and here I am, all these years later.

Ari: The answer has to do with how molecules interact with white light, which contains all the colors of the rainbow. Each molecule absorbs different wavelengths of light, pulling colors out of that rainbow. The leftover colors – that composite – is what we see.

Now Dixon gets to work with color all the time in her lab. It makes her work a lot easier – because she can see where her molecules are when she's running her experiments. Her molecule of choice is heme.

Dixon: Heme is what makes blood its bright red color.

Ari: Heme is found inside hemoglobin – the protein in red blood cells that transports oxygen from your lungs to the rest of your body. It's a flat array of atoms.

Dixon: Has four nitrogen atoms in the middle. And those nitrogen atoms each hold on from four different directions, kind of north, south, east, west – to an iron atom in the middle.

Ari: Dixon studies bacteria – like the ones that cause strep throat – that consume the heme in our blood. Ultimately, they're after the iron, which they need to digest their food.

Dixon: You don't think that there's much blood in your mouth, but tiny little cuts – there's enough blood to keep the *Streptococcus* bacteria happy and provide enough heme out of the hemoglobin to let the bacteria live quite handily.

Ari: Dixon's question these days is how a bacterium manages to get the heme from outside its cell to the inside – which for a tiny molecule, is a long distance. Here's an analogy.

Dixon: Let's imagine we have a game that's a combination of ultimate Frisbee and basketball. So the Frisbee is the heme – large, flat entity – and it's got a little bit of iron in the middle, so we'll tape a tiny, little magnet to the middle of the Frisbee. People are gonna throw the Frisbee one to the other, and then when it gets to the end, you need to get the Frisbee down into the basket.

Ari: Bacteria have proteins embedded in their cell membranes, and the heme gets passed from one protein to the next – kind of like players tossing the Frisbee down the line. The heme enters the cell when it passes through a channel – the bacterial equivalent of the basket.

Dixon: Then it's destroyed by other proteins in the cell – they're basically gonna throw the Frisbee away because they just want that tiny little magnet. They want the iron.

Ari: Dixon wants to know how these bacterial proteins – some of which are totally unlike any proteins that have been described before – hold onto the heme, and how their shape changes when they release it to the next protein in the sequence. Understanding this, and eventually tampering with it, might lead to new antibiotics.

And, the fact that heme is red… not only makes doing this work easier – it goes back to Dixon's lifelong love of color.

Dixon: I get to see the beauty of colored molecules everyday in the lab.

Ari: Dixon doesn't keep her passion for color and chemistry to herself. She takes it on the road.

<fade up soft classroom ambient>

Ari: Dixon stands in front of a class of third graders at the Children's School in Atlanta.

Dixon: Everything in the whole universe is made up of molecules and atoms. So we're gonna show you pictures of molecules and atoms.

Ari: Dixon flashes a series of molecules onto a big screen.

Kids: Whoa!

Ari: Different colored spheres – which represent the atoms – pop into view.

Student 1: It looks like a bunch of sprinkles.

Student 2: Looks like a hairball from a cat.

Ari: This molecule happens to be hemoglobin. At the end of the class, Dixon asks her two undergraduate helpers – Arielle Hackel and Stephanie Thompson – to field questions from the kids.

Student 5: What made you want to be a scientist?

Hackel: I always asked a lot of questions, and I wanted to find some answers. And I just felt like being a scientist was probably the best way to do that.

Thompson: When I was your age, I loved science and I knew that when I grew up, I wanted to be a scientist. Does anybody want to be a scientist when they grow up? Awesome.

Ari tape: Half the class.

Thompson: Don't ever let it go. Go for it.

Ari: Their professor, Dabney Dixon, didn't meet a chemist until college. Now, she's determined to meet as many kids as she can, and introduce them not just to chemistry, but to a world full of colorful questions.

<applause & fade up music>

Our series, Small Matters, is produced by the Center for Chemical Evolution, and sponsored by the National Science Foundation, with additional support from NASA. I'm Ari Daniel.