4. Mental Models

Becoming More Aware of the Sources of Our Thinking

Imagine the baseball field near your school is being upgraded one day (courtesy of a donation from a local construction company), and the workmen strike a patch of sandstone with fossils embedded in it. As they sweep the stone, students excitedly gather around, and they see what appears to be a set of dinosaur footprints that look something like this (see Exhibit 1, below):

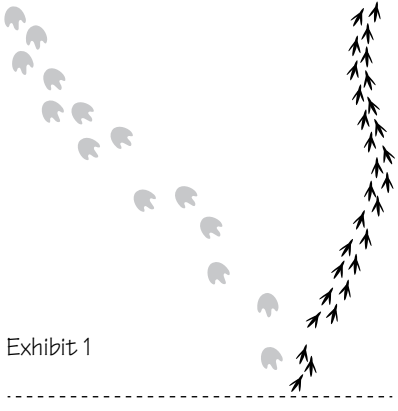

Exhibit 1

"What do you think happened here?" asks a teacher. All the students jump in with guesses. There were two different dinosaurs, they say, one with big feet and one with smaller feet. The big one's feet get farther apart, so it must have been running. Maybe it was chasing the smaller one; maybe it was hungry.

The workers dig up a little more stone, and now we see a

The dinosaur footprint puzzle dates back to the mid-1960s; it was published in the science text *Investigating the Earth*, by the American Geological Institute Earth Science Curriculum Project (Houghton-Mifflin, 1967). Interestingly, the tracks were based on real fossil footprints, the Paluxy dinosaur tracks found in rocks in Texas. See Jack Hassard, "The Dinosaur Footprint Puzzle: A Content or Process Approach?," *The Art of Teaching Science Blog*, November 2, 2010, http://www.artofteachingscience.org/?p=3081.

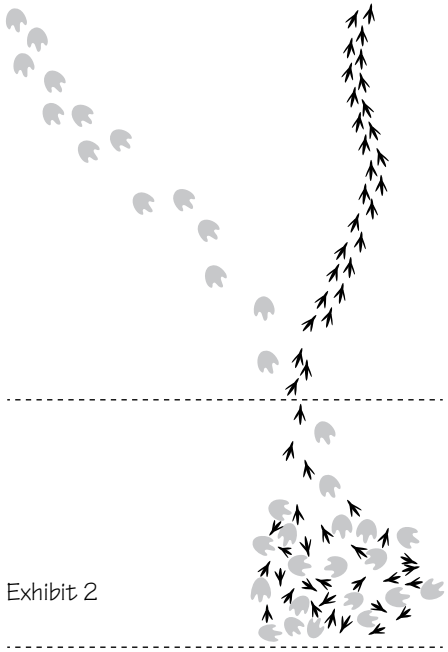

Exhibit 2

more complete image, as illustrated here (see Exhibit 2, left):

"The two of them got in a fight," says one student. "No, they're drinking from the same water hole," says another.

And then the workers clear the rest of the sandstone, producing a picture something like the one on the next page (see Exhibit 3).

"Hey," complains a student. "What happened to the little one?" By now, the site has attracted a large number of students from all grade levels. The middle school students have a theory: The big dinosaur ate the little one and walked away. But a third-grader says, "No, they're friends. The little one is riding on the big one's back." Someone else argues that it's a backwards-footed prehistoric animal, giving birth. Or was it a courtship? Hardly—the smaller one flew away and survived ("See where it jumped off?"). Or a pterodactyl swooped down and carried it away. An exchange student suggests that the two animals never met; the smaller one found food and flew away, and the larger one came fifteen minutes later, found nothing and stalked off. And then a canny high school student says, "Wait a minute. They probably lived thousands of years apart and just happened to be imprinted in the same piece of rock."

Find a picture or image of a set of dinosaur footprints and try this exercise yourself with a group of kids, gradually uncovering the full image, just as the imaginary workmen did. You'll find no shortage of widely varying interpretations, and many participants will be convinced that their interpretation must be right.

We sometimes use this exercise to open meetings of faculty or community groups. Then we turn to talk about whatever relevant events or issues are at hand—say a disciplinary problem or a budget dispute. "What happened here?" we ask, just as we did with the dinosaur exercise at the outset. Once again, everyone unveils their assumptions and attitudes. The first-year teacher who has just transferred from a different district has a very different mental model from the veteran teacher

of 25 years; the secretary who has seen three superintendents come and go outside her office has yet another view, the custodian has another. The women who work in the lunch line describe one thing; the classroom teacher who walks through the cafeteria every day disagrees. And because they have safely explored their different perspectives for a story about dinosaurs, they are now ready to hear each other on a potentially more volatile real-world issue.

Exhibit 3

The point of this exercise is to demonstrate that human beings are creatures of interpretation. Our behavior and our attitudes are shaped by our mental models: the images, assumptions, and stories that we carry in our minds of ourselves, other people, institutions, and every aspect of the world.

Because mental models are usually tacit, existing below the level of awareness, they are often untested and unexamined. They are generally invisible to us—until we look for them. Thus, reading this passage, you may have easily made your own interpretations of the dinosaur tracks, but you may or may not have noticed the other assumptions you implicitly read into this passage: that the school can't afford to pay for its landscaping, that landscaping workers are male, that the students play baseball (instead of, say, cricket), that the students of all grades use the same field, that the fossils would naturally show dinosaurs (instead of a prehistoric mammal and bird), and that only children, as opposed to adults, would want to guess at the meaning of the footprints.

Differences between mental models explain why two people can observe the same event and describe it differently: They are paying attention to different details. The core task of the discipline of mental models is to bring tacit assumptions and attitudes to the surface so people can explore and talk about their differences and misunderstandings with minimal de-

Also see *The Danger of a Single Story*, a TedTalk video by Chimamanda Adichie. This can be helpful in engaging a group in the exploration of mental models and the consequences of not questioning the images and stories that different people hold. See http://www.ted.com/talks/lang/eng/chimamanda_adichie_the_danger_of_a_single_story.html.

fensiveness. This process is crucial for people who want to understand their world, or their school, more completely—because, like a pane of glass framing and subtly distorting our vision, our mental models determine what we see. In any new experience, most people are drawn to take in and remember only the information that reinforces their existing mental models.

Though at first glance, working with mental models may seem to be an intellectual exercise with little relevance to the "real world," it is probably the most practical of the five disciplines. It has direct relevance for a surprising number of seemingly intractable challenges in schools. That's because unexamined mental models limit people's ability to change. A group of superintendents and school board members may tacitly believe that the only way to improve the schools is to invest more money; therefore, they don't consider other possible approaches. A teacher may assume that students from the "wrong side of the tracks" don't care about school, so he subtly dismisses them out of hand. An administrator may assume that the local teachers' union will block all innovation, so she approaches the unions defensively, holding back as much information as possible—which in turn makes the union leaders more defensive and confirms their belief that administrators cannot be trusted. The leaders of a school reform effort may assume, without even being fully aware of it, that parents don't really know much about their children's needs. Therefore, they inadvertently alienate parent groups, without ever understanding why. A forty-five-year-old laborer who never earned a high school diploma may assume that his children's teachers look down on him, so he never summons the courage to come in to school for meetings, and the teachers think he doesn't care. A local community member may assume that, because many schoolteachers are women, they do not need to be paid as much—and vote down the school referendum for a pay raise.

The consequences of untested and unsurfaced mental models can be tragic for children. Statistics suggest that bullying is a lifelong trait; a middle-school child who is recognized by teachers as a bully has a 69 percent chance of having a felony record as an adult. But could that be because the teachers and administrators have a mental model of that child as a bully and treat the child accordingly? Or because the child holds an unseen, unspoken mental model that bullying is the most effective way to solve problems—and never finds a mentor who can safely and persuasively challenge that assumption?

The practice of "working with mental models" helps us see the metaphorical pane of glass we look through and helps us re-form the glass by creating new mental models that serve us better. Two types of skills are central to this practice: reflection (slowing down our thinking processes

The practice of working with mental models emerged from "action science," a field of inquiry developed by the theorists and educators Chris Argyris and Donald Schön. Their work, in turn, is grounded in the "double-bind" theory of anthropologist Gregory Bateson and the semantic work of linguist S. I. Hayakawa. See *The Fifth Discipline*, p. 172ff, and *The Fifth Discipline Fieldbook*, p. 264, for more about the roots of this work, and Art Kleiner, *The Age of Heretics*, p. 186ff, for the story of Chris Argyris's work. Also see Argyris, "Teaching Smart People How to Learn," in *Harvard Business Review* (May–June 1991, reprint #91301), and *Organizational Traps: Leadership, Culture, Organizational Design* (Oxford University Press, 2010).

to become aware of how we form our mental models) and inquiry (holding conversations where we openly share views and develop knowledge about each other's assumptions).

Inquiry may be a particularly novel skill for some educators. There is an unwritten rule in many organizations, including many schools, that people should not ask questions unless they already have the answer to offer. The discipline of mental models flies in the face of that idea. People ask questions in the practice of this discipline because they are trying to learn more about their own, and each other's, most deeply held attitudes and beliefs. It takes reflection and conversational practice to learn to do this well. The exercises and conversational tools described here have proven effective in a variety of venues, including many school systems and government agencies, precisely because they teach people not just to ask questions but to learn from the answers.