

**MARY JAMES**, associate professor of physics, is among the few black women in the country to hold a doctoral degree in physics. A native of Chicago, James was the third of six children and credits her attorney parents with "teaching us how to read and then getting out of our way." James, who recently became a parent herself, is an expert in designing and building accelerators for particle physics, but finds that her greatest enjoyment comes from teaching undergraduates. James recently had the notable distinction of being placed on Rolling Stone magazine's "honor roll" of professors, a select listing of educators recognized for their excellence in teaching. James took her instant celebrity in stride, noting, "Jodie Foster got the cover."

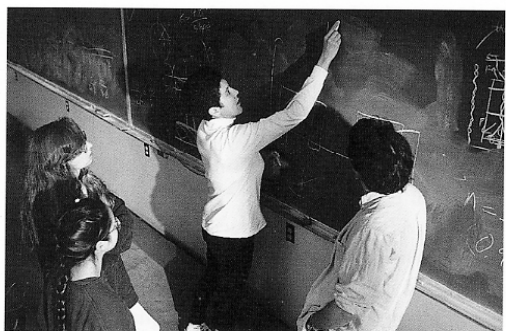
"When I graduated from college, I had a B.A. in physics, and I wasn't sure that I wanted to go on to graduate school. I got a summer internship at the Stanford Linear Accelerator Center and then was offered a permanent job there. I worked in a building that literally had 200 men and three women, and the other two were secretaries. One day I was walking down the hall and there was a technician coming from the other direction. When he saw me, his eyes kind of lit up and he said, 'Oh, you. I've heard about you. Are you a secretary or a prodigy?' I remember thinking, what a fascinating choice. If you're in this building, you could have two roles. You could be a scientific person, or you could have a clerical job. But underneath that he was saying, if you're on the scientific side, you have to be at the very top. You're either a prodigy or a secretary."

"That comment says so much about the cultural expectations of women in science. I believe women pick up this message loud and clear, that with the rare exception of phenomenal genius, there is no place for you in science. I am constantly banging on that Madame Curie myth. Science is an industry. It's huge. There are scientists who teach, scientists who do research, scientists who work for companies. Hundreds of thousands of people with scientific training work in some aspect of science or technology. But women are very likely to say to themselves, the only way in here is if I'm Madame

Curie, Jr. Every year I have students come to me and say, 'I took introductory physics this year. It was very hard, very challenging, I really liked it, and I would like to be a physics major. But I only got a B+ in the course.' And I say, you got a B+ in introductory physics? You're damn right you can be a physics major, you can be a good one, and you can go and use your training in lots of different ways. So certainly talking to students—all students, but particularly women—about the versatility of a scientific education and the many ways in which it can apply to a life beyond Reed, is a very important part of my mission."

"Even in high school, I was attracted to physics, because it was clear to me that there were a few overarching principles from which all else followed. To me the interesting thing was that these simple overarching principles could be combined in very intricate and powerful ways, creating enormous variety. So often in the lay literature you read that the job of physics is to reduce everything to its elemental form. But I say it's the opposite. Unification is the holy grail in physics. I like to illustrate this on the first day of my introductory physics class with a little story:

"When I was in second grade, I was taught that Isaac Newton discovered gravity. And I wondered what on earth could that mean, because what seven-year-old doesn't know what gravity is? I mean, things fall down. This is clear even to a two-year-old. Then I learned that Galileo, not Newton, was the one who dropped balls from high places and said it takes a certain amount of time for an object to fall a certain distance, and it's always true. So I thought gee, Newton didn't discover what every two-year-old knows; Galileo wrote down the precise mathematical details of objects falling near the surface of the earth, so why does Newton get all the credit? Why is Newton the one physicist in the whole history of Western civilization whose name every school child knows? Then I learned that Johannes Kepler was the physicist who worked out the precise mathematical description of







the planetary orbits around the sun. It was looking pretty bad for Newton. But what Newton did that no one else had done was to unify the theories of Galileo and Kepler. That is, he was able to see that the very, very different-looking events, namely, an apple falling near the surface of the earth and the path that Mars takes through the sky, were intricately related, that they were two different examples of a single natural force at work, because they obey the same physical law. Now that was an incredible scientific leap. But even more important was the cultural leap. If you were a 17th-century person, the surface of the earth and the orbit of Mars were in two distinct worlds, the world of

mortals, and God's world. So what Newton did would be similar to me answering the question, 'Do the laws of gravitation hold in the afterlife?' Now that is completely beyond me. I wouldn't begin to venture a guess. So what Newton did was literally to say that the heavenly world, God's world, the equivalent to us of the afterlife, obeys these laws. Wow. He unified the physical theories that governed what to people of his time were two completely different realms.

"And that's what physicists go after, to show that the events that occur in this incredibly diverse and varied universe can be unified, that they all follow a few fundamental laws, but that they can be

combined in enormous numbers of ways to achieve the variety that we see around us.

"At Reed, I make a very big point, particularly in the introductory class, of saying, look, this is a difficult course. Things are happening on many, many levels, all at the same time. Physics has a language and a grammar of its own. We're trying to teach the lexicon and the concepts at the same moment. It's a little bit like taking first-year French and French literature simultaneously. I ask my students to use whatever methods are most effective for them, and I tell them that most of the time, that means working with other people. So work with others on your homework, in the laboratory, come to office hours, ask questions. In taking on this daunting task, it's not required that you climb every mountain alone. And just like mountain climbing, it's not good technique to climb alone. You need mastery only at the point of examination. The process of coming to insight does not have to be a lonely one.

"The other reason I am such an advocate of group learning is because it's how scientists work. Almost no science is done by a single person sitting alone in a cubicle. There are now physics experiments at the big laboratories that involve 400 physicists collaborating on a single experiment that will run for ten years. I want my students to know the value of cross-pollination and the fertilization of ideas that comes from working together.

"As a small liberal arts college, we pride ourselves that every student has an adviser who really knows what's going on academically, who is thinking about that student's progress from the day he or she gets here until the day of graduation. I think that we can't overemphasize the importance of the advising process. I tell my advisees, you have certain special privileges in terms of

your access to me. If you walk by at office hours, there's going to be a line. And if you're struggling, or having doubts you may think, oh, I'll come back another time. But when you come back, there's still that line. So this is what you do: call me on the phone, leave a voicemail, and I promise I will make time for you in the next 24-hour period. That's the deal. Students can get on a slippery slope kind of fast. Maybe a disappointing math quiz is returned and the student starts to wonder, well, gee, maybe I'm not cut out to be a science student. We get valedictorians every year, students who have never been second, much less down in the middle of the ranks, and that can be a very difficult transition. So I think we can't take too much care with the academic advising process. And my view is to say that any issue or problem that is affecting academic life, whether personal, social, or academic, is appropriate for discussion.

"Reed is a very attractive place to teach, because the students are astoundingly dedicated to learning, to expanding themselves, and to working really hard. I think nurturing an atmosphere where the students take good care of each other is important. In our department, we encourage students to compete against the goal itself, rather than each other. I want to establish a tone in the classroom that makes it clear we are facing an enormous challenge. To meet that challenge requires individual effort from each student, as well as a collective effort which allows us, as a group, to come to insights and solutions we might not come to alone."