Student interns in Tom Sakmar's lab work and learn beside their mentors, creating a productive and fun experience for both.
Photo: Christopher Denney

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MENTORING THE YOUNGEST RESEARCHERS

Breaking New Ground

From his fifth-floor lab bench, Eugene Simuni looks out of a huge picture window onto Manhattan's East River and traffic-laden Queensboro Bridge. It's an expansive view, fitting for a high-powered workplace where a dozen researchers put in long hours exploring scientific questions. Simuni, however, seems a little out of place. With his lanky frame, angular face and dark eyes, he looks younger than his years. And since he's only 19, this is not yet a compliment.

A gangly adolescent seems an unlikely member of the HHMI laboratory of Thomas Sakmar, known for its pioneering studies of rhodopsin, the protein that reacts to light in the retina of the eye. Simuni has done research here since July 1998, working as an intern alongside postdocs, graduate students and lab technicians. Situated on The Rockefeller University campus, it's a friendly place, but an intellectual pressure-cooker— surely, no place for a kid.

Or maybe it's the perfect place for a kid.

Judging from the number of investigators these days who welcome high school interns—ordinary students as well as whiz kids—something must be going right. Educational altruism aside, though, why do highly competitive scientists devote space and time to those who are so young?

As with much in science, the answer surprises at first, then seems elegantly simple: Kids add spark to an experienced team. They also give researchers a chance to practice teaching and mentoring, and rather than turn up their noses at mundane lab work, teenagers tend to approach it with a sense of curiosity and fun. And, perhaps most important, their questions can jolt everyone into thinking more creatively.

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A Cautious Beginning

Eugene Simuni's (above) research as a high school intern led Thomas Sakmar's laboratory to turn in new directions.
Photo: Christopher Denney

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Simuni, who came to the United States from Russia only three years ago and has just begun his undergraduate studies at Harvard, was a star science student in his Brooklyn public high school. A crack computer programmer, he learned about the Sakmar laboratory through a Rockefeller University program that provides research opportunities for high school students, one of many such efforts across the country supported by HHMI grants.

Sakmar, who worked as an arc welder when *he* was in high school, welcomes interns like Simuni. Like many investigators, he designates a lab member to work closely with the youngster and then keeps an eye on things from afar. In Simuni's case, the bench-side mentor was Ethan Marin, an M.D., Ph.D. candidate.

Marin was—understandably—anxious when Sakmar first broached the idea. "My reaction was mixed," he recalls. "I was happy to have somebody else to work with, but I was uncertain about how much a high school student would be able to do." In the end, he decided to give it a try, in part because an intern would give him some teaching experience. At Rockefeller, explains Bonnie Kaiser, who runs the university's Science Outreach Program, "We have no undergraduates. One of the ways people get teaching experience is by mentoring."

Simuni learned quickly after Marin took him under his wing, studying a cellular signaling pathway involved in sending visual signals to the brain. Specifically, he focused on the structure and function of two important members of the G protein family. In a short time, Simuni became skilled enough to notice differences in how certain protein subunits interact, and to conclude that these interactions help control the rate at which G proteins are activated.

It was a remarkable discovery that won Simuni fifth place and a $25,000 scholarship in the prestigious Intel Science Talent Search. It also landed him and three classmates on the cover of the New York Times Magazine, for a story on "The Triumph of the Brainiac."

Simuni's experience in the Sakmar lab was not unique. At the opposite end of Rockefeller's campus, Marcelo Magnasco, a mathematical physicist, nurtured a high school star of his own: Raymond Raad, who studied how water flows through the intricate veins of leaves. Raad says his parents initially disapproved of his working in a lab for free, but he delighted in interacting almost every day with Magnasco. Under this

tutelage, Raad turned up startling evidence supporting his hypothesis that tree veins act more like water filters than plumbing pipes. The discovery enabled him to join Simuni and eight other students in the Rockefeller program as an Intel semifinalist—and to convince his parents he hadn't wasted his time.

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Fresh Thinking

Ethan Marin (left), an M.D., Ph.D. candidate, guided Eugene in his studies of cellular signaling pathways involved in sending visual signals to the brain.
Photo: Christopher Denney

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Prize-winning interns are actually pretty rare. But kids don't have to be prodigies to make a solid contribution. In truth, those who are a little less goal-oriented in their research are sometimes the most valuable because they'll tackle tasks that their more career-oriented labmates might shun.

Once they get going, in fact, teenagers can be amazingly productive in such work; some are better lab technicians than many college students. Even more important, perhaps, they have the freedom to pursue long-shot hypotheses that are too risky for postdocs or grad students, whose projects must offer promise of advancing their careers.

It's an interaction, in other words, that can serve everyone well. The students gain valuable—sometimes career-altering—experience, and the mentors have the satisfaction of knowing they've provided a service. Mentors like those at Rockefeller who invite kids back year after year say there's an even bigger payoff: the fresh thinking that results when you expose lab members to the infectious curiosity, the "naïve" questions of a novice.

No matter what type of work high schoolers do, "if they're good, they'll ask questions," Sakmar says. Answering those questions forces him to rethink his own assumptions. "It really gets you into a different mindset when you start trying to justify what you're doing in basic terms," he says.

Magnasco is even blunter. "They question you on one thing, on another thing," he says. "They question everything—they can be so bloody obnoxious. 'Why do you do it that way?' 'I don't know; my thesis adviser told me to do it that way!'"

"If you are doing basic research," he adds, "it is about asking fundamental questions—and who asks more fundamental questions than kids?"

That's what Raad, Magnasco's intern, did in pursuing his unorthodox notion that leaf veins are complexly woven, like cloth, and not simply built like a trunk with branches. "I don't think Marcelo believed me at first," Raad says. "All the books say that leaves are like trees. The books are just wrong."

Simuni, too, got hooked on a question his labmates had dismissed—and his findings left their mark on the Sakmar lab. "Eugene, in his interaction with Ethan, reactivated something we worked on previously and had set aside," Sakmar recalls. "His interest got other people interested, so now we have three people working on it."

That, in a nutshell, is why so many cutting-edge scientists offer high schoolers a seat at the bench, an enthusiasm that goes both ways. "I had to learn a lot of things to solve a [seemingly] simple question," says 18-year-old Raad. "I love science for giving me that—and, really, Marcelo for doing that."

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MENTORING THE  YOUNGEST RESEARCHERS

Working Relationships that Actually Work

Bringing high school students to a scientific laboratory can be fun and productive, but investigators who have enjoyed the experience also have some advice to offer:

- When interviewing a youngster, nothing trumps motivation and curiosity. "Their motivation is the most important thing," says Michael Lai, an HHMI investigator at the University of Southern California. "I tell them that science requires a long-term commitment."
- While students with proven academic accomplishments catch on especially quickly, investigators report very good experiences with youngsters whose academic backgrounds are less stellar, which is often the case with inner-city students. Robin Wright of the University of Washington in Seattle has hosted economically disadvantaged students from a program that targets those interested in earning an M.D., Ph.D. "One is in my lab now, and she is amazing," she said. Similarly, Bonnie Kaiser notes that a third of the participants in the Science Outreach Program at Rockefeller are disadvantaged or from groups underrepresented in science.
- Provide the student with a mentor who can really use an extra pair of hands. "You need to have somebody willing to supervise him closely," says Pamela Bjorkman, an HHMI investigator and structural biologist at Caltech, whose first intern was barely 16. "We didn't just turn him loose in the lab."
- Give the student something significant. "They are capable of far more than I ever expected," says Elizabeth Sanford, an organic chemist at Hope College in Michigan. "They're not content to do busy work; they want to do real science. I think you would fail if you tried to make them into a dishwasher. You have to have a real project for them."
- Consider how you feel about students who are motivated primarily by scientific competitions. Lai, for one, says, "It's OK with me, as long as the kid is motivated." Rockefeller's Magnasco agrees, but Sakmar will not accept students whose main motivation is to win an Intel or other prestigious award.
- Work through the institution regarding safety,

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parental permission and child labor laws. Typically, for example, high school students are not permitted to work with radioactive substances.
- Don't be disappointed if the student chooses a nonscience career. "It's important to remember that a successful outcome could be that students decide science isn't for them," Sanford says.

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4000 Jones Bridge Road Chevy Chase, MD 20815-6789
(301) 215-8500 E-mail: webmaster@hhmi.org