

Rensselaer's MoleculariumSM Project Teaches Kids What "Matters"

A new animated program is designed to spark children's interest in learning about atoms and molecules using planetariums in a new way for science education.

By Peter Dizikes

Schoolchildren love field trips to planetariums, and for good reason: Through the magic of special effects, they can explore the distant universe. Now a group of Rensselaer scientists, along with a New York City-based experience design firm, have developed a new twist on this enduring institution: The MoleculariumSM project, a show featuring a novel planetarium-format animated program, the "Riding Snowflakes" show, that helps schoolchildren explore the universe as it exists at the atomic scale.

Due to debut this fall, the show "Riding Snowflakes" (one of two in production), as well as the Molecularium project concept as a whole, is in good measure the idea of Linda Schadler, Ph.D., a professor of materials science and engineering at Rensselaer with a career-long interest in educational outreach programs for primary and secondary-school students. Looking for new methods of introducing kids to molecular science, Schadler began pondering ways to adapt the planetarium concept for her own field about five years ago, while keeping a central question in mind. "If you can go to the stars, why can't you go down to the molecular level?" Schadler asks.

The Molecularium project is part of the educational and outreach program of Rensselaer's National Science Foundation (NSF)-funded Nanoscale Science and Engineering Center (NSEC) for Directed Assembly of Nanostructures. Rensselaer's NSEC is directed by Richard Siegel, the Robert W. Hunt Professor of Materials Science and Engineering at Rensselaer. The Rensselaer faculty involved credit Siegel and the Institute for supporting the project since its inception.

Other like-minded Rensselaer faculty members have joined in the project. Daniel Gall and Pawel Koblinski, assistant and associate professors, respectively, of materials science and engineering, are acting as scientific consultants. Shekhar Garde, Ph.D., associate professor of chemical and biological engineering, oversees the scientific accuracy of the show. Garde thinks the Molecularium project is a long-overdue way of bringing excitement to the study of atoms and molecules – which, after all, are the building blocks of everything in our world.

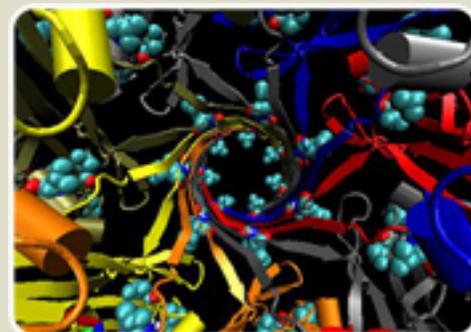
"Galaxies, to me, are too far away and I don't think about them every day," says Garde. "I drink water every day. Wouldn't it be fun to jump into it at the molecular level and see what it looks like?"



Linda Schadler, professor of materials science and engineering at Rensselaer and executive producer of the MoleculariumSM project.
(Photo by Mark McCarty)



Shekhar Garde, Ph.D., associate professor of chemical and biological engineering, oversees the scientific accuracy of the show.
(Photo by Mark McCarty)



Close-up of a protein molecule (alpha-hemolysin) — a sample piece of artwork used in the animation process for the MoleculariumSM project. ©2004 RPI

To do that, Schadler, Garde and other colleagues first implemented the MoleculariumSM project in 2002, with a seven-minute visual presentation on molecules they liken to “line drawings.” It may have been a little primitive technically, but, says Schadler, young students were “learning a tremendous amount” from the show. Encouraged, the Molecularium project team applied for, and received this spring, a \$660,000 National Science Foundation supplemental grant to the NSEC to take the project to a new level, by funding the production of the shows and a projection system for the planetarium-dome format.

To direct the show, Rensselaer hired Vishwanath Bush of the New York City-based experience design firm Tektraxadex. The company recently formed an offshoot production company called Nanotoons, which is “dedicated to the creation of a nanoscale cartooniverse,” according to Bush.

Bush – whose previous credits include “Sonic-Vision,” an animated musical show for the American Museum of Natural History – is now completing the “Riding Snowflakes” show along with his co-writer and producer, Kurt Przybilla, and a crew numbering about 25 people, including animators, artists, composers, engineers, Rensselaer graduate and undergraduate students, and faculty.

A Molecular Journey

So what will students see when they view the “Riding Snowflakes” show? The show follows a cast of characters, based on atoms, as they move throughout the universe from the perspective of a magical ship, also called the Molecularium. The ship can view matter on both the human and molecular levels. At first, a character representing an oxygen atom (“Oxy”) meets two hydrogen atoms (“Hydro” and “Hydra”), and teaches them to use the ship. “She’s taking them on their first lesson on how to fly the ship,” says Bush.

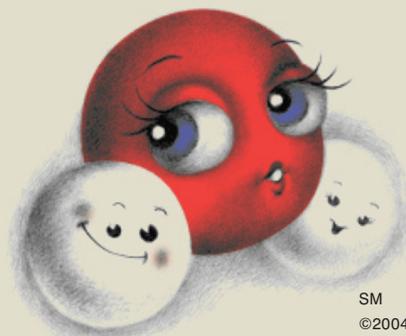
The atoms, who combine to form a water molecule, descend to earth and ride snowflakes, flying around and through them. As a snowflake melts and becomes a raindrop, the Molecularium voyages inside it, where the characters greet their fellow water molecules.

More adventures quickly ensue: The Molecularium voyages to another galaxy, returns to Earth with the steering help of a lonely carbon atom (“Carbón”) seeking life forms, rides a polymer roller-coaster, and explores the objects in a kid’s pocket, from a penny to a stick of gum. The adventure concludes with a “DNA ride” as the characters discover the secret of life. All this in a mere 19 minutes.

“It’s very fast-paced, it’s got a very light touch, and it’s very light-hearted,” says Bush. “Even if the kids don’t come out having memorized everything they learned in the show, it should definitely spark their interest about the topic. If we can do that, then it will be a life-long gift that we can give to these kids.”

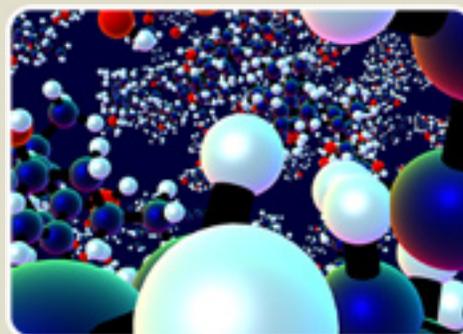
The show will be viewed in places like the Junior Museum in Troy, N.Y., and other digital-dome theaters both large and small throughout the country. A sneak-preview clip was shown in Washington, D.C., in June, on Capitol Hill as part of the Coalition for National Science Funding’s 10th annual science fair for politicians. The screenings will work in conjunction with additional learning materials for young students: Activities, written materials and quizzes, to reinforce the ideas presented in the show.

“The overall goal is to create an immersive environment for elementary school children to learn about molecular science and materials,” says Schadler. A typical school group venturing into the planetarium might spend an hour, all told, learning how the world works at the atomic scale. The topics are tied to the New York state curriculum for primary schools — which does not specify that students must learn about atoms and molecules, but requires them to learn about states of matter, starting in the first grade.



SM
©2004 RPI

MoleculariumSM project characters “Oxy”, “Hydro”, and “Hydra” form a water molecule.



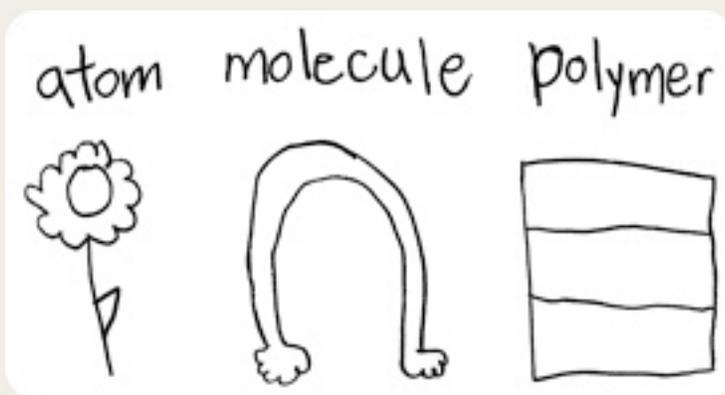
Sample animation frame from the “Riding Snowflakes” show. ©2004 RPI

“The technology we are using to coordinate talents both on and off campus is an exciting story on its own, but we didn’t stop there,” says Garde. “By merging technology with art, education, and community, we are developing a teaching tool that explores molecular science in a way that can be understood and enjoyed by people of all ages.”

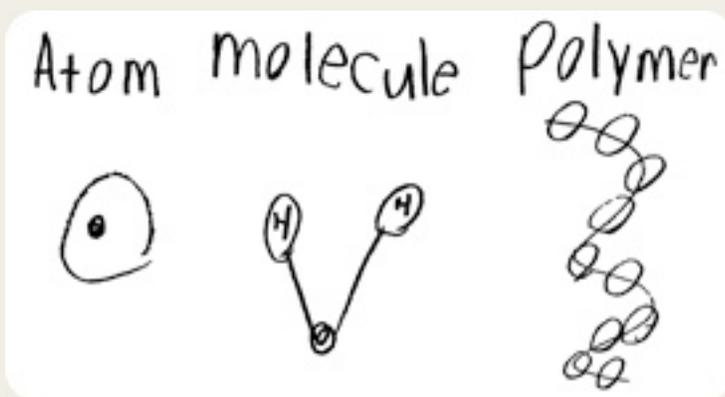
It is also no coincidence that the MoleculariumSM project has been a Rensselaer effort, since it stems from one of the university’s strengths. The project is an outgrowth of the extensive educational and outreach program of Rensselaer’s Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures – one of the original six such nanotechnology centers in the U.S. funded by the NSF in 2001.

For his part, Bush says he is impressed by how easily he has managed to coordinate his own creative work with the scientists from Rensselaer. “Basically anything we want, we can get it in five minutes,” says Bush. “For all of the molecular and scientific information, I can make a phone call and I have it on my desk in five minutes ... It’s a great resource for the project.”

And while the MoleculariumSM project has been some time in the making for Schadler, it could help turn young students into scientists of the future. After all, as Schadler says, when she “envisioned using a planetarium to teach about atoms and molecules, it just clicked with me. I’m a very visual person, and I learn visually.” Now schoolkids will be able to learn visually as well – and have another reason to make those field trips to planetariums.



Before the “Riding Snowflakes” show (pre-test)



After the “Riding Snowflakes” show (post-test)

Assessment: When asked to draw an atom, a molecule, and a polymer, and asked about states of matter, children’s understanding, based on quantitative assessment, tripled.