



## SciFair: Game Worlds for Learning

Cornell Theory Center, Cornell University

### What is it?

In 1998, Cornell University's Cornell Theory Center (CTC) for high-performance computing and interdisciplinary research founded SciCentr, an online museum of 3D virtual worlds containing interactive exhibits employing research conducted at Cornell on such subjects as the evolution of stars, the physics of helicopter flight, the volatility of stock markets, and the bioengineering of crops. SciCentr's virtual exhibition environments—3D, multiuser online chat worlds—were developed to engage young people in science, technology, engineering, and mathematics (STEM) subjects. The environments are currently in use as teaching aids in K–12 science classes. In 2001, the CTC began an outreach program called SciFair that matched 15 middle school students at Tioga County's Spender-Van Etten Central School with Cornell student mentors, who helped the teens build their own virtual knowledge spaces combining science exhibitions with game interactions. A portion of the online SciCentr museum was dubbed SciFair and set aside for the display of these student-developed virtual worlds.

Supported by funding from Cornell's Office of the Provost and from the GE Foundation, the SciFair outreach program has grown to involve more than 1,000 students and teachers annually from schools in Washington, California, Virginia, and New York. SciFair students create alien landscapes, medieval fortresses, and rainforests, filled with information presented in interactive formats. As they build their simulations, middle school students first master the medium, then take ownership of their own worlds, and finally work in teams to design, build, and present virtual science communication exhibits that represent a new collaborative way of organizing, presenting, and sharing knowledge.

Face-to-face and avatar-to-avatar showcase events allow students to demonstrate their team projects to school superintendents, families, friends, and peers. For example, middle school students have been asked to construct their own virtual greenhouses inside the GeneDome, a SciCentr virtual laboratory developed by Cornell researchers and CTC staffers to demonstrate Mendelian laws. Because students are focused on the enjoyment they derive from this creative exercise, they pick up a strong understanding of the research issues surrounding hydroponics without realizing how much solid research and patterns of scientific communication they are absorbing in the process.

### What problem does it solve?

The SciFair's core value as a 3D multiuser, chat-enabled virtual environment lies in its capacity to unite participants in an immersive, meaningful, and highly social context for shared exploration. A great deal has been written about the learning styles of today's students, with study patterns shaped by their immersion in massively multiplayer 3D gaming worlds. Efforts such as the SciFair outreach program use these emerging technologies to deliver instruction to a population of young people who are already fluent in multimedia and in simulation-based virtual settings. These same youngsters generally prefer communal learning approaches in which instructional experiences are co-designed, personalized, and situated in the context of a collaborative community that balances guided mentoring with hands-on experimentation.

### Science museum and science fair as familiar metaphors

Many faculty members find it difficult to shift toward immersive and interactive modes of instruction, particularly when the skills involved in designing and implementing educational simulations lie outside their own experiences. The science museum and the science fair, two long-standing models for effective public outreach and student engagement, provide the CTC with familiar metaphors that help carry teachers and students beyond their immediate comfort zones into the virtual realm.

For example, adopting the metaphor of the interactive science museum, Cornell undergraduates, graduate students, and staff members have designed virtual planetariums and laboratory settings. Visitors to the SciCentr virtual museum, for instance, can enter the Skyview world where they wander under a night sky, proceed through a series of information spaces linked to online information about star formation, and demonstrate their knowledge of astronomy to make their way successfully to the observatory, where they can chat with the avatar of a Cornell astrophysicist and enjoy a changing roster of shows. Insofar as these interactive worlds replicate tried-and-true process models for informal learning (the science fair, the Exploratorium, the observatory, the lab), they allow students to learn and to practice new skills within a meaningful context. Researchers refer to this principle as *situated cognition* and have demonstrated its effectiveness in many studies over the past 15 years.

## Students engaged in game design

As Richard Van Eck observed in his recent *EDUCAUSE Review* article on digital game-based learning, educators generally “adopt three approaches for integrating games into the learning process: have students build games from scratch; have educators and/or developers build educational games from scratch to teach students; and integrate commercial off-the-shelf games into the classroom.” SciFair aspires to be a combination of all three approaches by providing a commercial software program for simple, customized world creation, along with teams of trainers and an enabling infrastructure to support the collaborative design efforts of Cornell students, CTC staff, middle school students, and their teachers.

For teens with more advanced skills, virtual worlds are a medium that allows them to thoughtfully combine digital slide presentations, graphics, and sounds in exciting new ways to represent ideas and information. Some rise to the challenge of modeling their own custom 3D objects and writing plugins (bots) that support custom game features. Undergraduate mentors learn to communicate clearly and coach successfully online using multiple frameworks, from electronic discussion lists to e-mail and instant messaging. They also learn to work in a shared file system with Internet servers. Teachers and coaches expand their computing and graphics skills during training and begin to think about ways to apply this new medium to specific content areas. They, too, learn to maintain regular online communication through a variety of modes and get a glimpse of the inner workings of the computing network at their schools.

## How did they do it?

For its technical platform, SciFair currently uses Active Worlds, a Web-based commercial software application with an integrated chat feature that allows users without programming skills to create 3D interactive worlds with relative ease. Currently, Cornell hosts 80 virtual worlds created for the SciCentr and SciFair programs. For distribution and community-building purposes, Cornell licenses two virtual worlds within the Active Worlds Educational Universe, which charges educators an annual subscription fee based on the size of the virtual world, the number of simultaneous users, the number of student licenses required, and the kind of custom development services requested. Committed to providing educational opportunities that serve the next generation of computational scientists and engineers, the CTC is also examining other technological platforms that promise to expand the range of world-creation activities and interactive learning opportunities available to students and educators.

The content included in the SciCentr’s interactive exhibits is aligned to national and state learning standards for those school districts participating in the CTC’s SciFair outreach program. The challenge is to design worlds that require students to think critically and creatively, work as teams when called on to do so, and reflect on what they have seen, done, and accomplished.

Success will also depend on systematic training for district teachers who must learn to see the educational possibilities inherent in the new medium. The design of such interactive content is costly in terms of human resources and will benefit in future from further collaborations that cut across institutional and disciplinary boundaries.

## Why is it noteworthy?

- **Student engagement and interaction:** The SciFair venture follows a classically constructivist educational approach that emphasizes hands-on, team-based experimentation along with student investment in the learning process.
- **Curricular alignment:** The SciFair outreach program asks both educators and students to develop interactive exhibits that align appropriately with state and national curriculum standards, offering learners a creative way of reflecting on required STEM studies.
- **Familiar framework:** Based on the concept of a traditional science fair, the CTC process model for the team-based creation of 3D information spaces helps faculty embrace unfamiliar instructional approaches.

### To learn more

Visit the SciCentr Web site at <http://www.scicentr.org/>

### To share your innovation

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