

# Robert Amme: A new dimension in distance learning

When instructors from the University of Denver's Department of Physics and Astronomy were looking to expand distance-learning capabilities, they discovered an online resource that appealed to the younger generations that have grown up using computers. The resource, known as Second Life, allows a user to craft a 3-D virtual world where characters can be made to conduct experiments or climb mountains, among other things.

Available publicly since 2003, Second Life is the creation of Linden Lab and can be found online at <<http://secondlife.com>>. About 14 million people have visited or participated in the resource since its inception, according to Prof. Robert Amme, a physicist and the director of the University of Denver's Environmental Materials

Laboratory. Amme and his associate, Jeff Corbin, led the effort in 2006 to bring Second Life to the university.

About 10 000 students attend the University of Denver, half of whom are at the graduate level and the other half

*The University of Denver is taking advantage of an online, 3-D, virtual world, where distance-learning students use their computers to conduct experiments and learn about nuclear technology.*



**Amme:** "Second Life is a virtual digital world where you can build anything that your heart desires."

at the undergraduate level. Although no courses in nuclear engineering are offered, a division called University College has five different master's degree programs in applied science that are specifically aimed at environmental management. A sixth program is now being implemented that will emphasize the preparation and interpretation of environmental impact statements (EIS) as they relate to projects involving nuclear materials. Twelve courses make up the new program, four of which pertain to nuclear-related issues—nuclear waste management, ionizing radiation and its biological effects, nuclear power plant

operations, and transportation of hazardous wastes.

Amme, who said that Second Life has "tremendous potential" as a distance-learning tool, discussed the technology with Rick Michal, *NV* senior editor.

## *What is Second Life?*

Second Life is a virtual digital world where you can build anything that your heart desires. In the lingo of Linden Lab, the company that created it, this virtual world is in part composed of "islands." One island corresponds to the computing power of one-fourth of a major Class 5 server. To construct a building on an island, for example, a software program is written to create it. The building, and everything else in Second Life, appears in a three-dimension-

al virtual reality. The user creates his or her own personal character—called an avatar in computer-game language—which visits the places that have been created and interacts with the environment and with other avatars on the island. It's as though the user were actually there, walking into a virtual building, entering an auditorium, and taking a seat for a lecture.

## *How did you learn about Second Life?*

The University of Denver became in-

involved about two years ago when we started investigating Second Life as a possible tool for distance learning. Then about a year ago, the Nuclear Regulatory Commission announced that it was looking for institutions that could provide a curriculum that would train people on the subject of environmental impact assessments and environmental impact statements (EIS) with a nuclear component. People who get into that line of work must be broadly trained. An environmental impact assessment deals with geography,

land resources, cultural resources, air and water quality, geology, ecology, and transportation. It could also deal with hazardous waste transportation. In addition, there are public occupational health and safety concerns, such as environmental restoration,

and an Internet hookup with adequate bandwidth capabilities, he or she can interact with the apparatus and with other avatars who are attempting to learn or do the same experiments. The instructor can go in as an avatar and have discourse with the student

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waste management, and many other issues, that could be part of a project’s plan. Any number of slip-ups in the environmental impact developments could squelch an entire project if the NRC and the Environmental Protection Agency aren’t satisfied.

*So Second Life became a teaching tool for you?*

It will be. Our first classes using Second Life will begin this fall. We wrote a proposal on how we could use Second Life for education in distance learning. The NRC liked our idea, and so now we have a curriculum design that is funded by the NRC and is offered online. We have a dozen courses for students seeking a master’s degree in applied science emphasizing EISs. The students can take the courses locally, but the vast majority will take them online. The novel thing about Second Life is that it allows, I think for the first time, a very realistic environment in which students can do radiation experiments as well as tour virtual facilities interactively, from uranium mines to waste disposal sites.

Most physics courses have associated laboratory requirements, at least locally at the university, and students who are seeking a degree in physics are required to do lab work. We thought that one of the best ways for distance-learning students to learn about ionizing radiation and nuclear physics was to use Second Life labs. Students who are entrepreneurial enough to want to make their own avatars will be able to actually do their experiments in the virtual world, almost as though they were here on campus.

*How does an avatar conduct research in a virtual lab?*

We have created an island in Second Life that has laboratories that avatars can use to conduct experiments. A student can be sitting at home or be halfway around the world, but as long as there is a computer

avatars and demonstrate how the lab work is to be done.

We have five different experiments that are nearly complete now in Second Life. Their purpose is to demonstrate the basic physics of ionizing radiation. Students learn about neutrons, protons, alpha particles, gamma rays, and beta

rays. They measure beta- and gamma-ray spectra in the laboratory. Of course, for all five measurements and the data from those measurements, we have already done them in a real laboratory, and then we have translated the results into a virtual lab. To my knowledge, this is the first time that anyone has tried teaching physics, let alone nuclear physics, in an instructional pseudo-classroom environment.

*What are some of the experiments that will be conducted in the virtual lab?*

There is a radiation absorption experiment. There is also a virtual neutron howitzer containing a plutonium/beryllium source for neutron production that is used to activate foils of heavy metals. The foils become radioactive and undergo decay at a rate such that the avatars can follow the decay rates with a Geiger-Müller counter, and thus determine the half-lives. In particular, they employ silver and indium foils that have been neutron-activated. There are also experiments on the absorption of beta and gamma rays by shielding materials such as lead and aluminum. A virtual gamma-ray spectrometer with a solid-state particle detector also allows the determination of the gamma-ray spectra for a half-dozen radioisotopes.

*What other uses are you getting from Second Life?*

In addition to the laboratory work, we want to make it possible for students who are training in nuclear power to actually visit, as part of our curriculum, a virtual nuclear plant. This can be done right now. Our plant is not quite complete, but a good share of it is now finished. The reactor

itself is complete. The generators and the turbines are installed. The buildings are all there in place. All that’s missing is the central control room.

*Did you create a nuclear plant from scratch?*

No, we sort of had a blueprint to build one. It came to our attention that Areva had produced a cardboard kit of a nuclear plant. The kit is about 44 inches wide and has about 3000 pieces, and it’s really remarkable. A kit has been assembled by one of our students, and it resembles, very accurately,



Corbin

what Areva’s actual 1600-MWe pressurized water reactor plant at Olkiluoto, in Finland, will look like when it’s complete. A booklet that came with the kit told us many of the details. In some cases there were photographs, but in others there were just artistic drawings or schematic renditions of what various components will look like. Using that, we were able to write software to construct the reactor for Second Life. My associate, Jeffrey Corbin, did some of the build. A lot of the intricacies in design were farmed out to Aimee Weber Studios, a firm that specializes in that sort of thing and is still working on some of the plant. I should point out that some areas of the plant may not be detailed for security reasons.

*Are you planning to build anything else for teaching purposes?*

We’ve thought about building a second reactor, which would be a research reactor, such as the TRIGA (Training, Research, Isotopes, General Atomics). There are fewer safeguards that need to be observed compared with a commercial nuclear power plant. The research reactor is perceived to be less vulnerable to terrorist attack than a commercial reactor. We also expect to con-

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*Continued*

*Can anyone with a computer and an Internet connection gain access to your island and the facilities that you created there?*

Yes. There are ways to limit the visits, but we have not made an effort to do that. A few minor things have happened by visitors, but nothing serious. We actually have three islands, and on one of them, avatars can climb to the top of the virtual Mount Evans, in Colorado, where there is a virtual telescope that can be used for astronomical viewing. We went in one day and found that some avatar had left an empty pizza box on a lab table in the observatory. It was easy to remove, because anything in the virtual world can be repaired. Even if damage is done, we have the original images stored so we can bring them back up online without difficulty.

*Are you aware of other institutions using Second Life for learning purposes?*

Yes, there is a whole “archipelago” of islands called SciLands. There are now about 50 islands making up SciLands, all dedicated to science learning. Some of them are informal, where the avatar can walk through a display such as that created by the Exploratorium in San Francisco. Others include the National Oceanic and Atmospheric Administration, which has two or three islands. The Jet Propulsion Laboratory has islands, as well as NASA and the International Spaceflight Museum. All of the SciLands are located in the same general area, and the avatar can fly from one island to the next, or be teleported, or can walk.

*What is the cost of using Second Life?*

There is no cost for the avatar, but there is a \$150 monthly fee for the island builder, which covers the advancements made to the virtual world. For example, the avatars were recently equipped with lip motion so that their mouths move in conjunction with the spoken words. Part of the monthly fee goes to server maintenance. There’s also the cost of newer and faster servers, and the upgrades in quality of service. And right up front there is the purchase price of an island. About six acres of virtual land can be purchased by a nonprofit entity such as the University of Denver for less than \$1000. We have three islands, which include the labs, the nuclear plant, and other virtual sites, and so we have about a \$3000 capital investment. We own them, which is to say that we own that percentage of a major computer server. Once you have created your avatar (you have to download some Second Life software to do that) you can visit any island absolutely free. The builders—that’s us—have met all those costs.

*Is it easy to navigate on an island once an avatar has been created?*

Where people often get discouraged is when they try to manipulate their avatar. There is an introductory program that Second Life provides. Basically it’s the up-

down, left-right, and a couple of other keys on the computer keyboard that control the avatar’s movements. People say it takes a few hours to develop the skill to move with precision. Moving your head, arms, feet, sitting down—it all needs to be learned. And while sitting down is quite easy, peo-

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ple still need to know how it’s done. So there is a little training that goes into it. For SciLands, we have our own training island.

*How many students do you have that will take advantage of Second Life?*

The new degree program is to begin in the fall. Many adult learners are fully employed, which makes online coursework particularly attractive since they can set their own hours for study, and the labs in Second Life are available 24/7. Even different time zones are not a problem. In our other online master’s degree programs, we have approximately 250 students enrolled at various levels, and 80 percent of them are distance learners.

*Do you think your students will be eager to use Second Life as a learning tool?*

I think so. Assessing these activities will be a major undertaking, and relatively little has been done in this regard by other institutions. But we do know that computer games have proven to be quite popular and have now been around for a couple of decades. In a sense, our avatar student participants will feel the similarity.

*Is yours the only university that is using Second Life for nuclear teaching?*

As far as we know, no one is teaching course work in nuclear science or engineering using Second Life. One of the first things we discovered was that Harvard Law School had a presence in Second Life. Also, Prof. Mary Ann Clark, at Texas Wesleyan, teaches cell biology on her “Genome” island and uses it for in-house students as well as for distance learning. She is using it to see if she can generate more interest and enthusiasm in the laboratory environment. Using Second Life for formal education is fairly new to all of us, and so there is very little as yet by way of assessment. **■**

*See photos on following page →*

## Getting a Second Life

Signing up for an account in Second Life and creating a character known as an avatar can be done by visiting the SciLands home page at <<http://scilands.org>>.

SciLands is a part of the 3-D virtual world in Second Life created by scientific institutions such as the University of Denver (DU), the Space Studies Institute, and the United Kingdom’s National Physical Laboratory, among many others.

Once at the SciLands home page, click on the orange Register button and fill out the information fields for signing up for Second Life. When done, a direct link will open a page for downloading Second Life’s viewer software.

With the viewer software downloaded and executed, an avatar will need to be created in order to be transported to SciLands’ Initiation Island. The island has instructional signs that explain how to do some basic things in Second Life such as maneuvering.

Near the fountain at the end of the walkway on Initiation Island are some landmarks that direct avatars to places that provide more in-depth training, such as the Ivory Tower of Prims, where structure-building skills can be learned.

The University of Denver’s Science School island, which is southwest of Initiation Island, can be accessed by finding the University of Denver logo on the ground at Initiation Island and clicking on it. Second Life will then transport your avatar to Science School.

Yet another Science School island—Science School II, located directly west of Initiation Island—is where DU’s nuclear power plant is located. The nuclear plant’s buildings, such as the reactor containment and the turbine building, can be entered simply by flying through the roofs of the structures.

Good luck, avatars, and enjoy the journey!—R.M.

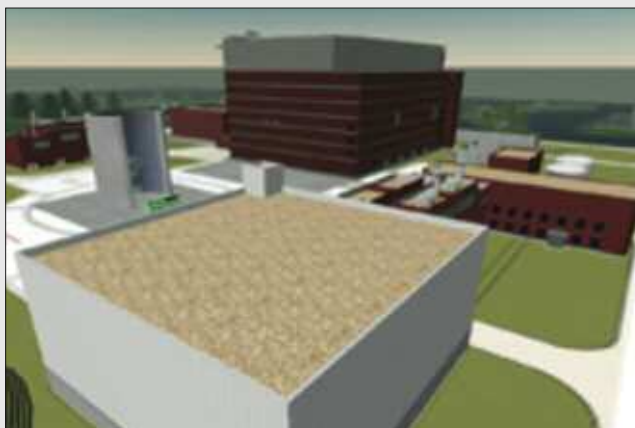
# University of Denver creations in Second Life

Some of the graphics below are taken from DU's virtual lab, where students will soon be able to conduct experiments that have been replicated from existing experiments in the university's real-world lab. In addition, the pair of graphics on the bottom right depicts a virtual nuclear power plant.

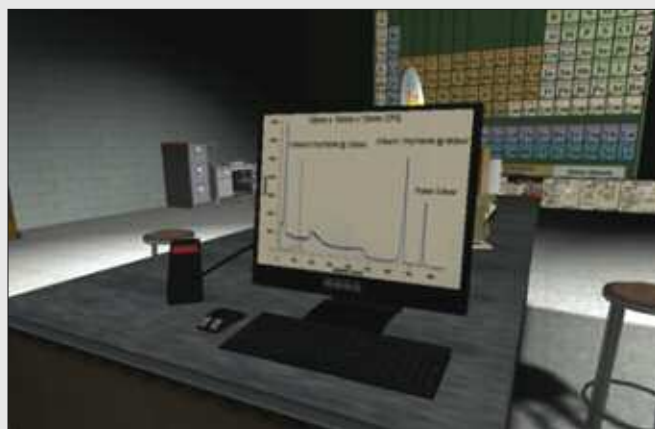
**Right:** A beta spectrometer is connected to a Geiger-Müller tube cabled to a Geiger counter, which includes a power switch, a tube voltage setting, and settings for counts and time. In experiments, the radioactive sources (thallium-204 and strontium-90) are measured 0 to 90 degrees clockwise and counterclockwise in 10-degree increments. The student then collects the data to be graphed. Results demonstrate that nuclear beta decay produces a wide spectrum of particle energies (unlike alpha decay). The inset is a clearer view of the Geiger counter.



**Left:** An avatar peeks in on a holder that has eight slots for lead or aluminum plates (or aluminum foils) and uses cobalt-60 or Sr-90 for experiments that demonstrate the levels of absorption, measured by the Geiger-Müller tube connected to the Geiger counter. The student inserts one plate at a time, making a measurement from each. Results are then plotted, and the slope yields a value for the absorption coefficient for each case. Statistical errors, such as Poisson distribution, are to be considered during the experiments. The inset is a clearer view of the holder.



**▲ Above and Below:** One of DU's islands is devoted to a replica of Areva-Siemens' Olkiluoto-3, a European Pressurized water Reactor, in Finland, that in real life is to be completed in 2010. In Second Life, the plant is about half completed. ▼



**▲ Above:** A virtual "iGEM" portable gamma-ray spectrometer, based on the actual item made by eV Products, is used for recording gamma-ray spectra for six radioisotopes onto a laptop. A degraded spectrum from the same group is provided and is to be compared with the six known spectra for identification. In addition, the student is to calibrate the gamma spectra given several emission peaks, from channel number to energy (keV), as well as to look for pair annihilation emission. The spectrometer employs a CZT (cadmium/zinc/tellurium) solid-state detector operating at room temperature, with good sensitivity and resolution.

