Public Interest Report

THE FEDERATION OF AMERICAN SCIENTISTS Volume 60, Number 4 Fall 2007

2 President's Message
3 Become a Member and Support FAS
4 FAS Explores Virtual Worlds for Learning
5 FAS in Second Life
8 *Immune Attack:* Learning Science & Games
10 Dual Use Research
11 Building Project Uses Online Tool for Building Inspectors
12 Digital Promise Moves Forward
14 Obituary – Wolfgang K.H. Panofsky
15 Series of Essays as Timely Today as in 1947

VIRTUAL WORLDS

FAS, in partnership with the Kauffman Foundation, is working to build a consortium to jump-start a market in education that will leverage social networking sites and the 3D Internet. This multi-organizational initiative will create an online environment that will further the goal of using virtual worlds effectively for research, education and training.
More on page 4.

FAS IN SECOND LIFE

FAS is recreating its learning game, Discover Babylon, in Second Life to virtually develop aspects of Mesopotamia. This 3D collaborative learning environment will let communities of scholars such as archeologists, architects, scientists, educators, and artists to share knowledge and expertise from a diversity of sources.
More on page 5.

IMMUNE ATTACK

Immune Attack introduces basic concepts of human immunology to high school and entry college students. Designed to supplement textbook lessons, IA excites students about the subject while illuminating general principles of immunology.
More on page 8.

About FAS

The Federation of American Scientists (FAS), founded on 8 December 1945 as the Federation of Atomic Scientists by Manhattan Project scientists, works to ensure that advances in science are used to build a secure, rewarding, environmentally sustainable future for all people by conducting research and advocacy on science public policy issues. Current weapons nonproliferation issues range from nuclear disarmament to biological and chemical weapons control to monitoring conventional arms sales and space policy. FAS also promotes learning technologies and limits on government secrecy. FAS is a tax-exempt, tax-deductible 501(c)(3) organization.

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PRESIDENT'S MESSAGE

New Communications Technologies Will Create a New World Order

While this newsletter is mailed out to FAS members, more than 300 times as many people will read it using a web browser. As traditional print and video formats lose market share – particularly with younger scientists and engineers – FAS has worked hard to make effective use of new tools ranging from blogging to complex online simulations. Reporters working for newspapers or television networks make heavy use of these FAS resources, which creates a channel to reach a broad international audience directly. FAS was one of the first non-governmental organizations to have a website. Steve Aftergood was blogging before the word "blog" was coined. FAS remains today a powerful presence in these new media.

But while we're celebrating the cost reduction to reach large numbers of people with these new media, it turns out this is only a very small part of the story. Powerful graphics, animations, and simulations introduce an entirely new dimension to convey complex concepts with greater clarity and efficiency. In many cases, innovations for conveying information recapture much of the fun inherent in the most ancient forms of learning – playing around with stuff, building things and trying them out, imitating the skills of experts and asking them for their help.

Virtual experience is not an exact substitute for experiments with natural phenomena, exposure to the great works of art, or visits to great historic, geographic, or environmental sites. But there is no practical way to deliver these experiences to the billions of people who could benefit from them without using new information tools. Simulations also allow us to experience phenomena and ideas on any physical level or any place in history. The conversations, collaborations, and trust created in the virtual spaces, of course, are very real.

An unexpected additional dimension has opened recently as practical tools become available for collaborating in the production and review of information available online. Wiki-tools for collaborative production and review are an increasingly familiar and convenient source of information – though solutions to the many problems raised by these techniques are still highly experimental. Technologies now rapidly entering the market are creating even more intriguing opportunities. Online collaborators can build complex 3D models and simulations to represent an ancient city, a functioning cell, or a virtual laboratory for exotic physics experiments. Building, reviewing, and using these tools in a way that ensures continuous review and improvement will not be easy. But success could transform the way knowledge from diverse sources is combined and communicated.

FAS has approached the challenge in several ways. First we've worked with Congress to invest in a national research and development effort to understand which technologies work and which do not. Second, FAS developed a series of new instructional systems for different groups of learners in diverse subject areas. We've learned a lot – including a long list of things we don't know. Third, we're moving away from the "go into a back room and build it" strategy for producing IT-based learning tools to create an environment where tools can be built and tested by collaborators worldwide. Specifically, FAS is working to build a community of academic, business, and government groups interested in collaborating on the construction and use of persistent online

3D worlds to be used for learning. And finally, FAS is using a number of these innovative tools in its own work.

We are, for example, exploring ways to use new online tools to help Americans understand the paradoxes inherent in the current U.S. nuclear posture and explore the implications of a major change – including deep reductions or the elimination of nuclear weapons. Our biosecurity project developed a powerful set of multimedia courses to emphasize the dangers inherent in dual use technology to research biologists without the usual kind of pedantry used in "you must listen to this" directives. The FAS building group will use simulations and animations to help builders and building inspectors understand how to create structures that are safer and dramatically more energy efficient.

This issue of the PIR will explore the use of these new communication technologies from many different perspectives. We hope it stimulates you to join the conversation. **FAS**

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FAS Explores Virtual Worlds for Learning

By Bruce C. Milligan, Learning Technologies Project Manager

According to legend, more than 2,000 years ago the great Chinese philosopher Confucius was the first person to found a private school in China. Were Confucius to walk into a classroom today, he would soon identify the room for its purpose, as – save a few gadgets and electrical lighting – today's classroom shares more similarities with that of Confucius than it has differences. Technology has made rapid and meaningful advances in many fields, but we still teach our children in essentially the same manner we did over 2,000 years ago. It is time for education to catch up, and emerging virtual world technologies may provide a powerful accelerant.

During its experience using electronic media and the Internet as learning tools, the Federation of American Scientists became increasingly interested in "virtual worlds" and this technology's potential to ease the problems of collaborative development and distribution. FAS, in partnership with the Kauffman Foundation, is working to build a consortium to jump-start a market in education that will leverage the creativity and energy powering social networking sites and the 3D Internet. This multi-organizational, interdisciplinary initiative will create an online environment that will further the goal of using virtual worlds effectively for research, education and training. This project relies on cooperation between a diverse group of partners and the use of common software across the spectrum of potential online platforms.

A virtual world is a computer-based environment in which users appear to one another in the form of avatars (3-D representations of human beings, or other entities) and communicate in various ways, including text chat, instant message, and with natural speech. Initially begun as online game and chat environments only, virtual worlds are increasingly perceived as ideal online venues for education and training for a wide variety of purposes, from military and medical training to middle school education.

To explore the educational use of these environments, we began to generate a comprehensive survey of all existing virtual worlds and related tools, both to further the knowledge that will result from this study, but also to help FAS and its partners assess which of the many available choices is most suitable to learning and training. To support this initiative, and to encourage the public to become active partners as well, FAS created a wiki site intended to serve as a compendium of virtual worlds and related sites. This site identifies and profiles virtual worlds, includes virtual world tools and news links, and provides an opportunity for people interested in the Internet and its educational potential to comment and participate.

Visitors to the FAS virtual worlds initiative site are encouraged to not only review the information they find, but also to add to and to edit content when it's deemed necessary. The site also includes a link to a white paper written by FAS president Henry Kelly, which offers a description of this virtual worlds initiative and a discussion of the criteria being used to evaluate virtual worlds.

FAS is also engaged in using existing platforms to develop a three-dimensional, interactive online learning environment, beginning with a popular virtual world, *Second Life*. *Second Life* is a 3D online virtual world with more than a million users. This work is truly just the beginning of an exciting and critically important, revolution in education — one which will have long-ranging effects across the spectrum of training and education.

To learn more about the FAS virtual worlds initiative, please visit www.fas.org/programs/ltp. **FAS**

FAS in Second Life

By Sachin Patil, Learning Technology Project Research Associate

The last couple decades have seen vast innovations in the delivery of information over networks and to the interaction between computers and humans. Educational theorists and computer programmers strived to develop various commercial and non-commercial interfaces and techniques to promote interaction.

Much of the innovation in educational technology has focused on specific delivery methods. Some used learning management systems to organize electronic text materials. Others used multimedia to create animated and interactive online tutorials. A few tried to develop natural language question answering. And then there were gamers who created highly interactive role-playing games and immersive training simulations.

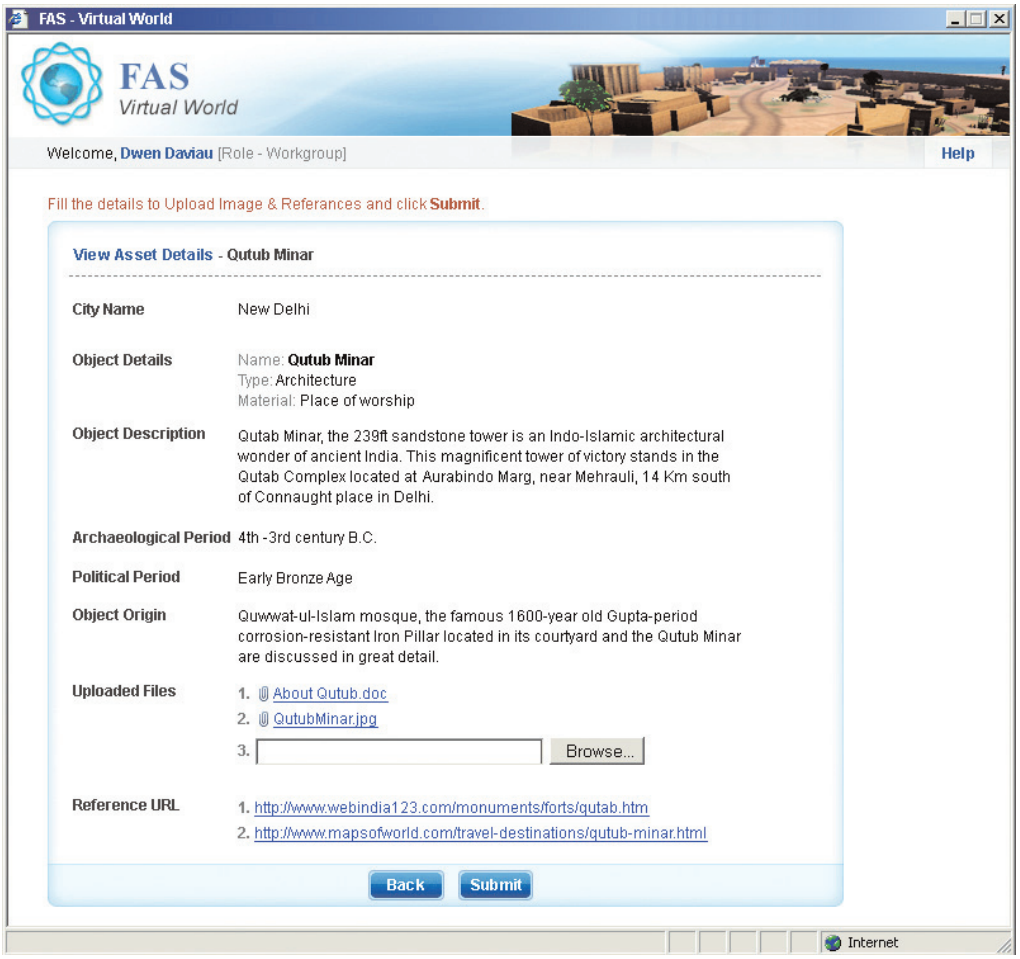
Each of these techniques is an effective instruction tool when used in the appropriate context. But these developments also called attention to the lack of seamlessness – the inability to blend interfaces. To maximize an individual's learning experience, a new platform would need to combine communication technologies and collaboration interfaces with 3D authoring tools. This learning environment would embrace instant messaging, email, file transfer, voice chat, discussion boards and shared workspaces, and game engines, multimedia tools, and content authoring tools.

Virtual World technologies in their present state possess promising potential to meet these expectations.

Virtual World technologies have been around for a while in two forms. Massively Multiplayer Online Games (MMOG) like *World of Warcraft,* and Massively Multiplayer Online Environments (MMOE) like *Active Worlds* are considered to be tools for game playing or social networking, respectively. The arrival of *Second Life* (SL) attracted major media attention and many users.

See FAS in ***Second Life****, p. 6*

Screenshot of the virtual learning project FAS has created in Second Life.



Screenshot of the web-integrated tool that facilitates knowleldge sharing and creation in virtual worlds.

***FAS in Second Life**, from p. 5*

SL provides social networking, a large, connected virtual landscape, a relatively easy to use building editor, and the ability to create and sell virtual objects.

A Virtual World like *Second Life* (SL) provides features to meet the needs of a generation of digital natives, that is learners who have grown up with computers and consider the Internet to be a primary source of knowledge. SL offers a fast and inexpensive method to create a realistic and engaging simulation experience through traditional real-time virtual reality walkthroughs or pre-rendered movies. Equal importance is given to the users' ability to interact, become immersed, and receive information. The platform encourages the formation of communities, facilitates meaningful conversations and negotiations with peers, and provides a virtual space for users to learn activities by doing them.

With shrewd management and creative experimentation, SL, and many of its competitors seem poised to offer multi-faceted, multi-disciplinary collaborative learning environments.

FAS in *Second Life*

To explore the potential of *Second Life*, FAS is transferring materials used to create *Discover Babylon* — an educational video game about the diverse cultural contributions of ancient Mesopotamia – to virtually recreate aspects of this civilization so scholars across different disciplines may share expertise and information. This 3D collaborative learning environment will let communities of scholars such as archeologists, architects, scientists, educators, and artists to share knowledge and expertise from a diversity of sources.

Users will be able to interact with "residents" of ancient Mesopotamia, and see how they lived, in a stunning, realistic 3-D world that will provide a perspective no single book or museum collection could match. Animals and automated human avatars (also known as non-player characters) will roam through the simulated Mesopotamian cities and engage in day-to-day activities in real time. Contributors will be able to build out the environment by adding or editing content based on academic findings to create more accurate renderings of ancient sites. These simulated places and cities can eventually be used to reconstruct real-life scenarios that require higher order skills such as strategic thinking, interpretative analysis, and experimentation for problem solving.

The following hypothetical situation will better explain the future use of this collaborative online system. Specialists interested in reconstructing historical sites or events submit proposals to FAS. Upon approval, the archaeologist will work with the administrator to develop content for the new city and author non-playing animals and human avatars for specific behaviors, each loaded with routine dialogues. After construction of the environment is complete, the new area will be open to all registered SL users (the Virtual World residents). Some of these residents may create 3D objects or assets to be placed within the new city or share ideas or host live virtual events in the space. Other visitors to the 3D environment might use it to augment classroom learning.

The initial phase of this project focused on an increased comfort level with the various Virtual World technologies. The second phase, started this year, includes simulating the *Discover Babylon* environment in SL and

of evaluating other Virtual World platforms. The third phase will import the Mesopotamian prototype from *Second Life* to another Virtual World platform.

FAS will eventually create a full-scale collaborative application that will work across all Virtual Worlds – not just *Second Life*.

The next few decades will continue to introduce incredible technological innovations that improve the way people receive information and interact online. The research conducted by FAS will provide the building blocks and important feedback for the success of those virtual leaps. However successful the *Second Life* virtual ancient city proves to be for FAS, this is still a pilot project. The lessons learnt will be applied to the much larger, and far more ambitious, virtual worlds initiative as it has been conceived by FAS its partners and contributors. **FAS**

The Viability of 3D Virtual Worlds

One critical issue is the viability of 3D content created and organized for Virtual Worlds. Over the last two years, zealous interest in Virtual World technologies has prompted competitors to launch hundreds of platforms such as Multiverse, Croquet, Home, and others, each with more or less the same set of functionality. Different technologies are used to build these worlds, and as such, most do not support interoperable content.

The result of this proliferation of worlds has some drawbacks for users and content creators. For example, if you develop 3D content for one Virtual World, no direct way exists to view or interact with that content in a different virtual platform. This technological rigidity adds an uncertainty to the future use of 3D content developed for virtual worlds. The industry needs to solve this problem. Standards developed for the Web allow users to access content created by different editing packages that are saved to a server using different web browsers. The same content, for example, can be viewed via Firefox, Internet Explorer, Safari, or Opera. It is our hope that a solution can be found to enable users to access content created for 3D virtual worlds.

With thoughtful management, advances in Virtual World technologies can and will account for revolutionary changes in present day computer-human interfaces and interaction techniques in coming years.

Immune Attack: Learning Science & Games

Image 1. The initial 2D symbolic design for selecting specific macromolecules to induce transmigration.

By Adam Burrowbridge, Learning Technology Research Associate

Information technologies have transformed the way we bank, fight wars, shop and communicate, but this potential has not yet been realized in the way we teach and learn. Computer simulations are often used to convey difficult concepts or to create environments that are either too difficult or too expensive to replicate in the physical world. One immediate challenge is to accumulate evidence that games are more efficient and effective than traditional methods at teaching some classroom subjects while increasing the user's interest. The Federation of American Scientists developed the educational video game *Immune Attack* (IA) to research how gameplay can be used to communicate complex concepts in a compelling and effective way.

Immune Attack introduces basic concepts of human immunology to high school and entry-level college students. Designed to give depth and enhance textbook lessons, IA aims to excite students about the subject, while illuminating both general principles and detailed concepts of immunology. This serious game is both a simulation and a mechanism for rewarding the user's interest and achievement.

Immune Attack tackles complex subject matter in a realistic 3D environment while aligning learning objectives to standards of learning. By design, the gameplay limits the cellular interactions to those that could feasibly occur in the human body. This specification emphasizes IA's scientific accuracy and pedagogical authority. Painstaking attention to detail ensured that the simulation would accurately reflect real-world biology while maintaining the motivation intrinsic to games.

Through focus group feedback and formal evaluations, the FAS team broke ground with innovative solutions to unique challenges. While developing IA, one early challenge was to balance the immunologists' desire to present an accurate scale of objects in the game environment to enable authentic discovery-based learning. The first release of IA incorporated a three-dimensional (3D) game environment depicting the bloodstream and presented learning challenges in two-dimensional (2D) mini-games. The player needed to win these smaller challenges to master the immunological concepts necessary to succeed with the greater mission objective. While the 2D approach accurately depicted the concept, it created a visual disconnect between the 3D immersive environment and the 2D challenge. The user was forced to shift gears during play from experiential learning in an engrossing 3D discovery-based environment to a 2D symbolic representation. [See image 1]

The game was then ported to a new engine that provided an opportunity to solve technical problems and to redevelop the mini-games as 3D models. The first learning

Image 2. The first 3D design for selecting macromolecules that tackles the issue of scale.

Image 3. The current 3D environment accurately showcases the scale of the both the macromolecules and the blood cells while conveying the actions of the monocyte in game.

challenge focused on the process of transmigration, when leukocytes adhere to the endothelial lining of the blood vessel wall and migrate through the wall towards the site of infection. During the first design change, the previously 2D symbolic game was modeled accurately to scale in the immersive environment. Ligands were more than one thousand times smaller than the white blood cells they sat on. The mini-game depicted the scale of the macromolecules while also clearly presenting the overarching concept of transmigration. The redesign enhanced visualization of key concepts by virtually placing the user between a moving monocyte and the vessel wall. Through this redesign the user was now able to fully interact with 3D realistic biological entities. [See image 2]

In the latest iteration of IA, users race through the flowing bloodstream and mark the correct ligands before the monocyte passes them by. The environment was dramatically increased so the player could view both the ligands and leukocytes at full scale when in the proper perspective (up-close for the small ligands and far away to see the entire cell). The user is also equipped with a limited amount of speed bursts to be strategically used by the player to finish the game in less time. User feedback inspired the changes to IA that now place the user in the driver's seat of complex biological processes to fight infections. [See image 3]

FAS has applied a process of repeated evaluations with students and experts that has resulted in a cycle of continuous improvement. Feedback is analyzed to determine how best to translate recommendations into functional design specifications. Past evaluations have included Advance Placement biology students and teachers. Each was asked to complete pre- and post-tests that consisted of 14 questions to assess the user's interest level, difficulty with the subject matter, relevance, and attitude. The test also contained questions to measure knowledge of specific concepts addressed through gameplay. Preliminary evaluation results displayed a gain in knowledge after playing the game that could not be otherwise accounted for by school, gender, class, or gaming experience.

Exploratory research in conjunction with teachers' and students' verbal feedback has improved the design and development of IA. Design tweaks based on user data have improved IA and FAS will begin the next round of evaluation in spring 2008. More than one hundred high school teachers and entry-level college professors plan to test and implement IA in their curriculum. By increasing the sample size and refining the evaluation metrics, *Immune Attack* will continue to further our understanding of the impact of games on learning. **FAS**

Attention FAS Members

In our continuing effort to provide the FAS community with articles about national security, learning technologies and other areas of science and technology policy, we are inviting members to submit proposals for articles (maximum of 1,000 words). Selection of articles is at the discretion of the Editor and completed articles will be peer-reviewed.

Please provide us with your full mailing address, including email in all correspondence.

Proposals should be sent to:
Editor, PIR,
Federation of American Scientists
1725 DeSales Street, NW
6th Floor
Washington, DC 20036
or to mamarelo@fas.org.

Dual Use Research

By Cheryl Vos, Biosecurity Project Research Associate

Since the anthrax letter attacks in 2001, concern has grown over "dual-use research"; legitimate scientific work that could be misused to threaten public health and national security. After the attacks, the U.S. dramatically increased its biodefense research activities and budget, and therefore, naturally increased the amount of dual-use research activities. Through grants from the Carnegie Corporation of New York, the Federation of American Scientists launched a series of online case studies aimed at increasing awareness of the pitfalls of research that could potentially be used for malevolent purposes. The online *Case Studies in Dual-Use Biological Research,* profiles the experiences of scientists who have dealt with dual-use issues in their own research.

The case studies include an introductory module featuring a history of biological weapons and bioterrorism, as well as the laws, regulations, and treaties that apply to biodefense research. The rest of the case studies present individual experiments involving dual-use biology research, the public's reaction to the research, and a discussion of the implications of the work. Each case study includes a short animation to illustrate and explain the experiments that were performed and video clips from interviews with the researchers who did the work. The clips focus on discussions of the experiments, the motivation for doing them and their perspectives on dual-use research.

The topics currently focus on cases that are relevant to a range of research in the biological sciences, including synthetic biology, genetics, genomics, virology, drug delivery, molecular biology and antibiotic resistance. Each of the case studies is about 20 or 30 minutes in length, and each module exists as an independent educational unit. Because of this design, a researcher would only need to look at the modules that are most relevant to their work, instead of having to sort through bits and pieces of all of them.

In the spring of 2007 the National Science Advisory Board for Biosecurity released a series of preliminary recommendations including a strong recommendation that dual-use awareness training be made mandatory for all graduate students in the biological sciences. Our case studies are designed to easily incorporate into the responsible conduct of research training courses that the NIH requires all recipients of their grants and fellowships to complete. When we surveyed a small group of people who had used the case studies, nearly all thought that they should be used in these courses.

Advances in information technologies are adding flexibility to education and the use of multimedia engages individuals from a variety of backgrounds and skill sets. The same case study can be used to introduce a scientist to the societal implications of their work, and to teach a policy minded individual about some of the science behind dual-use issues. Because the education material is online, it is also accessible at anytime world wide. For research scientists with many responsibilities and very little time, the ability to complete required dual-use training at their convenience is very useful. In addition, dual-use research is an international issue, and our survey suggests that more than a tenth of those who use the case studies are from outside of the US.

We plan to make the *Case Studies in Dual-Use Biological Research* an integral part of the Education Center of our planned Virtual Biosecurity Center (VBC). The VBC will be a one stop shop for biosecurity news, information and education. Since information is being consumed differently today than it was even a few years ago, the VBC will focus on being flexible and adaptable to the ever-changing landscape of media consumption. We envision the VBC as a dedicated biosecurity resource that aggregates information in a convenient format and actively engages the biosecurity community. The site will have a section dedicated to daily biosecurity and public health preparedness news and will feature a daily e-mail alert that will be sent out in the mornings with the day's news, reports and happenings. The VBC will also launch wiki-style pages to discuss current topics, utilize video to draw a wide audience and create novel content in the form of solicited opinion pieces and video interviews with key players in biosecurity. The VBC will be built in partnership with the National Academies of Sciences, the American Association for the Advancement of Science and the Center for Strategic and International Studies under a grant from the Carnegie Corporation of New York. **FAS**

Building Project Uses Online Tool for Building Inspectors

By Brian Doherty, Building Technology Research Associate

To better promote and enable the use of energy efficient, advanced building systems, the FAS Building Technologies Program is developing online training and certification resources for building inspectors. This multi-media resource will further FAS's mission of mitigating climate change and advancing social justice and environmental responsibility through technology.

New standards for energy efficiency and seismic design, new incentives tied to energy audits, and innovative new building technologies allow for significant improvements in the building industry. However, the impact of these measures depends heavily on the quality of building inspections. Inspectors unable to give proper credit to new building systems can discourage innovation that could cut cost and improve quality. Multiple, complex inspections discourage homeowners from taking advantage of credits for home energy retrofits, and energy efficiency gains are not realized.

FAS will develop a three tiered online training and certification resource for new and existing inspectors. The first portion of this program will focus on educating building inspectors in energy efficiency standards, seismic standards, and advanced building systems. Multimedia tools, including simulations and animations, will make the information easily accessible and reduce the gap separating the artifice of instruction and the reality of the work actually performed by inspectors.

The second section of the project will be a certification program, requiring the inspector to correctly inspect a virtual building (or a series of virtual buildings) for energy and seismic code compliance, as well as for correct construction methods and code compliance of alternative building systems. This will assure the understanding and knowledge of building codes, as well as an ability to visually recognize code compliance. The final section of the project will train home inspectors to conduct energy efficiency audits for existing homes utilizing a similar interactive interface.

This project is currently in planning stages, but its further development demonstrates the potential of applying learning technologies to different sectors. And while this is only one example, it provides insight into how advanced learning technologies and multi-media resources can promote humanitarian progress in all fields of science and technology. **FAS**

Digital Promise Moves Forward

By Janet Hall Werner and Anne Murphy, Director of the Digital Promise Project

A Significant Step for Digital Promise

Digital Promise – championed by FAS and a national coalition of educational institutions, libraries, museums and pubic and corporate leadership – took a great leap forward as the first session of the 110th Congress wrapped up its work prior to the 2007 holidays. Speaker Nancy Pelosi, Education and Labor Committee Chair George Miller, and Reps. John Yarmuth (D-KY) and Ralph Regula (R-OH) provided considerable help and support.

The proposal to create a federal program to transform education, skills training and lifelong learning for the digital age by providing financing for innovation, research, and development was incorporated into House legislation to reauthorize the Higher Education Act (HR 4137). Called the National Center for Learning Science and Technology, it will stimulate the application of information technologies to these fields. The bill is expected to pass the full House early in the next session, and will then go to conference with the higher education bill previously passed by the Senate. Indications are that the Senate will accept the provisions to create the National Center for Learning Science and Technology. Final passage by both houses of Congress could take place as early as March 2008.

The National Center for Learning Science and Technology Trust will be structured as a Congressionally originated 501(c)(3) nonprofit corporation with a nine-member Board of Directors, appointed by the Secretary of Education. Grants and contracts will be awarded on merit. The Board and Director of the Trust will develop policies that follow the tested procedures of the National Science Foundation and the National Institutes of Health. Congress will review the Trust's budget and financial performance annually. The Trust will be financed through appropriations from Congress, as well as through donations, contracts, grants, and other private and public sources of funds.

The Trust will:

- Provide financing for research, development, and demonstration of advanced information technologies that can transform education, training, and lifelong learning just as the National Science Foundation and the National Institutes of Health have done so successfully in their fields.
- Build multi-disciplinary teams that combine the skills in America's schools, colleges, universities, museums, libraries, public broadcasting entities and other similar organizations, as well as the corporate sector to achieve these goals.
- Support the testing and evaluation of these systems; and encourage the widespread adoption and use of effective approaches to learning.

Any successful strategy for American competitiveness and innovation in the 21st Century must address essential R&D for education and training. The nation's education and training institutions are not making the most effective use of advanced information technologies that have transformed almost every other sector of society. State-of-the-art simulations, visualizations, and other information technology tools are accelerating mastery of complex expertise in a variety of subject areas. These advanced instruments could be implemented for the first time in affordable new approaches to teaching and learning long recommended by experts in pedagogy.

Moreover, these new tools can be used anywhere in the world, including inner cities and remote rural areas. The technologies are particularly effective in building critical "21st century skills" needed for American workers to compete in the fast changing global economy. These skills include critical thinking, interpretative analysis, problem solving, plan formulation and execution, efficient data assembly and learning.

U.S. competitors in the international marketplace, such as China, Japan, Ireland, and India, are already responding to those needs by investing heavily in upgrading their education and training systems with R&D in learning technologies. At present, no federal agency has a comprehensive and coherent program to undertake the difficult research needed to develop and test innovative learning strategies using advanced information technology. Nor is there any initiative to ensure that the research will be made available for immediate and widespread use on a national level.

To demonstrate these concepts to legislative leaders, FAS took the lead, in partnership with Digital Promise, to develop three prototypes that exemplify the promising examples of information technology.

"Discover Babylon" – This program is targeted at ages 8 – 12, to demonstrate the invention and development of writing. It uses sophisticated video gaming strategies and realistic digital environments to engage the learner in challenges and mysteries that can be solved through developing an understanding of Mesopotamian society.

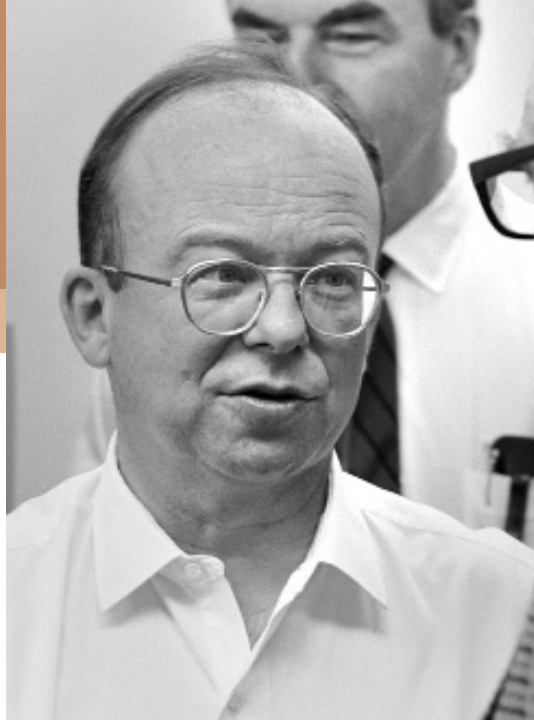
"Multi Casualty Incident Responder" – Developed with the help of the Fire Department of New York City, this program provides a training system for first responders that combines realistic simulations with advanced technologies to teach teams of firefighters. It demonstrates the potential for new technologies to dramatically improve multi-casualty incident response training on a national level and serves as a model for other first responder training in any community in the world.

"Immune Attack" – This program for high school and college biology students, combines realistic depictions of biological structure and function with advanced educational technologies to demonstrate how our bodies' immune system works. By engaging high school and college students in the battle between infectious agents and the immune system, it teaches basic concepts in immunology. The program employs stunning three-dimensional graphics and gripping interactive and motivational experiences of modern game technology.

More information on these prototypes is available on the Digital Promise and FAS websites (www.digitalpromise.org) and (www.FAS.org). **FAS**

OBITUARY – Wolfgang K. H. Panofsky

By Richard L. Garwin



On September 24, 2007, Wolfgang K.H. Panofsky, universally known as Pief, died minutes after having suffered a heart attack at home. Pief was a good friend and colleague, and a force of nature. Informative obituaries of this great man have been published. (1)(2)(3) Here I recount some personal interactions with Pief and some of our shared activities.

In 1958 I saw Pief in action when he was on the U.S. team in Geneva at the Conference on the Discontinuance of Nuclear Tests, although I was primarily there as a U.S. team member on the U.N.-Sponsored Conference on Prevention of Surprise Attack. And then I saw Pief's style in physics when we worked on the "muon g-2 experiment" at CERN 1959-60. A piece of serendipity: Pief had come across a reference to an article in a German journal that would be of interest to us in designing the magnets to contain mu mesons for several microseconds, and ordered the volume through inter-library loan. When it came, the desired article had been neatly excised, but the following article provided a key element to the solution of our orbit problem.

I worked with Pief on the President's Science Advisory Committee—PSAC—of which he was a member 1961-64, and before that in connection with the work of PSAC's Strategic Military Panel that kept track of and reviewed for the President U.S. and foreign activities on strategic weapons—particularly strategic ballistic missiles and missile defense. Every year we would write a highly classified report for the President explaining why the National Missile Defense proposed by the Army that year would be ineffective, vulnerable, or incapable of providing the desired protection. We did that also at the advent of the first Nixon administration January 1969, only to find the president insistent on deploying the so-called SAFEGUARD system to protect 150 Minuteman missiles against attack by the Soviet Union—a fool's game with that technology because destroying either of the two radars involved would be far simpler than attacking the silos themselves, and that would have rendered the defense totally ineffective.

Up to the day of his death, at age 88, Pief was indefatigable in his science and policy activities. He was a major technical contributor to the design of particle accelerators—particularly the magnificent machines built at Stanford and then at the Stanford Linear Accelerator Center, of which he was founding director and inspiration, and where the feasible technology was deployed and the future technology made real.

Pief was born in Berlin, April 24, 1919, emigrated to the United States with his family in 1934 and received his B.S. from Princeton University. Pief received a Ph.D. from Caltech in 1942 and worked at Los Alamos until the end of World War II—not on the development of nuclear weapons, but especially on a pressure gauge that would be dropped by parachute and would telemeter the pressure pulse from the explosion to provide a measurement of the explosive yield of the weapon.

Returning to Berkeley from Los Alamos at war's end, Luis Alvarez induced Pief to come with him to the Radiation Laboratory, where Alvarez called Pief his "secret weapon," in view of Pief's technical ability, persistence, and his relative anonymity. Pief played a key role in the design and construction of the "Materials Testing Accelerator"—MTA—code word for a large accelerator that had the purpose of creating neutron cascades in uranium, in order to breed plutonium for nuclear weapons. This was the Rad Lab's scheme to compensate for the felt lack of domestic uranium ore, soon to be revealed by market forces to be plentiful in the United States. Pief moved to Stanford in 1951 as a result of the "loyalty oath" dispute in the University of California—recounted well by Sid Drell.(4)

Beyond his technical work and his advising in Washington, at which he was superb, Pief was seized with the danger posed by nuclear weapons in the hands of the United States and other countries, and worked incessantly and effectively to restrain and control those weapons. He contributed mightily to the Comprehensive Test Ban Treaty and the Nonproliferation Treaty, and to his last days was effective in showing that for the most part the security of a nation would be impaired rather than improved by the acquisition of nuclear weapons.

Series of Essays as Timely Today as in 1947

By Monica Amarelo

Pief played a key role in the National Academy of Sciences Committee on International Security and Arms Control (CISAC) from its inception in 1980, and chaired the Committee for a decade from 1985. After Pief toured the science academies of Europe in 1986 to try to get them involved in helping their governments address problems of national security, Edoardo Amaldi, a prominent Italian physicist, took fire and persuaded the Academia dei Lincei to host an annual conference, aptly named by the Lincei "Amaldi Conference" to address such matters.

I have often answered my phone, to hear, "Dr. Panofsky would like to talk with you," or occasionally, "This is Pief." Eminently reasonable, Pief would assume that his priorities were your priorities, and usually they should have been.

Because of his effectiveness, his positive personality, his willingness to write the report himself, his tenacity, and especially his ability to focus on the most important topics, Pief was my personal hero. Despite his claims that he was the bionic man, he maintained to the end an admirable brain and a human heart.

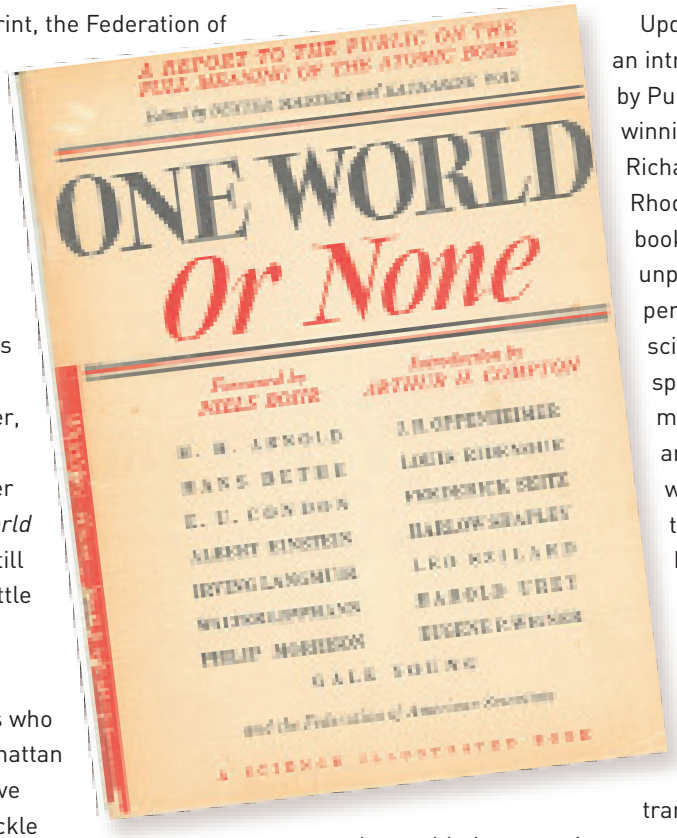
1 E.g., "Famed physicist Wolfgang K.H. Panofsky dies in Los Altos" David Perlman, Chronicle Science Editor, September 26, 2007.(http://tinyurl.com/yqzolv)

2 "Physicist, SLAC founding director Wolfgang Panofsky is dead at 88" Stanford Report, September 25, 2007. (http://tinyurl.com/2cqnj7)

3 "In memoriam: Pief Panofsky (1919-2007)", by Sidney D. Drell, October 3, 2007 (http://tinyurl.com/2a8gxl)

4 Op. cit. **FAS**

Long out of print, the Federation of American Scientists reissued the 1947 *New York Times* bestseller and classic anti-nuke text *One World or None,* which features original essays by Albert Einstein, Robert Oppenheimer, Hans Bethe, Leo Szilard, among other luminaries. *One World or None* was, and still is, an astonishing little book.



In *One World or None,* the scientists who worked on the Manhattan Project, including five Nobel laureates, tackle questions every bit as relevant today as they were sixty years ago: how are atomic bombs different in kind from all weapons that preceded them? What implications does splitting the atom have for world peace? Is there an effective defense against nuclear weapons

Updated with an introduction by Pulitzer Prize winning author Richard Rhodes, this book marks an unprecedented period when scientists spoke with a moral voice and were listened to. People recognized the new power of the atom would transform the world, they were just not sure how. A special report by Dr. Ivan Oelrich, the vice president of the Strategic Security Program at the Federation of American Scientists, is available on the FAS website at http://fas.org/One_world_or_none_intro_Ivan_2007.pdf. **FAS**

"An illuminating, powerful, threatening and hopeful statement, which will clarify a lot of confused thinking about atomic energy."

—*THE NEW YORK HERALD TRIBUNE BOOK REVIEW,* MARCH 17, 1946

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