Summary

WorldWide Telescope (WWT) is a rich visualization environment that functions as a virtual telescope, allowing anyone to make use of professional astronomical data to explore and understand the Universe. The WWT Ambassadors Program is recruiting astronomically-literate volunteers, including retired scientists and engineers—who will be trained to be experts in using WWT as a teaching tool. Ambassadors will give volunteer presentations at public libraries, community centers, museums, and schools, demonstrating WWT’s power to help laypeople visualize and understand our Universe. Ambassadors will learn how to use WWT’s tools to create and publish guided “Tours” of astrophysical concepts, which allow users to display beautiful astronomical images in their proper context in the night sky, while demonstrating the physical principles at work in those images.

Tour creators will be able draw upon and link to highly vetted multimedia content from NOVA, the renowned PBS multi-platform series produced by WGBH. Tours will be freely available and centrally managed in order to form a comprehensive astronomy curriculum for both formal and informal educational use. The Tours will be searchable and distributed online from popular websites such as NOVA Online and WGBH Teachers’ Domain, touting almost 400,000 registered users. [www.teachersdomain.org]

WWT Ambassadors will help to increase science literacy in the general public while fostering intergenerational connections within communities.
Program Goals

The Ambassadors Program will promote WWT as a future-leaning way to teach and learn STEM concepts. In order for the U.S. to remain at the forefront of technology, science teaching must focus on active inquiry and discovery, rather than rote memorization of facts. WWT fosters these critical learning goals by providing the following powerful features:

- **Unprecedented access** to real astronomical data, allowing users to experience the thrill of discovery that comes from exploring and understanding our Universe.
- Guided Tours that encourage learners to engage actively with the material, and that allow experts to create exciting and accurate educational content.
- A 3-dimensional environment built on a gaming engine, using real data, that allows users to visualize concepts that are challenging to understand through traditional media.
- A compellingly detailed visualization interface that gives users a holistic perspective on the scope and scale of the Universe.
- **Rich media linked within a natural context**, including instant links “off the sky” to online content at a variety of levels, from Wikipedia entries to refereed journal articles.

We have begun piloting our methods at Clarke Middle School, a public school in Lexington, MA. In collaboration with our partner teacher at the school, we recently completed a successful 3-day session to introduce WWT to sixth grade students. After these sessions, we surveyed the 72 students who participated, asking them how they think WWT can help them to learn science. They expressed genuine excitement at being given the freedom to explore and learn on their own. Here are some direct quotes from their surveys:

★ “Learning about our Universe by actually seeing and exploring it makes it easier to contemplate and more fun.”
★ “You can explore the Universe yourself and you don't always have to only learn from the teacher.”

Other students cited the ability to take “guided Tours” with astronomy experts, and a few of these 11-to-12-year-old students even reflected how WWT helps users gain “a better mental map of the Universe.”

The WWT Ambassadors Program will serve as a “proof-of-concept,” demonstrating how similar “cyber” infrastructure could be applied to other scientific fields, such as biology or chemistry. In fact, the WWT engine itself is being considered as a way to attach deep links to 2D and 3D images more generally, in fields ranging from genomics to medicine.

Astronomy in particular is a highly effective “hook” for drawing students toward STEM subjects. Feedback we have received from the pilot group at Clarke indicates that WWT will be particularly successful at generating interest in astronomy and space. In an anonymous written survey, 90% of the students described WWT as “awesome,” “cool,” or “a fun way to learn science,”

*WWT Ambassadors, 1/20/10*
or said they would recommend WWT to their best friend. The WWT can help change how students learn science by demonstrating the joys of inquiry and discovery. We believe that this student enthusiasm will spill over into other areas of science, especially if this kind of visualization environment is enabled in other fields.

Target Audience

The WWT computer program has already been downloaded 2 million times internationally, most often by amateur astronomers. The WWT Ambassadors Program has the potential, though, to reach a broader range of learners, from school-aged children in both formal and informal settings, to adults in community settings. We plan to design much of our program (e.g. guided Tours of astrophysical concepts created by Ambassadors) with a focus toward formal educational settings because this is the environment that will benefit most from the structured planning that a program like WWT Ambassadors can provide.

However, the benefits of learning with WWT are not limited to formal educational environments. A 2004 report by the NSF on Science and Engineering Indicators shows that fewer than 20% of adult Americans can be considered minimally science literate in the sense required for participation in civic society\(^1\). WWT Ambassadors will be effective at promoting continued science education among adults at libraries and community events, helping them to access available resources, which they can continue to use on their own in their homes.

Retired scientists and other volunteers who serve as Ambassadors will have an opportunity to improve science literacy in the general public, and we envision this model working in both formal and informal educational settings. Ambassadors will be able to choose involvement in the program as “content creators” (e.g. of Tours), “presenters,” or both. As explained below, Ambassadors will be vetted by our Ph.D-level staff, and then trained, either in-person or online to be expert in the use of WWT.

Program Methods

WWT’s interactive platform gives experts and learners unprecedented access to the Universe. We will showcase WWT as a new kind of teaching tool through a multi-pronged approach.

Ambassador recruiting and training

We will welcome interested and qualified Ambassadors of all backgrounds, although we will focus our recruiting efforts toward retired scientists and engineers. Other educational outreach efforts that bring retirees into schools\(^2\) have demonstrated that this is a population who can make a significant difference in science education. Anecdotal feedback we’ve received from scientists who are in or near retirement has been uniformly positive and enthusiastic. In fact, the concept of tapping into the pool of retired astronomers came to us from Steve Strom, a prominent astronomer at the National Optical Astronomy Observatory. After seeing a demonstration of WWT in May 2009, Steve volunteered immediately to participate in the Tucson, AZ area if we could make the Ambassadors program happen. When Kevin Marvel, the Executive Officer of the American

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\(^1\) Fraknoi, Andrew, *Steps and Missteps Toward and Emerging Profession*, Mercury, 2005, 34, 5.

\(^2\) See for example, RESEED, ReSET, TOPS, and the MCPS Science Volunteer Project (through AAAS).
Astronomical Society, learned of the Ambassadors program, he agreed to encourage *emeritus* members of the Society to volunteer as Ambassadors. Rick Fienberg, the brand-new AAS Press Officer/Education and Outreach Coordinator is also a supporter of the program, so we expect formal AAS participation will expand beyond just help with recruiting Ambassadors during 2010.

From preliminary announcements about the WWT Ambassadors Program, we have already drawn interest from about a dozen retired scientists, amateur astronomers, and educators in the Boston area alone. We have at least one strong contact or partner in each of several proposed expansion sites (see below). In addition to recruiting from *emeritus* members of the American Astronomical Society, we will also seek volunteers from amateur astronomy organizations and graduate astronomy departments local to our program areas.

We will develop materials to train Ambassadors in creating WWT Tours that maximize educational potential, that focus on describing *how* we know what we know, rather than just presenting facts. Initially, we will travel to proposed sites to train the Ambassadors in person. In cases where travel is impractical, and as we expand the program, we will rely on screen-sharing and online conferences to train Ambassadors. Ambassadors who would like to make presentations at schools and community centers will also be asked to demonstrate their capacity for public speaking.

**Curriculum development**

To build up the educational resources that will allow WWT to be used easily in classrooms, public presentations, and homes, Ambassadors will help create a library of WWT Tours that are relevant and broad. We are creating a matrix of Tour topics that will comprise our curriculum. Trained Ambassadors will produce Tours related to their areas of expertise by “claiming” topics from the curriculum matrix. We envision the creation of Tours at multiple levels, so learners can begin learning about a topic through the “beginner” level Tour and then work their way to a more nuanced understanding through “advanced” level Tours.

We will create teaching frameworks for Ambassadors to follow, for example the “lecture tutorial,” where just enough information is presented to students to whet their curiosity and challenge them to answer a series of questions as a team. For younger students, this could be in the form of an astronomical scavenger hunt. WGBH, via the Teachers Domain website, will provide vetted educational content, including NOVA video, that WWT Ambassadors can link to in their Tours.

In order to manage the volume of Tours that we anticipate being created, we will put in place a sensible system for searching the database of available Tours, sorting them, and interlinking them in intuitive ways. WGBH will regulate the hosting system, perhaps by enabling a login process for volunteers to upload Tours they have created, and we will produce a rubric for vetting Tours that members upload to the site. We hope to eventually form an interactive online community where users, including teachers, can rate Tours and offer feedback and suggestions on how to best implement a particular Tour in the classroom or at a public talk.

Curtis Wong, creator of WWT, has described the possibility of a “hypermedia web of learning where instead of hyperlinking among words, we’re linking among stories and paths and ideas.” Skillful management of the Tour curriculum created by the WWT Ambassadors Program can begin to make this possible.

**Pilot Studies**

As described above, we have begun piloting our methods at a public middle school in Lexington, MA. We will return to this school in the Spring during their 6-week unit on astronomy to help
students explore constellations and the life cycles of stars using WWT. The students usually end the astronomy unit with a special project to demonstrate to their classmates what they have learned. This year, students will have the option of creating a WWT Tour (in lieu of, or in addition to, a PowerPoint or poster presentation) for their final project.

Beyond the Boston area, we are in the planning phases of pilot programs in geographically and socio-economically diverse locations. One promising partnership involves the Appalachian Region Commission (ARC). Jeffrey Schwartz, the Education Program Manager of the ARC has recommended a cluster of schools in Eastern Kentucky located near Morehead State University, which has a new aerospace facility and planetarium. We aim to identify interested Ambassadors, schools, and teachers this spring, and then work with them through the summer to plan how WWT projects can best be implemented in these classrooms.

This ARC partnership gives us the advantage of piloting our program in a rural, economically distressed region, and it can help draw students toward STEM subjects in a region that already has a strong science career program in place.

We are exploring additional potential partnerships in Tucson, AZ, Seattle, WA, and Gainesville, FL.

**Program Evaluation**

We plan to do pre- and post-testing of our learners to evaluate the effectiveness of our methods and to determine what contributions WWT has made toward students’ understanding of science. We will use vetted assessment tools such as those created by the AWE (Assessing Women and Men in Engineering) Project. We also plan to incorporate Tour-making by learners into the assessment process. As shown below, we will collaborate with members of the Science Education Department at the Harvard-Smithsonian Center for Astrophysics, and members of WGBH’s Education and Outreach Staff in designing our evaluation program.

**Who is involved?**

Staff from the Harvard-Smithsonian Center for Astrophysics and WGBH are running the WWT Ambassadors program in collaboration with Microsoft Research Staff and Volunteer Ambassadors.

**Program Leaders**

- Alyssa Goodman, Ph.D., Professor of Astronomy at Harvard University, WGBH Scholar-in-Residence, and Microsoft Academic Partner, is leading the WWT Ambassadors Program.
- Annie Valva, M.Ed., Director of Research & Development for WGBH Interactive, is the lead contact at WGBH.
- Curtis Wong, creator of WWT and Head of MSR Next Media Group, is helping to guide the Ambassadors program on behalf of Microsoft Research.
- Patricia Udomprasert, Ph.D. is an astronomer and science educator who is serving as the Program Coordinator for the WWT Ambassadors Program.

**Additional Participants and Advisors**

- Jonathan Fay, Software Engineer for WWT
- Yan Xu, Ph.D., Liaison to Academic Partners Program
- Tony Hey, Ph.D., Vice President of External Research for Microsoft
Note: As detailed below, Microsoft Research will be donating software, equipment, technical support, and travel costs towards the Ambassadors project.

Harvard/Center for Astrophysics
• Roy Gould, Education Specialist, CfA Science Education Department
• Susan Sunbury, Education Specialist, CfA Science Education Department
• Megan Watzke, NASA Chandra Public Affairs Coordinator

Other Advisors
• Christine Borgman, Lead Author, NSF Cyberlearning Report (UCLA)

Pilot Ambassadors/Regional Contacts
• Michelle Bartley, Science Teacher, Clarke Middle School, Lexington, MA
• Jeffrey Schwartz, Ed. D., Education Program Manager, Appalachian Region Commission
• Phil Rosenfield, Graduate Student, University of Washington
• Steve Strom, Ph.D., Retired Astronomer, NOAO, Tucson, AZ
• Elizabeth Lada, Chair, Department of Astronomy, University of Florida

Preliminary Budget Estimation
The Pilot phase (ongoing, 2009-10) of the WWT Ambassadors Program has been funded through a Microsoft Academic Partnership gift to Alyssa Goodman at Harvard University.

As sketched in the list below, the cash cost of the Phase I (2010-11) project will amount to ~1.6 FTEs/year. For an 18-month startup project, these FTE costs would be roughly $480K.
• Project Director (Ph.D. scientist with teaching and management experience) [0.6 FTE, Phase I]
• Project coordinator at each site [Volunteer, with paid expenses, Phase I]
• Science Educator for Coordination with Teachers’ Domain [WGBH, 0.2 FTE, Phase I]
• Web Producer/Web Designer/Web Tech [WGBH, 0.6 FTE total, Phase I]
• Rights/Clearances advisor [WGBH, 0.1 FTE]
• Academic Advisor [Harvard, 0.1 FTE]
• Computer Tech Support Staff [Microsoft, in-kind contribution]
• Windows Licenses [Microsoft, in-kind contribution]
• Travel to sites/conferences [Microsoft, in-kind contribution]
• Laptop computers for most active Ambassadors [Microsoft Academic Partner gift to Harvard]

Phase II (2011-2014) ramp-up would add part-time paid coordinators at additional sites, and additional curriculum development staff at WGBH.

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