

SPORE* SERIES WINNER

Got a Question? "Ask A Biologist"

Charles Kazilek

Adjusting her headphones, fifth-grader Itzany Mendez carefully reads through her handwritten list to select her next interview question. She fixes Rebecca Clark, a doctoral student in the School of Life Sciences at Arizona State University (ASU), with a curious look (see the first figure). Mendez's question reflects the perspective and natural observation skills found in a young scientist: "Why do ants huddle up like penguins?" she asks. "That's a great question," Clark says, as she launches into a short discussion of animals and social groups.

Mendez is one of three fifth-graders gathered in the bright blue- and green-painted Grass Roots Studio, the recording site for the Ask A Biologist podcast. These students are winners of the Ask A Biologist podcast cohost contest, whose high point is this moment, where they cohost a podcast of their own and interview an ASU scientist. Along with their parents and teachers, they have also had tours of laboratories, constructed ant farms from recycled music CD cases, peered inside leaf cutter colonies to see carefully tended fungal gardens, discovered wicked plants, and observed how birds use their feathers. Most importantly, the students have discovered what scientists do on a daily basis, and how they can fill those same shoes.

Mendez's time with Clark opened the world of science in a most personal way. Most online science education portals cannot achieve this one-on-one exchange and also scale up to reach millions. However, the Ask A Biologist Web site (askabiologist.asu.edu) which hosts the podcast and the podcast contest, has been on this path in multiple forms since 1997.

Ask A Biologist was originally created as a vehicle to host an online question-and-answer (Q&A) feature for kids. Since its inception, the Web site has answered more than 25,000 queries from students, teachers, and lifelong learners. Users come from around the globe to ask some of biology's most perplexing questions. Why do some plant leaves turn red or yellow in the winter? Why are fingers wrinkled after a long bath?

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*SPORE, Science Prize for Online Resources in Education, www.sciencemag.org/special/spore/.



I. Mendez learns some ant facts from R. Clark (top) and asks questions during a podcast recording session (bottom).

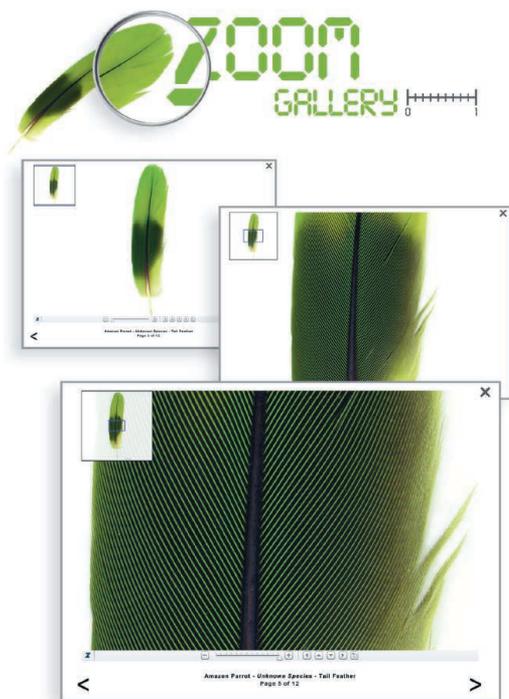
Teachers, both formal and informal, are also a key portion of the audience. Instructors of K–12 students can find confirmation or advice about a range of topics in biology. In some cases, it is unexpected results from an experiment that send a teacher to Ask A Biologist for clarification or advice. Sometimes it's a complicated topic, such as whether genetically modified food crops affect migrating butterflies, that leads them to the Web site. The addition of the Ask A Biologist podcast in 2006 gives teachers the ability to bring scientists' voices into the classroom to mesh with the day's lessons. Parents and grandparents can use the Web site and podcast program to help teach their young charges or to satisfy their own curiosity.

As Ask A Biologist has grown, its content has also adapted to visitors' needs. Although search engine tools have improved and made it easier to find information, search engine results often return multiple answers to a question, sometimes with conflicting, incorrect, or out-of-date information. Resolving these conflicts requires more than a search engine; it takes the human touch. This is the power of putting the working scientist in touch with children and the public. The ASU School of Life Sciences houses more

An educational Web site adds new twists to learning by promoting direct conversations between scientists and the public.

than 100 faculty and 240 graduate students. This pool of expert volunteers—with their range of experiences, challenges, and scientific insights—is an immense resource. Their diverse backgrounds often provide the perspective needed to resolve contradictions and inadequate answers that pop up in Web searches.

The Q&A process work begins with a simple e-mail form. Through an established work flow, Ask A Biologist receives and distributes questions to volunteer scientists in the School of Life Sciences and other institutions. This ensures that questions are directed toward the best possible experts. It also allows the opportunity for review of the answer to make sure it is grade appropriate. The form uses a generic e-mail address that protects volunteers from being overwhelmed by questions. An off-line database of past questions and answers can be used for repeat questions. However, off-line materials usually require modifications, to address the grade level of the person submitting the question, and revisions to include the most current scientific findings. Maintaining the database off-line also keeps outdated information off the Web, eliminating the possibility that stu-



Zoom Gallery.

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Downloaded from www.sciencemag.org on November 29, 2010

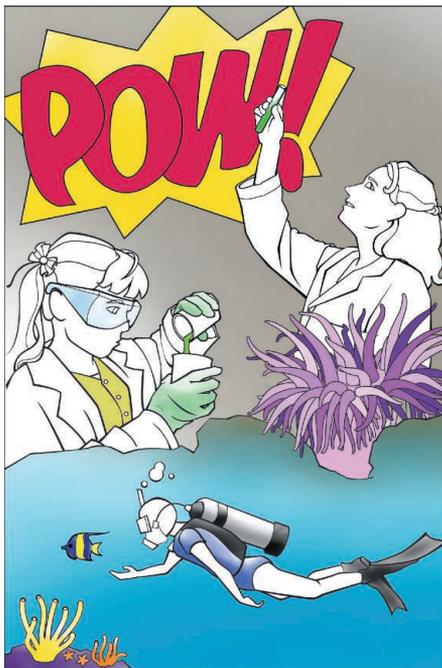
dents or teachers will confound current information with out-of-date replies.

The Q&A feature has also served the secondary role of advancing the Web site's development. Directly linked with users, this tool has guided the creation of content. Once a single page, the Ask A Biologist Web site now has more than 2500 pages of materials. Many of the pages were "asked" for as a direct result of questions sent via the Web site form. For example, the coloring page section was developed in response to parents and grandparents searching for activities for young students who are at pre- or early reading levels. The Quizzes and the Mystery Image gallery came about in response to student requests for ways to test their comprehension of articles and a desire to explore the microscopic world.

Of the 25,000 questions posed to Ask A Biologist, roughly 25% are career related, resulting in the development of our "Meet Our Biologists" profiles. Students ask questions such as "What is it like to put on a lab coat and work in a laboratory?" and "What is it like to travel to Africa or the Arctic to study plants and animals?" Other times, children are looking for academic guidance and ask, "What are the best classes to take in high school if you want to be wildlife biologist?" and "Do I need to take math in school if I want to be a biologist?" A glance through the Ask A Biologist podcast collection tells the tale clearly: There is no one way to become a scientist and no single type of person who one has to be in order to be passionate about science.

Having a direct link with the public has been invaluable in the development of Ask A Biologist materials. One key lesson learned through interaction with teachers is that even though the Web is a powerful tool, content that can only be used with a computer places limits on its use. For this reason, the Web site includes materials that can be used on- and off-line, or a combination of both. Teachers are also looking for learning tools that include data sets. With these two priorities in mind, Ask A Biologist has invested in development of materials that are flexible in how and where they can be used.

One such activity is the Virtual Pocket Seed Experiment. This activity provides options for exploring seed germination, energy, gravitropism, and the scientific method both online and as a hands-on experiment. Online there is a pictorial data set involving various seed germination treatments. To help engage students in the activity, time-lapse animations of each seed treatment are included. The compan-



Mysterious World of Dr. Biology.

ion Pocket Seed Packet can be downloaded and used to run the experiment as a hands-on activity in the classroom or at home. This places experimental control in the hands of students. The flexibility of the activity allows teachers to select which options best fit their students' needs as well as their access to technology. The popularity of this activity is reflected in the Web site analytics and usage requests submitted through the online permission form. It is downloaded and used by hundreds of thousands of students and teachers yearly.

Ongoing dialogue with the public has also led to the development of other media, including coloring pages, worksheets, word puzzles, and quizzes. All of these are tied to online stories and activities. Most recently, Ask A Biologist has added companion video channels on Vimeo, YouTube, and TeacherTube. The Image Gallery has added the biology-themed computer wallpaper and the popular Zoom Galleries, which offer the opportunity to explore the macro and microscopic world (see the second figure). Using a simple microscope-like interface, visitors can explore the beauty and structure of feathers or take an ultra-close view of pollen grains.

In addition to focusing on science education, Ask A Biologist recognizes the need for expanding student language skills to incorporate new ideas and concepts. Capitalizing on the popularity of comic book-based content, the Mysterious World of Dr. Biology was developed (see the third figure).

This activity offers a collection of biology-themed clip-art. Students fill in blank text bubbles and chose panels to create their own stories. The comic-book theme allows children to partner creative thinking with written language skills development around a biology-based theme (1).

What is next for Ask A Biologist? As the Internet becomes increasingly accessible on a global level, it is important to provide content in languages other than English. Using its established volunteer model, the program is adding French and Spanish translations of its content to the Web site. New partnerships are also being formed to expand content-rich sections within the Web site. For example, Ask A Biologist is working with the Arizona Science Center to build and host a Web version of their Body Depot gallery program (2). The project introduces students, ages 8 to 14 years, and their teachers to three biomedical research areas inspired by National Institutes of Health's Roadmap (3) for Medical Research: Biological Pathways, Bioinformatics, and Nanomedicine, by using the metaphor of a hardware store to explain how the body maintains and repairs itself.

As access to the Internet continues to grow and educators and content developers refine online tools, the future of science education seems bright. No other tool has been as powerful as the Internet for putting science education directly in users' hands, in multiple formats that can excite discussion and critical thinking. Ask A Biologist plans to continue offering students, teachers, parents, and lifelong learners access to the latest in scientific trends and technology while maintaining the link between the public and working scientists. This social component of Ask A Biologist has been a key to its past success and will remain a vital part of future development.

References and Notes

1. Teacher Information, Ask A Biologist; <http://askabiologist.asu.edu/teacher-information>.
2. Body Depot is part of the NIH-funded program, Framing New Pathways to Medical Discovery for Families, Students, and Teachers.
3. New Pathways to Discovery, The NIH Common Fund, <http://nihroadmap.nih.gov/newpathways/>.
4. Ask A Biologist is funded in part by a grant from the National Science Foundation and the National STEM Distributed Learning program (award 0840788). I thank J. Sahertian, S. Deviche, J. Mayfield, and J. Baxter for photographs and illustrations. Grass Roots Studio photo by Actual Films.
5. Charles Kazilek is the director of Technology Integration and Outreach for the ASU School of Life Sciences, a division of the College of Liberal Arts and Sciences. He is also the creator and caretaker of the Ask A Biologist program and Web site. Mr. Kazilek would like to thank Margaret Coulombe for her invaluable help in reviewing and editing this essay.

10.1126/science.1186993