SPORE* SERIES WINNER

An Online Community for Students Who Love STEM

The next generation of STEM innovators interacts with practicing scientists, mathematicians, and each other.

Kristi Birch,† Carol Blackburn, Linda Brody, Patricia Wallace

Before 2006, advanced precollege students from around the world were in need of a place where they could engage in scientific and mathematical conversations and showcase their achievements. They found that place at Cogito, www.cogito.org, the online community and Web site launched in 2006 by the Johns Hopkins Center for Talented Youth (CTY) for high-achieving middle and high school students who love science, technology, engineering, and math (STEM). Through Cogito, students have direct contact with their peers and with practicing scientists and mathematicians to enrich their learning beyond classroom walls.

Cogito's first student members gave the site its name, Latin for "I think." Additionally, they helped to shape its features, which include profiles of students and their projects; interactive interviews with experts; live webinars; discussion forums; and a centralized directory of challenges outside of school, such as international competitions, internships, summer programs, and online learning.

Most of this content is available to any site visitor, but the discussion forums, blogs, and special events are only for Cogito members. Students are nominated for membership by CTY or other organizations that serve academically advanced students, including the Davidson Institute, the Belin-Blank Center, National PERMATApintar Centre in Malaysia, the talent search programs at Duke University and Northwestern University, the precollege math and science competition communities, and others, some of whom helped plan Cogito's approach from the beginning. We also welcome nominations from middle and high school teachers, who spot talented students who are excited about science and math, and from students themselves. As students graduate from high school, they remain Cogito members, with an "over 18" designation in the discussion forums where they serve important roles as "near peers."

A central feature of Cogito is its ability to engage students in STEM fields not normally included in a high school curriculum. For example, geophysicist Allen West, whose theories about the extinction of the great mammals were featured in NOVA on the Public Broadcasting Service, came onto the site for an interview. Cogito also featured a discussion forum with five science writers to talk with Cogito members. And, after a special focus on chemical sciences included a discussion with environmental chemist Alan Stone, a Cogito member exclaimed, "Now, I think that might be something I want to have a career in, and … I had never heard about it before the interview with Dr. Stone."

For students like Philip Streich, whom *Discover* magazine named one of the top five young scientists under age 20 in 2008 (*1*), the discussion forums found on Cogito were a lifeline. He wrote, "Living on a farm in rural Wisconsin, I'd had no opportunity to hear about and communicate with other kids my age who were as passionate as I was about science. Cogito brought me into a scientific community that I would otherwise never have had a chance to be part of … it motivated me to start doing research myself … and helped me picture myself doing research alongside them someday."

Cogito's interviews and forums underscore the relevance and vitality of contemporary research. Experts welcome questions from students and post their answers online. Johns Hopkins bioethicist Debra Mathews, for example, grappled with questions such as who is "worthy" to make ethical decisions about medical issues and what makes them so. Cogito has also featured mathematician and Fields Medalist Terence Tao, who proved that prime numbers contain infinitely many progressions of all finite lengths; planet hunter Paul Kalas, whose research team took some of the first direct images of planets orbiting other stars; and computer scientist Zoran Popovi, who was one of the developers of the online protein folding game, Fold-It.

During live Cogito webinars, which are announced ahead of time via Cogito's e-newsletter, members from around the world log into a virtual conference hall to interact with a guest expert in real time. The opportunity to discuss contemporary scientific issues with renowned experts is a major draw for students, although live events for a worldwide membership can be challenging to coordinate. When

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Cogito members and Center Scholars. Ilenna Jones and Alex Malerba learn about genomics.

The Johns Hopkins University Center for Talented Youth, Baltimore, MD 21209, USA.

*SPORE, *Science* Prize for Online Resources in Education; www.sciencemag.org/site/special/spore/. †Author for correspondence. E-mail: kbirch@jhu.edu (K.B.) or cogitocty@jhu.edu

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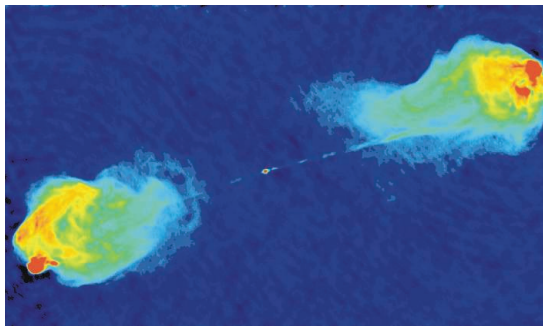
Cogito hosted its first webinar called Swine Online '09, two epidemiologists began with a presentation about the H1N1 outbreak (*2*). Questions from Cogito attendees poured in via phone, chat, and instant message, filling the screen and surprising the presenters, who said later, "These are more like questions from our doctoral students."

We have learned that Cogito offers bright kids a place not to just hang out, but to "geek out" (*3*). Instead of just surfing the Web for tidbits of information or being satisfied with a Wikipedia entry, geeking out goes much further. It is a peer-driven online activity, a social one in which young people learn more about topics that fascinate them by exchanging knowledge on a subject of interest (see the photo). On Cogito, they pursue advanced subject matter as they gather to discuss extrasolar planets, epigenetics, or Ricci flow. Cogito members themselves started an "I Learn, I Teach" set of forums in which individual members teach other members about a subject they are pursuing, such as nanotechnology, anatomy, and Chinese. Students with special expertise are also invited to share their knowledge. For example, Benjamin Clark, a 15-year-old senior who won the top prize at the Siemens Competition in Math, Science, and Technology, came onto the site to talk about his winning astrophysics project. Similarly, high school student Ilenna Jones, who spent a summer working with genomics researchers at Johns Hopkins as part of the Center Scholars program, developed by CTY and Johns Hopkins' Center for Excellence in Genome Science, was featured on the Web site (see the photo, p. 467). Her excitement about what she and her mentors in the lab are discovering shines through in the short video interview featured on Cogito. "We're trailblazing, finally!" she remarked.



"What is this?" Visitors try to identify a scientific image. Guesses for this image of the radio galaxy Cygnus A included "a meteorologic picture of two tropical storms" and "volcanic islands with a boat traveling between them."

Cogito's members now hail from over 70 countries, and the international membership is growing rapidly. Organizations in many countries are seeking out CTY's help in their efforts to nurture the talent of their own gifted youth, particularly in science and math. In Malaysia, for example, CTY is working with Universiti Kebangsaan Malaysia (National University of Malaysia) to create a new school for gifted children on the university campus and also to provide more services to the brightest students throughout the nation. Cogito is part of that effort, offering a way to bring international attention to the innovative work their top students and scientists are doing, and giving the Malaysian students opportunities to interact with their peers and experts around the world.

We also invite students from international competitions, such as the Intel International Science and Engineering Fair, as well as students from organizations in other countries that serve gifted students. We look for opportunities to highlight the research projects of students from around the world who are not only role models for their own country's youth, but who also bring a global perspective to the site. This year, Cogito interviewed a team of five Saudi Arabian girls who took first place at Ibtikar, a large invention competition, for a virtual reality game they created for children with cancer. Cogito member Priyanka Kumar researched and compared the health habits of her American classmates with those of students in India, where she spends her summers, and Sean Ballinger reported on his internship in computer programming at a German space center. As the site expands internationally, we will be adding translations of the content into different languages and looking for ways to host more webinar events within different time zones.

As the National Science Board stressed in its 2010 report, the nation's future prosperity relies on today's youth who have the potential to become the vanguard of scientific and technological innovation, and strategies to develop their talents are critical (*4*). The same can be said of youth in other countries. We hope Cogito will continue to be that place where bright students from around the world will always feel comfortable geeking out and where their growing expertise and interest in STEM are celebrated and nurtured.

About the authors

From left, Patricia Wallace, Kristi Birch, Carol Blackburn, and Linda Brody.

Patricia Wallace is Cogito's principal investigator and senior director of CTYOnline and Information Technology. **Kristi Birch** is Cogito's managing editor and a science writer. **Carol Blackburn** is a research psychologist at CTY's Study of Exceptional Talent and was Cogito's initial project director. **Linda Brody** directs the Study of Exceptional Talent at CTY and was Cogito's initial principal investigator.

References and Notes

1. E. Westly, *Discover* **29**, 37 (December 2008).
2. S. Cavanagh, *Educ. Week* **9**, 12 (2009).
3. M. Ito *et al.*, *Living and Learning with New Media: Summary of Findings from the Digital Youth Project* (The John D. and Catherine T. MacArthur Foundation Chicago, IL, 2008).
4. National Science Board, *Preparing the Next Generation of STEM Innovators: Identifying and Developing Our Nation's Human Capital* (National Science Foundation, Arlington, VA, 2010).
5. Sir John Templeton, the Rhodes Scholar whose foundation provided funding for Cogito's development, understood the plight of very bright students with few local resources to challenge their intellect. When his high school in rural Tennessee did not offer as much math as Yale required for admission, he developed an advanced course and taught it himself. The John Templeton Foundation maintains a strong commitment to young people who demonstrate exceptional talent in mathematics and science. Additional funding for Cogito has come from the Camille and Henry Dreyfus Foundation, Newman's Own Foundation, PERMATApintar, and others.

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