

Friend promotes a revolution in biomedical research

By Eddy Ball

Researchers at NIEHS and guests from nearby institutions had an opportunity March 1 to hear from scientist and visionary Stephen Friend, M.D., Ph.D., during a talk hosted by NIEHS and NTP Director Linda Birnbaum, Ph.D. The title of his talk, "[Integrating Genomes and Networks to Understand Health and Disease](http://sagebase.org/info/NewsInfoDownloads/friend_niehs_2013_0301.pdf)," (http://sagebase.org/info/NewsInfoDownloads/friend_niehs_2013_0301.pdf) reflected just how ambitious Friend's plans are, as well as his systems biology approach to discovery.

With outstanding credentials as a scientist and clinician, [Friend](http://sagebase.org/info/directors.php) (<http://sagebase.org/info/directors.php>) is a fitting leader for the mission of transforming how scientific discovery happens, by challenging the traditional competitive culture of science. His model marries big data, social media, and participatory science, in a way that challenges the hierarchy of science and takes a much more data-intensive approach to scientific discovery.

Linked Video

[Watch as Friend discusses his strategies for breaking down the information walls \(09:05\)](#)

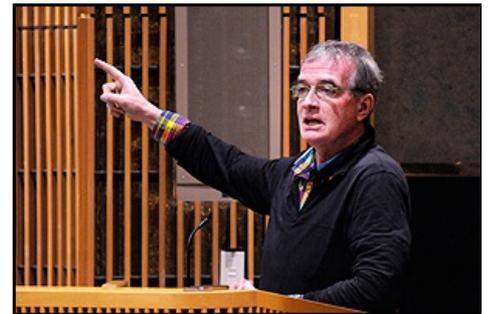
Friend envisions an open-access scientific commons, where the contributions of patients and citizen scientists may prove to be as valuable as those of tenured scientists at privileged institutions. "We're at the edge of a totally remarkable transition," Friend said of the biomedical revolution at hand. "Things happen when people care and they're passionate and they have energy, not because they have degrees."

Open systems of sharing in a commons

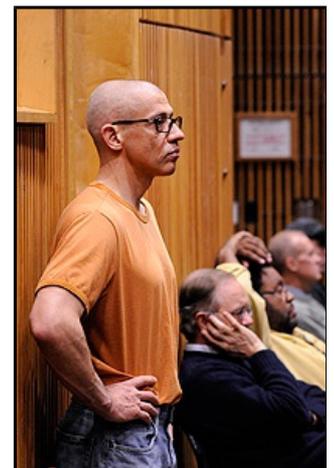
At the heart of Friend's vision is the enormous amount of data that would be available if teams of individual researchers, their institutions, patients, and pharmaceutical companies combined their resources. For the model to succeed, each of these stakeholders needs to modify attitudes toward recognition, ownership of data, patient consent, and intellectual property protection.

Underscoring the complexity of biological systems, Friend pointed to built-in redundancy and overlapping pathways that he said help explain why scientists, looking at the same mechanism, may get different results. "We don't know how to think in those multiple dimensions, and until we learn ..., we're going to be puzzled by the answers we get back, in terms of how they don't fit together," he said.

As Friend envisions this new community science, harnessing that volume of data in an unbiased, what he called naive, search for new patterns, could lead to insights for reducing and eliminating disease. "You can look at unknowns," Friend said, "if you have a large enough compendium."



As he pointed to the sea of stars on his slide, Friend compared what is happening in biomedical research to an early 20th century revolution in astrophysics. In 1911, cosmologist Edwin Hubble was able to show that instead of one galaxy, there were some 100 million galaxies the size of our own, forming a far more complex network than astronomers had previously imagined. (Photo courtesy of Steve McCaw)



Not surprisingly, the capacity audience included statisticians involved in big-data projects, such as NIEHS lead researcher Dmitri Zaykin, Ph.D., above, and Fred Wright, Ph.D., of the Carolina Center for Genome Sciences at the University of North Carolina at Chapel Hill. (Photo courtesy of Steve McCaw)

Obstacles and promise

Although [Sage Bionetworks](http://sagebase.org/), (<http://sagebase.org/>) the non-profit Friend co-founded, has made significant progress in securing free cloud computing space and launching an online consent project, there remain important challenges. He admits that giving researchers timely and adequate reward for their work on teams remains problematic. Restrictive consent forms proved to be a barrier for pharmaceutical companies and others who are willing to share data.

However, Friend said, "I think the whole world is waking up to this." Referring to the 2011 Institute of Medicine (IOM) report, "[Toward Precision Medicine: Building a Knowledge Network for Biomedical Research and a New Taxonomy of Disease](http://www.nap.edu/catalog.php?record_id=13284)," (http://www.nap.edu/catalog.php?record_id=13284) He explained that the kind of biomedical breakthroughs he envisions ultimately depend on a fundamental change in how researchers perceive information and derive meaning from it.

"What it [the IOM report] basically said is, if we're going to shift from symptom-based to one that takes molecular characterization into account, we've got to build a new taxonomic classification system," said Friend. "To do that, we need an information commons and we need a knowledge network."

In an effort to move this open-access network science forward, Friend and colleagues have conducted high-profile proof-of-principle studies. Borrowing a concept from Star Trek, they also formed a federation to host seed projects.

The first of the federation's challenge projects launched last summer, the Sage Bionetworks - DREAM (Dialogue for Reverse Engineering Assessments and Methods) Breast Cancer Prognosis Challenge, marshaled the diverse talents of 1,700 teams from 40 countries. To Friend's obvious delight, the winner turned out to be a physicist who took an approach he said electrical engineers would take, not one doctors would — an example of the potential of his inclusive model for advancing scientific discovery.



NIEHS staff on hand for Friend's talk included, left to right, bioinformatics scientist David Fargo, Ph.D.; senior associate scientist Dmitri Gordenin, Ph.D.; Scientific Director Darryl Zeldin, M.D.; and Senior Advisor Allen Darry, Ph.D. (Photo courtesy of Steve McCaw)



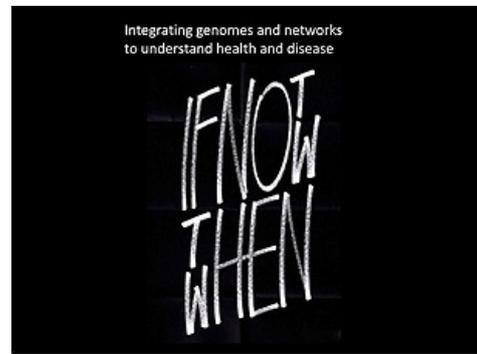
Among the many NIEHS attendees with varying interests in Friend's project were, left to right, Molecular Genomics Core biologist Stella Sieber and NTP toxicologist Stephanie Smith-Roe, Ph.D. (Photo courtesy of Steve McCaw)



Health Science Administrator Thad Schug, Ph.D., was one of several NIEHS Division of Extramural Research and Training grant administrators who attended the talk. (Photo courtesy of Steve McCaw)



Birnbaum, right, moderated the question-and-answer segment of the presentation. Friend praised NIEHS leadership for its willingness to embrace new ideas, and cited the Tox21 consortium as an example of progressive data-intensive network science. (Photo courtesy of Steve McCaw)



Friend opened and closed his presentation with this question, which reinforces the urgency and timeliness of his proposal. (Photo courtesy of Sage Bionetworks)

Supporting a new approach to scientific discovery

Friend described five scientific and social developments that are the building blocks for networked science.

- **Data** — It is now possible to generate a massive amount of human ‘omics data. “We’re now capable of doing data-driven science in a way we weren’t ten years ago.”
- **Modeling** — Network modeling approaches for diseases are emerging that utilize three or more layers of information. “If you only have two layers of information, you’re talking about associations. When you have three and four layers of information, you can begin to build causal and non-causal linkages between components that actually begin to build up and look at relationships.”
- **Internet** — Information technology infrastructure and cloud computing capacity now allows a generative, open approach to biomedical problem solving. “Data generated in one place can be truly accessible to everyone.”
- **Patient empowerment** — There is growing movement among patients for controlling sensitive information themselves to allow for sharing. “They generate it for free, they’re very interested in putting it together, and you’re not paying them to do it. We’ve got to find some way of pulling that data in, because of the depth of it.”
- **Gaming** — Open social media allows citizens and experts to use gaming to solve problems, often outperforming the so-called experts with advanced degrees. “When large groups of people get together and work on things, you’re tapping into an energy that doesn’t cost a lot of money.”

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