



The Future of Cyberinfrastructure and Communication

- an NIH perspective

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2009 Southeast IDeA Regional Meeting

November 11, 2009





The prevailing view of NIH...





NIH is 27 separately funded Institutes and Centers...

Bethesda, MD:

NIH Campus

Rockville, Poolesville, MD

NCI, NINDS, NIBIB, NIMH, NCRR

Baltimore, MD

Bayview Campus: NIDA, NIA

Frederick, MD

Frederick Cancer Research Center

Research Triangle Park, NC

NIEHS

Hamilton, MT

Rocky Mountain Laboratory





Promoting the nation's health through research.

- Not a monolithic Agency - 27 Institutes and Centers
- Intramural research (NIH labs) - 10% of the budget, 6,000 scientists
- Extramural research (grants) - 80-90% of the budget

NCI \$4.7B	NIAID \$4.3B	NHLBI \$2.9B	NIDDK \$1.8B	NINDS \$1.5B	NIMH \$1.3
NICHD \$1.2B	NIA \$1.0B	NIDA \$0.9B	NEI \$0.6B	NIHHS \$0.6B	NIAMS \$0.5B
NIAAA \$0.4B	NIDCD \$0.3B	NIDCR \$0.3B	NCMHD \$0.1B	NCCAM \$0.1B	NINR \$0.1B
NIGMS \$1.9B	NCRR \$1.0B	NHGRI \$0.4B	NLM \$0.3B	NIBIB \$0.2B	
CC	CIT	CSR	FIC	OD	



Center for Bioinformatics and Computational Biology (CBCB)

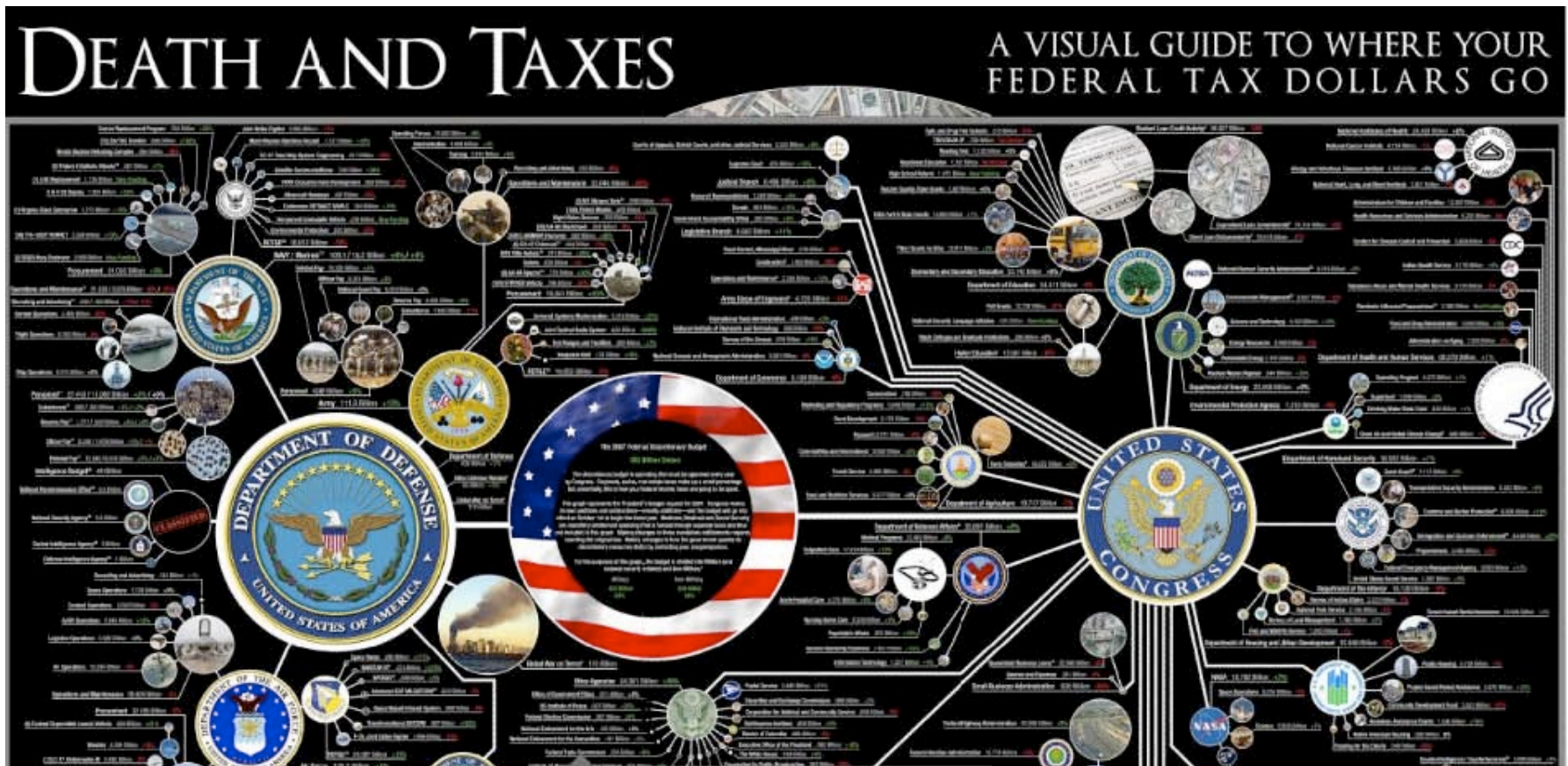


- **NIGMS:**
 - R01 portfolio in bioinformatics (interpreted very broadly), modeling, software development and maintenance...
 - Systems Biology Centers
 - MIDAS (Models of Infectious Disease Agent Study)
 - Training grants in Bioinformatics, and Biostatistics
- **Trans-NIH:**
 - Roadmap: National Centers for Biomedical Computing
 - BISTI: Biomedical Informatics Science and Technology Initiative
- **Inter-agency Coordination**





Check out: <http://www.thebudgetgraph.com>





Interagency Perspective on “Cyberinfrastructure”:

Exascale Bio Report
Just another press.mcs.anl.gov weblog

[About](#) [Section Input](#) November 11, 2011

Section Input

Post-workshop input from break out sessions:

1. Tissues, Organelles, and Physiology Modeling [\[slides\]](#) [\[section draft\]](#)
2. Pathways, Cells and Organelles [\[slides\]](#) [\[section draft\]](#)
3. Macromolecular Proteins and Protein Complexes [\[slides\]](#) [\[section draft\]](#) [\[draft v2\]](#) [\[challenges\]](#)
4. From Genomics and Populations to Ecosystems and Evolutionary Dynamics

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Interagency Perspective on “Cyberinfrastructure”:



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BLUE WATERS

SUSTAINED PETASCALE COMPUTING

About the Blue Waters project

- [Blue Waters Project](#)
- › [Petascale Science and Engineering](#)
- › [Computing System](#)
- [Illinois Petascale Computing Facility](#)
- [Education, Outreach and Training](#)
- [Industry Partnerships](#)
- [Project Office](#)

Blue Waters is expected to be the most powerful supercomputer in the world for open scientific research when it comes online in 2011. It will be the first system of its kind to sustain one petaflop performance on a range of science and engineering applications. The project also includes intense collaboration with dozens of teams in the development of [science and engineering applications](#), [system software](#), interactions with [business and industry](#), and [educational programs](#). This comprehensive approach will ensure that scientists and engineers across the country will be able to use Blue Waters to its fullest potential.

Scientists will create breakthroughs in nearly all

Apply for a Blue Waters allocation

[Petascale Computing Resource Allocations](#) from the National Science Foundation allow research teams to work closely with the Blue Waters project team in preparing their codes. Applications for these allocations are due once a year, throughout the life of the Blue Waters



Cyberinfrastructure and communications for NIH:



Some (of many) application challenges requiring major developments in biomedical cyberinfrastructure

- Assessment of the metabolic and regulatory potential of 1000s of microbes
- Quantitative imaging of macromolecules in single cells – through space and time
- Reverse engineering the brain
- Modeling the spread of infectious disease throughout the population
- Clinical data exchange across research centers – seamless, secure, coordinated



Cyberinfrastructure and communications for NIH:



What's the future?

- A “Cyber-capable” biomedical workforce
- Interdisciplinary crosstalk (*that's productive*)
- Leveraged software investments
- Community development

Communication,
Communication,
Communication





Cyberinfrastructure and communications for NIH:

- Develop new tools and computational approaches
- Enable new science
- Promote collaboration
- Encourage Reduce/Reuse/Recycle





Building a Cyber Capable Workforce:

Example: Cyber-capable training, as sponsored by NLM:

- Research training in biomedical informatics, including both graduate education and postdoctoral research experiences
- Wide range of areas including:
 - health care informatics
 - bioinformatics and computational biology
 - clinical research translational informatics, and
 - public health informatics
- Many programs also offer additional tracks in areas such as imaging, dental, and library informatics
- Currently programs at 18 educational institutions across the United States.





Building a Cyber Capable Workforce:

NIGMS: Pre-doctoral training program in Bioinformatics

Key Programmatic Features (beyond courses):

- Research rotations in both computational and biological domains

Goal: Scientists who are conversant in experimental biology as well as in theoretical biology, computational implementation, and application of new methodologies.



Building a Cyber Capable Workforce:

NIGMS: Pre-doctoral training program in Bioinformatics

Key Programmatic Features (beyond courses):

- Research rotations in both computational and biological domains
- Emphasis on problem solving, “computational thinking”

Independent scientists in the area of bioinformatics and computational biology need to be able to bring together knowledge from disparate domains in order to solve important problems.



Building a Cyber Capable Workforce:

NIGMS: Pre-doctoral training program in Bioinformatics

Key Programmatic Features (beyond courses):

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- Emphasis on problem solving, “computational thinking”
- Joint mentorship

Depth of scholarship in both computer science and biology



Building a Cyber Capable Workforce:

NIGMS: Pre-doctoral training program in Bioinformatics

Key Programmatic Features (beyond courses):

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- Emphasis on problem solving, “computational thinking”
- Joint mentorship
- Seminar series

Exposure to visiting scholars, and development an internal sense of the identity of their field--including its primary open challenges and problems for which satisfactory solutions exist.



An promising idea to watch: “Virtual School” program developing through the NCSA



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The Vaccination Theory of education(?)

From TEACHING AS A SUBVERSIVE ACTIVITY

Neil Postman & Charles Weingartner

English is not history and history is not science and
science is not art and art is not music,
and art and music are minor subjects and

English, history and science major subjects, and
a subject is something you 'take' and
when you have taken it, you have 'had' it, and
if you have 'had' it, you are immune
and need not take it again.





Building a Biomedical Cyberinfrastructure :

- BISTI Report (Botstein, Smarr, et al., 1999)
 - Recommended 5-20 National Programs of Excellence in Biomedical Computing
- P20 Planning Grants for National Program in Biocomputing
- NIH Roadmap process (2002-2003)
 - Internal competition among potentially transformative, trans-NIH concepts
 - Bioinformatics and Computational Biology one of nine areas selected





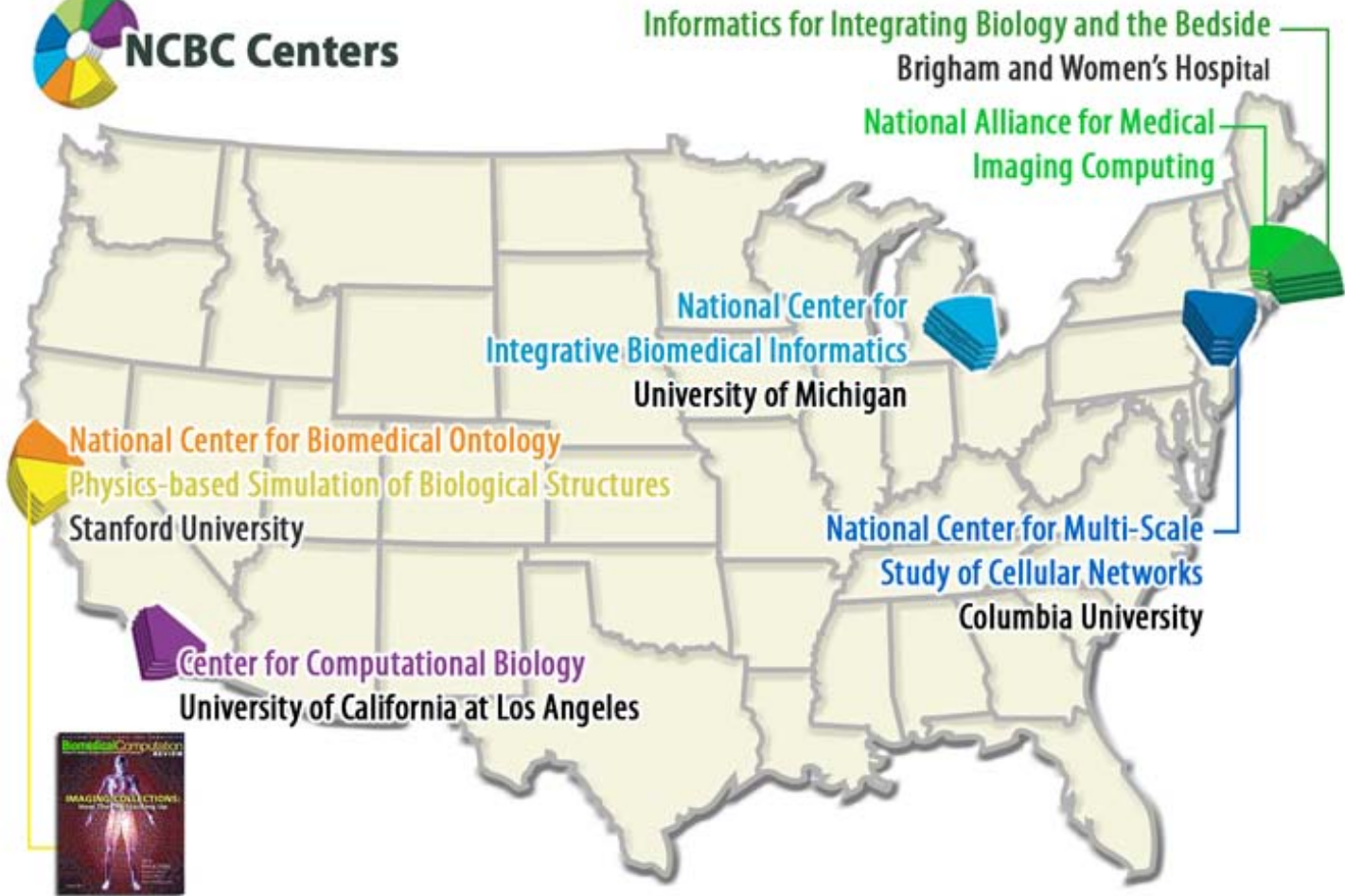
The National Centers for Biomedical Computing

- **National Center for Integrative Biomedical Informatics**
PI: [Brian D. Athey, Ph.D.](#)
Institution: University of Michigan
- **National Center for the Multi-Scale Analysis of Genomic and Cellular Networks**
PI: [Andrea Califano, Ph.D.](#)
Institution: Columbia University
- **National Center for Biomedical Ontology**
PI: [Mark A. Musen, M.D., Ph.D.](#)
Institution: Stanford University
- **Physics-based Simulation of Biological Structures**
PI: [Russ Altman, M.D., Ph.D.](#)
Institution: Stanford University
- **National Alliance for Medical Imaging Computing**
PI: [Ron Kikinis, M.D.](#)
Institution: Brigham and Women's Hospital
- **Informatics for Integrating Biology and the Bedside**
PI: [Isaac Kohane, M.D., Ph.D.](#)
Institution: Brigham and Women's Hospital
- **Center for Computational Biology**
PI: [Arthur Toga, Ph.D.](#)
Institution: University of California at Los Angeles





NCBC Centers



www.ncbcs.org





Building a Biomedical Cyberinfrastructure :

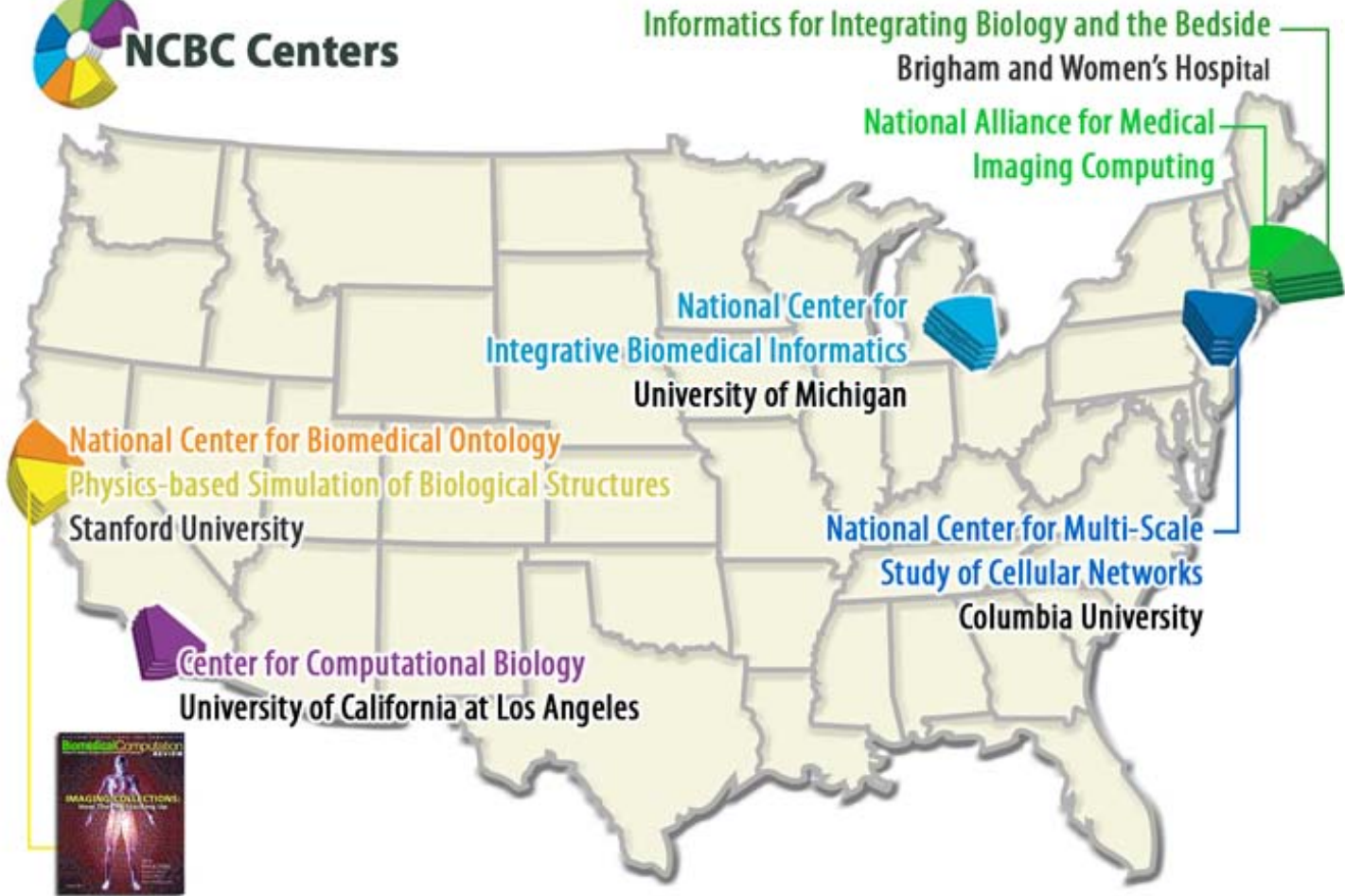
NCBC Goals

- ***Development*** of cutting edge computer science
- ***Translation*** of this computer science into biomedical computation, i.e., effective algorithms and environments for solving real biological problems
 - Enable the analysis, modeling, understanding, and prediction of dynamic and complex biomedical systems across time and distance scales
 - Allow the integration of biomedical and behavioral data and knowledge at all levels of organization





NCBC Centers



www.ncbcs.org





Building a Biomedical Cyberinfrastructure :

NCBCs Software and Data Integration Working Group

Mission Statement:

- To advance the domain sciences, and promote software interoperability and data exchange.
- To capture the collective knowledge of software engineering and practices among the Centers and publish this knowledge widely.





Building a Biomedical Cyberinfrastructure :

NCBCs competitive renewal just released:

RFA-RM-09-002 (See the NIH Guide for full details)

- Letter of intent requested by Dec 9th, 2009
- Receipt date: January 8, 2010
- Total cost cap per center of \$3.5M





“BISTI”

***The Biomedical Information Science and
Technology Initiative***



BISTI Website: <http://www.bisti.nih.gov>



Biomedical Information Science and Technology Initiative (BISTI) - Windows Internet Explorer

http://www.bisti.nih.gov/

Search web... Google

Google Search

Biomedical Information Science and Technology ...

BISTI

Biomedical Information Science and Technology Initiative

Your source for biomedical informatics at NIH

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The **Biomedical Information Science and Technology Initiative** is a consortium of representatives from each of the NIH institutes and centers. BISTI was established in May 2000 to serve as the focus of biomedical computing issues at the NIH.

The mission of BISTI is to make optimal use of computer science and technology to address problems in biology and medicine by fostering new basic understandings, collaborations, and transdisciplinary initiatives between the computational and biomedical sciences.

In support of this mission, the BISTI coordinates research grants, training opportunities, and scientific symposia associated with biomedical computing. Regular monthly meetings are conducted to discuss program status, future needs and directions, and topics of interest to the bioinformatics community.


[NIH Working Definition of Bioinformatics and Computational Biology](#), July 2000

Funding




Funding for biomedical informatics is spread broadly across NIH Institutes and Centers. The NIH Guide is available for customized searches of current announcements. BISTI coordinates several cross-cutting opportunities. [Read more about funding »](#)

Library




BISTI-related reports, white papers, and other documents are posted in our online library for reference. [Read more in the BISTI library »](#)

Related Initiatives



Links to an alphabet soup of programs related to BISTI are consolidated here in

Intramural Research



NIH is home to a rich intramural research community. [Read more about](#)

http://www.bisti.nih.gov/index.asp

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BISTI Website: <http://www.bisti.nih.gov>

BISTI Biomedical Information
Science and Technology Initiative
Your source for biomedical informatics at NIH

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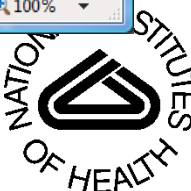
BISTI R01 Contact List

IC	Contact	Email	Phone No.
National Institute of Allergy and Infectious Diseases (NIAID)	Dr. Cheryl Kraft	CKraft@niaid.nih.gov	301-496-7551
National Institute of Allergy and Infectious Diseases (NIAID)	Ms. Valentina Di Francesco	VDiFrancesco@niaid.nih.gov	301-496-1884
National Institute of Neurological Disorders and Stroke (NINDS)	Dr. Yuan Liu	liuyuan@ninds.nih.gov	301-496-0012
National Institutes of Diabetes and Digestive and Kidney Diseases (NIDDK)	Dr. Arthur Castle	CastleA@mail.nih.gov	301-541-7719
National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)	Dr. Gayle Lester	gl83g@nih.gov	301-594-5055

Funding Categories

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- [Funding Process](#)
- [Funding Contacts](#)
- [Funded Projects](#)

<http://www.bisti.nih.gov/index.asp> Internet | Protected Mode: On 100%



PAR-07-344: *Innovations in Biomedical Computational Science and Technology (R01)*



Supports R&D in computational science and technology to enable rapid progress in areas of scientific opportunity in biomedical research. Includes areas such as:

- database design
- graphical interfaces
- querying approaches
- data retrieval
- data visualization and manipulation
- data integration through the development of integrated analytical tools
- tools for electronic collaboration
- development of structural, functional, integrative, and analytical models and simulations.





...ACROSS AGENCIES





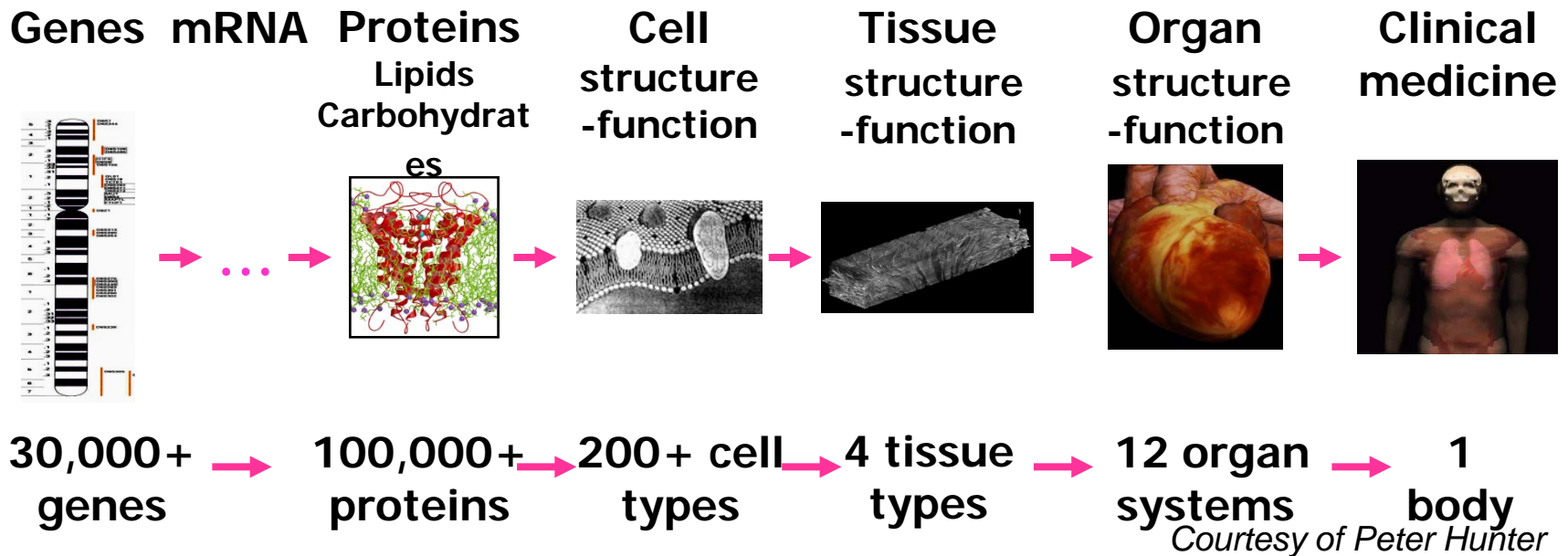
Some Cyber Related Inter-Agency Activities:

- Networking and Information Technology Research and Development (NITRD)
- Interagency Modeling and Analysis Group (IMAG) NSF 04 607
- Collaborative Research in Computational Neurosciences (CRCNS) NSF 04 514
- Dynamic Data Driven Applications Systems NSF 05 570
- Multi-Agency Tissue Engineering Science (MATES) Working Group
- The Biomaterials and Medical Implant Science (BMIS) Coordinating Committee
- Roundtable on Biomedical Engineering Materials and Applications (BEMA)
- Interagency Image Guided Interventions (IGI)
- Joint NSF-NIH Initiative to Support Research in the Areas of Mathematical Biology NSF 04 572, NSF 06 607



Multiscale Modeling

Spanning scales from molecular to population, designed to illuminate biological processes and further the predictive capability in biological, biomedical and environmental systems. Multi-scale modeling encompasses concepts of space, time and state space.



Biological Scales



Interagency Modeling and Analysis Group

IMAG Multiscale Modeling (MSM) Consortium Working Groups

- Filament Dynamics and Simulation (FDS)
- Cardiac and Skeletal Muscle Physiology
- Macro-To-Micro Scale Transport in Human Systems
- Cell Level Modeling
- High Performance Computing, Computational Issues and Algorithms
- Tissue Mechanics
- Multiscale Imaging
- Theoretical Methods
- Nano-modeling
- Model Sharing



Contact: Grace Peng, NIBIB, email: penggr@mail.nih.gov





Building a Biomedical Cyberinfrastructure :

The CHALLENGES of computational funding at the NIH





Support of NIH Study Sections, when it comes to interdisciplinary teams and emerging areas:





To encourage fair review in emerging areas:

- Special Emphasis Panels for targeted FOAs
- Multiple PI applications
- Encouragement of “New” Investigators
 - IC-level policies to boost likelihood of funding
- “Enhancing Peer-Review” effort





Another challenge: appropriate funding mechanisms

- Interdisciplinary science – interdisciplinary teams
- Multiple PIs - strong leadership and shared vision
- Sustainable funding plans





NIH Center for Bioinformatics and Computational Biology

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