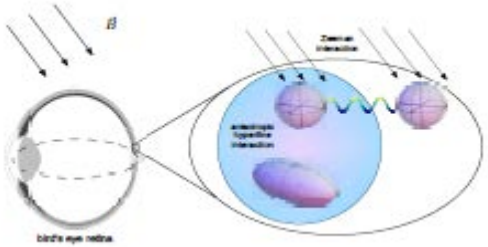
Frontiers of Science and Engineering Education: Interdisciplinary Research, Teaming, and Organizations

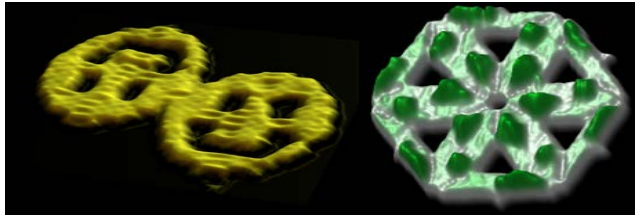
Mark Ritter, Ph.D.
Senior Manager, Physical Sciences
IBM T.J. Watson Research Center
Yorktown Heights, New York

April 30, 2014
Session 3.5 Rm B116 15:00
Going Global 2014, Miami

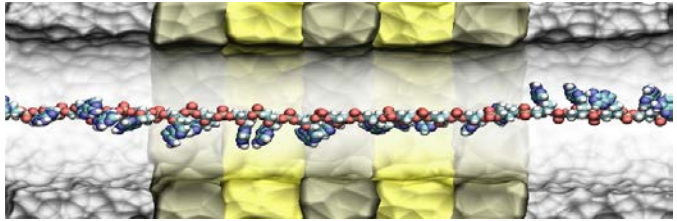
Examples of Multi-disciplinary Science



Avian Compass: combines
Biology, Physics, Chemistry



Directed Self Assembly (DSA):
DNA "Molecular Programming"
Biology, Engineering, Computer Science



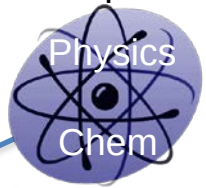
DNA Transistor:
Biology, Engineering, Physics

Greatest future potential comes from interdisciplinary innovation

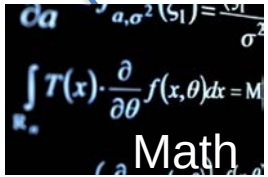
New Science and Engineering Frontiers

Describe Life
Improve Life

Foundational
Principles

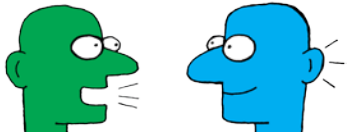


Integrative
Sciences of
the Future



Systems
Applications

Analytics
Algorithms



Ability to communicate ideas

Present-day Cross-disciplinary Innovations:

- Bioinformatics: Algorithms to explore genome, proteins, structures of bio-active molecules, first-steps of drug design
- Directed Self-assembly (DSA)
- Beginning of cognitive computing (Watson)
- Quantum computing

Future Integrative Sciences Innovations:

- HPC *ab initio* drug design
- Sequence patient's DNA and create target drugs
- DSA of nanodevices, new bio-inspired devices
- Cognitive computing comes of age

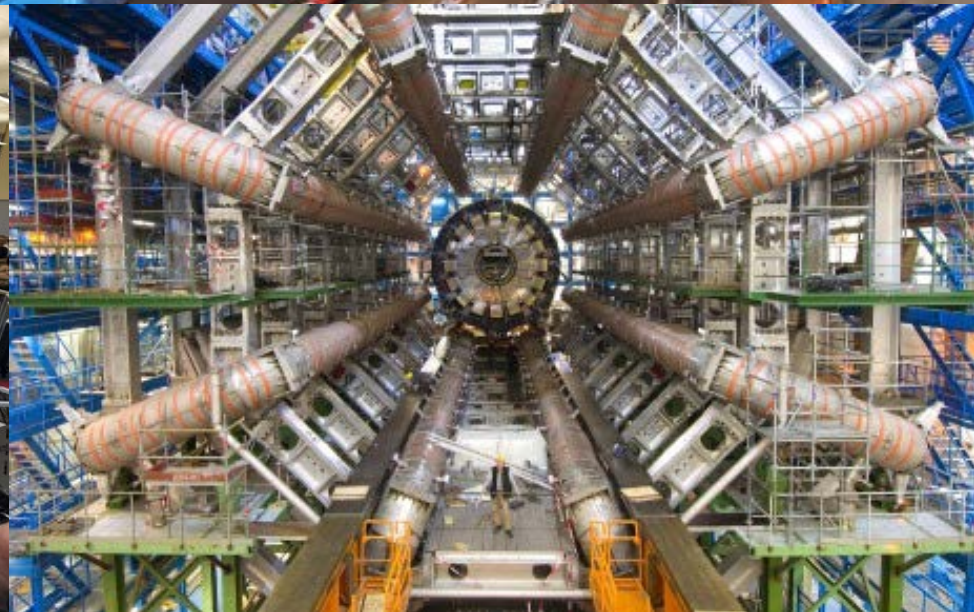
New Integrative Sciences require new curricula and approaches to teaching…

Engineering Education Requirements for New Leaders

- Curiosity and a desire to serve fellow men
- Sufficient depth in science and analytics
- Focus in one field with working knowledge of key concepts in more than one field
- Experience applying concepts and analytics across disciplines (integrative curricula)
- Understanding of key needs of society: food, energy, health, security, information, transportation, manufacturing, services
- Emphasis on key leadership requirements: responsibility and respect, vision, sound ethics, collaboration (teaming), organization

Leaders of the future require a revised mix of depth and breadth to meet challenges

Concise Requirements for Success

- Vision
- Resources
- People with drive and skills

Organization for Teamwork