Opportunities and Challenges in the Wiess School of Natural Sciences
Understanding Our Roots

• Edgar Odell Lovett’s vision
  “No upper limit” to our aspirations

Commitment to “investigation” as well as to “instruction”

• Rice’s first 100 years provides an inspiring basis for our future and propels our ambitions
Rice Seeks:

• To be a *leading* intellectual center
• To attain a position of distinction in research/graduate education
• To strengthen its standing among the best undergraduate institutions
• To provide national leaders in impact and service to society
Wiess School Strengths

• Great new hires — dynamic/collégial
• High rankings reflect quality of work
• High level of research funding ($34M 2005)
• Innovative research programs
• Leadership in interdisciplinary areas
• High standards for undergraduate teaching and research engagement
Wiess School Challenges

• Retaining excellent faculty
• Generating name recognition — size/location
• Attracting the best graduate students and post-docs
• Communicating importance of basic research
• Uncertain federal funding future
• Maintaining momentum and energy level
Wiess School Opportunities

- Have leadership ready to take next step
- Enhance reputation with what we *are*!
- Leverage our strong faculty base
- Positions through retirements
- Expand unique and highly visible postdoctoral programs
- Engage and reward the loyalty of staff
- Utilize resources outside hedges
Faculty Retention

Younger faculty see the world differently
– Look for places they can succeed, more mobile
– Aware of institutional context for their cohorts

Demands on faculty are unprecedented
– Ambitious in their career goals
– Larger, more dynamic research programs
– Highly competitive, demanding research pace

Retention of our talented faculty will make or break our future!
Wiess School Strategic Goals

• Support and sustain a culture of achievement

• Demand excellence in our research and education programs

• Enhance our visibility

• Craft bold new initiatives that leverage our strengths
Interdisciplinary Environment Leverages Disciplinary Strengths

Rice University

Wiess School of Natural Sciences
- Biochemistry & Cell Biology
- Chemistry
- Ecology & Evolutionary Biology
- Earth Science
- Mathematics
- Physics & Astronomy

Institutes and Centers
- SINST
- RQI
- IBB
- CITI
- EESI
- RSI
- GCC
- BIPP

Brown School of Engineering
- Bioengineering
- Chemical and Biomolecular Engineering
- Civil & Environmental Engineering
- Computational & Applied Mathematics
- Computer Science
- Electrical & Computer Engineering
- Mechanical Engineering & Materials Science
- Statistics
Biochemistry & Cell Biology
George Bennett, Chair
Biology Building, George Brown Hall, Keck Hall

20 Faculty (1 open), 3 Faculty Fellows
71 graduate students
Degrees: BA, BS, MA, PhD
165 majors, 2750 students with EEB

Research Areas
$6,076,000 Research Expenditures
Sequence, structure, and function of macromolecules
Signal transduction and neurobiology
Plant biochemistry and genetics
Molecular biophysics and protein engineering
Biological chemistry and metabolic engineering
Cell and developmental biology
Microbiology and molecular genetics

Special Activities
NIH and NSF Training Grant Programs in IBB
Keck Center for Interdisciplinary Bioscience Training
K12 Outreach Programs

US News Rank for Biology
#51
(243 programs, 21%ile)
Ecology & Evolutionary Biology
Joan Strassmann, Chair
Biology Building

9 Faculty, 2 Huxley Fellows
25 graduate students
Degrees: BA, BS, MA, MS, Prof. MS, PhD
45 majors, 2750 students with BCB

Research Areas
$1,484,000 Research Expenditures

Community Ecology/Conservation Biology
Evolution and Social Behavior
Cooperation and Mutualism

Special Activities
Lynn Lowery Arboretum
Field Study Sites — on campus, regionally and internationally
Wray-Todd Graduate Fellows Program
Center for the Study of Environment and Society
Houston Arboretum
Chemistry
Ken Whitmire, Chair
Dell Butcher Hall, George Brown Hall, Space Science Building, Biology Building

23 Faculty (4 open), 4 Faculty Fellows, 2 Instructors  105 graduate students
Degrees: BA, BS, MA, PhD  34 majors, 2600 students
undergraduates

Research Areas

$11,661,000  Research Expenditures

Development of nanoscale materials and processes
  – Carbon nanomaterials
  – Self-assembling polymers for molecular computing

Synthesis of pharmacologically interesting materials

Theoretical and computational approaches to chemical
  and biochemical processes

Materials science and molecular electronics

Catalysis

Special Activities

Nanotechnology

Owlchemy — ACS Undergraduate Affiliates

US News Rank
#31
(194 programs, 16%ile)
Earth Science
Alan Levander, Chair
Keith - Wiess Geological Laboratories

18 Faculty (4 open), 15 adjunct faculty from community
48 graduate students
Degrees: BA, BS, MS, Professional MS, PhD
16 majors, 745 students

Research Areas
$2,097,000 Research Expenditures
Earth Structure and Dynamics/Evolution of the continents
– Tectonics, high temperature geochemistry, seismology
  geodynamics, solid earth geophysics
Earth Systems Science
– Global change, paleoclimatology, low temperature geochemistry
– Surficial processes, environmental research
Energy Resources
– Sedimentology, reflection seismology, basin analysis,
  physical/chemical processes in fluid-saturated media

Special Activities
Rice Type-Locale Field Trip, K-12 Outreach programs
Center for Computational Geophysics / CITI / EESI
Engagement with petroleum and space communities

US News Rank
#25
(105 programs, 24%ile)

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Mathematics
Michael Wolf, Chair
Herman Brown Hall

14 Faculty, 5 Evans Instructors, 2 VIGRE Instr.
Degrees: BA, MA, PhD

29 graduate students
35 majors, 1850 students

$966,000 Research Expenditures

Research Areas
Ergodic Theory
Combinatorics
Algebraic and Geometric Topology
Differential Geometry
Algebraic Geometry & Number Theory
Differential Equations/Real & Complex Analysis
Mathematical Physics

Special Activities
Rice University School Mathematics Project
VIGRE Program (joint with CAAM and Statistics)

US News Rank
#26
(159 programs, 16%ile)
Physics & Astronomy

F. Barry Dunning, Chair

Herzstein Hall, Herman Brown Hall, Biology Building, Space Science, Dell Butcher Hall

37 Faculty, 5 Faculty Fellows, 2 Instructors
119 graduate students

Degrees: BA, BS, MA, MS, Prof. MS, MST, PhD
41 majors, 1800 students

Research Areas

Atomic, Molecular, & Optical Physics
Biophysics
High-energy Astrophysics
High-energy/Nuclear Physics
Nanoscale Science
Observational Astronomy
Space Plasma and Solar Physics
Surface and Condensed Matter Physics

Special Activities

Public Connection Outreach Program
Public Viewing Nights at On-Campus Observatory

$9,300,000 Research Expenditures

US News Rank
#27 (#9 in AMO Physics)
(161 programs, 17%ile)
Goal: To develop informatics in all areas

Members: ~120 faculty from across multiple Schools

Program areas and centers include:

- Center for High Performance Software (HiPerSoft)
- Center for Multimedia Communication (CMC)
- Center for Computational Geophysics (CCG)
- Center for Computational Finance and Economic Systems (CoFES)
- Center for Technology in Teaching and Learning (CTTL)
- Center for Excellence and Equity in Education (CEEE)
- Research groups in dynamical systems, statistical consulting, bioinformatics, robotics, sensor nets, computational neuroscience
- Rice Terascale Cluster
Energy & Environmental Systems Institute
Walter Chapman, Director

Goal: To build a bridge to a sustainable, affordable, and secure energy future

Members: >65 faculty from six Schools at Rice

Program areas and centers include:

- Sustainable energy strategies — biofuels and biomass
- Nano applications — quantum wire, photonics
- Climate change — carbon cycle
- Fossil fuels — enhanced oil recovery, gas hydrates, robotics
- Projects — Rice/China Center on Environmental Remediation & Sustainability, International Consortium for Environment & Nanotechnology Research, Center for Study of Environment & Society
- Industrial consortia in porous media, brine chemistry, inversion modeling
Institute of Bioscience and Bioengineering
Jennifer West, Director

Goal: Promote cross-disciplinary research and education encompassing the biological, chemical, and engineering disciplines

• Facilitate interdisciplinary research and education
• Foster ties with TMC and create partnerships with industry
• Promote translation of research

Members: ~100 faculty from Rice, TMC, and NASA JSC

Programs:
• NIH Biotechnology Training Grant
• NSF IGERT in Cellular Engineering
• Cox Laboratory for Biomedical Engineering
• Greenwood Laboratory for Metabolic Biochemistry
• Center for Excellence in Tissue Engineering
Rice Quantum Institute
Randy Hulet, Chair, Steering Committee
Bruce Johnson, Executive Director

Goal: Develop programs based at the quantum level
- Quantum electronics and electronic devices
- Photonics and plasmonics
- Atomic and molecule sciences
- Materials science and engineering

Members: ~60 faculty from across Natural Sciences and Engineering

Programs:
- Applied Physics Ph.D. Program
- Laboratory for Nanophotonics
- Laboratory for Ultracold Atoms
- Laboratory for Quantum Magnetism
- Summer REU program and Symposium
Rice Space Institute
Patricia Reiff, Director

Goal: To “Make the universe smaller”

• Facilitate interdisciplinary research and education
• Chart the course for next generation of peaceful uses of space

Members: ~45 faculty from Rice, TMC, and NASA JSC
~90 staff and student members
~138 community associates

Program areas include:

• Public Connection and IMAGE outreach programs
• Seminar series — Marlar Distinguished Lecture Series
• Texas Space Grant consortium
• Research in space weather, exploration, astrophysics, technology, history and public policy, remote sensing
Smalley Institute for Nanoscale Science & Technology
Wade Adams, Director

Goal: Sustain our leadership role in nanoscale science and engineering

- Carbon nanotubes — multiple applications in energy, medicine and aerospace, among others
- Nanoshells — photonics, medical diagnostics and treatment
- Nanocrystals — photonics, sensors, biomaterials
- Nanomembranes — filters, composites, catalysts

Members: >100 faculty from >13 departments

Programs:
- Center for Biological and Environmental Nanotechnology (CBEN)
- Shared Equipment Authority
- Carbon Nanotechnology Laboratory
Need for Basic Research:
We don’t know what we don’t know

• Curiosity-driven exploration opens new areas

• Essential first step on road to applications

• Examples
  - Buckyballs, Magnetic resonance (MRI), Restriction enzymes (DNA revolution)....
Research Expands Frontiers of Science and Society

- Prepares students to succeed in a world that is in constant change
- Creates critical thinkers that can convert knowledge to deeper wisdom
- Provides experiences linking classroom to the world — defining moments of connection
Wiess School Research

- Covers many areas
  ....But can only highlight a few (see department web pages for more)
- Explores exciting new horizons
- Opens novel possibilities for future applications
Wiess School Research

• For details on all our research:

http://biochem.rice.edu/
http://www.chem.rice.edu/
http://earthscience.rice.edu/
http://eeb.rice.edu/
http://math.rice.edu/
http://www.physics.rice.edu/
Shapes of Nature

• What shapes are possible?
  Can form a variety of stable and unstable shapes — predicted mathematically

• Gold nanostars
  Novel shapes to for oriented detection schemes
Shape as Form/Function

- Filled buckyballs and buckytubes for contrast or delivery
- Creating new states of matter - superfluid condensates with novel properties
New Structures

• Gas hydrates
  - Likely source of climate change
    Buried shallowly at continental margins
    Small temperature change can release
  - Potential source of energy

[Image of gas hydrate molecule] [Map indicating locations of gas hydrates]
Understanding Natural Processes

• How organisms sense gravity

• How plants regulate gene expression
Unexpected Connections

- Effect of environmental factors on invasive species
- Evolution of warfarin resistance — human cardiovascular disease, osteoporosis, and vitamin K
Wiess School Strategic Goals

• Support and sustain a culture of achievement and leadership

• Demand excellence in our research and education programs

• Enhance our visibility

• Craft bold new initiatives that leverage our strengths
Tactical Goal #1

- Provide space, resources, and infrastructure for cutting-edge research and educational endeavors
  - New Physics/Sci-Eng building
  - Enhance infrastructure support and staff initiative/leadership
  - Utilize local resources to support faculty more effectively
Tactical Goal #2

• Foster an intellectually exciting research environment
  - Nurture a culture of excellence and promote leadership
  - Ensure competitive salaries and start-up packages
  - Provide staff professional development
  - Create named fellowship programs for post-docs and graduate students
Tactical Goal #3

- Ensure recognition nationally and internationally
  - Create an effective web presence with “Rice” brand
  - Educate national and international communities about Rice
  - Support faculty-organized symposia on campus
  - Engage Houston community creatively
Tactical Goal #4

- Support core endeavors, be highly selective in new initiatives, and provide effective support
  - Ensure support for core activities
  - Develop seed funding for new initiatives
  - Identify what we are already doing that provides opportunities for leverage
Possible New Initiatives

Energy
- Nanoenergy/Quantum wire
- Biofuels
- Enhanced Recovery
- Imaging
- Gas Hydrates

Evolution
- Evosynthesis
- Synthetic Biology
- Pathogen evolution

Post-doc Program
Graduate Fellowships
Undergraduate Opportunities

Quantum World
- Ultracold atoms
- Magnetism
- Photonics

Health
- Nano-based detection/treatment
- Pathogen evolution
- Novel pharmaceuticals
Tactical Goal #5

• Integrate undergraduates, graduates, postdocs, and faculty into effective teams for leadership

- Recruit/support outstanding post-docs
- Enhance graduate programs
- Expand support for undergraduate research participation
Undergraduate Research Participation

- Engages students in solving problems for which answer is unknown or uncertain, demands *thinking* in a new way
- Provides opportunities to interact with postdocs and graduate students
- Creates opportunities outside Rice for collaborative experiences (QEP/CCE)

>60% of Natural Sciences undergraduate majors engage in a research experience – want to expand this number!
Rice’s Energy Journey

Energy Level

Time Course of Rice’s Path

*Aspiration*
Major US intellectual center

Regional Institution with High Aspirations

Excellent Undergrad Institution

Excellent Research, Grad & Undergrad Institution

2006
Our Future

- Depends on ability to be the university of choice for the brightest and the best
  - Recruit and retain outstanding faculty, staff, postdocs, graduate & undergraduate students
  - Provide excellent infrastructure
  - Pursue the most challenging problems
  - Make Rice highly visible as top-tier research/educational institution

Quality/quantity of space, quality of staff support, faculty retention/recruitment will control our future
Intellectual Leadership

• Influencing decisions for future directions
• Shaping the thinking in our spheres of activity
• Defining the parameters and being the source of new ideas, new capabilities, and new technologies

Empower and engage our faculty and students in going for the “gold”
Our Future...is Open......

• We must seize the opportunities and face the challenges