Making Undergraduate Education an Integral Part of the Global Research University

Dr. G. Wayne Clough, President

Georgia Institute of Technology

Transforming the Culture: Undergraduate Education and the Multiple Functions of the Research University
November 10, 2006

The new context for higher education

- Societal forces

- Economic forces

- Competing in the "flat world"

- Pressure to become a driver of high-end economic development

- Educating the workforce in a world in which routine work is commoditized
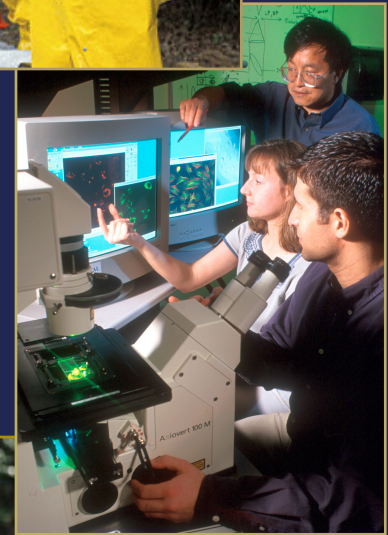
Societal forces

➤ Growing population

➤ Fresh water shortages

➤ Terrorism; wars in Iraq, Afghanistan

➤ New diseases

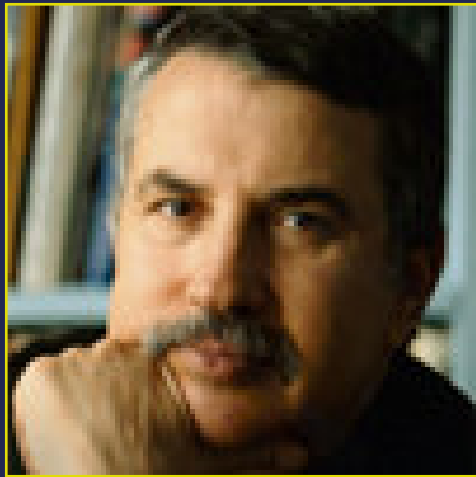➤ Global warming, environmental problems

➤ Coastal development

Economic forces

- Internet/high-speed communications

- Markets have opened up

- Emergence of technology-based economies in other nations

- Sustained investment in higher education in countries like China and India

Competing in the flat world

"It is now possible for more people than ever to collaborate and compete in real time with more other people on more different kinds of work from more different corners of the planet and on a more equal footing than at any previous time in the history of the world."

Thomas L. Friedman
The World is Flat

Competing in a world in which…

➢ U.S. produces only one of every 4-5 inventions.

➢ Our wages and health-care costs are higher than those of our competitors.

➢ The largest high-tech markets are in Asia.

➢ The largest technological workforces are in other nations.

"We came to India for the costs, we stayed for the quality, and now we're investing for the innovation."

Dan Scheinman, Senior VP, Cisco

"The big winners in the increasingly fierce global scramble for supremacy will not be those who simply make commodities faster and cheaper than the competition. They will be those who develop talent, techniques, and tools so advanced that there is no competition."

Sustaining the Nation's Innovation Ecosystems, Information Technology Manufacturing and Competitiveness, PCAST

Universities as drivers of innovation

- Educate the talent

- Conduct fundamental research that provides discoveries and knowledge

- Promote technology transfer and commercialization

Universities and their graduates will compete in a world in which…

➢ Jobs migrate to the place of lowest cost as their economic sector becomes commoditized.

➢ An understanding of the global forces driving the world becomes more critical.

➢ Future success for the United States is at the highest end of the innovation spectrum.

"In tomorrow's world, a nation's wealth will derive from its capacity to educate, attract, and retain citizens who are able to work smarter and learn faster – making educational achievement ever more important both for individuals and for society at large."

A Test of Leadership: Charting the Future of U.S. Higher Education
Report of the Spellings Commission on the Future of Higher Education

Reinventing undergraduate education

ABET

Transforming accreditation criteria

NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES

NAE's Engineer of 2020

Georgia Tech's undergraduate initiative

# Transforming accreditation criteria

- ABET revised engineering accreditation criteria (EC2000) to emphasize outcomes rather than inputs.

- New criteria specify 11 learning outcomes in which students must demonstrate achievement.

- Criteria emphasize problem solving, communications skills, teamwork in addition to scientific and technological knowledge and abilities.

- Include ethical and social context for professional practice.

Study documents impact

- Changes are occurring in
  - Curriculum
  - Teaching methods
  - Faculty practices
  - Student experience
- Recent grads have a better understanding of societal and global issues, professional and ethical issues; are better at group skills, can apply skills and principles better
- Majority of employers report improvements, find recent graduates better prepared, although still room for improvement

Study by Penn State Center for the Study of Higher Education commissioned by ABET
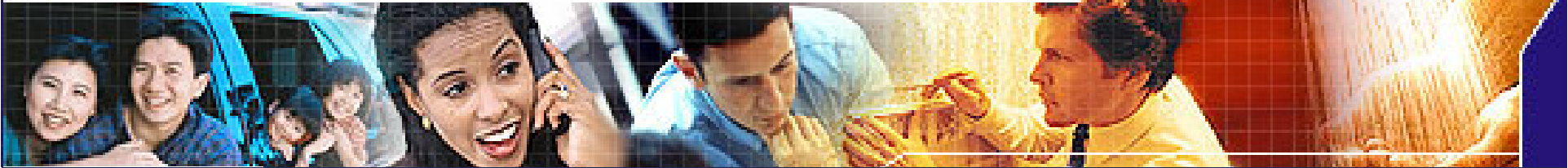
Engineer of 2020: The premise

➤ Past: Engineering education changed only when driven to do so.

➤ Present: A reactive posture puts engineering education at risk in a time of rapid change.

➤ Premise: Anticipate the future and shape engineering education in advance to create a significant, dynamic role for our profession.

The process

➢ Phase I: Imagine the future and the challenges it will present to engineering: Woods Hole Workshop

➢ Phase II: Consider how engineering education should prepare for that future: Washington DC Summit
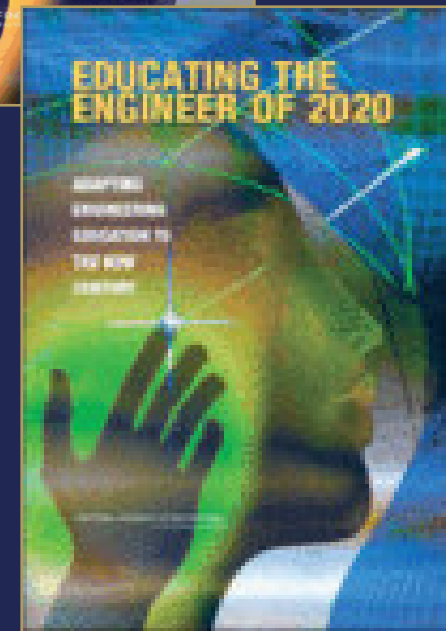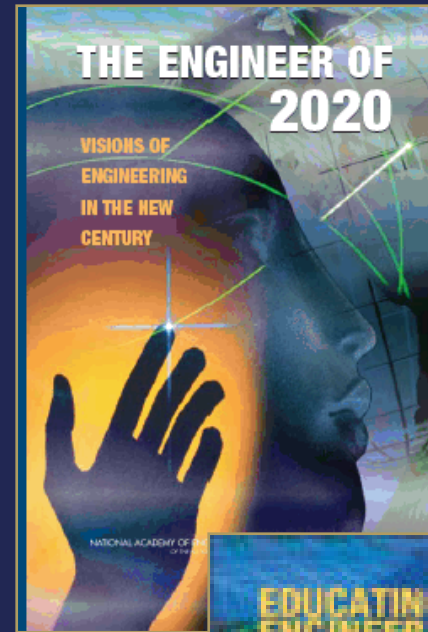
Phase I: Scenario-based planning

➢ Facilitated by Peter Schwartz, author of *The Art of the Long View*

➢ Scenarios considered:

   ▷ The Next Scientific Revolution

   ▷ The Biotechnology Revolution in a Societal Context

   ▷ The Natural World Interrupts the Technology

   ▷ Global Conflict/Globalization
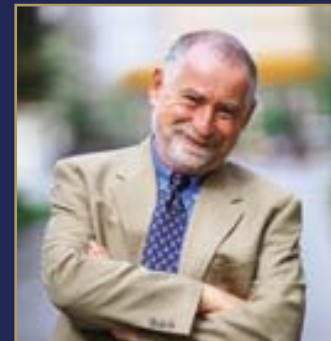
Phase II: Engineering education

➢ Attract best and brightest with a forward-looking education

➢ Educate them to be ready:

    ▷ To implement new technology

    ▷ To focus on innovation

    ▷ To understand global trends
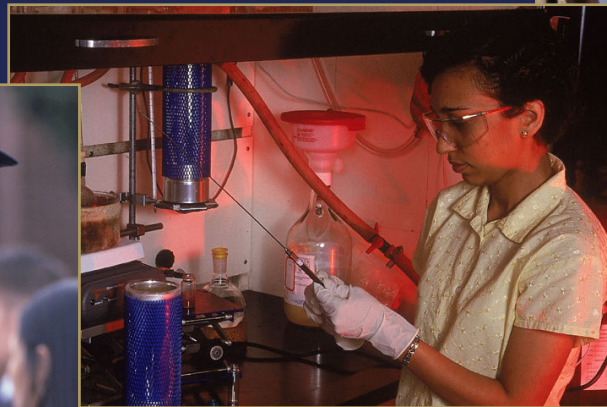
Attributes of the Engineer of 2020

"He or she will aspire to have the ingenuity of Lillian Gilbraeth, the problem-solving capabilities of Gordon Moore, the scientific insight of Albert Einstein, the creativity of Pablo Picasso, the determination of the Wright brothers, the leadership abilities of Bill Gates, the conscience of Eleanor Roosevelt, the vision of Martin Luther King Jr., and the curiosity and wonder of our grandchildren"

The Engineer of 2020
National Academy of Engineering
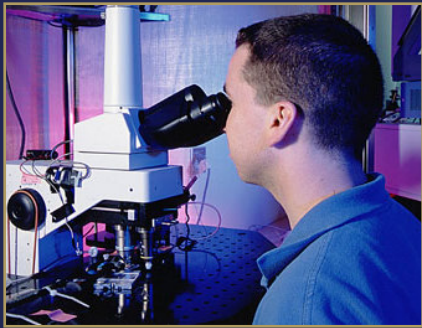
Reinventing the undergraduate experience at Georgia Tech

➢ Pioneering educational technology

➢ Reinventing the curriculum

➢ Shaping the space for interaction

➢ Educating citizens of the world

➢ Joining the research enterprise

➢ Preparing leaders

➢ Expanding the right brain experience

➢ Helping faculty teach better

Pioneering educational technology

➢ Required computer initiative: every student required to have a computer that meets certain specifications

➢ Complete wireless and walk-up port environment

➢ Web enhancements to the curriculum:

▷ Hand-outs, reference materials online

▷ Answers to homework, tests provided online after the fact as a study tool

▷ Small groups "meet" online in chat rooms

▷ Computing tutors carry "work station in a backpack," hold tutorials in dorms, Campus Rec Center, Student Ctr

24/7 Library Commons

West Commons

- Multi-media center combines reference desk and IT help desk
- Sophisticated video, Web tools
- Doubled library usage

East Commons

- Flexible space combines living room comfort with latest in presentation technology
- Focus on group projects, collaborative study

Reinventing the curriculum

➢ Interdisciplinary degrees
  ▷ International affairs and modern languages
  ▷ Global economics and modern languages
  ▷ International affairs and economics
  ▷ History, technology, and society
  ▷ Science, technology, and culture
  ▷ Biomedical engineering
  ▷ Digital media

➢ Making the whole greater than the sum of the parts


At the Technical University of Munich

Professors Blair McIntyre, computing, and Jay Bolter, liberal arts, with student Maribeth Gandy

Weaving the curriculum from "threads"

➤ Undergraduates in computing customize their degrees around 2 of 8 "threads" or subject areas that utilizing computing, such as media, computational modeling, people, and platforms

➤ "Roles," which help students define what they want to do with their knowledge, are integrated with the threads.
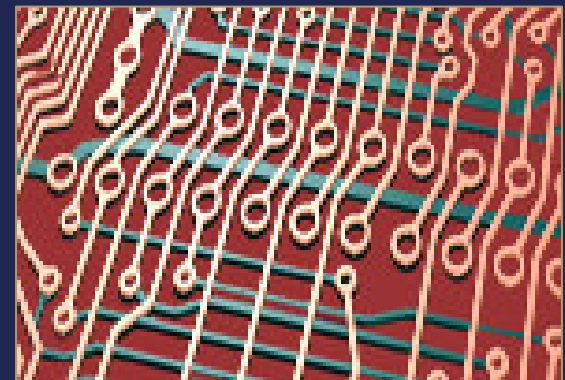
Problem-based learning
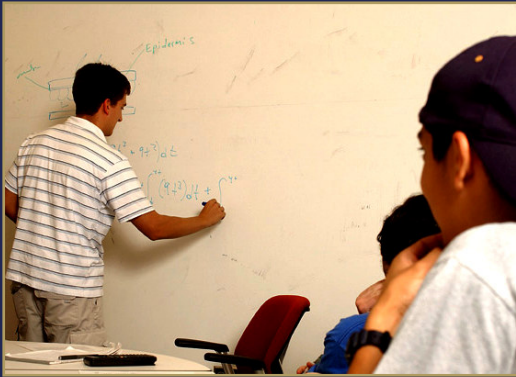
➢ Biomedical engineering: begins with first year students who work on real-life problems facing biomedical engineers today; do research, develop solutions, present to other students, faculty

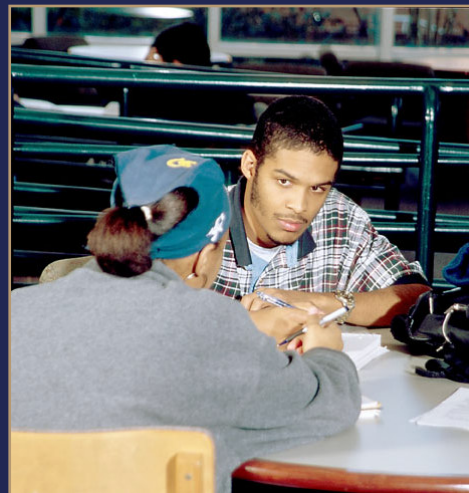➢ Classrooms support curriculum with small group workrooms that have walls you can write on

Shaping the space for interaction

From this…

…to this

Spaces for interaction interspersed among classrooms

Educating citizens of the world

- The International Plan
  - 14 majors offer degrees with International Designators
  - Courses in language, international affairs, global economics
  - Two study/work semesters abroad
- Work/study year abroad
  - Intensive language study first
  - Semester at technological university
  - Semester internship at international corporation

Aerospace Engineering major Don Niggley interned with Lufthansa in Hamburg, Germany

Five campuses on three continents

Georgia Tech Atlanta

Georgia Tech Lorraine

Georgia Tech Singapore

Georgia Tech Savannah

Georgia Tech Ireland
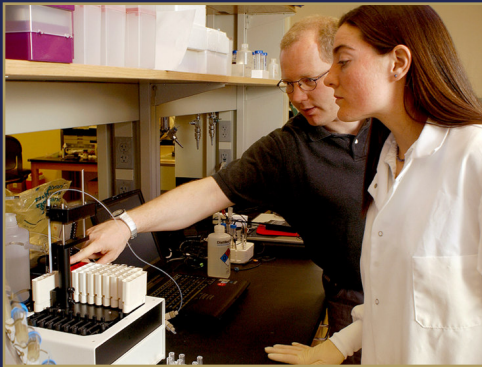
Reaching out beyond our borders

Students map the path of a pipeline to bring clean water to a remote Honduran village.

New Tech-Emory Center for Global Safe Water tackles water-related health issues. Latrine project in Bolivia won a World Bank Development Marketplace Award.

Joining the research enterprise

- ➢ 40% of undergrads are engaged in structure research activities
- ➢ Undergraduate Research Option
  - ▷ 9 credit hours of research
  - ▷ 2-hour course in dissertation writing
  - ▷ Write dissertation on results
- ➢ President's Undergraduate Research Awards provide funding on competitive basis

LEAD: Leadership Education And Development program

➢ Multiple opportunities for students to develop and practice leadership skills

Organizations   Workshops   Career portfolio
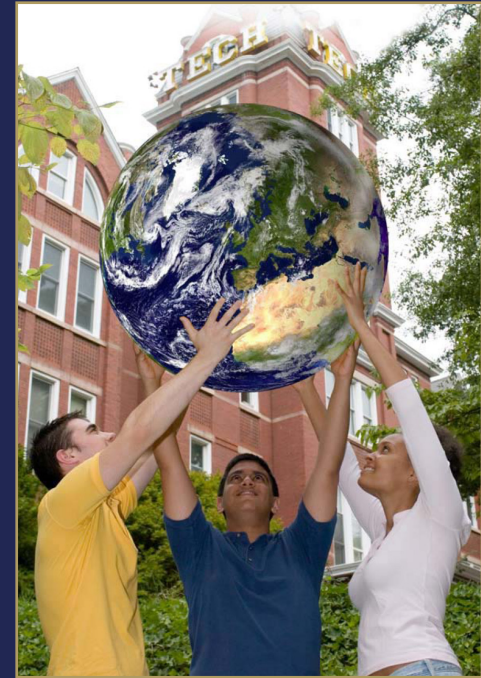Community service   Internships   Certificate program

➢ Certificate program in leadership

  ▷ 12-hour program in the School of Public Policy

  ▷ Courses in social, political, economic, cultural, global, technical dimensions of leadership; theory, skills, teamwork, communication

  ▷ Knowledge, skills applied and refined in an internship

Expanding the right brain experience

- At any given time, over 1,000 undergraduates engaged music

- Pioneering music technology

- One of the nation's most aggressive poetry programs with 2 endowed chairs

- Packed-house poetry readings with nation's leading poets

McEver Chair in Poetry Tom Lux

Helping faculty teach better
Center for the Enhancement of Teaching and Learning

➢ Young faculty learn teaching skills

➢ Older faculty update teaching style, learn to incorporate technology

➢ Graduate students "test drive" teaching at local high schools

➢ 1999 Hesburgh Award for Faculty Development to Enhance Undergraduate Teaching and Learning
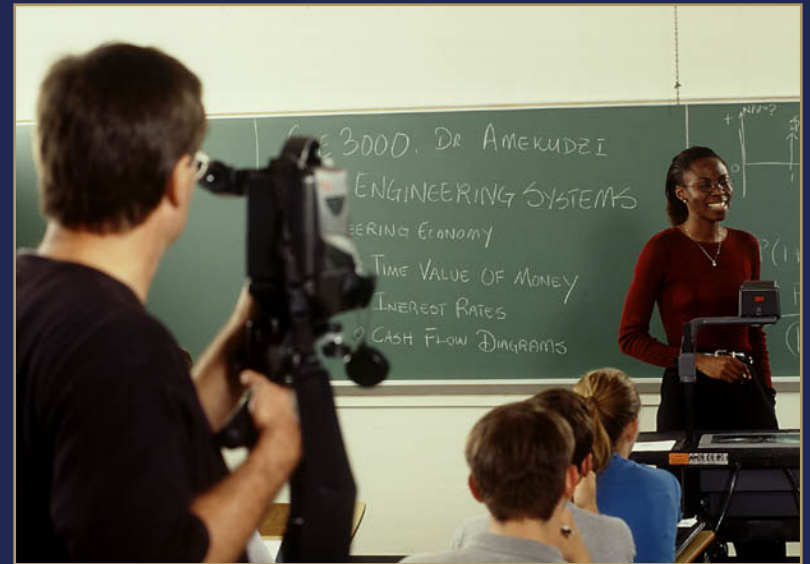
"The emerging global university is set to be one of the transformative institutions of the current era."

"The brains business"
The Economist, September 2005