Trends in Engineering Education

Driving Change:
Greening the Automotive Workforce
Center for Automotive Research
May 4, 2011

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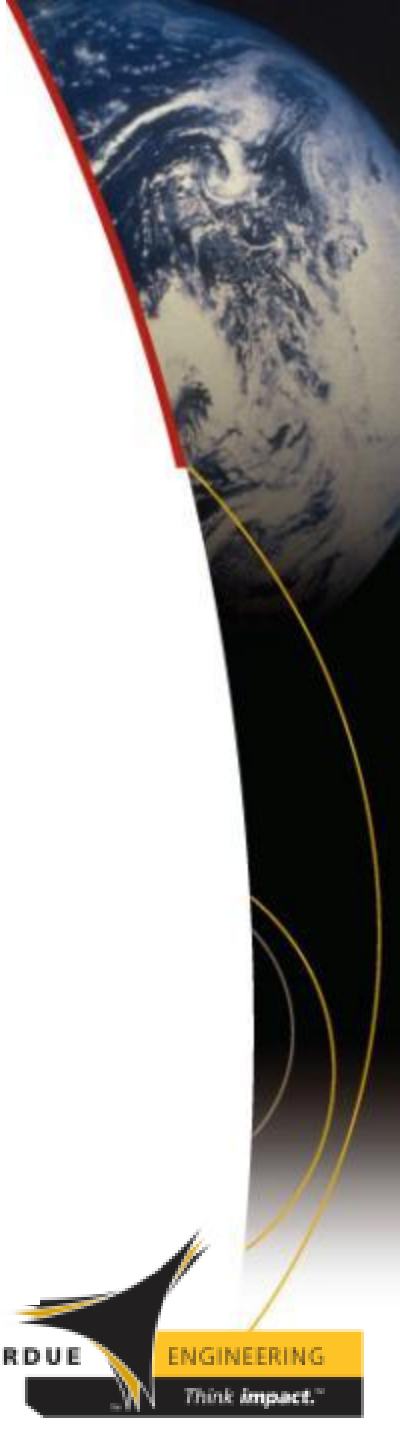
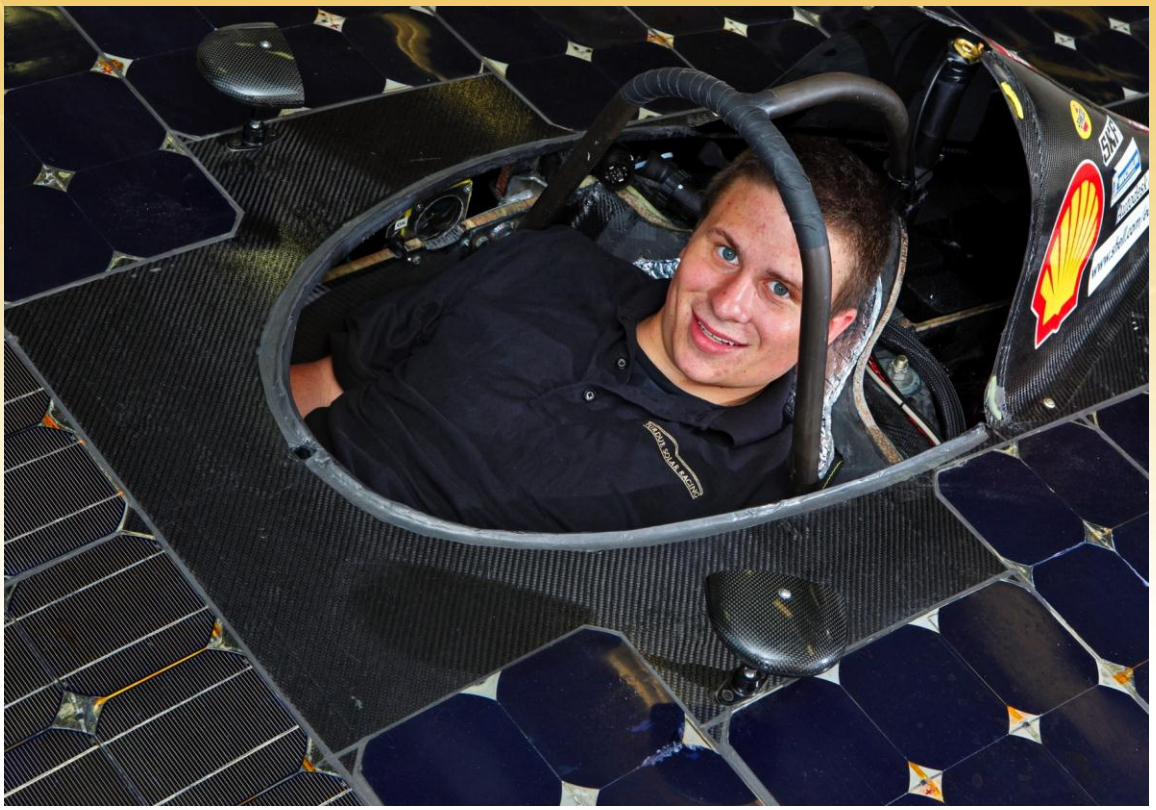
Outline

- Drivers for Change: The 30,000-foot view
  - New technologies, multidisciplinary technologies
  - Rate of technological change
  - Workforce trends
  - Globalization
  - Global grand challenges
- Coming down to earth: What's happening now
  - Curriculum
  - Pedagogy and styles of education
  - Workforce development examples



Drivers for Change



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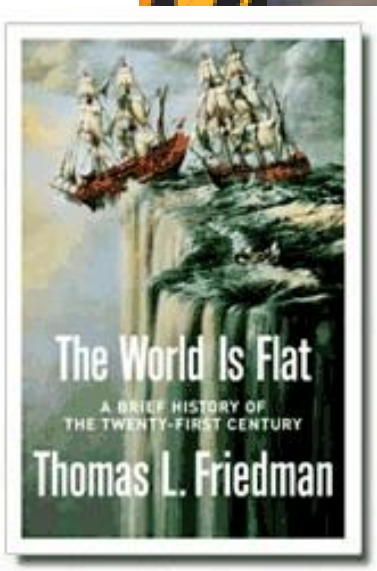
Pace of Change and Workforce Trends

- The half-life of an engineer's knowledge is estimated to be less than five years
- In 10 years 90% of what an engineer knows will be available on the computer
- 60% of future jobs will require training that only 20% of the current (U.S.) work force possesses

- [Workforce 2020 : Work and Workers in the 21st Century]

Calls to Action

- U.S. National Academy of Engineering:
  - The Engineer of 2020: Visions of Engineering in the New Century
  - Educating the Engineer of 2020: Adapting Engineering Education to the New Century
  - Rising Above the Gathering Storm
  - Grand Challenges
- Tom Friedman's *The World is Flat*
- America Competes / Innovate America
- Europe: Bologna Process
- China, Peru, Namibia, Colombia, … : Focus on innovation



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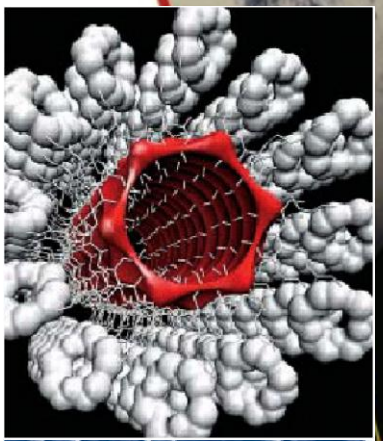
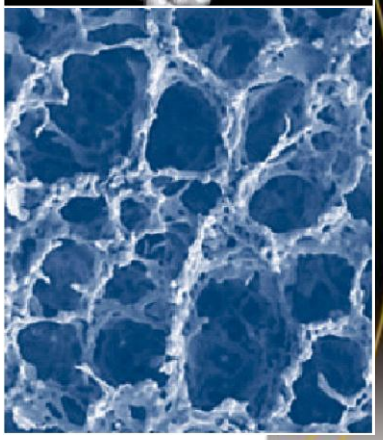
National Academy of Engineering's *The Engineer of 2020*

- Technological Context
  - Breakthrough technologies: biotechnology, nanotechnology, materials science and photonics, information and communications technology, information explosion, logistics
  - Technological challenges: urban physical infrastructure, information and communications infrastructure, environment, technology for an aging population





Accelerating rate of technological change, interdisciplinary solutions, understanding complexity, systems perspective

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National Academy of Engineering's *The Engineer of 2020*

- Societal, Global, and Professional Contexts
  - Population: By 2020, 8 billion people, mostly in urban centers; changing workforce demographics
  - Accelerating global economy
  - Customerization: made-to-order products & environments
  - Health and healthcare delivery
  - Security
  - Increasing convergence of engineering and public policy
  - Public understanding of engineering

Engineering in a broad global, societal context

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Attributes of NAE's *Engineer of 2020*

- Analytical skills
- Practical ingenuity
- Creativity
- Communication & teamwork skills
- Business & management skills
- High ethical standards
- Professionalism
- Leadership, including bridging public policy and technology
- Dynamism/agility/resilience/flexibility
- Lifelong learners

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Purdue's Future Engineer

Vision: Purdue Engineers will be prepared for leadership roles in responding to the global technological, economic, and societal challenges of the 21st century.

Abilities

- leadership
- teamwork
- communication
- decision-making
- recognize & manage change
- work effectively in diverse & multicultural environments
- work effectively in the global engineering profession
- synthesize engineering, business, and societal perspectives

Knowledge Areas

- science & math
- engineering fundamentals
- analytical skills
- open-ended design & problem solving skills
- multidisciplinarity within and beyond engineering
- integration of analytical, problem solving, and design skills

Qualities

- innovative
- strong work ethic
- ethically responsible in a global, social, intellectual, and technological context
- adaptable in a changing environment
- entrepreneurial and intrapreneurial
- curious and persistent continuous learners

WHAT DO YOU THINK?

NAE's Engineering Grand Challenges

Make solar energy economical

Provide energy from fusion

Develop carbon sequestration methods

Manage the nitrogen cycle

Provide access to clean water

Restore and improve urban infrastructure

Advance health informatics

Engineer better medicines

Reverse-engineer the brain

Prevent nuclear terror

Secure cyberspace

Enhance virtual reality

Advance personalized learning

Engineer the tools of scientific discovery

What's happening now?

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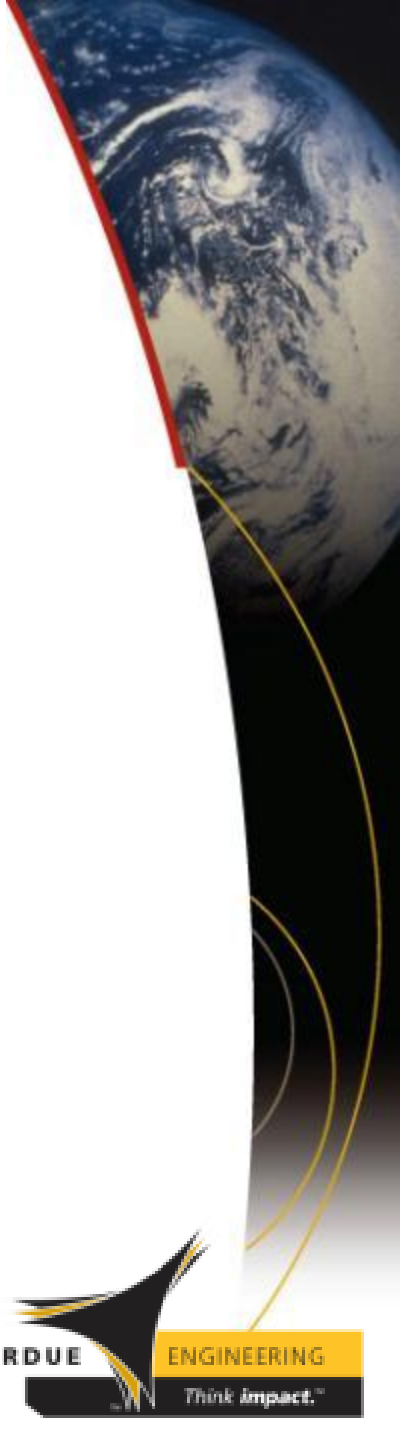

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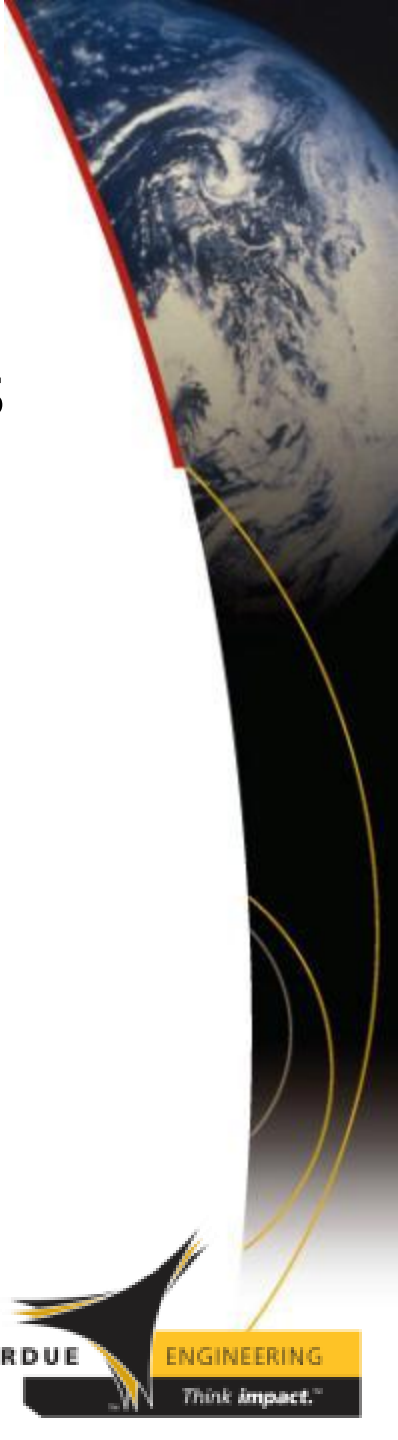
Curriculum

- Courses on systems thinking & systems design
  - Engineering systems
  - Engineering + economics / sustainability / policy / regulation / …
- Life-cycle analysis & design
- Materials, energy, sustainability
- Green manufacturing
- Grand Challenges themes



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Pedagogy & Style of Education

- Design education
- Active learning
- Problem-based learning
- Inquiry-guided learning
- Multi-level learning
- Experiential education: *learning by doing*

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Pedagogy & Style of Education

- Experiential Education – Learning by doing

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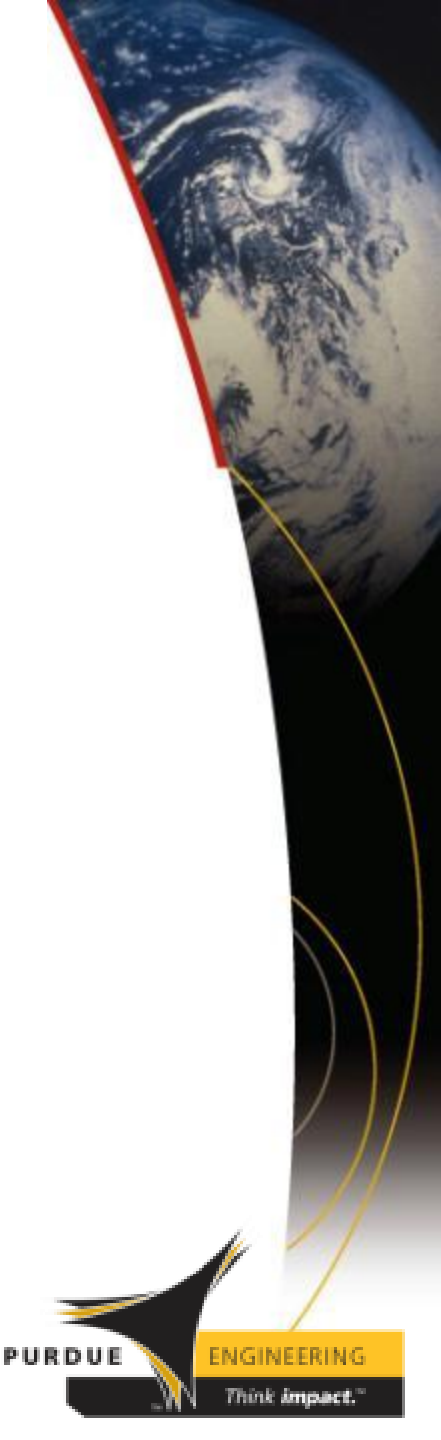
Pedagogy & Style of Education

- **Experiential education**
  - Co-op and internships
  - **Competitions**
  - Service learning, Engineering Projects in Community Service (EPICS)
  - Entrepreneurship activities
  - Undergraduate research
  - International experiences



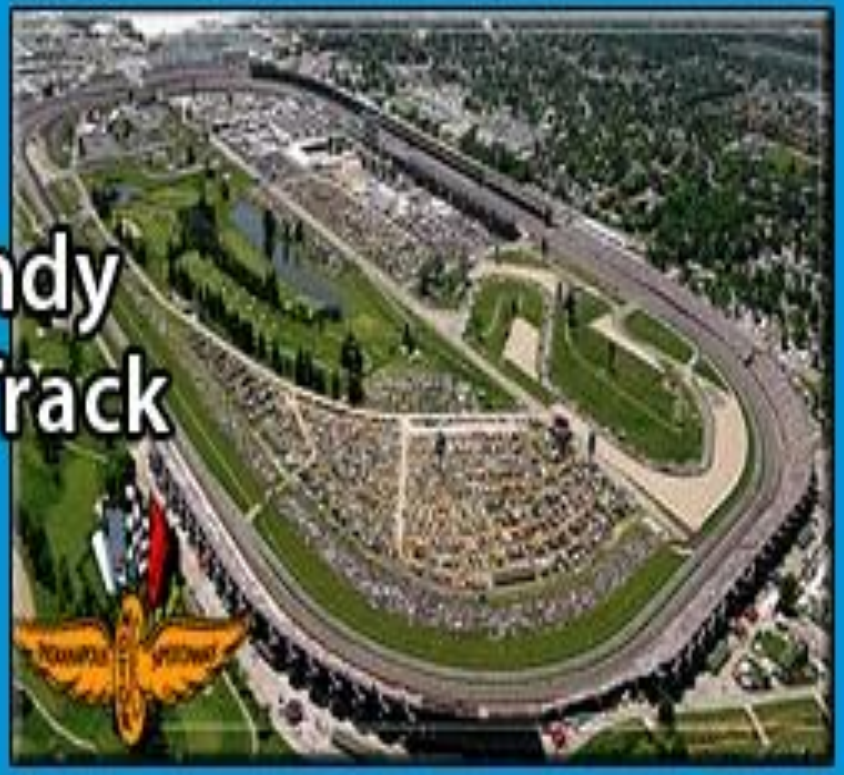

purdue solar racing
Urban Concept
CELERITAS
P

evGRANDPRIX™
accelerate innovation.

Race Dates & Locations

Purdue University: April 30, 2011

Gates Open: 11:00 AM
Race Starts: 1:00 PM



Indy Motorspeedway: May 7, 2011

FREE EVENT
Gates open 12:00 pm
Sprint Car Races Begin 1:00 pm
Main Event 2:30 pm

Workforce Development & Training

- I-AEVtec (Indiana Advanced Electric Vehicle Training and Education Consortium)
  - Purdue, IU-Purdue Indianapolis, Notre Dame, Purdue Calumet, IU Northwest, Ivy Tech Community College
  - $6.1M Department of Energy ARRA grant, ~$3M from industry and IN workforce development grants

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I-AEVtec Courses & Training

- Courses, modules, and labs at Purdue, Ivy Tech, IUPUI, Purdue-Calumet
  - Batteries, fuel cells, electric motors, hybrid engines, grid technology and consumer issues
  - smartenergyhub.org: lecture notes, homework, exams, streaming videos of experiments, simulations
- Professional MS in Energy Storage Systems to be offered at Crane Naval Surface Warfare Center
- Hybrid EV 101 developed for Delphi; to be offered online
- In progress: Purdue & Vincennes w/ 5 IN school districts – Associate's Degree in Advanced Manufacturing upon high school graduation

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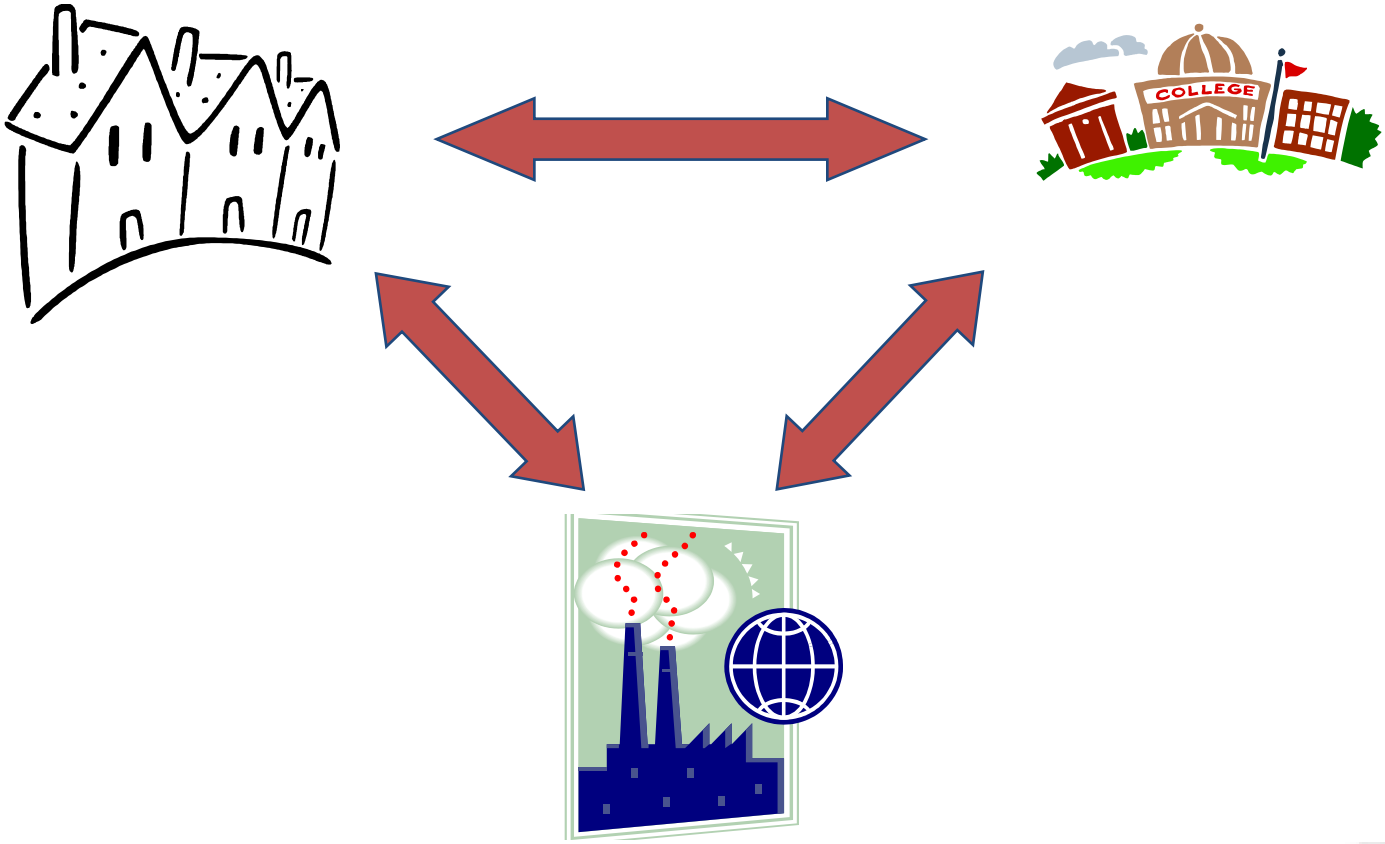
Opportunities for School/Community – University – Industry Partnerships



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Thank you!