



## Engineering Education

*Learning to make a difference*

# Make a flying start on designing YOUR PhD pathway

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Epistemology Professor of Engineering Education

**PhD Student Orientation**  
August, 2012

## Kamyar Haghighi



Foundation Head  
Department (now School) of  
Engineering Education



ENE Strategic Advance, January 2008

## IMAGINE many possible futures for YOU



*analyze past and current job announcements*



## TAILOR the graduate competencies to suit you



Create Knowledge

Synthesize Knowledge

Communicate Knowledge

Think Critically and Reflectively

Teach Engineering

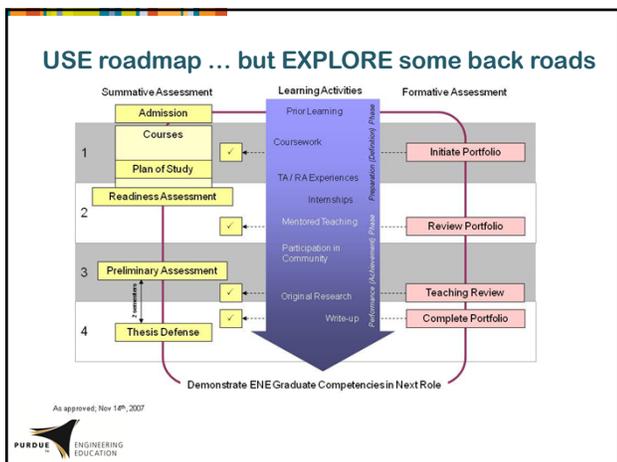
Apply Engineering Education Principles to the Solution of Instructional or Curricular Problems

Demonstrate Engineering Skills

Participate Actively in Professional Community

Engage in Professional Development

Explain and Critique Education Policy

## UNDERSTAND the purpose of critical milestones

Name & Milestone	Developmental Question(s)	Assessment Type & Method	Competencies Assessed	Decision Criteria	Decision Data / Evidence	Ways Forward (If Yes)	Ways Forward (If No)
Admission	Do you have the potential and the resources to undertake a PhD and contribute to the ongoing academic community?	Summative Interviews and Review Committee	Potential to demonstrate all 10 competencies	Academic record Professional life experience Ability to express knowledge of the field Motivation	GRE's General Program entry Interviewation Review File Review Reading Letters	Admit to Program	Suggest alternative paths
Initiate Portfolio	Are your research experiences being met? How will this contribute to the ENE?	Formative Student Development Advisor	Think critically & reflectively Engage in professional development	Ability to meet challenges of the field Motivation to succeed	Self-reflection Interviewation & student Chair/mentor/advisee	Check off	Withdrawal or proceed to Research
Plan of Study	Do you have a clear program in the field? How will this contribute to the ENE?	Summative Plan of Study Committee	Demonstrate engineering skills Communicate knowledge Think critically and reflectively Participate actively in a community	Appropriate breadth & depth of student Goals Depth in some aspects Ability to design & apply knowledge Ability to articulate & defend a position	Interviewation Committee Review Chair/mentor/advisee File Review	Proceed to Research Assessment	Withdrawal or proceed to Research
Readiness Assessment	Can you demonstrate your ability to apply the breadth & depth of your fundamental knowledge to a particular area of research in the field?	Summative Interviewation and Review Committee	Communicate knowledge Think critically and reflectively Participate actively in a community	Depth in some aspects Ability to design & apply knowledge Ability to articulate & defend a position	Interviewation Committee Review Chair/mentor/advisee File Review	Proceed to Research	Withdrawal or proceed to Research
Review Portfolio	Can you articulate your abilities, needs or interests?	Formative Self-reflection and peer review	Most of the competencies	Coverage Depth	Public Review Interviewation	Check off	Advance on New to Research
Preliminary Assessment	Are you able to design a research study to answer a significant question in your chosen area?	Summative Interviewation and Review Committee	Synthesize knowledge Communicate knowledge Think critically and reflectively	Critical literature review Research Question (and theoretical framework) Methodology & methods	Interviewation Committee Review Chair/mentor/advisee File Review	Proceed to Research	Withdrawal or proceed to Research
Teaching Review	Can you design and teach in an informed and effective way and reflect critically upon your teaching?	Formative Peer Review and Interviewation	Apply ENE principles to instructional or curricular Communicate knowledge Synthesize knowledge	Apply ENE principles to instructional or curricular Teach Engineering Communicate knowledge Synthesize knowledge	Interviewation Committee Review Chair/mentor/advisee File Review	Check off Proceed	Repeat
Complete Portfolio	Can you demonstrate that you have completed all ten competencies?	Formative Self-reflection and peer review	All competencies	Depth of analysis/reflection	Self-reflection Interviewation Committee Review Chair/mentor/advisee File Review	Check off	Proceed to Research
Thesis Defense	Have you been able to answer a significant research question and draw conclusions based on defensible evidence?	Summative Interviewation	Think critically and reflectively Create knowledge Communicate knowledge Engage & critique educational practice Participate and lead well	As with Preliminary job Quality of data gathering, analysis and interpretation Engage & critique educational practice Critical discussion of strategy Conclusion and future work	Interviewation Committee Review Chair/mentor/advisee File Review	Award of PhD	Proceed to Research
Post-PhD	Where will you contribute to the world and the ENE?	Authentic/ External Interviewation and Review Committee	Apply ENE principles to instructional or curricular Communicate knowledge Synthesize knowledge	Potential to contribute to an institution of ENE Community	Interviewation Committee Review Chair/mentor/advisee File Review	Successful next step	Not an option



### ENSURE you create a firm foundation

- Engineering Education **Fundamentals** (13 credits minimum)
  - Seminar in Engineering Education (Fall; 1cr.)
  - History and Philosophy of Engineering Education (Fall; 3 cr.)
  - Theories of Development and Engineering Thinking (Spring; 3 cr.)
  - Leadership, Policy and Change in STEM Education (Spring; 3cr.)
  - Pedagogy, Content and Assessment (Spring; 3 cr.)
  - Research Seminar (Fall, Spring, 0 cr.)
- Other **Engineering Specialty** (9 credits minimum)
- **Research Preparation** (9 credits minimum)
  - Engineering Education Inquiry (Fall; 3 cr.)
  - Research methods elective 1
  - Statistics



### BE STRATEGIC about the choices you make

- **Engineering Education Specialization** (6 credits minimum)
  - A variety of 1 and 3 credit course from ENE faculty
  - Wide choice of courses from across the university
- **Advanced Research Methods Elective** (3 credits)
  - Research methods elective 2



### DON'T LIMIT your ideas about research scope

Pre-K



K-12



College



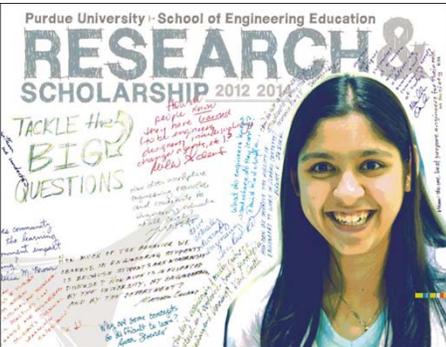
Industry



*understanding knowledge construction & sharing  
and community membership processes  
in engineering contexts  
across all life and career stages  
in  
formal and informal learning environments*



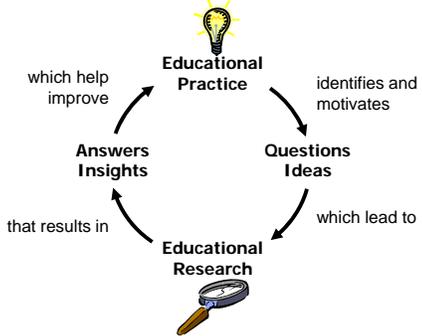
### GET TO KNOW what other research is going on




### LIVE the virtuous cycle of research & practice

Creating a Culture for Scholarly and Systematic Innovation in Engineering Education

ASEE, 2009





### DEVELOP attributes of success

- a strong sense of adventure;
- curiosity and an inquiring mind;
- being more comfortable with questions than answers;
- building arguments based on evidence;
- initiative, resourcefulness, persistence;
- tolerance of uncertainty and ambiguity;
- taking personal responsibility;
- holding self and others accountable.

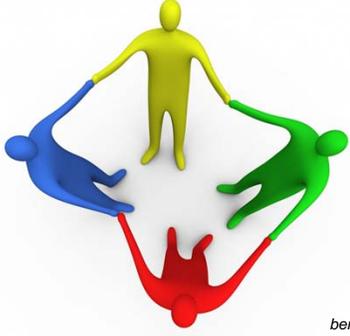


Gus Grissom - July 21, 1961

*in short .....a pioneering disposition*



### BE a constructive, courteous, community member



*benefit of the doubt*

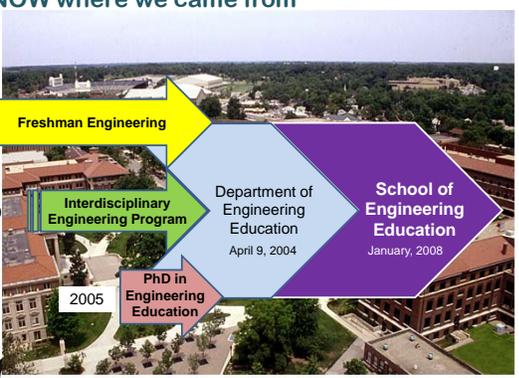


### LEARN how things are done around here

- take the initiative
- develop appropriate, informed expectations
- rely on authoritative information sources
- ask how and then go do it
- take responsibility
- don't assume
- be respectful
- be patient
- learn as you go
- help others




### KNOW where we came from



1953 Freshman Engineering

1969 Interdisciplinary Engineering Program

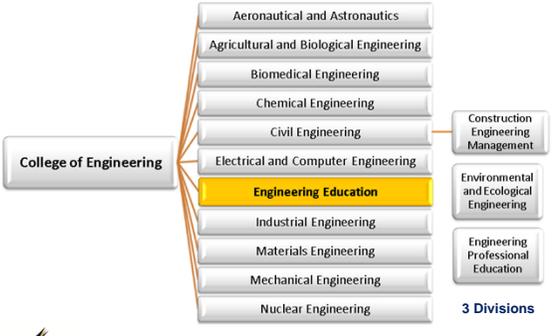
2005 PhD in Engineering Education

Department of Engineering Education  
April 9, 2004

School of Engineering Education  
January, 2008



### LEARN about the College



College of Engineering

- Aeronautical and Astronautics
- Agricultural and Biological Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Electrical and Computer Engineering
- Engineering Education**
- Industrial Engineering
- Materials Engineering
- Mechanical Engineering
- Nuclear Engineering

Construction Engineering Management

Environmental and Ecological Engineering

Engineering Professional Education

3 Divisions

11 Schools



### SHARE our VISION

*A more inclusive, socially connected and scholarly engineering education*

We envision engineers who, in collaboration with others, help communities globally to achieve their aspirations in creative yet responsible and sustainable ways. Their education is informed by sophisticated knowledge about how people learn to engineer, one that attracts and develops a diverse range of people and is suited to addressing complex socio-technical issues. This implies we radically re-think the boundaries of engineering and the purpose of engineering education.



ENE Strategic Plan (2009-14)

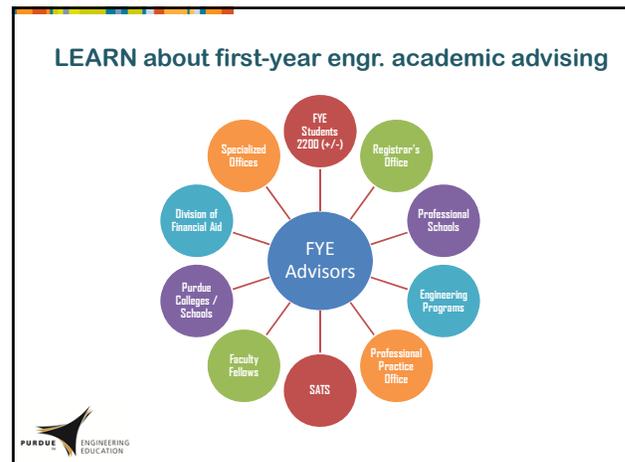
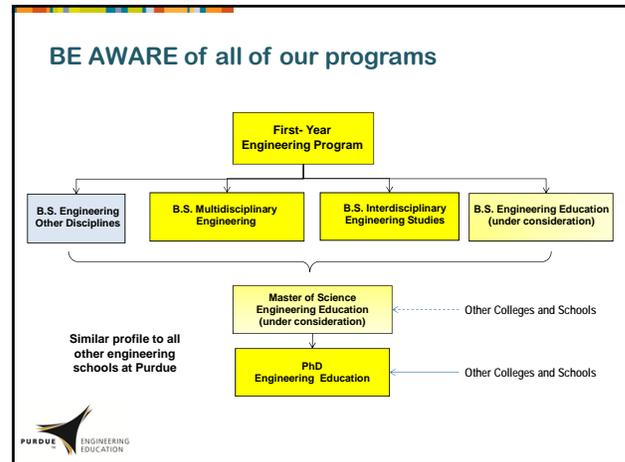
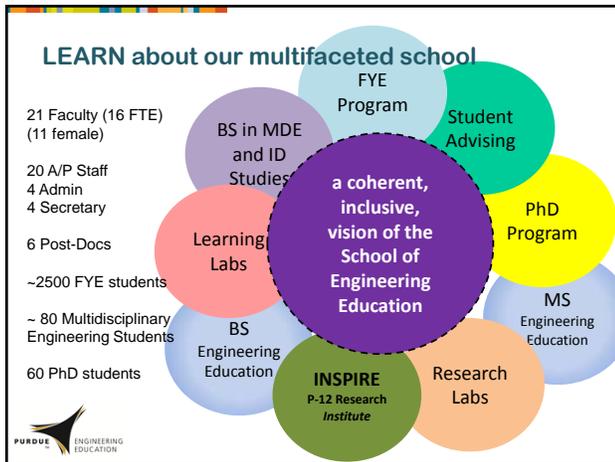
### BE PART OF our MISSION

*Transforming engineering education based on scholarship and research*

- **Re-imagine Engineering and Engineering Education**
  - Diversify engineering
  - Embed creativity, innovation and social responsibility
  - Enrich the student experience
- **Create field-shaping Knowledge**
- **Empower Agents of Change**



ENE Strategic Plan (2009-14)



### EMBRACE the legacy of our innovative interdisciplinary engineering program

- Founded 1969 to recruit students interested in engineering
- *Design your own program AND incubate new programs*
- **Interdisciplinary Engineering Studies:** not ABET accredited
- **Multidisciplinary Engineering:** ABET accredited in 2008
- Over 1600 graduates in 40 years.

**PURDUE ENGINEERING EDUCATION**

