Preparing STEM Educators for 21st Century Classrooms

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THE OHIO STATE UNIVERSITY

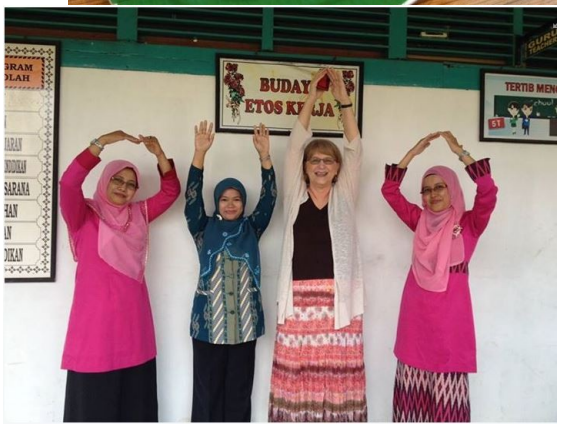
Background

- BS and MS in organic chemistry, 1970
- PhD Science Education 2003
- 19 years teaching chemistry, high school, community college, university
- Two children, 6 grandchildren
- OSU, 2003 – to now
- 1 year Germany; 3 years Tokyo; New York, Pennsylvania, California, Florida, Washington DC, North Carolina, Tennessee, Virginia, Ohio

Introd

India,2016,2018

Indonesia,2015



Sweden, 2017

STEM
Teaching & Learning

- Pipeline
- Good Teaching
- How People Learn
- What we are doing
- What are you doing?

Pipeline

- The pipeline to STEM careers often starts early
- Many students never consider STEM
- Many who consider STEM change their minds

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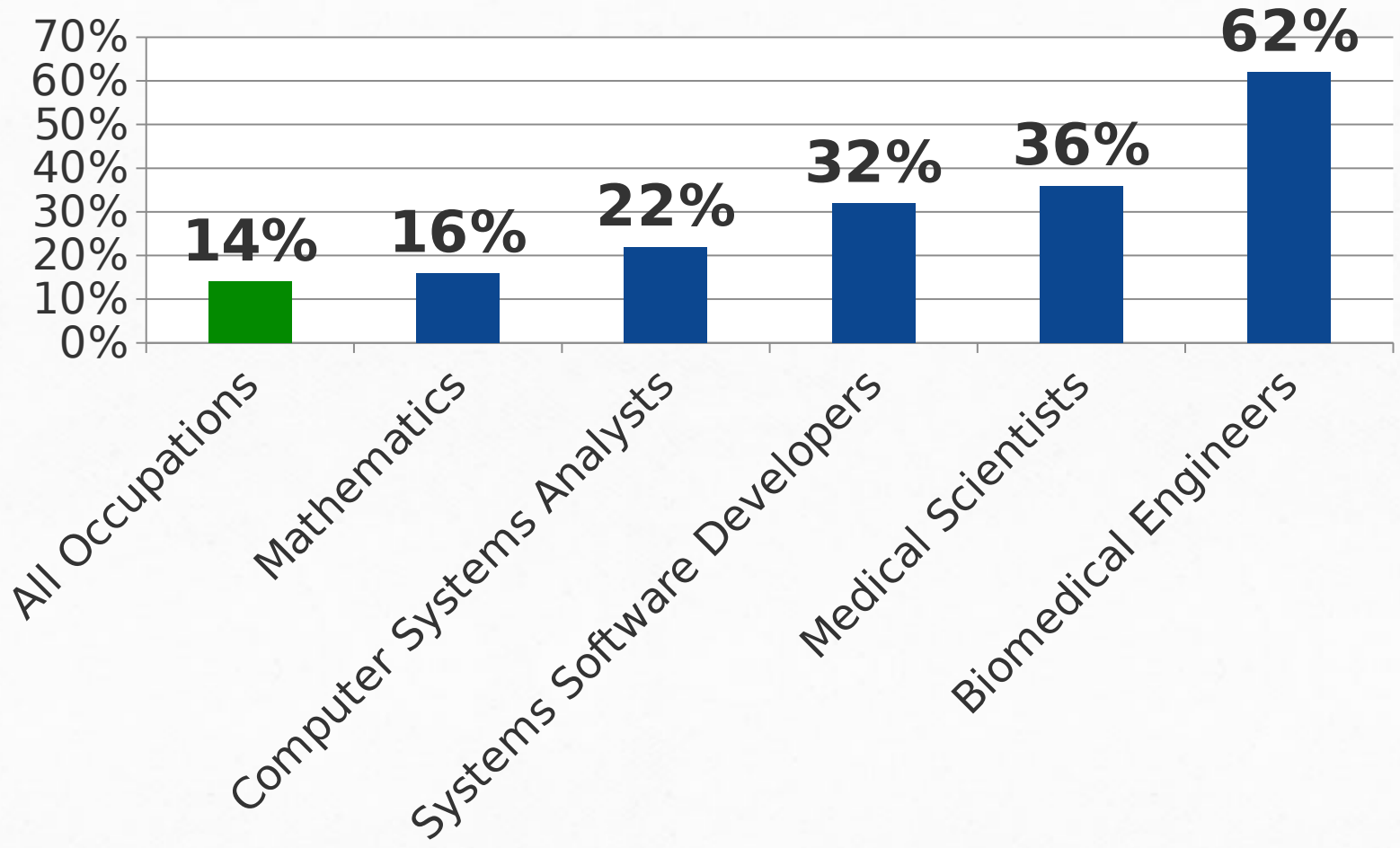
STEM EDUCATION:

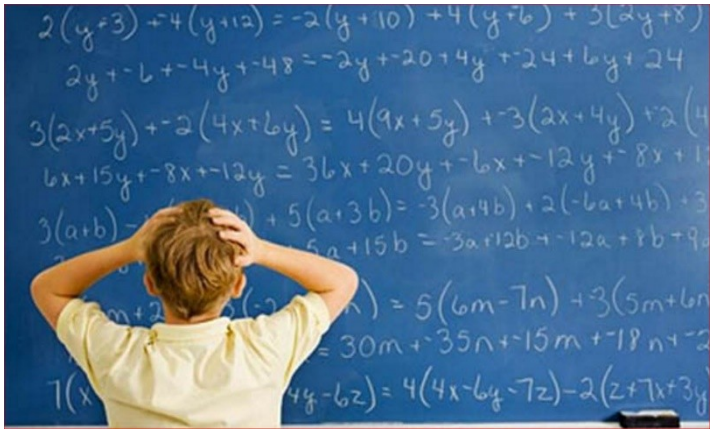
IMPORTANT TO OUR ECONOMIC FUTURE

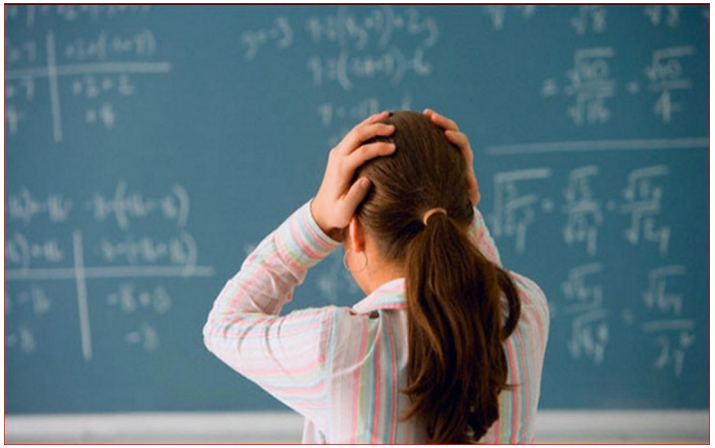
ojected Percentage Increases in STEM Jobs: 2010-202



The Learning Challenge

- Only ~**16%** of US high school seniors are proficient in math and science
- ~**40%** of U.S. students who enter college with declared STEM majors, switch majors.
- If Pre-Med students are counted, ~**60% leave STEM fields**

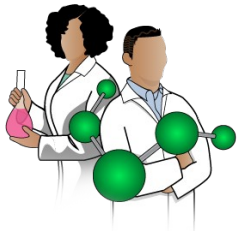


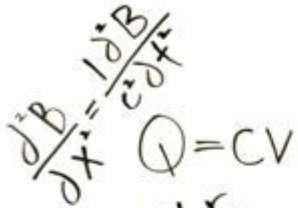


Christopher Drew, 2011

The Learning Challenge

- Math-Science – Many find these diffic





Aaron Wolf

The Problem

- Increase the supply of talented STEM professionals
  - Teaching and learning STEM is difficult
  - High quality graduates are needed
- The goal: Increase access to STEM education

Good Teaching Matters

- Schools and universities need strong STEM teaching
- Faculty development is an imperative, not a luxury
- Academic role models are critical to sustainable faculty development
- Intentional teaching is based on how people learn

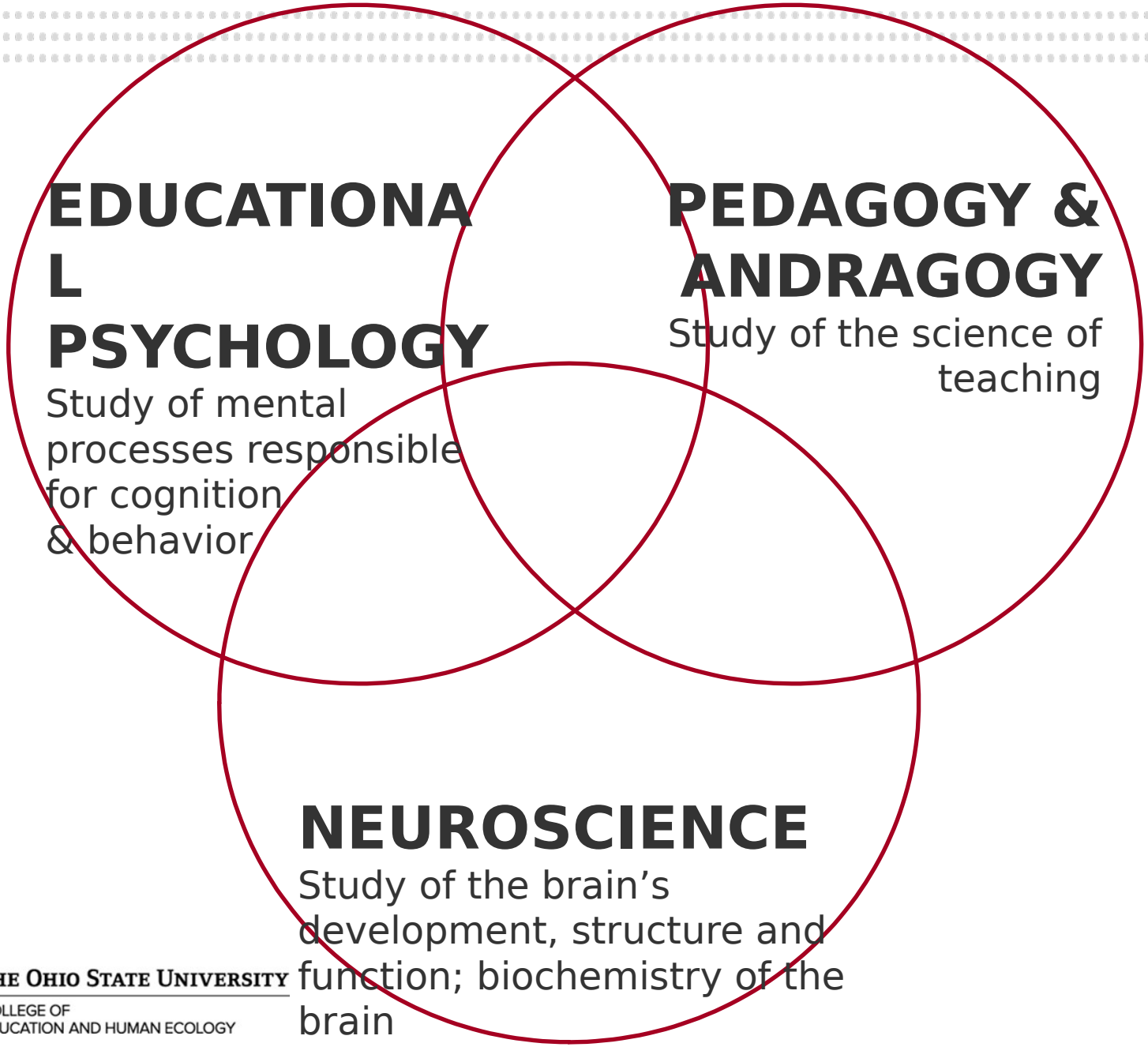
Preparing to Teach STEM

- Teachers of K-12 students receive preparation.
  - BSED program
  - MED program
- STEM professors receive little preparation beyond being students.

Science of Teaching & Learning

- If you want to know how to help people learn, you should know something about how learning works.
- If you want to be an effective teacher, you should know what works in the classroom.

Meyer, 2011, p vii


EDUCATIONAL PSYCHOLOGY
Study of mental processes responsible for cognition & behavior
PEDAGOGY & ANDRAGOGY
Study of the science of teaching
NEUROSCIENCE
Study of the brain's development, structure and function; biochemistry of the brain

What is a Myth?

Preparing STEM Faculty

- STEM content knowledge
- STEM research experience
- Science of learning (instruction & assessment)
- Teaching practice & mentoring

What do we know about how people learn?

- Student engagement
  - Active Learning
  - Doing Science
  - Talking science,
    - Academic Language

What do we know about how people learn?

- Feedback
  - Students need feedback
  - Teachers need feedback
  - Formative
  - Summative

What do we know about how people learn?

- Rich Tasks
  - Multiple solution pathways
  - Multiple representations
  - Require student explanations

Stein & Lane, 1996

What do we know about how people learn?

- Rich Tasks
  - Provide opportunities for students and teacher to engage in feedback
  - Multiple points to give/receive feedback

Irving, 2016

Technology Assisted Feedback

- Provide just-in-time information
- Aggregate information for ease of understanding
- Examples
  - Connected classrooms

Irving, 2016

Technology can help

- Examples:
  - Simulations
  - Video formative feedback
  - Rich tasks with online data sets
  - Computer assisted formative feedback on writing

What are we doing?

- Preparing teachers for high needs classrooms
- Providing professional development
- Studying efficacy of teaching strategies (connected classrooms)
- Engaging in international partnerships

Irving, 2016

Preparing teachers for high needs classrooms

- ENABLE STEM – NSF funded project
  - Tuition help and salary supplements
  - Informal Science experiences, COSI
  - Urban Teaching Seminar
  - MED teacher preparation; collaborative methods course

STEM Professional development for elementary teachers

- Engineering is Elementary –OHIO
  - 3 year state funded project
  - PD for elementary teachers (20-30 each year)
  - EiE lessons

Connected Classrooms - random control trial

- Audience response system technology
- Algebra 1 classrooms
- 3 year study in 28 states, about 600 Ss per year
- Summer PD followed by implementation
- Classrooms with CCT showed consistent statistically greater improvement in algebra achievement than control groups over three years.

International Projects

- Obama-Singh project with AMU
  - Dual Degree program
    - MED in Education from OSU;
    - PhD from AMU
  - Equal emphasis on research and andragogy
- EHE has ongoing projects with Turkey, China, Japan

What is your university doing to support pre-college STEM education?

Summary

- STEM faculty at universities benefit from supporting K-12 STEM teaching and learning
- Many possibilities exist to partner
  - in interdisciplinary teams within your university
  - across universities and industry
  - in your communities

Thank you!

Questions?

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