Science In Motion - Advancing Science

Pennsylvania’s Basic Ed / Higher Ed Partnerships Supporting Biology and Chemistry
Today’s Agenda:

- Who are we?
- What do we do and why?
- How can you participate?
- Hands-on time!
PA Consortium Members

- Cedar Crest College
- Drexel University
- Gettysburg College
- Susquehanna University
- Ursinus College
- Wilkes University
- Clarion University
- Gannon University
- Juniata College
- University of Pittsburgh/Bradford
- Westminster College

and ~200 school districts in Pennsylvania
Why are Basic Education / Higher Education Science & Technology Partnerships essential for better science education?
OUR MISSION:
HELPING TEACHERS
OVERCOME THE
OBSTACLES TO TEACHING
GOOD SCIENCE
There are obstacles to good science education in many of our schools and school systems.

- Obstacles are systemic; they are not related to particular individuals or groups

The problem is NOT our TEACHERS!!!

- What are the problems with the system?
Obstacles to Good Science Education: Systemic Shortcomings

Many teachers lack:

- **Resources** for the classroom
- **Good professional development opportunities** in science teachers’ content area
- **Opportunity & time to develop good science curriculum**
Over $200,000 in modern scientific equipment – NOT JUST COMPUTERS!
Resources for Classroom

- Fourteen foot cube van for each discipline drop-off, picks-up FULLY PREPARED instrumentation and labs
- Brings resources YOU request to YOUR classroom
- Allows every student to get "Hands-On"
**Typical Chemistry Equipment**

- Spec 20/21, UV, & IR Spectrophotometers
- Gas Chromatographs
- Nuclear Scalars
- Analytical Balances
- Melting Point Apparatus
- Micropipets
- Microscale Synthesis Kits
- pH Meters
- Hand-held/Laptop Data Collection Systems
Typical Biology Equipment

- Thirty High-resolution Microscopes
- Autoclaves
- Incubators & Water Baths
- Physiology Equipment
- Electrophoresis Cells with Power Supplies
- Digital/Video Microscopes
- Portable pH Meters
- Conductivity Meters
- Spec 20, UV, & VIS Spectrophotometers
- Hand-held/Laptop Data Collection Systems
Professional Development

- Summer Science Workshops
  - Two levels –
    - Introductory
    - Advanced
  - Training on science instrumentation
  - Practice with laboratory exercises
  - College/university & peer facilitators
  - Act 48 approved &
  - Inquiry & Standards-Based

- One-day Workshops

- Assistance IN THE CLASSROOM
Chemistry Topics

- Physical Properties
- Nuclear Chemistry
- Spectrophotometry (UV, Vis, & IR)
- pH
- Water Analysis/HACH & Vernier
- Separations & Microscale Techniques
- Chromatography & Electrophoresis
- Nanotechnology
- Computational Chemistry
Biology Topics

- Bacterial Morphology
- Bacterial Culture & Growth
- Animal Histology
- Proteins and Enzymes
- Plant Physiology
- Genetics
- Biotechnology
- Aquatic Testing
- Anthropology
- Videomicroscopy
- Human Physiology and Anatomy
- Biomechanics: Form & Function
Curriculum Development

- Workshops allow teachers to align current curriculum with standards
- Advanced level workshops allow teachers to work with peers, including higher ed faculty, to develop new curriculum materials
- Free access to curriculum at www.scienceinmotion.org
3.2 Inquiry and Design

The nature of science and technology is characterized by applying knowledge that enables students to become independent learners. These skills include observing, classifying, inferring, predicting, measuring, computing, testing and experimenting...
PA Standards for Science & Technology

3.4 Physical Science Chemistry & Physics

Physics and chemistry involve the study of objects and their properties. Students *examine changes to materials*… In chemistry… *Laboratory investigations of the properties of substances and their changes* …
3.6 & 3.7 Technology Education & Devices

Technology education is ... *Students develop the ability to select and correctly use materials, tools, techniques, and processes to answer questions...*

*These overriding themes require students to design, create, use, evaluate and modify systems of Biotechnologies, Information Technologies, and Physical Technologies.*
Help Others Understand the Importance of INQUIRY-BASED SCIENCE & the Effectiveness of BASIC ED/HIGHER ED PARTNERSHIPS!

- Better Test Scores
- Meeting national and PA Standards
- Success in Student Behavior
- Students who meet employer expectations = Workforce Development
Proven Impact of Existing Partnerships: Demonstrated Success

How Successful Have We Been?

It is critical to convince policy-makers of the effectiveness of partnerships!
Impact of Partnerships and Demonstrated Success (cont...)

- Student Results:
  - Independent, third-party assessment
    - Twice as many test questions correctly compared to controls
    - Higher-order thinking skills
    - High school students are capable of using the techniques that modern scientists use
    - More meaning Science Fair Projects!
Impact: Test Scores

1st Year Biology Students

Questions Answered Correctly

Pretest Posttest

1st Year Chemistry Students

Questions Answered Correctly

Pretest Posttest

1999 Assessment Results
Impact of Partnerships and Demonstrated Success (cont...)

- Impact on Teachers
  - Says it’s the most significant program in which they have been involved
  - They feel more like scientists
  - They are excited to have up-to-date activities for their students
RECONGNIZED SUCCESS

- Featured by
  - ABC News with Peter Jennings
  - Nightly Business Review feature with Morley Safer

- Winner of the 2004 Innovations Award from the national Council of State Governments
How to Obtain Long-term Support for Science & Technology
Science In Motion / Advancing Science in Pennsylvania

*Science In Motion* sites in Pennsylvania are:

- Funded by the Pennsylvania General Assembly
- Administered by Pennsylvania Dept. of Education
- Based on Juniata College Model
Science In Motion/Advancing Science Sites in PA

- Cedar Crest College – Dr. Brian Exton
- Clarion University – Dr. Bruce Smith
- Drexel University – Dr. Sally Solomon
- Gannon University – Dr. Ken Andersen
- Gettysburg College – Dr. Kay Etheridge
- Juniata College – Dr. Lorraine Mulfinger
- Susquehanna Univ. – Dr. Jan Reichard-Brown
- U. Pittsburg at Bradford – Dr. Clythera Horning
- Ursinus College – Dr. Vic Tortorelli
- Westminster College – Dr. Timothy Wooster
- Wilkes University – Dr. Terri Wignot
GET INVOLVED!

What if there is no partnership to serve you?

1. Organize Local Support ($$’s or Political Backing): Teachers/Administrators/School Board
2. Contact nearest Basic Ed/Higher Ed Program Director & Lorraine Mulfinger
3. Contact your Legislators – PA House & Senate
4. Contact the PA Dept. of Education:
   - Dr. Vicki Phillips – PA Sec. for Ed
   - Dr. Jerry Zahorochack – PA Sec. for Basic Ed
   - Dr. Kip Bollinger – PA Science Coordinator
Long-term Support for Science Partnerships

The Ideal Program...

- Partnerships should serve:
  - 16,000 students, K-12
    - 8-10 Rural School Districts
    - OR
    - Part of a Single Urban School District
Long-term Support for Science Partnerships (cont...)

Each Partnership would have:
- Biology Van
- Chemistry Van
- Physics Van
- Elementary Van
Some Arguments:

- High Tech Workforce Development
- Equity
- Scientific Literacy
- Meeting PA SCIENCE STANDARDS!
SIM Pennsylvania

Statewide Project Coordinators:

– Dr. Lorraine Mulfinger
– Dr. Don Mitchell

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Huntingdon, PA 16652

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www.scienceinmotion.org*

*internet links to every PA Higher Ed partner/provider
In Philadelphia

www.philasim.org

PA House and Senate

www.state.pa.us

Click: “Contact your Legislators”

PA Department of Education

www.pde.state.pa.us
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TODAY’s HANDS-ON

- Molecular Size, Shape & Bonding: Computational Chemistry Basics
- Study of Colloidal Gold: A Nanotechnology Experiment
- Distillation of Nail Polish Removers
- Separation of Alcohols using Gas Chromatography
- Pressures Under Foot: Introducing Biomechanics
GANNON SCIENCE IN MOTION

Computational Chemistry
Pa Standard 3.4.10.A – Structure of Matter
Dr. Ken Anderson & Mary Harsh

- HyperChemLite
  - Building Basics
  - Periodic Table Trends
  - Molecular Bonding & Geometry

- AP Chemistry from Juniata College:
  - Exploring chirality and conformational isomers
  - Free Demo Version:
    www.hyper.com/products/evaluation/hyper7/default.html
DREXEL SCIENCE IN MOTION

Drs. Sally Solomon and Susan Rutkowsky

- Study of Colloidal Gold: A Nanotechnology Experiment
- Distillation of Nail Polish Removers
JUNIATA COLLEGE - CHEMISTRY IN MOTION

Tara Fitzsimmons

Gas Chromatography

Understanding pure compounds and mixtures

PA Standards 3.1.10.E – Gas Laws
3.7.10.B – Applying Appropriate Instruments
The Gas Chromatograph

- Separation technique
- Mobile phase = air; Stationary phase = column
- Separate low molecular weight alcohols
Separation of Alcohols

- Students run 3 different standards, which are pure chemicals.
Unknown Mixtures

- Finally the students run a mixture of 2 or 3 of the standards.
- They use retention time and area to calculate the composition of the unknown mixture.
JUNIATA COLLEGE – BIOLOGY IN MOTION

Sharon Conaway

Pressures Underfoot
An Introduction to Biomechanics: Structure & Function Relationships*
Pressures Underfoot
Hi-tech Equipment:

- Laptop computers
- Vernier® Labpro Interface
- Vernier® force plate
- EMED pressure pad
Pressures Underfoot: Additional supplies / Lo-tech Equipment:

- Forensic ink
- Developing paper
- Cotton balls
- Rubbing alcohol
Pressures Underfoot: Introducing Biomechanics

- Interdisciplinary: interface between biology, physics & mathematics!
- Addresses PA standards in Biology, Technology Education & Technological Devices
- Can be adapted for Physics Applications – force vectors, velocity, acceleration, momentum & impulse
- Sports Medicine/Physical Therapy Applications
Pressure = Force / Area
Pressure = Force / Area
HAVE FUN!

Science In Motion – Advancing Science:
Pennsylvania Basic Ed / Higher Ed Partnerships