

# Setting and Assessing Student Learning Outcomes

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# Do your STEM learning goals include...

- High levels of engagement in active learning (making presentations, asking questions in class)
- Significant interaction with peers on projects and assignments outside of class
- Integrating ideas across courses

**If yes,** have you used NSSE results to gauge if your students achieve these goals?

# What is NSSE?



- NSSE annually gathers information on extent to which students engage in and are exposed to proven educational practices that correspond to desirable learning outcomes.
  - ❖ Results are estimate of how undergraduates spend their time & what they gain
  - ❖ NSSE items represent empirically confirmed ‘good practices’; reflect behaviors associated with student learning and development.



# NSSE Project



- For **institutional assessment of effective educational practices**
- Institutions with NSSE data can conduct **student-level analyses** – examine variations by major, STEM vs. non-STEM, study factors related to retention, GPA, deep approaches to learning, outcome measures...
- **Generalizable lessons for undergraduate education** from NSSE research: High-Impact Practices, student-faculty research; deep approaches to learning; first-year student engagement dispositions.

# NSSE: A Tool for Your STEM Assessment Work



- **Inventory data you have.** NSSE, entering student information, placement tests...how is this informing your design, assessment and evaluation?
- **Examine variation within.** Is experience the same for first-generation students? Women?
- **Benchmark against something meaningful.** criterion referenced, normative, longitudinal
- **Consider lessons for effective educational practice.** STEM learning, deep learning, high-impact activities



# Linking NSSE & STEM/PKAL Learning



## Mine student-level data to learn more about your students' experiences

- What is current state? How frequently do your students experience integrated learning? *What does this suggest for STEM?*
- Compare STEM vs. non-STEM
- Study impact...*How is the FY experience different since implementing STEM reform? Has STEM changed*

# What you can learn from your NSSE data about STEM vs. Non STEM students

1. 20% FY in STEM study more than 20hrs per week. [18% non-STEM]
2. 49% FY in STEM frequently (“very often” + “often”) worked with classmates OUTSIDE OF CLASS to prepare class assignments. [40% non-STEM]
3. 65% FY in STEM frequently (“very often” + “often”) worked on a paper/project that required integrating ideas or information. [75% non-STEM]

# NSSE Benchmarks & Scales

## *potential scales to examine in STEM assessment?*

- Level of Academic Challenge
- Active & Collaborative Learning
- Student –Faculty Interaction
- Enriching Educational Experiences
- Supportive Campus Environment
- Course Challenge
- Writing
- Higher-Order Thinking Skills
- Integrative Learning
- Active Learning
- Collaborative Learning
- Course Interaction
- Out-of-Class Interaction
- Information Technology
- Diversity Experience
- Support for Student Success
- Interpersonal Environment

Scale properties available:

[www.nsse.iub.edu/pdf/Norms and Scales- 2008NSSE Scales Scalelets.pdf](http://www.nsse.iub.edu/pdf/Norms%20and%20Scales-2008NSSE_Scales_Scalelets.pdf)

# NSSE Item Mean & Frequencies by Major

*potential benchmarks for STEM assessment?*

- **Opportunity to benchmark against NSSE “Grand Means by Major”**
- **Examine:**
  - **Are our Physical Science students doing more active learning than peers at other college and universities?**

Go to: [www.nsse.iub.edu](http://www.nsse.iub.edu) – Reports and Services, Annual Report 2009

# NSSE Multi-year Analysis Guide

## *potential longitudinal examination of STEM learning*

 Confirm stability and reliability

 *Has our Senior student STEM student experience been stable?*

 Measure change due to campus initiatives

 *Given the implementation of a campus initiative, did engagement change?*

 Identify trends over time

 *What trends are apparent in given engagement measures over time?*

## Check in: Mining NSSE Data

✓ If yes, how might you use results to inform PKAL/STEM initiatives?

✓ How might you use results in your assessment activities?

✓ How might you use lessons from NSSE to bolster, benchmark or explore in your improvement and assessment activities?



# For Your Consideration:



- **NSSE STEM Beta Items 2009**
- **Deep approaches to learning**
  - scales to assess effectiveness, shape STEM pedagogy
- **High-Impact Practices**
  - research with a faculty member,
- **NSSE & FSSE Disciplinary Comparisons**
  - does engagement vary by discipline?

# NSSE Results 2009: Comparing STEM vs. Non-STEM seniors

## Seniors not majoring in STEM fields:

- More engaged in classroom discussions and presentations, reading, and writing
- Greater progress in writing and speaking skills, and in understanding diversity

## Seniors in STEM:

- More do tutoring, group work outside of class, and research with faculty
- Greater gains in quantitative knowledge and skills

# NSSE STEM Beta Items 2009

**1. In your experience at your institution during the current school year, about how often have you done each of the following?** *Response Set = Very often, Often, Sometimes, Never*

- Attended meetings and events put on by a student chapter of a professional society or organization in your major field
- Worked with other students to solve mathematical or computational problems
- Worked on a project requiring hands-on physical design or technical modeling
- Completed an assignment or project that required computer assisted design software (CADD, ECAD, CAE, etc.)

**2. During the**

*11-20, More*

- Number of
- Number of
- Number of
- Number of

**3. Which of**

*= Done, Pla*

- Participate
- Present or
- Make a pre
- Hold an offi
- Take a com

**4. About ho**

*10, 11-15, 1*

- Preparing f
- Working in

• Completing mathematical or scientific problems or assignments *on your own*

• Completing mathematical or scientific problems or assignments *with other students*

**5. To what extent has your experience at this institution contributed to your knowledge, skills, and personal development in the following areas?** *(Response Set = Very much, Quite a bit, Some, Very little)*

- Designing and conducting experiments, surveys, or field research
- Interpreting results from an experiment, surveys, or field research
- Recognizing when to use a formula, algorithm, or other method of calculation
- Representing data visually (models, graphs, tables, etc.)

**View Items & Results:**

**[www.nsse.iub.edu](http://www.nsse.iub.edu)**

**(go to Reports & Services)**

**NSSE participating institutions  
invited to test questions**



# Comparing STEM vs. Non- STEM on NSSE 2009 Beta items

•STEM seniors more likely to participate; yet, a third non-STEM students do these things (particularly in social science fields)

Table 6: Percentage of Seniors Engaging in STEM Activities and Reporting Gains in STEM Areas

	STEM	Non-STEM
Worked with other students to solve mathematical or computational problems <sup>a</sup>	55%	25%
Worked on a project requiring hands-on physical design or technical modeling <sup>a</sup>	37%	21%
Wrote five or more papers in which you discussed methods or findings related to data from lab or field work, a survey project, etc.	44%	31%
Wrote five or more papers in which you explained the meaning of numerical or statistical data	34%	18%
Wrote five or more papers in which you included graphs, drawings, tables, photos, screen shots, or other visual content	45%	24%
Took a computer language or programming course	41%	18%
Gains in designing and conducting experiments, surveys, or field research <sup>b</sup>	55%	32%
Gains in interpreting results from experiments, surveys, or field research <sup>b</sup>	66%	37%

<sup>a</sup> "Very often" or "Often"

<sup>b</sup> "Very much" or "Quite a bit"

# STEM engagement measures

- 1. Hands-on Experiences:** Preparing for, working in lab and design workshops, computer assisted assignments
  - 2. Scientific Writing:** Papers discussing methods or findings related to data, explaining meaning of numerical or statistical data, and including visual content i.e., graphs,
  - 3. Problem Solving:** Time spent solving mathematical, computational, or scientific problems alone or in groups
- 3 scales associated with gains in practical competence of students in STEM fields, but not for non-STEM seniors
  - Level of Academic Challenge associated with gains for STEM seniors, but less so for non-STEM
  - Supportive campus environment related to gains for both groups

# Deep Approaches to Learning Scales

## 🌀 Deep approaches to learning

🌀 Higher order thinking (item 2b,c,d,e)

🌀 Integrated learning (items 1d,e,i,p,t)

🌀 Reflective learning (items 6d,e,f)

- *Educationally substantive*
- *Interesting to faculty*
- *Perform well in analyses*

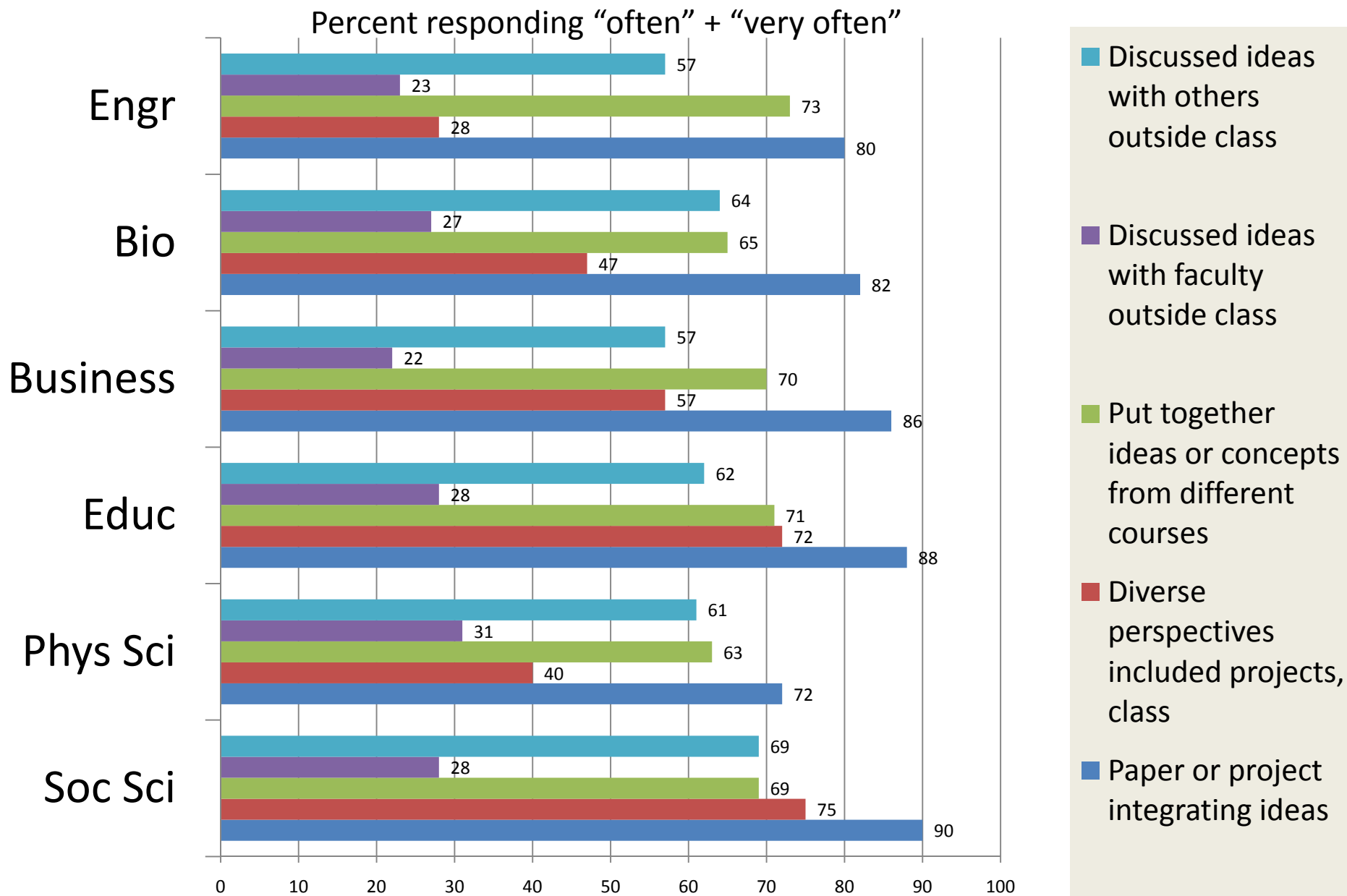


# NSSE Integrative Learning Scale

Students indicate how often (1 = “never” to 4 = “very often”) they did the following during the current school year:

- ◆ Working on a paper or project that integrates ideas or information from various sources
- ◆ Including diverse perspectives in class discussions or writing
- ◆ Putting together ideas from different courses in assignments or class discussions
- ◆ Discussing ideas from readings or class...
  - ◆ with faculty members outside of class
  - ◆ with others outside of class

# Integrative Learning Items by Major



# What do we Know about High-Impact Practices?

🌐 AAC&U defined “High-Impact Practices” align with NSSE measures

🌐 Learning Communities

🌐 Service Learning

🌐 Research with a Faculty Member

🌐 Study Abroad

🌐 Culminating Senior Experience



*Association  
of American  
Colleges and  
Universities*

🌐 Findings from AAC&U & NSSE: Growing evidence that “high-impact practices” provide substantial educational benefits to students

[AAC&U, 2008 publication: *High-Impact Educational Practices: What They Are, Who Has Access To Them, and Why They Matter*]

## **High-Impact Practices:** *Research with a Faculty Member*

**Students report lots of different research activities but, which are associated with deep approaches to learning?**

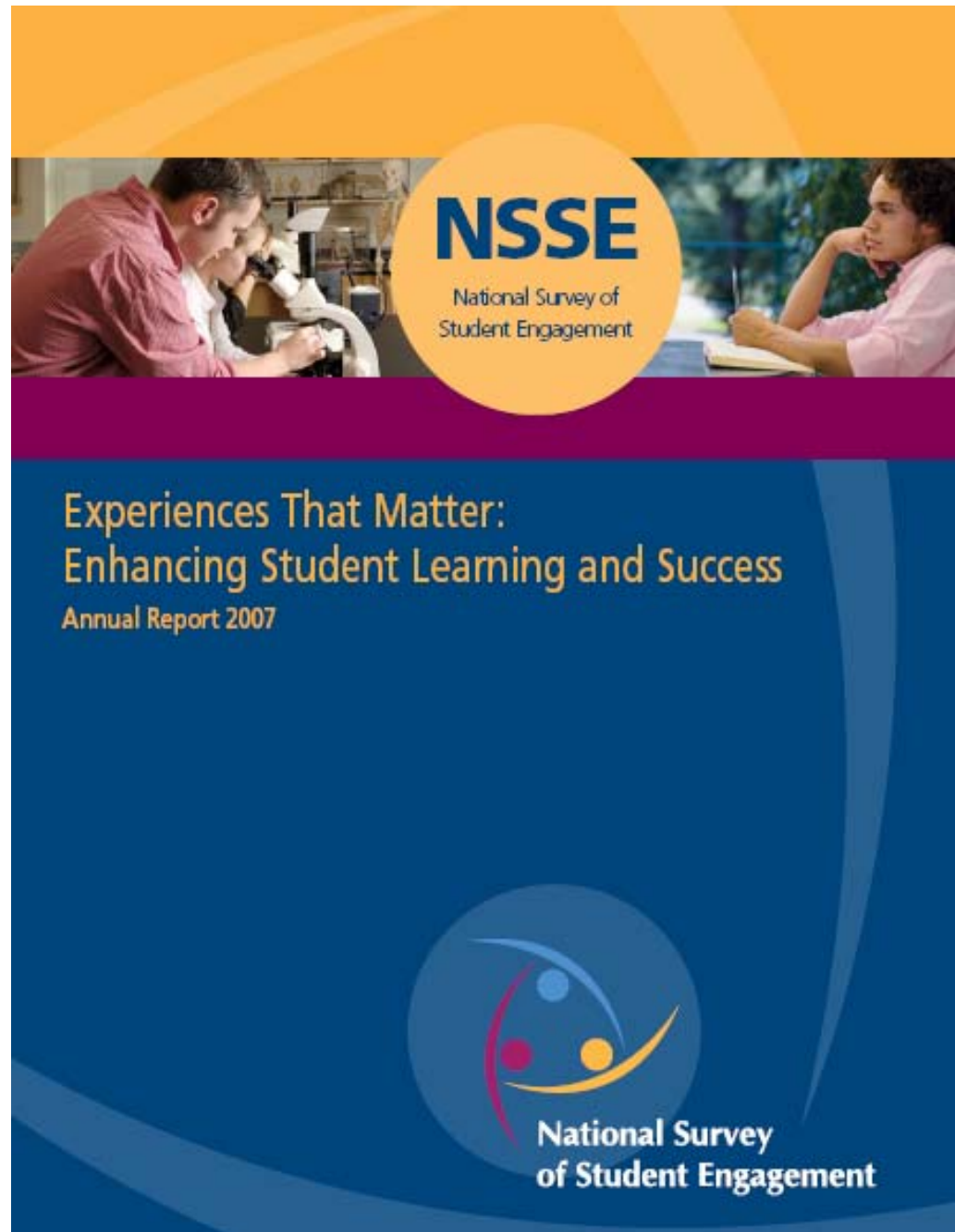
- Reviewing literature and interpreting findings most positively related to deep learning.**
- Data collection had the weakest relationship.**

# NSSE Annual Report 2007

## High Impact Practice results

Download:

[www.nsse.iub.edu](http://www.nsse.iub.edu)  
("Reports & Services")



# NSSE & FSSE Disciplinary Comparisons

## Integrative Learning

