

# **Special Challenges in STEM Teaching**

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# Outline

- ◆ **The particular problems that STEM faces**
- ◆ **Possible ways to address those problems**
- ◆ **Resources that can help us**
- ◆ **An exercise**
- ◆ **Questions and comments**

# A Question

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  - ↑ **Major in your field?**
  - ↑ **Go to graduate school in your field?**
  - ↑ **Become college faculty?**

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- ◆ **How many of them change their mind during your course?**

# Why Undergrads Leave STEM?

## ◆ 1990-1993 Seymour & Hewitt study:

↑ Studied 335 students at 7 institutions

## ◆ Findings:

↑ 41% of “switchers” cited poor teaching as a factor in the decision to switch.

↑ 98% of “switchers” cited poor teaching as a concern.

↑ 86% of “non-switchers” also cited poor teaching as a concern.

# Why Undergrads Leave STEM?

- ◆ **Attrition...not due to differential levels of ability.**
  - ↑ **Classroom climate and teaching played a critical role in who did or did not persist.**
- ◆ **Engineering students suffered these classroom problems even more acutely.**

# Why Undergrads Leave STEM?

- ◆ **Distinguishing feature of “non-switchers”**
  - ↑ **Are able to “put up” with it.**

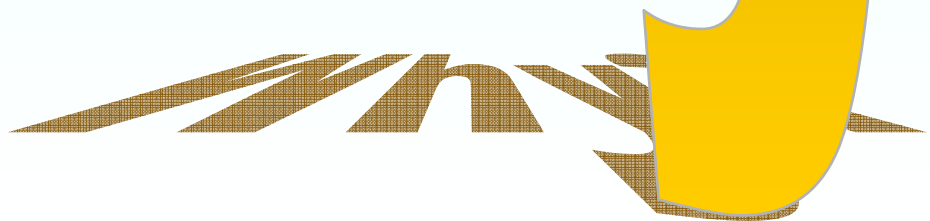
**“...in short, unless they are a younger version of the science (and engineering) academic community itself, many otherwise intelligent, curious, and ambitious young people...conclude there is no place for them in science (and engineering).”**

- Sheila Tobias, 1990

# Summing Up The Problem

- ◆ **We (STEM Faculty) tend to be boring teachers.**
- ◆ **We focus on verbal rather than visual learning.**
- ◆ **We rarely consider the learning style or personality of our students.**
- ◆ **We tend to teach the way we were taught, thus perpetuating the problems!**

Why?



# Why do we (STEM Faculty) Teach this way?

◆ Because nobody ever taught us how to teach (for the most part...)

↑ But is that a good excuse?

◆ OK, so if that is the problem, how do we fix it?

◆ After all, we STEM folk are problem solvers, aren't we?

# **What Can We Do About It?**

- ◆ **Make the classroom environment more friendly/less hostile.**
- ◆ **Know your students and where they are coming from.**
- ◆ **Make the material relevant/ engaging.**
- ◆ **Take steps to assess the impact of instructional practices.**

# Fostering a Constructive Classroom Climate

- ◆ **Learn the students' names, even in large classes.**
  - ↑ **Put in teams**
  - ↑ **Class participation**
  - ↑ **Out-of-class meetings**
  - ↑ **Take pictures**
- ◆ **Seek and acknowledge student participation.**
  - ↑ **Thinking time**
  - ↑ **Wait time**
- ◆ **Indicate that students have your trust.**
- ◆ **Don't insult your students.**
- ◆ **Humor is a double-edged sword.**

# Knowing Your Students

- ◆ **Basic demographics.**
- ◆ **Learning styles.**
- ◆ **Mastery of prerequisites.**
- ◆ **Preconceptions.**
  - ↑ **Content**
  - ↑ **Epistemology**

# **What do Students Think?**

**On a day with no wind, a mosquito lands on top of the Washington monument. Think about whether the mosquito exerts a force on the monument and whether the monument exerts a force on the mosquito while it is resting there. Which of the following is true?**

**\*Question and data from John Clement, University of Massachusetts - Amherst**

- A. Each exerts a force on the other, but the mosquito exerts a larger force.**
- B. Each exerts a force, but the monument exerts a larger force.**
- C. Each exerts a force, and the forces are the same size.**
- D. Only the monument is exerting a force.**
- E. Only the mosquito is exerting a force.**
- F. Neither exerts a force on the other.**

- A. Each exerts a force on the other, but the mosquito exerts a larger force.**
- B. Each exerts a force, but the monument exerts a larger force. (56%)**
- C. Each exerts a force, and the forces are the same size.**
- D. Only the monument is exerting a force.**
- E. Only the mosquito is exerting a force.**
- F. Neither exerts a force on the other.**

# Stressing the Visual

- ◆ Lots of in-class demos.
- ◆ Lots of “real life” examples.
- ◆ Lots of hands-on work.
- ◆ Lots of work in teams.
- ◆ Minimize the PowerPoint stuff.
  - ↑ Avoid “death by PowerPoint”!

# An Example

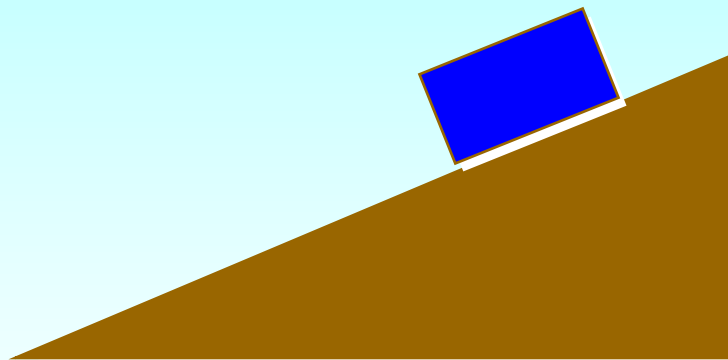
- ◆ Take a look at a film clip.
- ◆ Working in teams, develop three ways to use this in a classroom setting to illustrate some sort of STEM point.
  - ↑ High challenge, low risk!
- ◆ We will then share some of those ideas.

# **Interactivity**

- ◆ **Having students work on unusual problems and share their thoughts can be a very effective tool.**
- ◆ **So are various non-traditional problem types.**

# A Traditional Problem

- ◆ A 1.5-kg block slides down a 35-degree ramp. What is its acceleration?



# Alternative Problem Types

- ◆ **Context-Rich Problems**
- ◆ **Jeopardy! Problems**
- ◆ **Problem Posing**
- ◆ **Ranking Tasks**
- ◆ **WRONG Problems**

**An excellent NMSU resource: Steve Kanim,  
Physics**

# How Do We Know How We're Doing?

- ◆ **Take data, of course!**
  - ↑ **Qualitative, quantitative**
  - ↑ **Content, attitudes, retention**
- ◆ **Use good research skills.**
- ◆ **Many useful resources exist.**
- ◆ **Consult relevant educational research/  
Scholarship of Teaching and Learning.**
- ◆ **Publish your results – decrease the production  
of “flat tires”!**

# Two Key Definitions

- ◆ **Assessment** - A measurement of performance, for the purpose of improving future performance.
- ◆ **Evaluation** - A measurement of performance against a set of prescribed standards, usually for the purpose of reward or punishment.

# Conclusions

- ◆ **Students who leave STEM are not low ability students.**
  - ↑ **Often poor teaching drives them away**
- ◆ **By modifying our methods, we may increase retention.**
- ◆ **Think friendly, visual, and interactive!**
- ◆ **Apply your research skills to your students' learning.**

Questions?