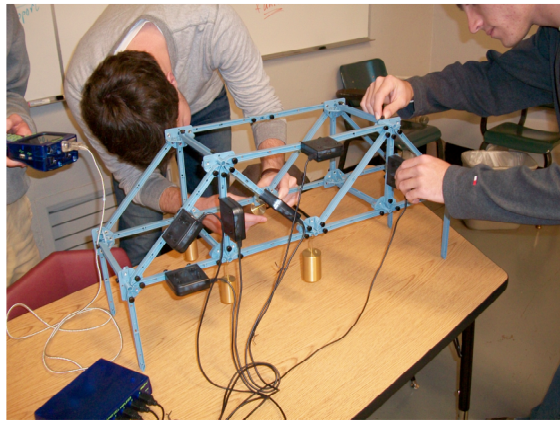


Engaging Students in Redesign of Statics

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Hot Topics in Course Redesign: Engaging Students in New Ways of Learning
The Fourth Annual Redesign Alliance Conference
March 28-30, 2010

Background

- **Statics:** Sophomore-level engineering mechanics course
- **Course significance:** Fundamental course in engineering; prerequisite for advanced mechanics courses
- **Recent enrollment:** ~400 students in 14 sections per year with ~30 students per section
- **Traditional approach:** Lecture, multiple instructors
- **Historical success rate:** ~74% (Grade of C or higher), 77% (W's omitted)
- **Current trend:** Rising enrollment + shrinking budgets
- **Redesign goals:** Improve learning & reduce instructional costs
- **Redesign model:** Emporium
- **Pilot phase:** Spring 2009 (parallel traditional & redesigned sections)
- **Full implementation phase:** Fall 2009 (7 redesigned sections)

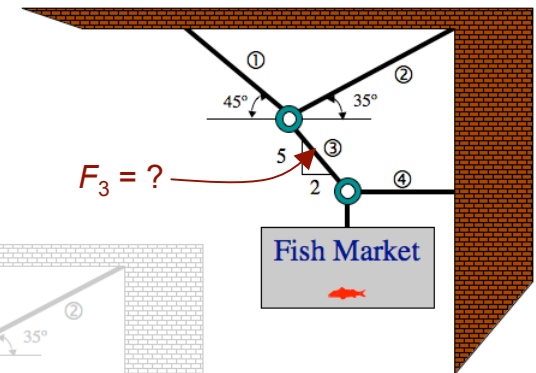
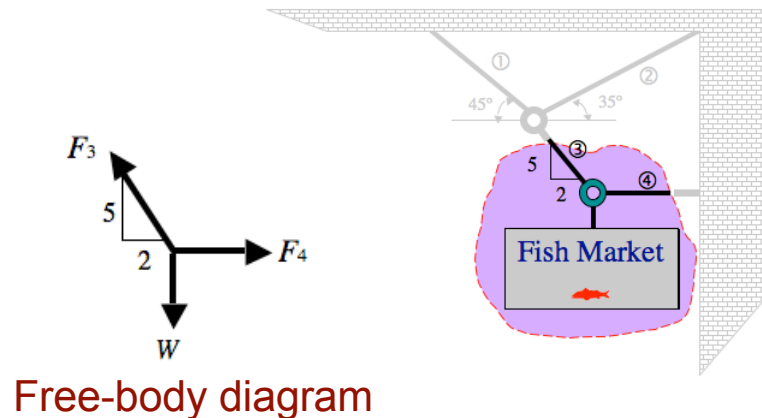


General Overview of Statics

- A required course for Aerospace, Biological, Chemical, Civil, & Mechanical Engineering majors, optional for the other three
- **Prerequisites:** Calculus II & Physics I
- **Contents:**
 - Rigid-body mechanics
 - Forces and moments in 2- and 3-dimensional spaces
 - Friction
 - Analysis of truss and frame structures
- Strong emphasis on analytical thinking & problem-solving skills

Force equilibrium:

$$\begin{aligned}
 W &= 200 \text{ kg} \\
 + \uparrow \sum F_y &= 0 \quad \Rightarrow \quad F_3 \frac{5}{\sqrt{29}} - 200(9.81) = 0 \\
 \Rightarrow \quad F_3 &= 2,113.14 \text{ N}
 \end{aligned}$$



Pre-Emporium

- **Pre-emporium:** Activities performed outside the classroom in lieu of traditional lectures
 - All course content delivered asynchronously online
 - Watch prerecorded tutorial videos online (www.YourOtherTeacher.com)
 - Explanation of specific concepts & step-by-step solutions for multiple examples
 - Pause and replay as often as necessary

Listen to what he says...

Watch what he does...

Example
Determine the forces in members BI and BH. Units: kN, m.

USING ENTIRE FBD

$$\sum F_x \Rightarrow A_x = 0$$

$$\sum M_E = 0 = 4(3) + 1(9) + 5(15) - A_y(15) \Rightarrow A_y = 5.33 \text{ kN}$$

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JOINT A

$$\sum F_y = 0 = 5.33 - F_{AI} \sin(60) \Rightarrow F_{AI} = 6.15 \text{ kN (t)}$$

$$\sum F_x = 0 = F_{AB} - F_{AI} \cos(60) \Rightarrow F_{AB} = 3.07 \text{ kN (t)}$$

JOINT I

$$\sum F_y = 0 = F_{BI} - 6.15 \Rightarrow F_{BI} = 6.15 \text{ kN}$$

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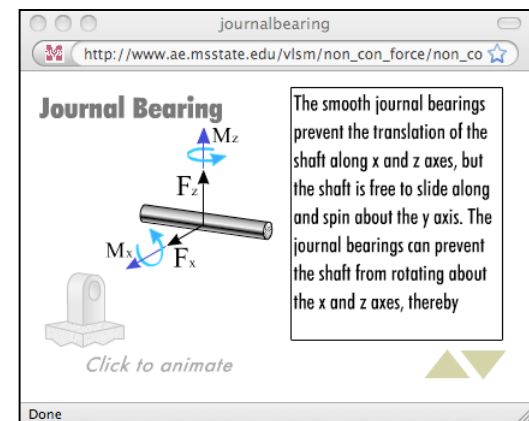
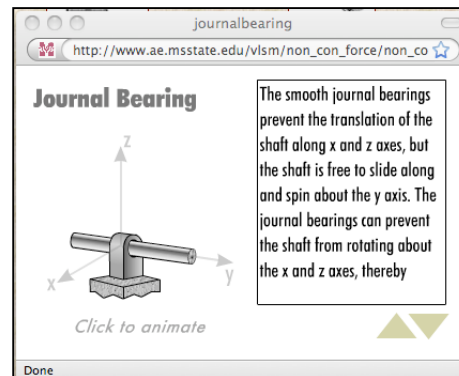
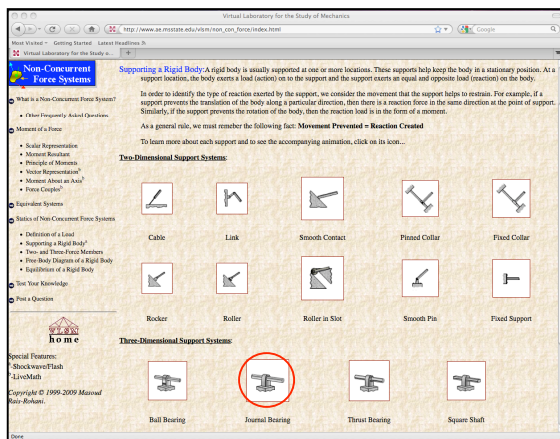


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 - Study interactive content at *Virtual Laboratory for the Study of Mechanics* (www.ae.msstate.edu/vlsm)
 - **LiveMath[®]** examples: Change data, see the effect on solution
 - **Test-Your-Knowledge exercises:** Get multiple hints if the answer is wrong
 - **Shockwave[®] and Flash[®]** animation: Understand key concepts through motion



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 - **Shockwave[®] and Flash[®] animation:** Understand key concepts through motion
 - Study select sections of e-textbook (www.wiley.com)
- **Compliance:**
 - Student's access (date, time, duration) is tracked via *MyCourses[®]*
 - 12% of course grade tied to pre-emporium activities
 - Lack of compliance reflected in assignment and quiz grades



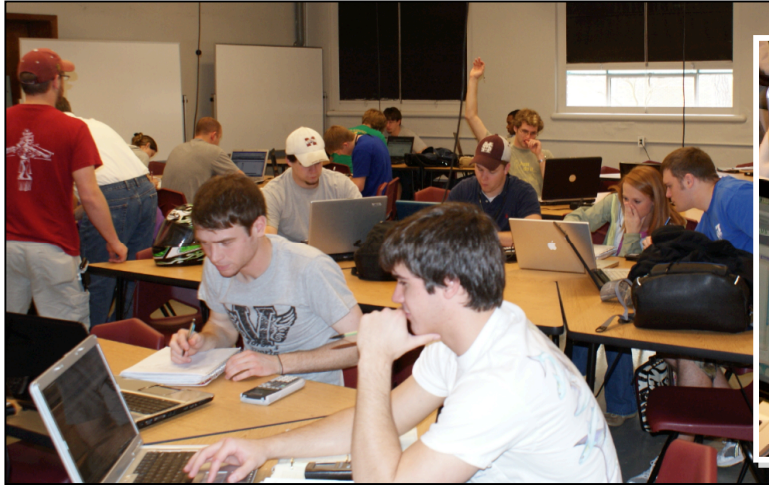
Emporium

- **Emporium:** Activities performed inside the classroom during regular periods
 - Computer-based Assignments
 - Students log into Blackboard Vista (*myCourses*®) to access their assignments
 - All work the same problems with different algorithmically generated numbers
 - Work problems by hand calculation and submit answers online
 - Four attempts to submit correct answer to each problem to receive credit
 - Peer discussions permitted and often encouraged
 - Receive individualized assistance from instructor and learning assistants
 - Experiment-based Assignments
 - Form groups of four
 - Work a problem by hand calculation
 - Setup and perform experiments with physical models to verify answers

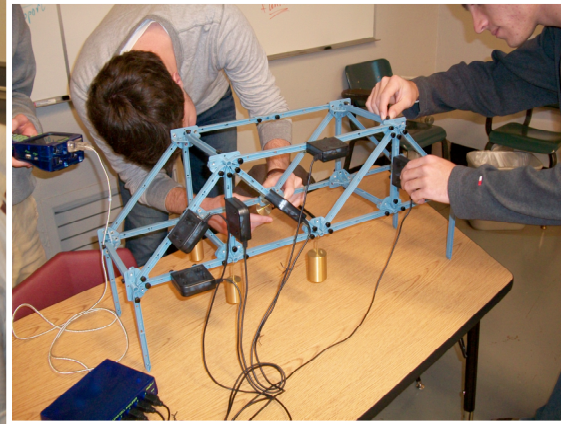
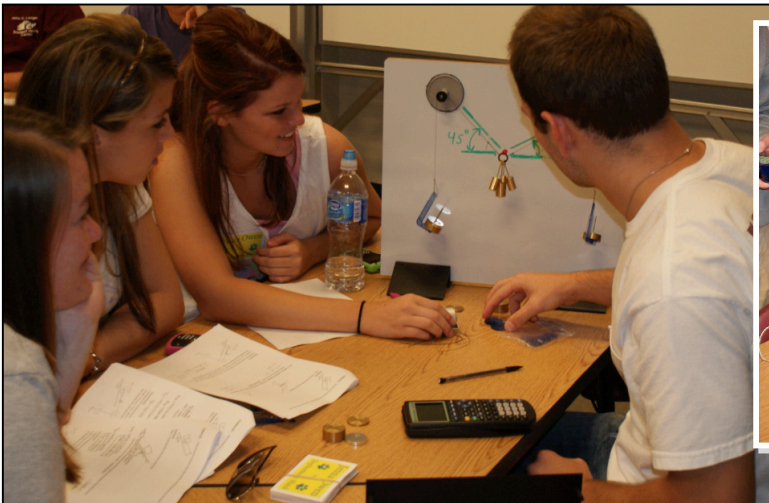


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Students
working on
assignment
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Students
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 - Experiment-based Assignments
 - Form groups of four
 - Work a problem by hand calculation
 - Setup and perform experiments with physical models to verify answers
- **Compliance:**
 - Students can only access assignments from inside the classroom
 - 18% of course grade tied to emporium assignments
 - ~89% class attendance rate in fall 2009



Post-Emporium

- **Post-emporium:** Activities performed inside the classroom after regular periods
 - Return to emporium hall to finish incomplete assignment problems
 - Hours of operation: 3:00 - 6:00 PM (Monday - Thursday, Sunday)
 - Learning assistants available for assistance
- **Student feedback*:** 1- strongly disagree to 5 - strongly agree
 - It was beneficial to work assignments in the emporium where help was available.
3.53 (1.2)
 - Hands-on lab exercises helped me better understand the Statics concepts.
3.61 (1.1)
 - I devoted more time working problems than I would have if the course was taught using the traditional approach.
3.17 (1.4)

* 79% of 228 students in fall 2009 responded to a multi-part survey.



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