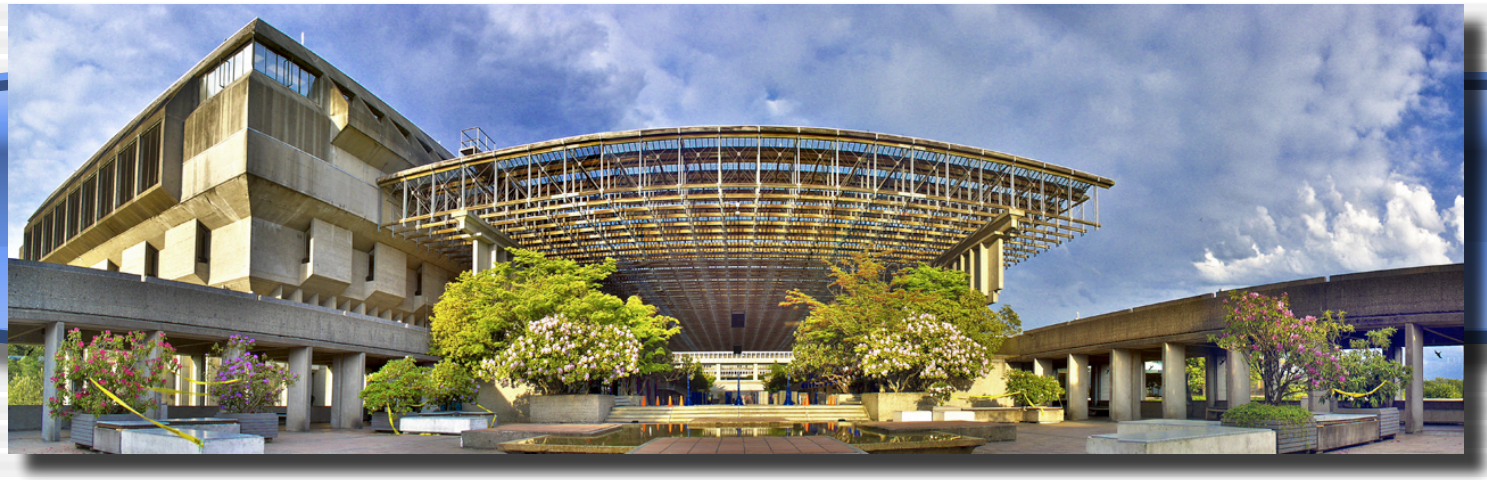
LON-CAPA:
Open Source Course Management and Assessment System



Gerd Kortemeyer

Michigan State University

10th Annual LON-CAPA Conference and Workshop
Simon Fraser University May 2008

Sponsors

Conference Sponsorship is provided by:

- Simon Fraser University
- Michigan State University
- Dell Computer
- i>clicker

Resource Sharing

Sharing of Resources

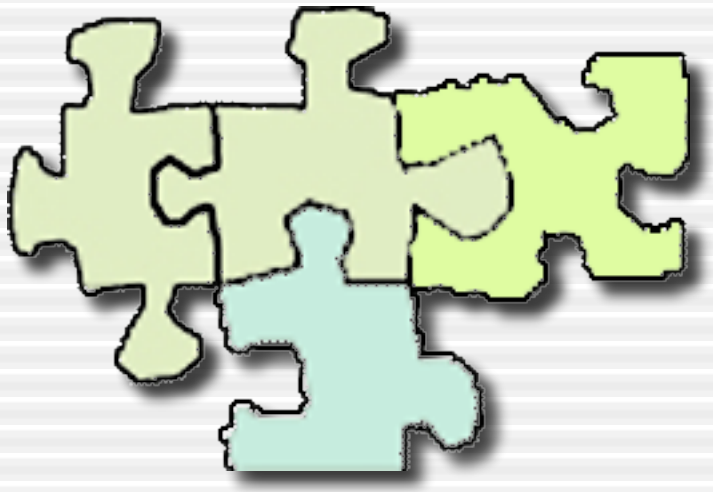
- Creating online resources (web pages, images, homework problems) is a lot of work
- Doing so for use in just one course is a waste of time and effort
- Many resources could be used among a number of courses and across institutions

Key to Re-Usability

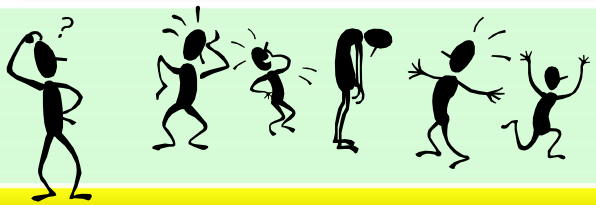
- The key to re-usability is to create course-context free resources
- In other words, same resource can be used in different contexts
- This means:
  - No button “next resource”
  - No button “back to course menu”
  - No wording such as “as we have previously seen”
  - etc

Using Re-Usable Resources

- BUT: how do you use context-free re-usable resources in the context of a course?
- You need an infrastructure to
  - Find resources in a library of resources
  - Sequence them up (put the puzzle together)
  - Serve them out to the students



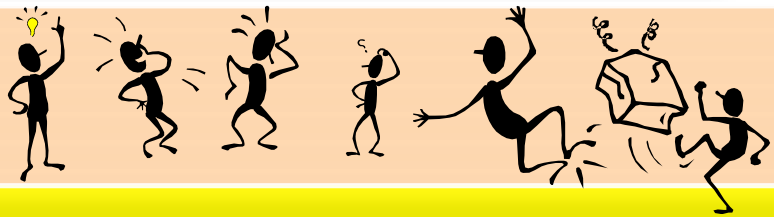
LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



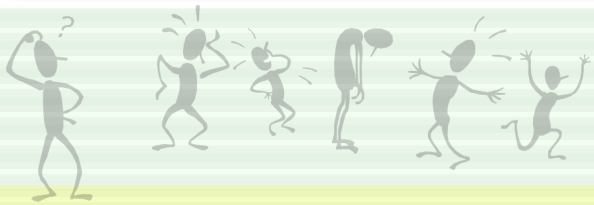
Course Management

Campus B

Resource Assembly

Shared Cross-Institutional Resource Library

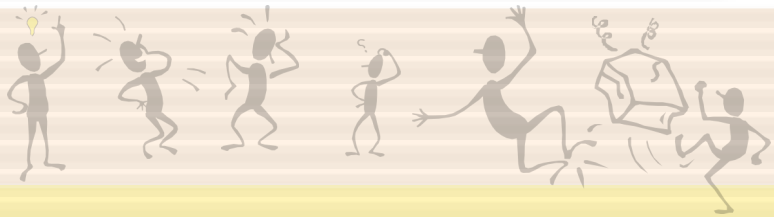
LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



Course Management

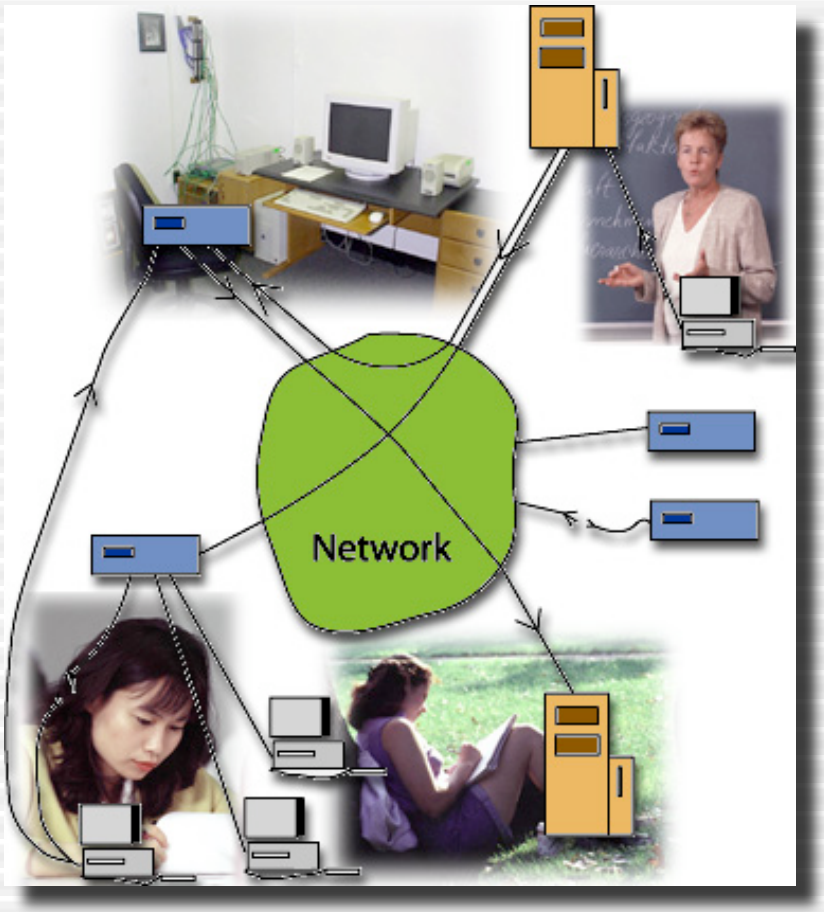
Campus B

Resource Assembly

Shared Cross-Institutional Resource Library

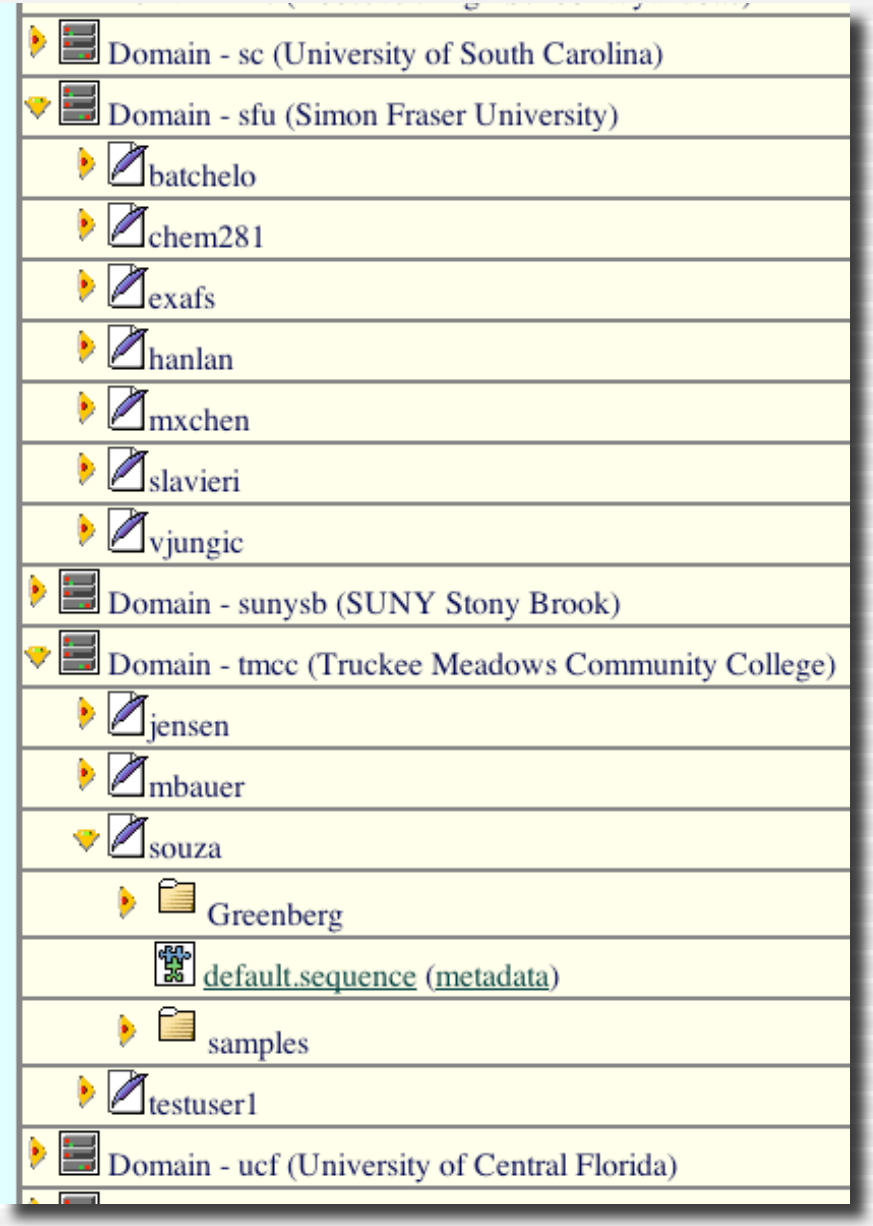
Shared Resource Library

- LON-CAPA currently links 120 institutions in eight countries



Shared Resource Library

- The distributed network looks like one big file system
- You can see each institution, the authors at that institution, and their resources



Shared Resource Library

- Resources may be web pages …

EXAMPLE

Example: Looping

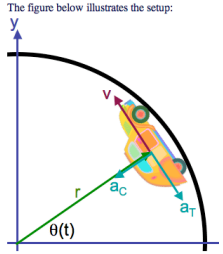
A toy car can go through a looping if it is fast enough. What are the forces that act on it? How fast does it have to be?

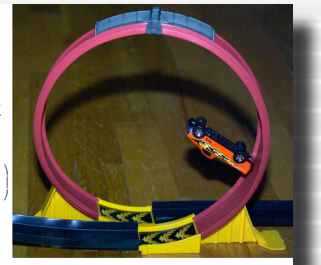
The motion is obviously circular, but non-uniform: the car will slow down on the way up, and speed up on the way down. With r being the radius of the looping, the x-axis horizontal, the y-axis pointing up, the origin being in the center of the looping, and $\theta(t)$ being the angle, the position of the car is given by

$$\vec{r}\,(t) = \begin{pmatrix} r\cos(\theta(t)) \\ r\sin(\theta(t)) \end{pmatrix}$$

as long as it does not fall off the track.

The figure below illustrates the setup:





EXAMPLE

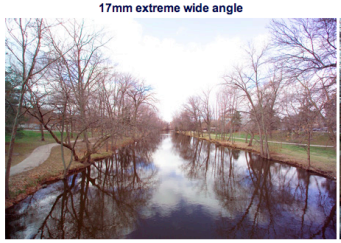
Focal Length

The following pictures are taken from the same vantage point with three different zoom lenses:

- 17mm-35mm wideangle zoom
- 24mm-70mm normal zoom
- 70mm-300mm tele zoom

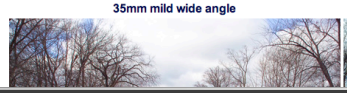
using a digital camera with an image sensor of 24mm x 36mm (standard so-called 35mm image format).

17mm extreme wide angle

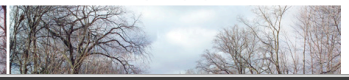


24mm wide angle

35mm mild wide angle



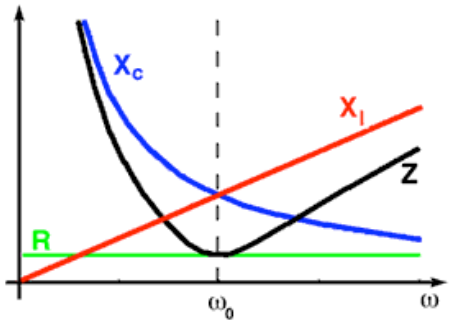
48mm normal



Impedance

The addition of the three currents (through the resistor, the inductance, and the capacitance), each of which is 90° out of phase with each other, in quadrature yields:

$$\begin{aligned} V &= \sqrt{V_R^2 + (V_C - V_L)^2} \\ &= \sqrt{(I\,R)^2 + (I\,X_C - I\,X_L)^2} \\ &= I\sqrt{R^2 + (X_C - X_L)^2} \\ &= I\,Z \end{aligned}$$



where I is the current, X_C and X_L are the capacitive and inductive reactances, respectively, and Z is the impedance. Putting in the values of the reactances, we obtain for Z:

$$\begin{aligned} Z = \frac{V}{I} &= \sqrt{R^2 + (X_C - X_L)^2} \\ &= \sqrt{R^2 + \left(\frac{1}{\omega C} - \omega L\right)^2} \\ &= \sqrt{R^2 + \left(\frac{1}{2\pi f C} - 2\pi f L\right)^2} \end{aligned}$$

nd has its minimum of Z = R when

$$\omega_0 = (LC)^{-1/2},$$

pure LC circuit. This is the resonance frequency of the RLC circuit. The dance and of the reactances is shown in the figure.

ave to be added in a special way. They end up as a single quantity Z, the alent of the resistance.

Shared Resource Library

- … with math in them …

One XML/LaTeX Source Code

```
<html>
<head>
<title>A Math Equation</title>
</head>
<body bgcolor="#FFFFFF">
The function is
<m>\[f(T)=\frac{1}{\omega}\int_{0}^{T}dt\frac{1}{t^2}\]</m>
where <m>$\omega$</m> is the frequency, and <m>$T$</m> is the period.
</body>
</html>
```

Online

The function is

$$f(T)=\frac{1}{\omega}\int_{0}^{T}dt\frac{1}{t^2}$$

where ω is the frequency, and T is the period.

Print

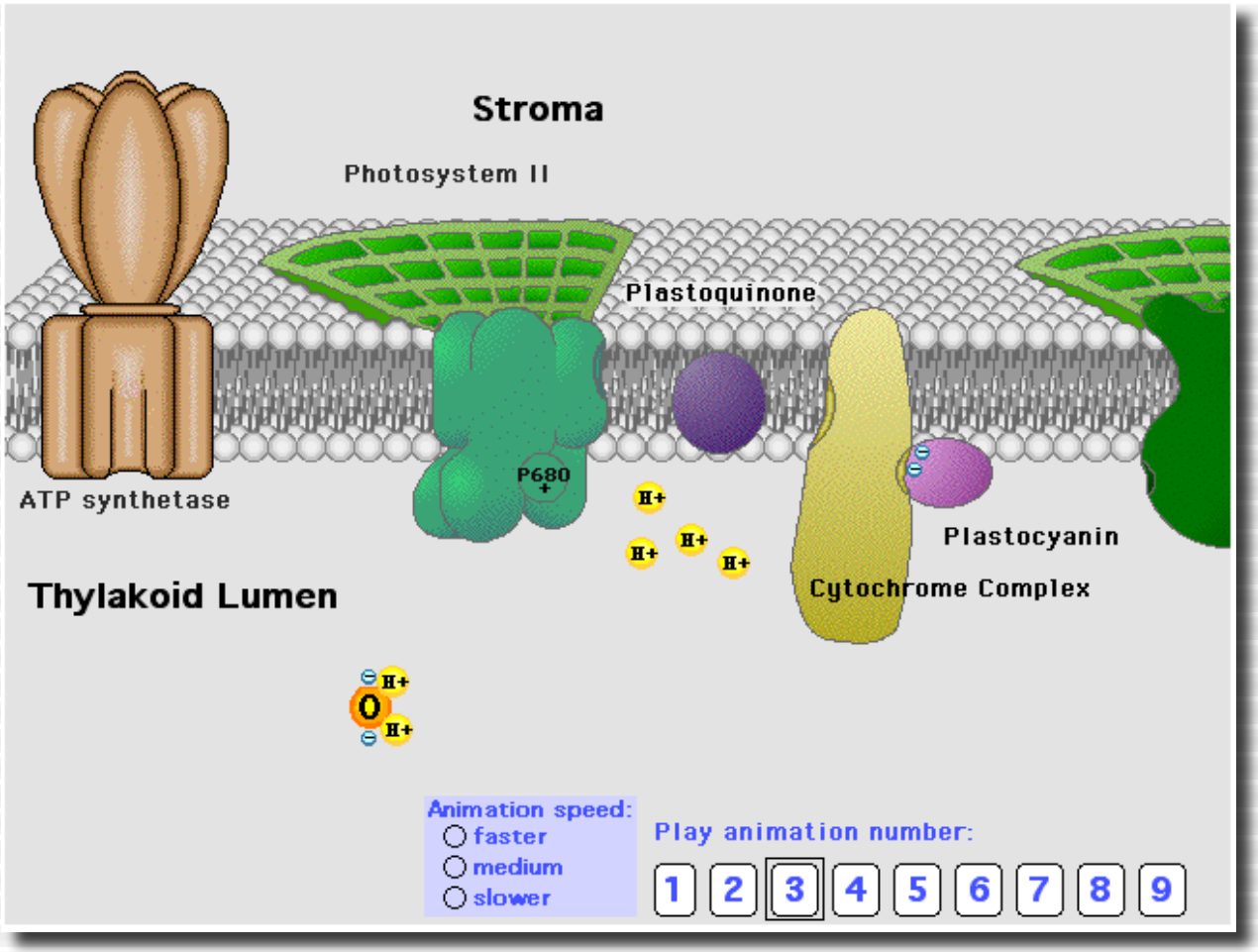
The function is

$$f(T) = \frac{1}{\omega}\int_0^T dt\frac{1}{t^2}$$

where ω is the frequency, and T is the period.

Shared Resource Library

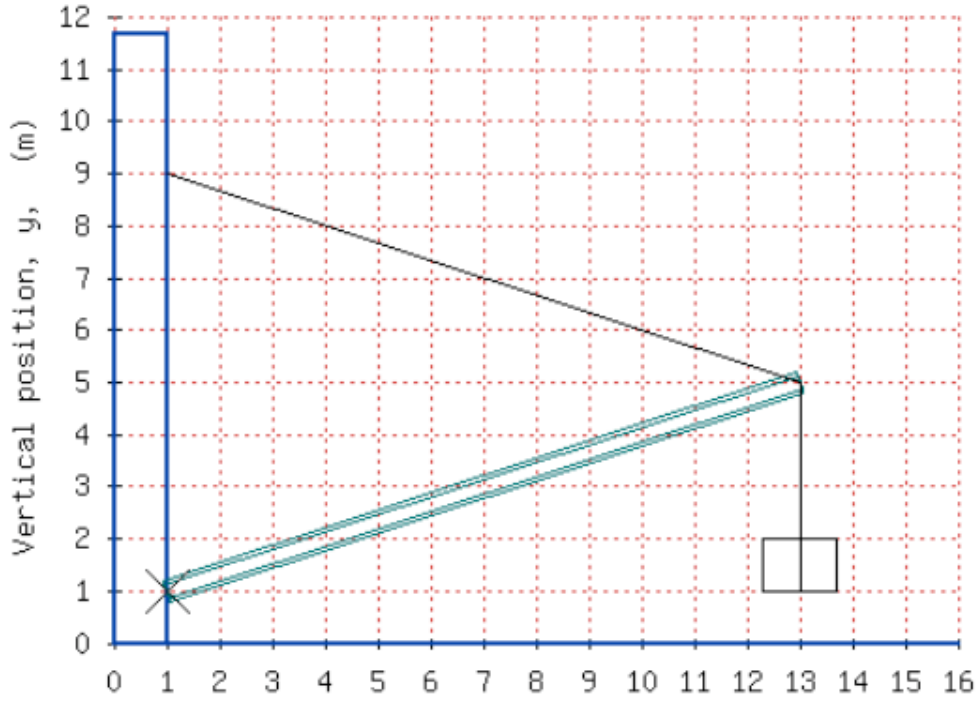
- … or simulations and animations …



Shared Resource Library

- … or this kind of randomizing online problems

A crate with a mass of 155.5 kg is suspended from the end of a uniform boom with mass of 89.5 kg. The upper end of the boom is supported by a cable attached to the wall and the lower end by a pivot (marked X) on the same wall. Calculate the tension in the cable.



Shared Resource Library

- …special emphasis on math …

What is the derivative of

$$\begin{pmatrix} 4t^3 \\ 8t^8 \end{pmatrix}$$

with respect to t? 4t^2,8t^7

You need to multiply with the original exponent.

Submit Answer Incorrect. Tries 1

Give an example of a function

1. which is orthogonal to $6\cdot\cos(7\cdot x)-2\cdot\sin(2\cdot x)$ with respect to the scalar product

$$< g \mid h > = \frac{1}{\pi} \int_{-\pi}^{\pi} dx\, g(x) \cdot h(x)$$

2. whose norm is 1.

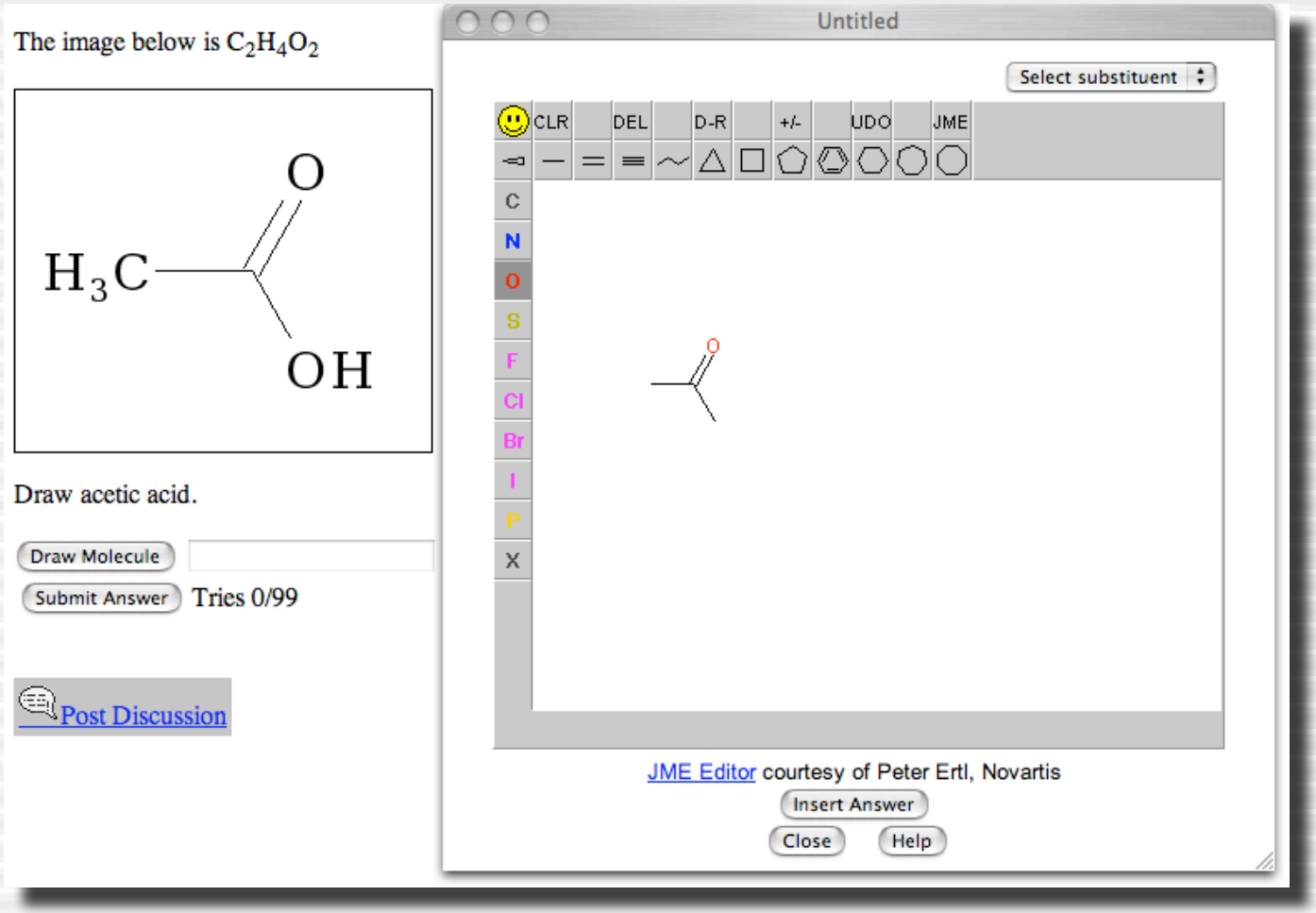
cos(2x)+sin(7x)

The function you have provided does not have a norm of one.

Submit Answer Incorrect. Tries 1

Shared Resource Library

- … chemistry …



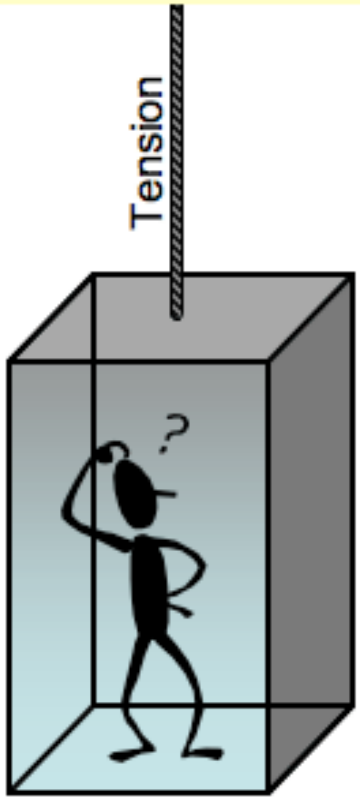
Shared Resource Library

- … physical units …

Elevator Problem Due never

An elevator (cabin mass 500 kg) is designed for a maximum load of 2600 kg, and to reach a velocity of 3 m/s in 5 s. For this scenario, what is the tension the elevator rope has to withstand? 32270 kg*m/s^2

Submit Answer Tries 0/99

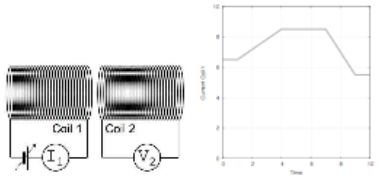


Shared Resource Library

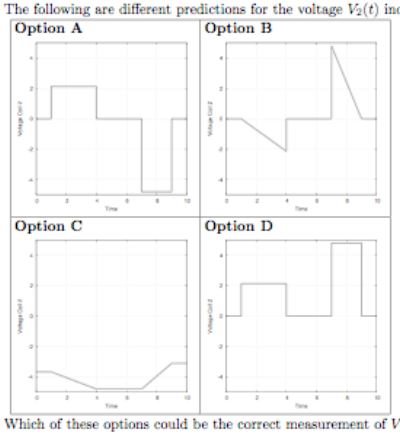
- Dynamic Graphing

Gerd Kortemeyer

Two short coils are located close to each other as shown below. The current $I_1(t)$ through Coil 1 is variable and shown as a function of time in the plot below.



The following are different predictions for the voltage $V_2(t)$ induced in Coil 2.



Which of these options could be the correct measurement of $V_2(t)$?

A. Option A
B. Option B
C. Option C
D. Option D

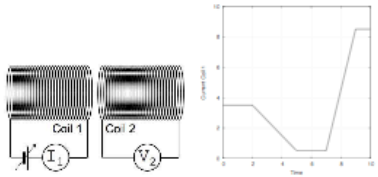
Which one of the following actions would result in a higher magnitude of the peak voltage across the Coil 2?

A. Placing the whole apparatus into a medium with lower permeability.
B. Increasing the current through Coil 1 by a constant positive offset ΔI, i.e., $I_1'(t) = I_1(t) + \Delta I$.
C. Decreasing the number of turns of Coil 1.
D. Changing the current through Coil 1 more rapidly.
E. Decreasing the number of turns of Coil 2.

If Coil 1 has 180 turns, and Coil 2 has 380 turns, and if a current of $I_1 = 3A$ through Coil 1 results in an average flux of $\Phi_2 = 0.08Tm^2$ inside Coil 2, what is the mutual inductance? [ ]
Now the coils are moved closer together, so that the new mutual inductance is 68 H. What is the magnitude of the induced voltage V_2 while I_1 is at a constant $3A$? [ ]
Using the same setup with a mutual inductance of 68 H, what is the magnitude of the induced voltage V_2 if I_1 increases with $5A/s$? [ ]

Gerd Kortemeyer 1

Two short coils are located close to each other as shown below. The current $I_1(t)$ through Coil 1 is variable and shown as a function of time in the plot below.



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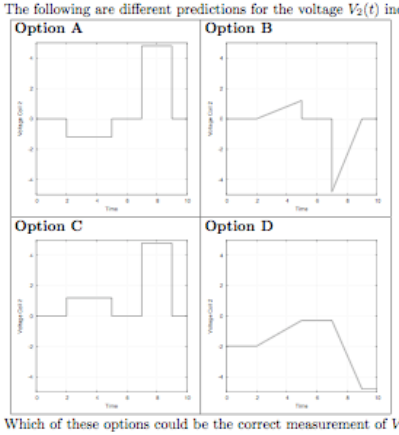

Which of these options could be the correct measurement of $V_2(t)$?

A. Option A
B. Option B
C. Option C
D. Option D

Which one of the following actions would result in a higher magnitude of the peak voltage across the Coil 2?

A. Decreasing the number of turns of Coil 1.
B. Placing the whole apparatus into a medium with lower permeability.
C. Decreasing the number of turns of Coil 2.
D. Increasing the current through Coil 1 by a constant positive offset ΔI, i.e., $I_1'(t) = I_1(t) + \Delta I$.
E. Changing the current through Coil 1 more rapidly.

If Coil 1 has 190 turns, and Coil 2 has 370 turns, and if a current of $I_1 = 3A$ through Coil 1 results in an average flux of $\Phi_2 = 0.07Tm^2$ inside Coil 2, what is the mutual inductance? [ ]
Now the coils are moved closer together, so that the new mutual inductance is 50 H. What is the magnitude of the induced voltage V_2 while I_1 is at a constant $3A$? [ ]
Using the same setup with a mutual inductance of 50 H, what is the magnitude of the induced voltage V_2 if I_1 increases with $2A/s$? [ ]

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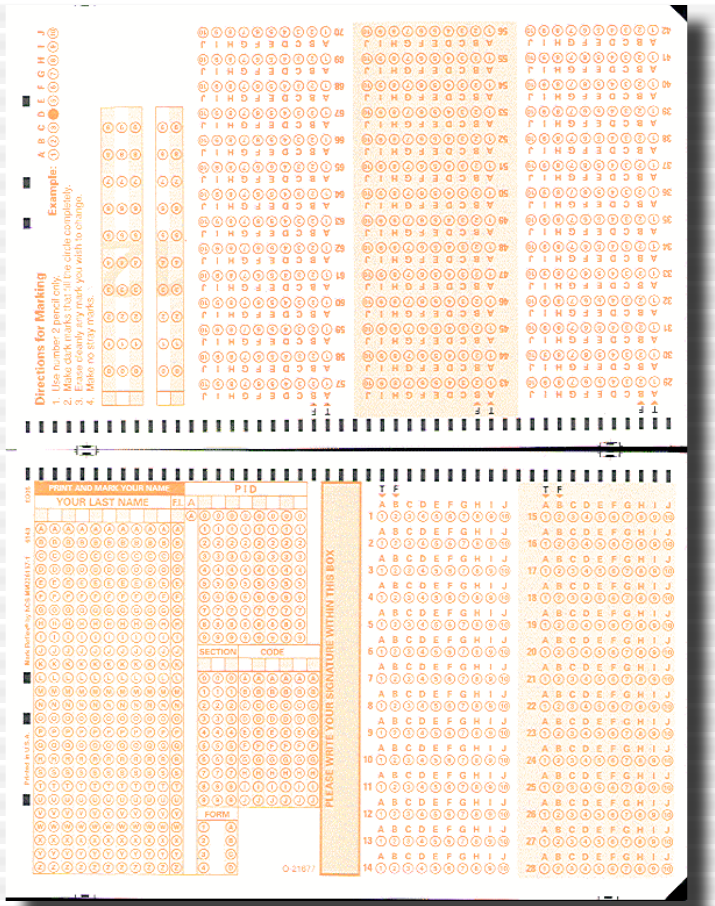
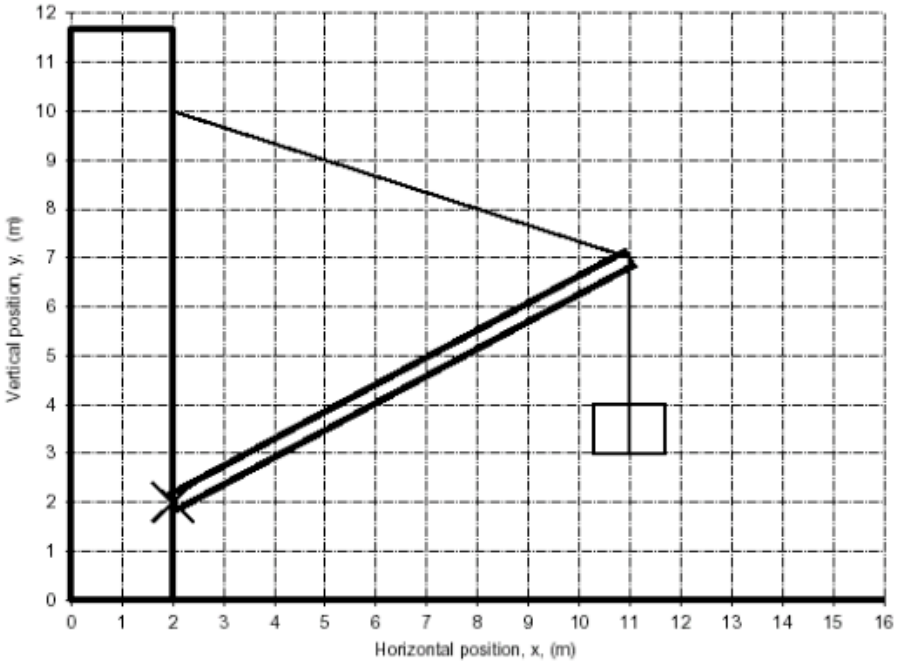
Shared Resource Library

- Same Resource, multiple uses
- Tests and Exams



A crate with a mass of 177.5 kg is suspended from the end of a uniform boom with mass of 88.5 kg. The

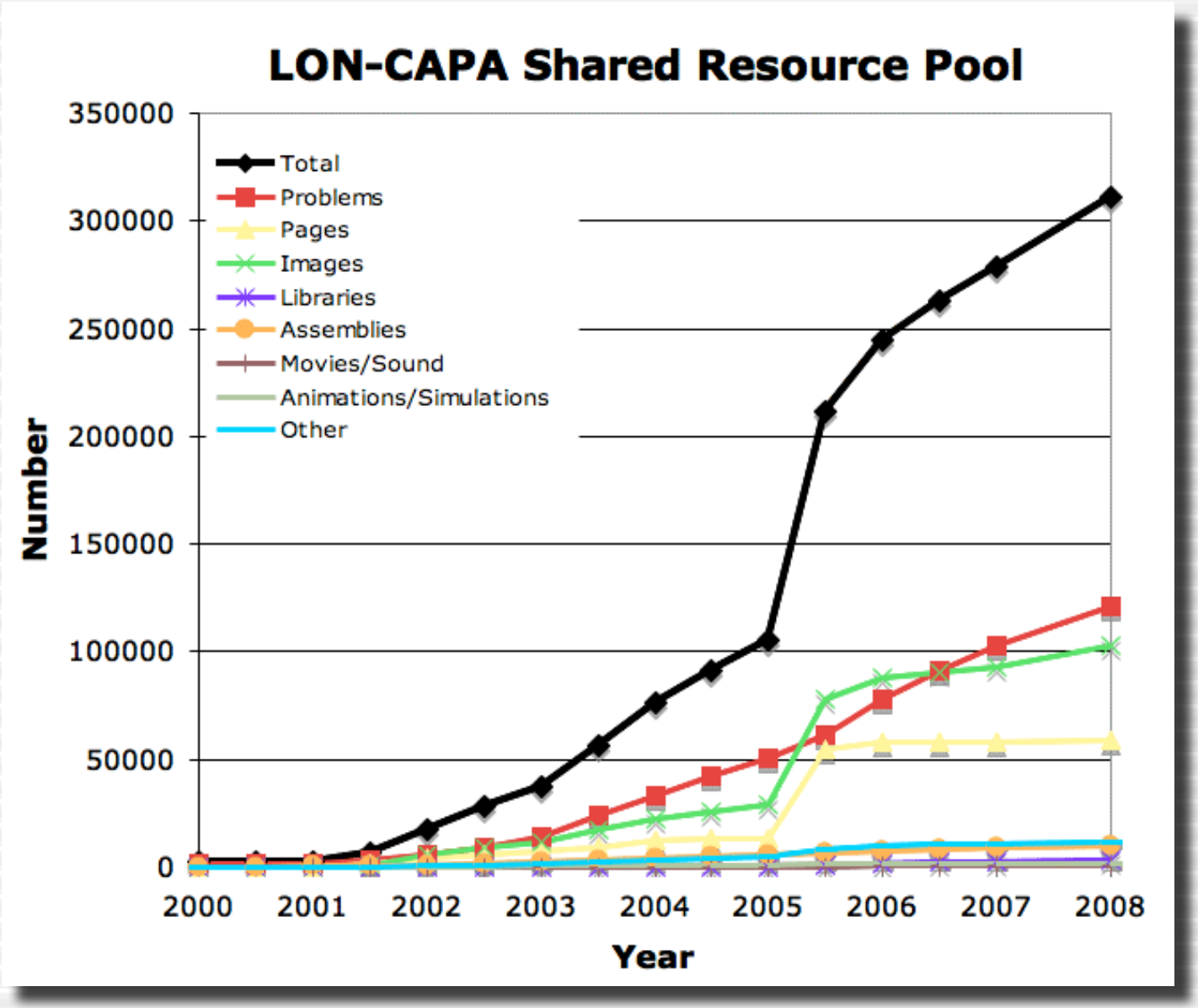
1 pt A crate with a mass of 177.5 kg is suspended from the end of a uniform boom with mass of 88.5 kg. The upper end of the boom is supported by a cable attached to the wall and the lower end by a pivot (marked X) on the same wall. Calculate the tension in the cable.



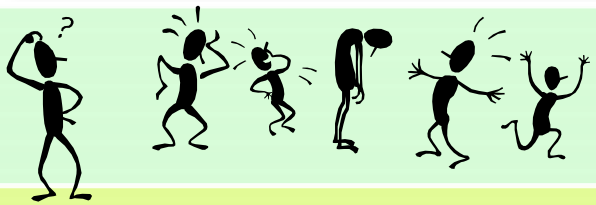
(in N)

22. A○ 2.58×10^3 B○ 2.92×10^3 C○ 3.29×10^3
D○ 3.72×10^3 E○ 4.21×10^3 F○ 4.75×10^3
G○ 5.37×10^3 H○ 6.07×10^3

Shared Resource Library



LON-CAPA Architecture



Course Management

Campus A

Resource Assembly

Course Management

Campus B

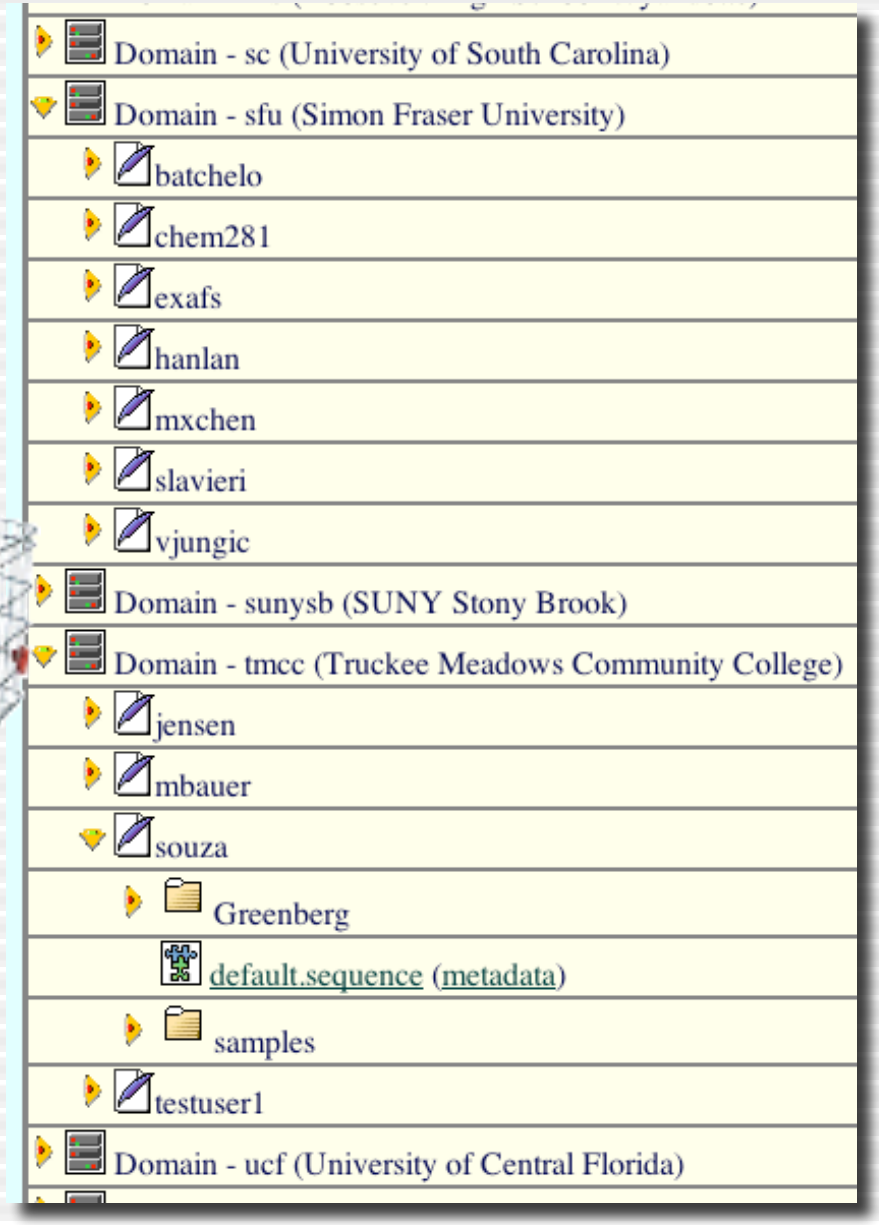
Resource Assembly

Shared Cross-Institutional Resource Library

Resource Assembly

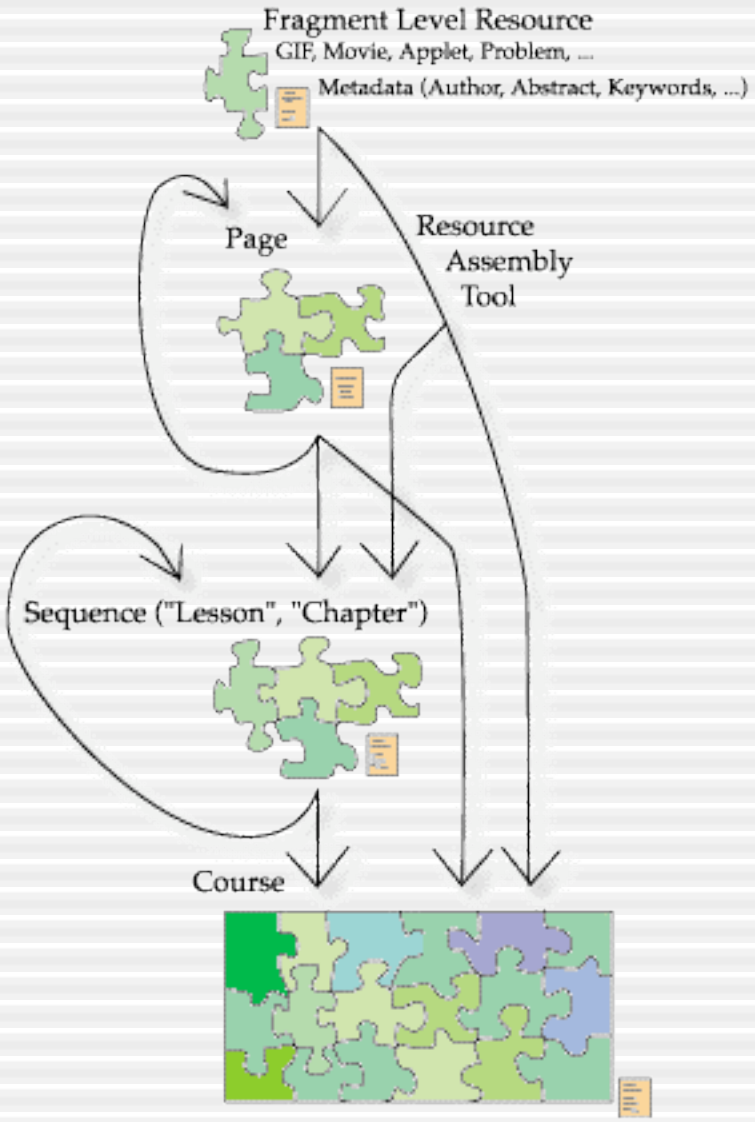
- Shopping Cart

"Supermarket"



Resource Assembly

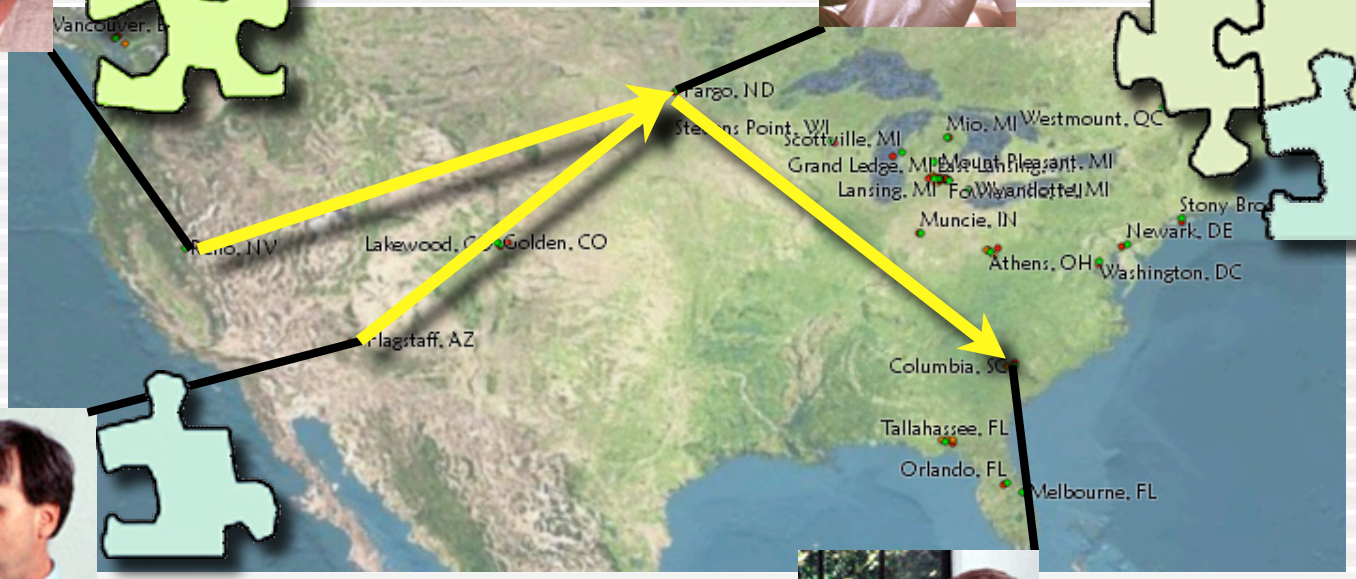
- Nested Assemblies
- No pre-defined levels of granularity („module“, „chapter“, etc)
- People can never agree what those terms mean
- Re-use possible on any level



Resource Assembly

Writes module about energy conservation

Compiles modules about conservation laws



Writes module about momentum conservation

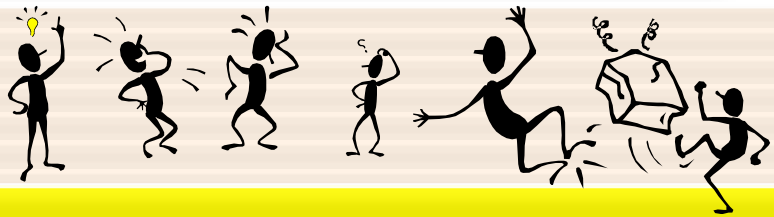
Uses whole assembly in his course

Dynamic Metadata

Course Management

Campus A

Resource Assembly



Course Management

Campus B

Resource Assembly

Shared Cross-Institutional Resource Library

Dynamic Metadata

- Dynamic metadata from usage
- Assistance in resource selection („amazon.com“)
- Quality control

Access and Usage Statistics

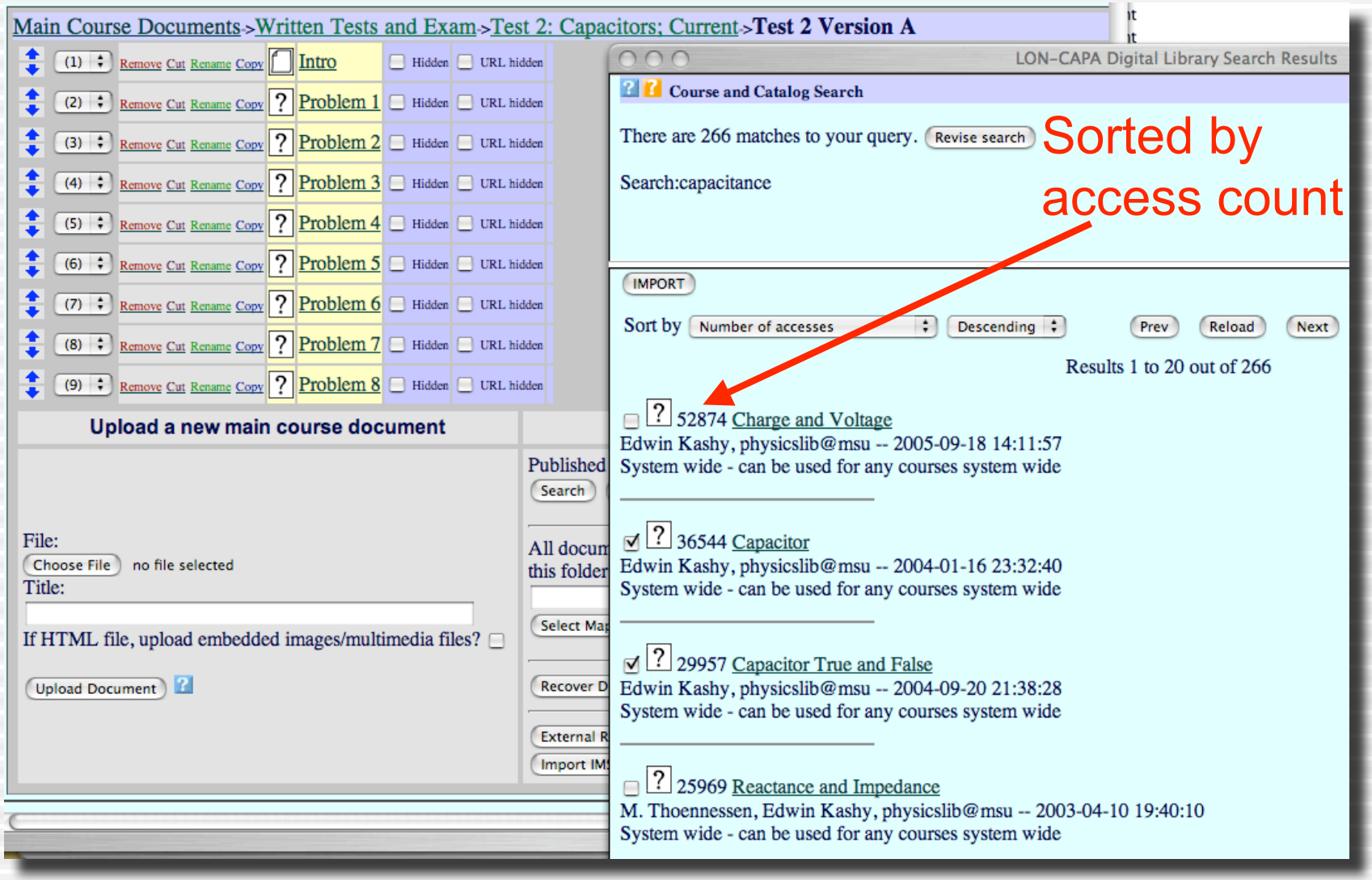
Network-wide number of accesses (hits)	890
Number of resources using or importing resource	1 • Eukaryotic Gene Control [msu/bio/Gene_Expr/111f03GeneCntrl.sequence]
Number of resources that lead up to this resource in maps	1 • Back to the Original Question [msu/bio/Gene_Expr/problems/originalquestion.problem]
Number of resources that follow this resource in maps	1 • Eukaryotic vs Prokaryotic Gene Expression II [msu/bio/Gene_Expr/problems/eukvsprokII.problem]
Network-wide number of courses using resource	3 • LBS 145 - Spring 2004 • ZOL 341 - Fall 2003 • BS 111 - Fall 2003

Assessment Statistical Data

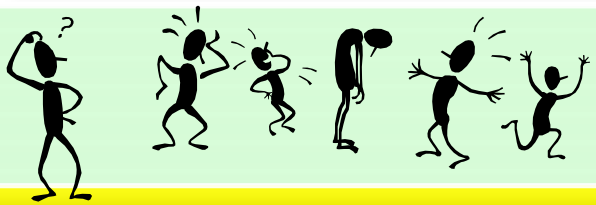
Total number of students who have worked on this problem	291
Average number of tries till solved	1.37
Degree of difficulty	(0.36)

Selection Help

- Assembling materials for a course



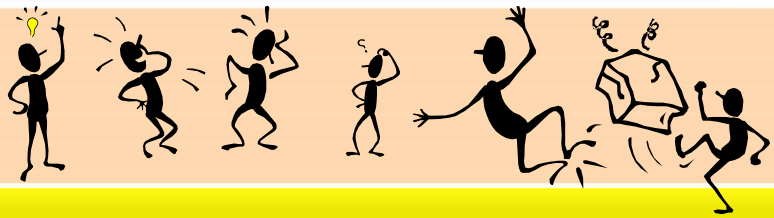
LON-CAPA Architecture



Course Management

Campus A

Resource Assembly



Course Management

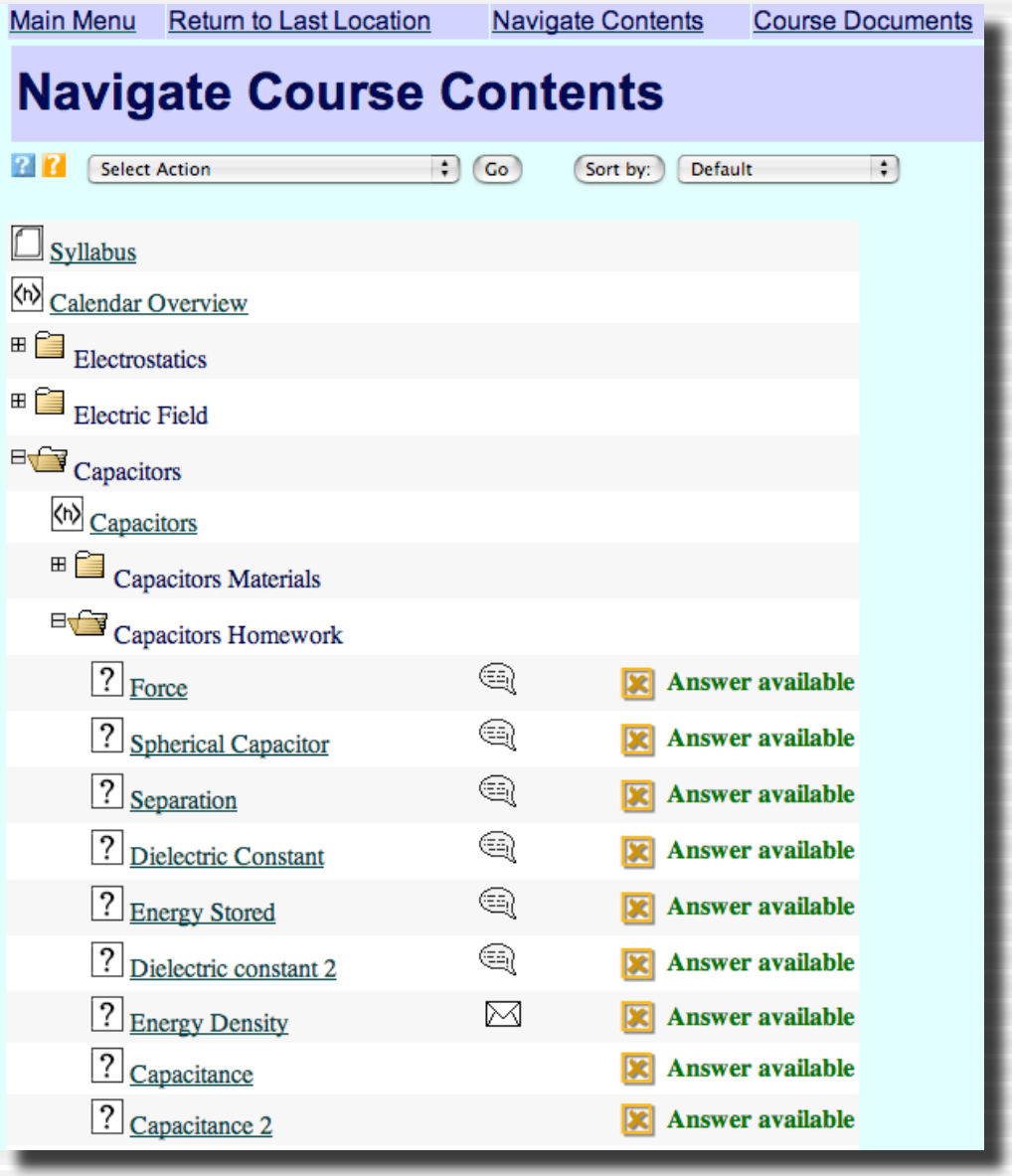
Campus B

Resource Assembly

Shared Cross-Institutional Resource Library

Course Management

- Instructors can directly use the assembled material in their courses
  - navigational tools for students to access the material
  - grade book
  - communications
  - calendar/scheduling
  - access rights management
  - portfolio space



Course Management

Course Action Items

Gerd Kortemeyer
Course Coordinator
LBS 272 - Spring 2006

LBS 272 - Spring 2006->**Display Action Items** What's New?

Go to first resource

Page set to be displayed after you have selected a role in this course? Currently: *What's New? page (user preference)* **Change** for just this course or for all your courses.

Hide all Show all

Problems requiring handgrading — Hide

Problem Name	Number ungraded
Electric Field	4

Problems with errors — Hide

No problems with errors

Problems with av. attempts ≥ 3 or deg. difficulty ≥ 0.8 and total number of students with submissions ≥ 4 — Hide

Change thresholds?

Resource	Part	Num. students	Av. Attempts	Deg. Diff	Last Reset	Reset Count?
Field Lines	single part	24	2.12	0.84		☐
Net Force	single part	53	2.49	0.80		☐
Pith Balls	single part	52	4.12	0.90		☐

Reset counters to 0

Resources in course with version changes since last week — Hide

Change interval?

Resource	Last revised	New version	Version used
Applet: Electron Orbit	Fri Jan 13 10:18:52 2006 (EST)	10	10
Capacitance of a Sphere	Mon Jan 16 12:03:13 2006	8	8

Unread course discussion posts — Hide

Change options?

Location	Type	Time of last post	Number of new posts
Coulomb	Resource	last Monday, Jan 16 at 04:55 pm (EST)	1
Distance Change	Resource	last Monday, Jan 16 at 07:00 pm (EST)	1
Field Lines	Resource	last Monday, Jan 16 at 07:49 pm (EST)	1
Force	Resource	on Wednesday, Jan 11 at 07:01 pm (EST)	3
Net Force	Resource	23 hours, 19 minutes ago	5
Pith Balls	Resource	last Monday, Jan 16 at 09:21 pm (EST)	6
Point P	Resource	last Friday, Jan 13 at 02:34 pm (EST)	5
Potential	Resource	last Sunday, Jan 15 at 03:15 pm (EST)	1
Two Charges	Resource	last Sunday, Jan 15 at 03:26 pm (EST)	1
Vector	Resource	last Saturday, Jan 14 at 01:32 am (EST)	1
Vectors	Resource	last Saturday, Jan 14 at 12:09 pm (EST)	2

New course messages — Hide

Number	Subject	Sender	Date/Time
1.	Feedback [msu/mmp/kap18/problems/cd460.problem]	[redacted]@msu	Sat Jan 14 10:45:02 2006 (EST)

New critical messages in course — Hide

No unread critical messages in course

Course Management

- Student homework progress

LBS 272 Spring 2004 Thu Apr 1 20:14:39 2004

Number **Resource:** Two Charges

View of the problem - [redacted]

Two opposite charges are placed some distance apart in a vacuum.

What will happen if ...?

One forth the force: The distance between the charges is doubled.
Double the force: The magnitude of one of the two charges is doubled.
Four times the force: The magnitude of both charges is doubled.
Four times the force: The distance between the two charges is cut in half.
Half the force: The charges are placed in a medium with a factor two higher permittivity.

You are correct.
Your receipt is 498-1666

Correct answer:

Answer for Part:0	One forth the force	Double the force	Four times the force	Four times the force	Half the force

Fullname: [redacted]

Date/Time	Submission	Status
Mon Jan 19 20:15:19 2004	**Part 0** (ID 11) **Trial 1**	**Part 0** incorrect
Mon Jan 19 20:15:29 2004	**Part 0** (ID 11) **Trial 2**	**Part 0** incorrect

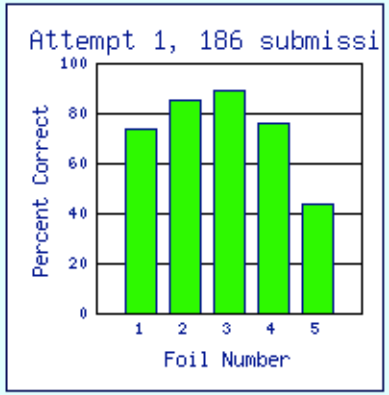
Answer	**One forth the force**	**Double the force**	**Four times the force**	**Four times the force**	*Double the force*
Option ID	1_6_1_4_2	1_6_1_3_2	1_6_1_2_2	1_6_1_1_2	1_6_1_5_2

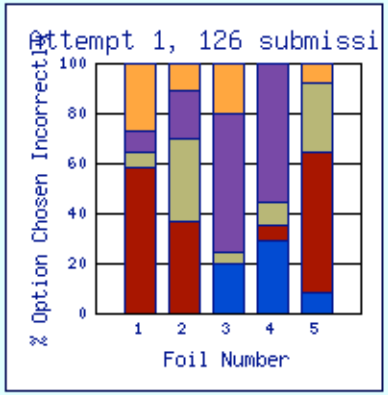
Answer	**One forth the**	**Double the**	**Four times the**	**Four times the**	*Four times the*

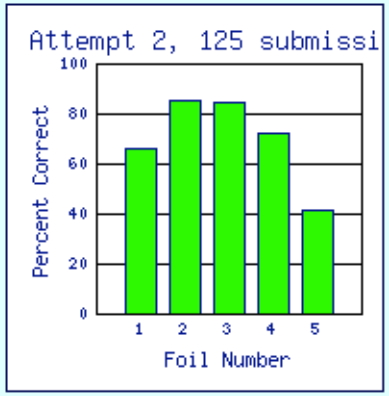
Course Management

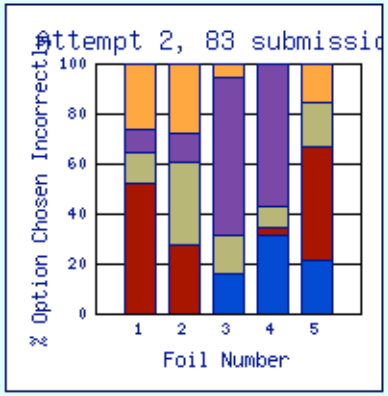
- Question Analysis

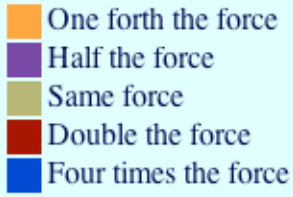
Foil Number	Foil Name	Foil Text	Correct Value
1	1_6_1_1_2	The distance between the two charges is cut in half.	Four times the force
2	1_6_1_2_2	The magnitude of both charges is doubled.	Four times the force
3	1_6_1_3_2	The magnitude of one of the two charges is doubled.	Double the force
4	1_6_1_4_2	The distance between the charges is doubled.	One forth the force
5	1_6_1_5_2	The charges are placed in a medium with a factor two higher permittivity.	Half the force

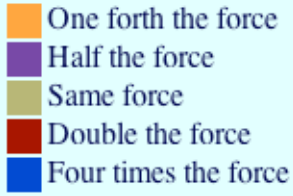












Course Management

- Enabling new modes of running your course

Collaborative learning space

Computer-enhanced student laboratory

Course Management

LON-CAPA Grading

http://phy1.lbs.msu.edu/adm/gi

Google

Getting Started Latest Headlines

LON-CAPA Course Statistics an...

LON-CAPA Grading

Main Menu | Return to Last Location | Navigate Contents | Course Documents | Groups | Launch Remote Control | Roles | Help | Exit

Grading

Gerd The Kortemeyer
Course Coordinator
Bio Test Course

Current Resource: Sept. 14th Lecture

Part: 0 score **Type:** numerical

Specify a file containing the clicker information for this resource.

/Users/korte/Documents/iclicker/L0610311025.csv Browse...

Type: i>clicker

Award points just for participation:

Correctness determined from response by course personnel:

Correctness determined from response with clicker ID(s): 629AF8

Percentage points for correct solution: 95

Percentage points for incorrect solution: 75

Upload File

Grading Menu

Getting Started Latest Headlines

LON-CAPA Course Statistics a

Main Menu

Change Preferen

Menu->Set User Preferences->Re

Enter response device ("clicker

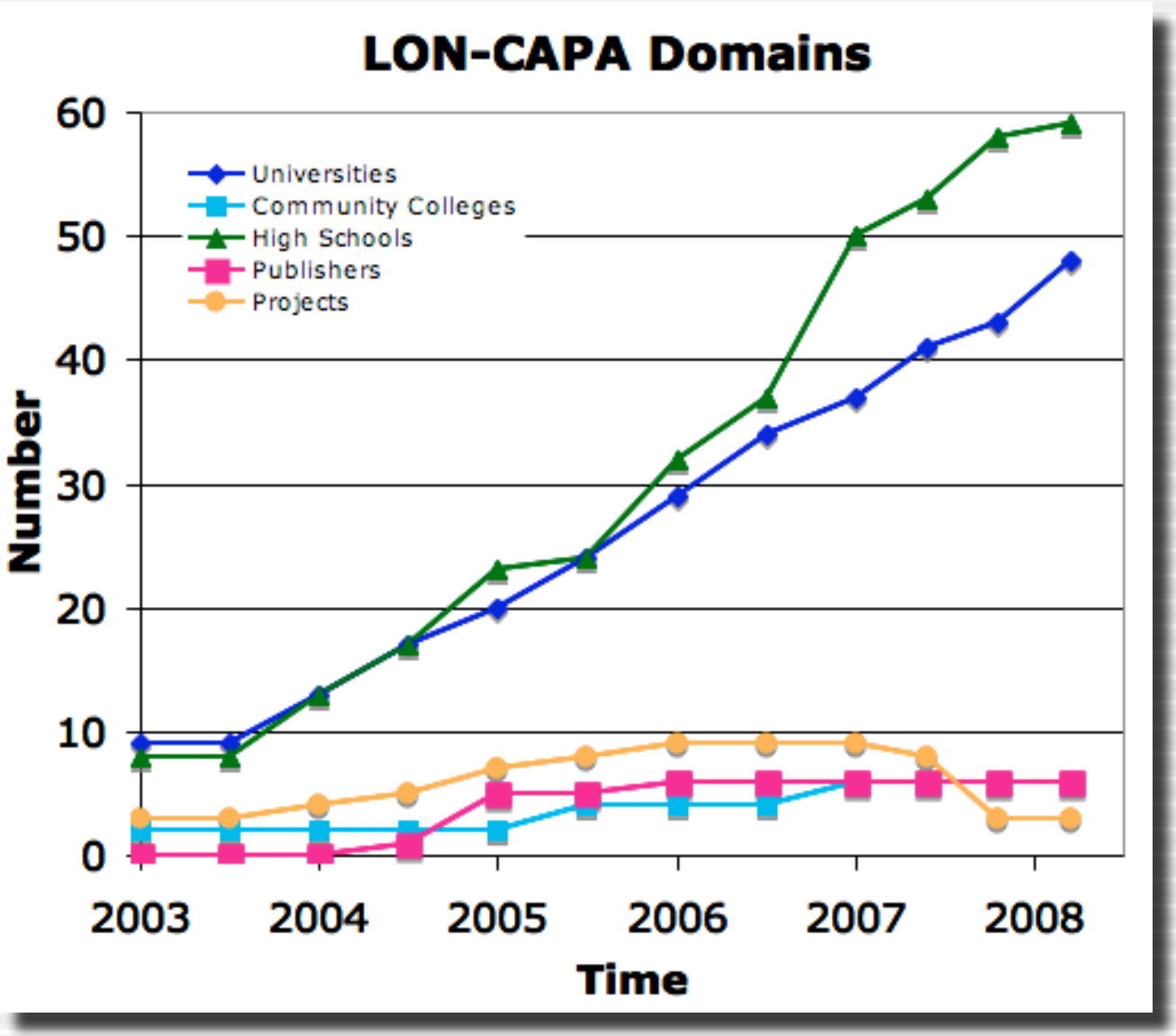
005BC59E

Register

Communities of Practice

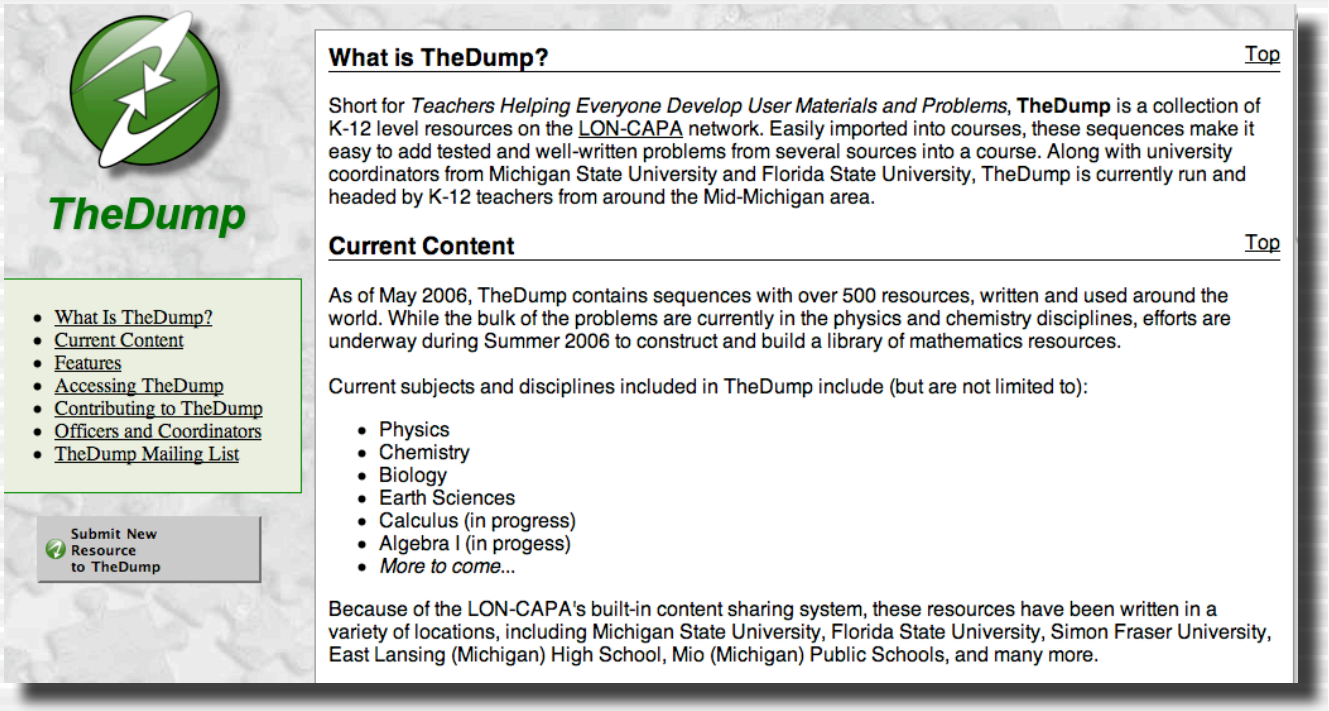
User Institutions

- Increasing number of institutions
- Unexpected growths at K-12 schools



Teacher Initiative

- Initiative: THEDUMP („Teachers Helping Everyone Develop User Materials and Problems“)
- Assembling materials that are appropriate for high school use according to curricular units
- Including university materials



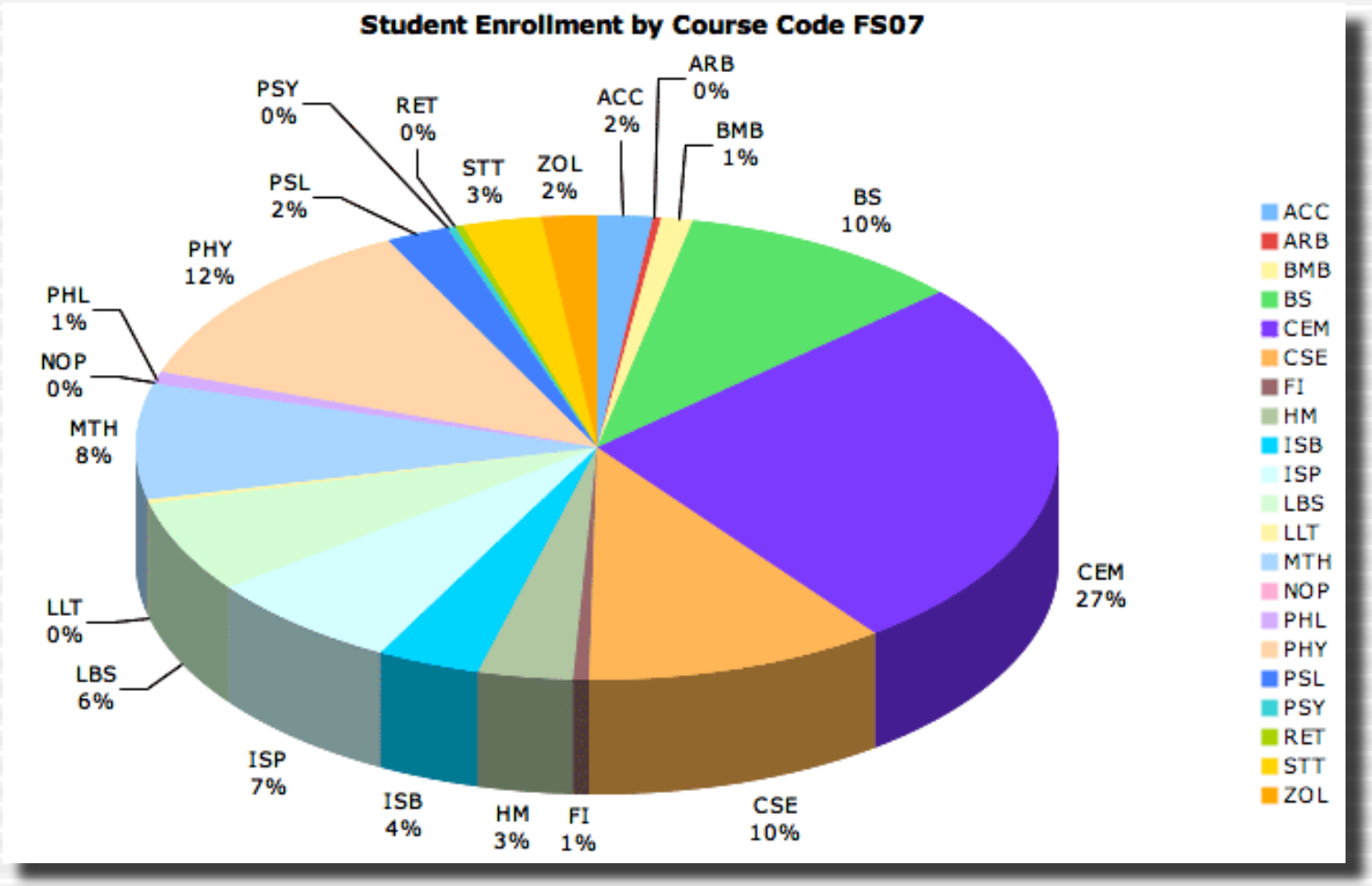
Sharing Communities

- Online communities of practice
- Contributors versus users (institutions)

		U01	U04	PR01	U06	U17	U05	U03	HS20	U12	PR06	U11	U08	U
	Available	144418	17545	10809	8799	7635	7037	5120	4439	4066	3750	3283	2989	27
	Used	38245	7596	340	4821	2908	4880	3411	3842	2841	1502	1231	2102	3
	Used externally	17099	1804	339	974	276	3507	1735	1035	1997	1502	415	62	3
	Using													
U01	38855	34790	301	105	17	49	1621	294	74	102	298	137	3	
U05	11668	4881	23	14	3	33	4357	866	29	500	328	5	3	
U04	10343	2393	6969		10		207	374	8	128	2	18		
U06	10089	2261	64	13	4755		305	1001	8	10	2	72	2	2
U03	9973	4053	58	27	5	84	1213	3173	7	728	14	166		
U08	8578	2014	1078	6	2	2	720	5					2097	
HS20	6465	2138	1	47			40	350	3767	21	70	4		
CC04	6356	1156	25		2	31	1586	789	197	1522		64	7	
U17	6270	2689	4	7		2813	188	205	94	140	4		2	
HS40	5251	3899	22	5		40	65	293	388	70	27	16	1	
U14	5135	1682	213	42	12	1	665	42		3	7	114		
U09	4246	3409	7		1			15		1		1		
U12	3768	184					136	760		2684				
HS39	3467	2101	19	20	5	2	68	26	29	1	808	71		

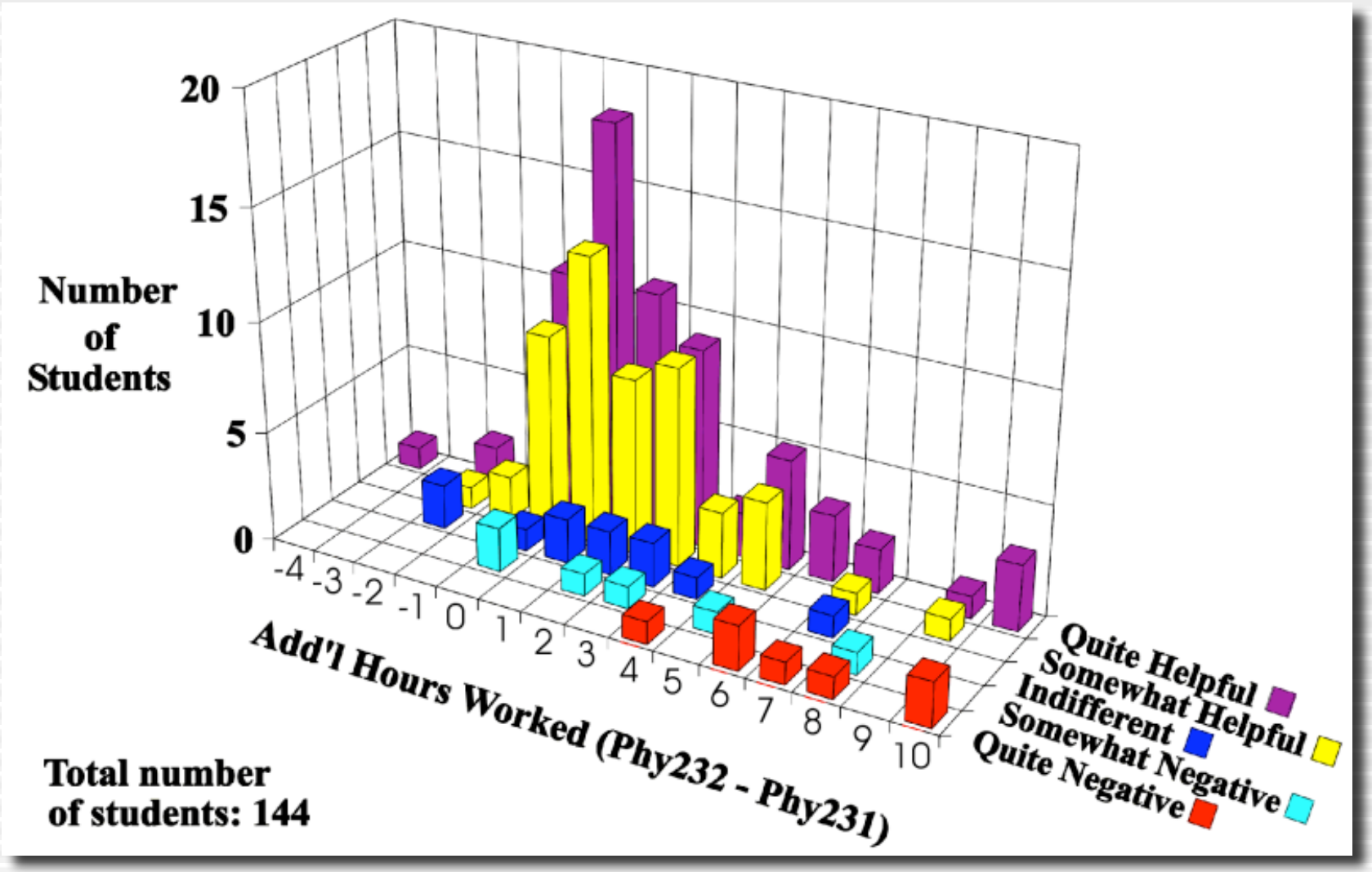
Communities of Practice

- Disciplines
- Data from MSU



Some OLD Results - Still True

Time On Task


20
15
10
5
0
Number of Students
-4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10
Add'l Hours Worked (Phy232 - Phy231)
Quite Helpful
Somewhat Helpful
Indifferent
Somewhat Negative
Quite Negative
Total number of students: 144

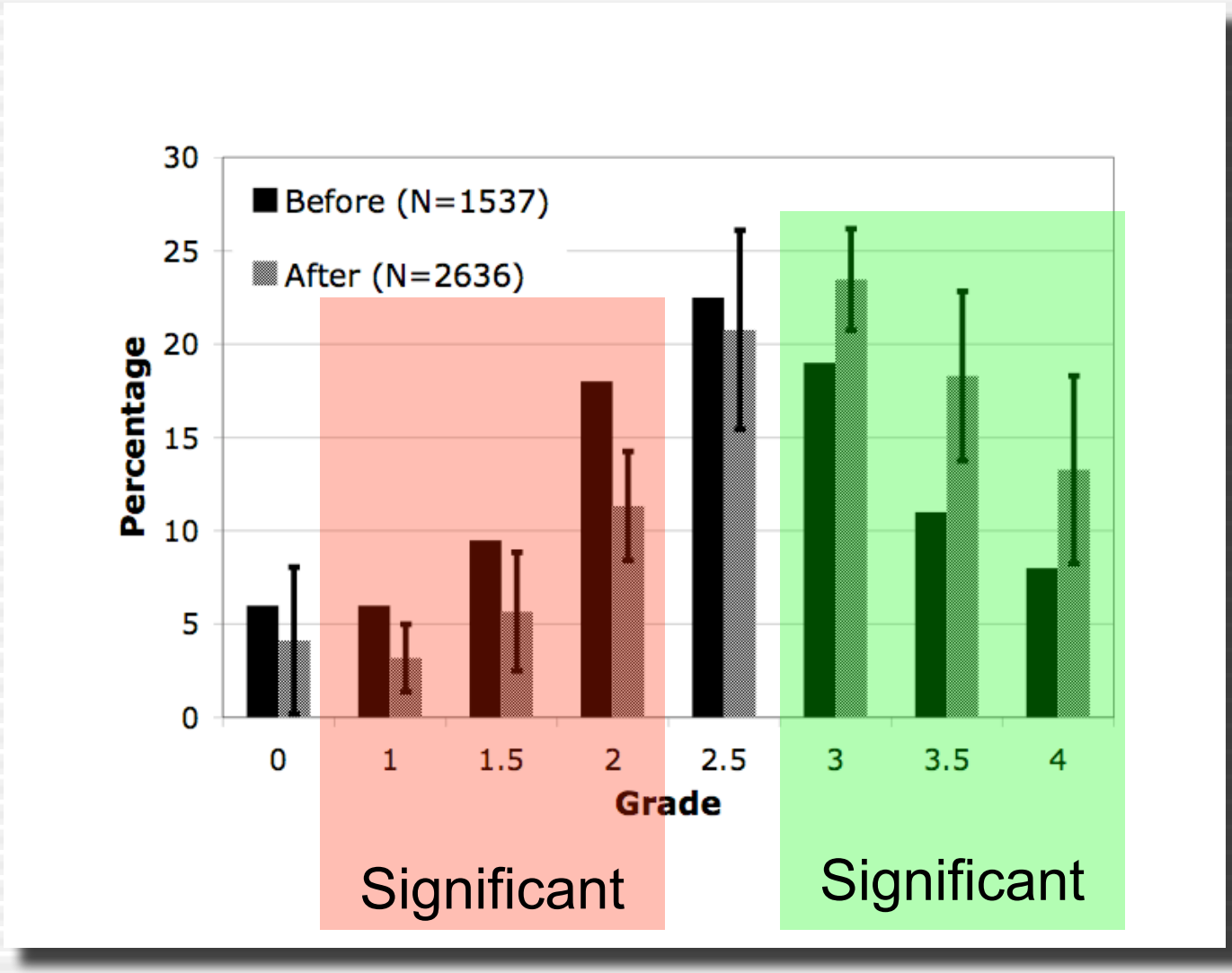
Exam and Course Grades

Intro Physics for Scientists and Engineers

Before: 1992-1994

After: 1996-2007

Different Instructors every semester!



Acknowledgements and Website

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  - National Science Foundation
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  - The Alfred P. Sloan Foundation
  - The Andrew W. Mellon Foundation
  - **Our partner universities**

Visit us at http://www.lon-capa.org/