

The Interactive Classroom

204th AAS Meeting
Denver, CO, 31 May 2004

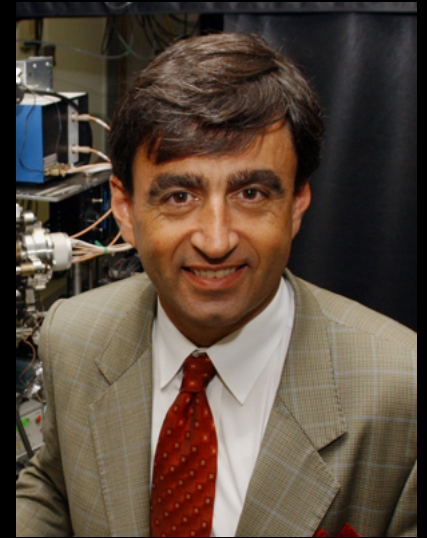




Veronica McCauley



Suvendra Dutta



Eric Mazur

and also....

Programming:

**Michael Tucker
Jean Moreau
Olaf Jonmaker
Vijay Salagala
Juston Payne**

Editing:

**Prof. Ed. Ginsberg (UMass Boston)
Prof. Peter Dourmashkin (MIT)
Prof. Chris Gould (USC)**

Beta testing:

**Prof. John Belcher (MIT)
Andrew McKinney (MIT)
Sue Gautsch (USC)
Prof. Catherine Crouch (Swarthmore)
Prof. Clifford V. Johnson (USC)**

...and hundreds of students in dozens of courses

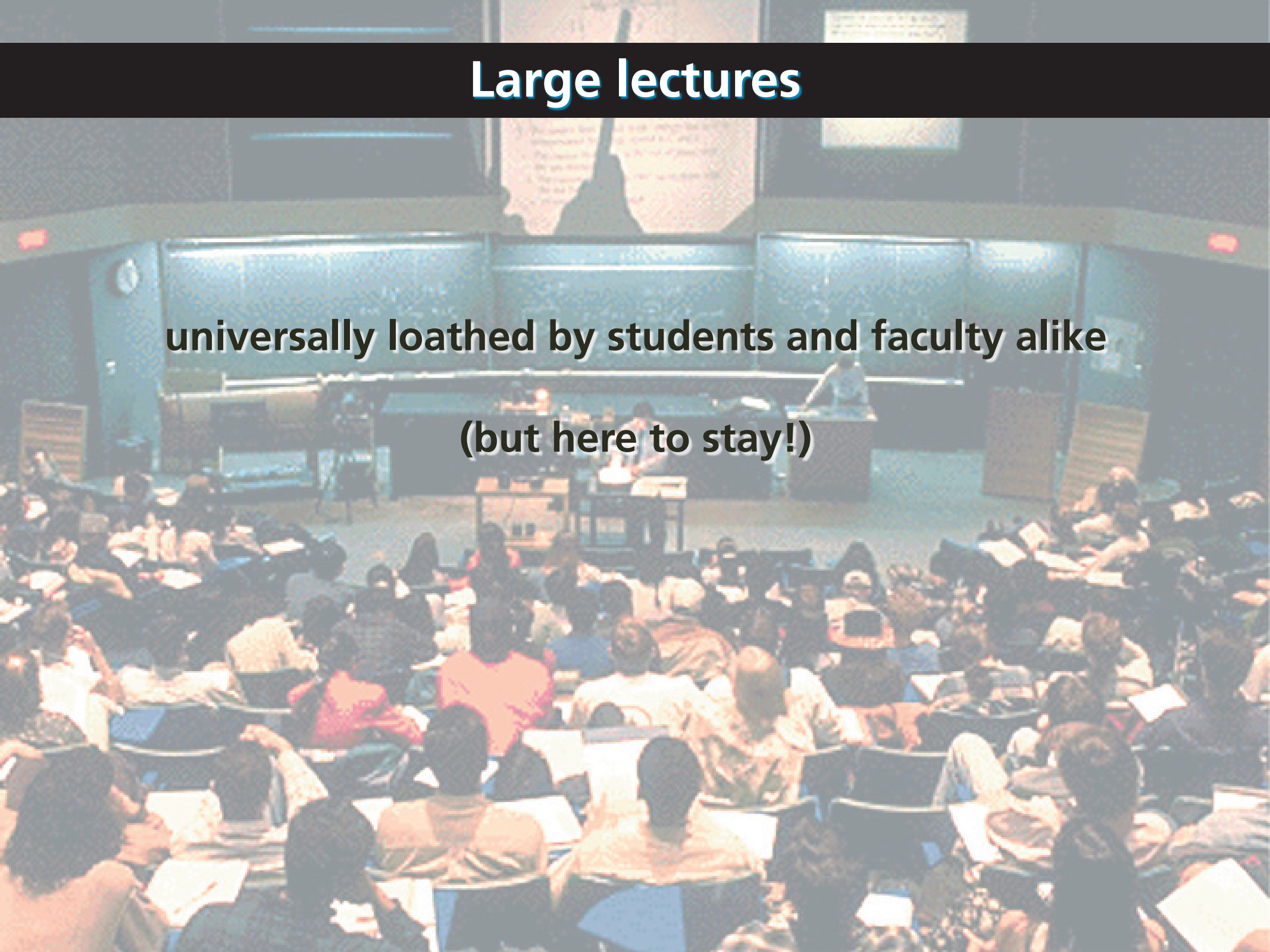
Large lectures



Large lectures

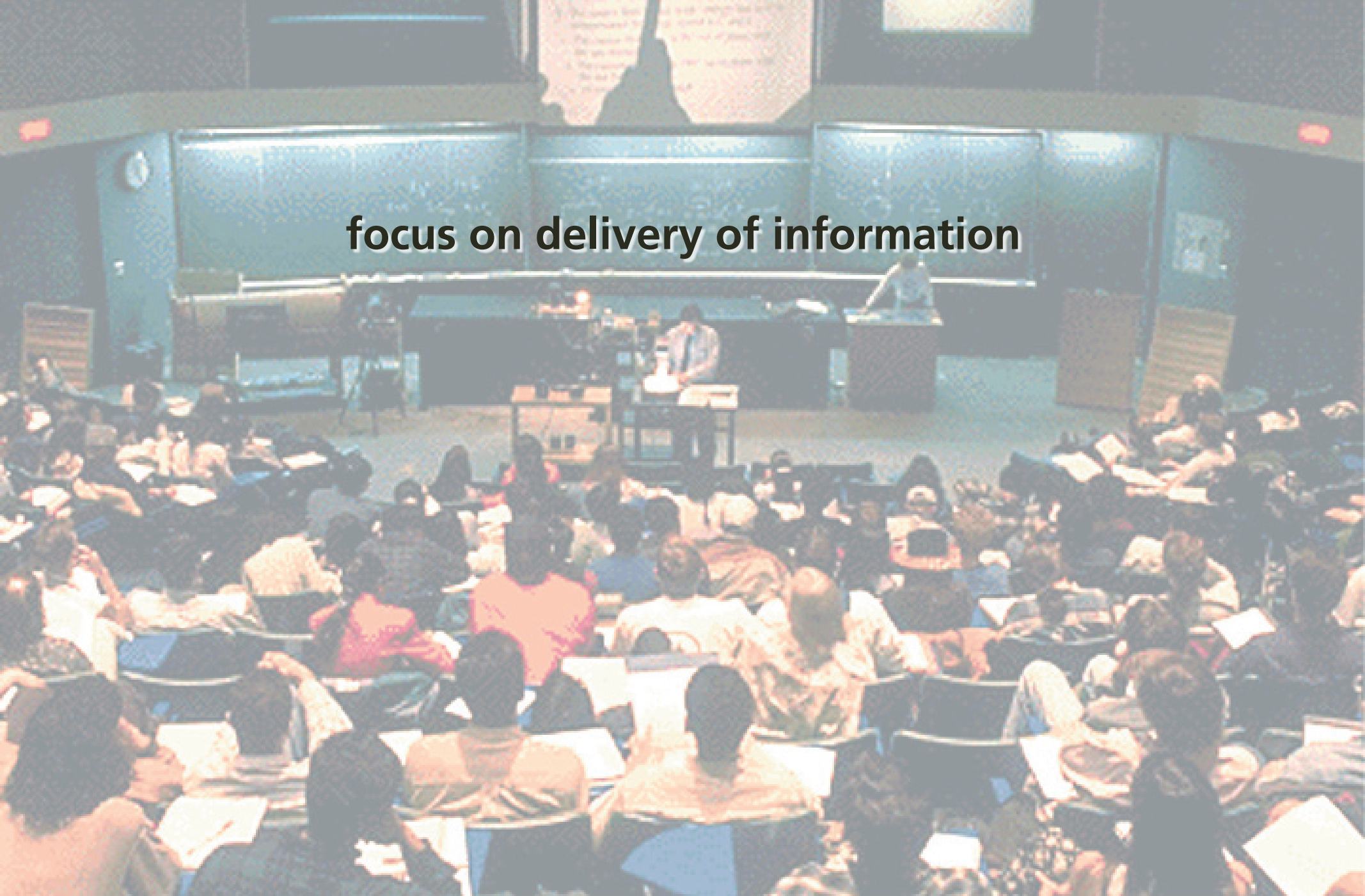
universally loathed by students and faculty alike

(but here to stay!)



Large lectures

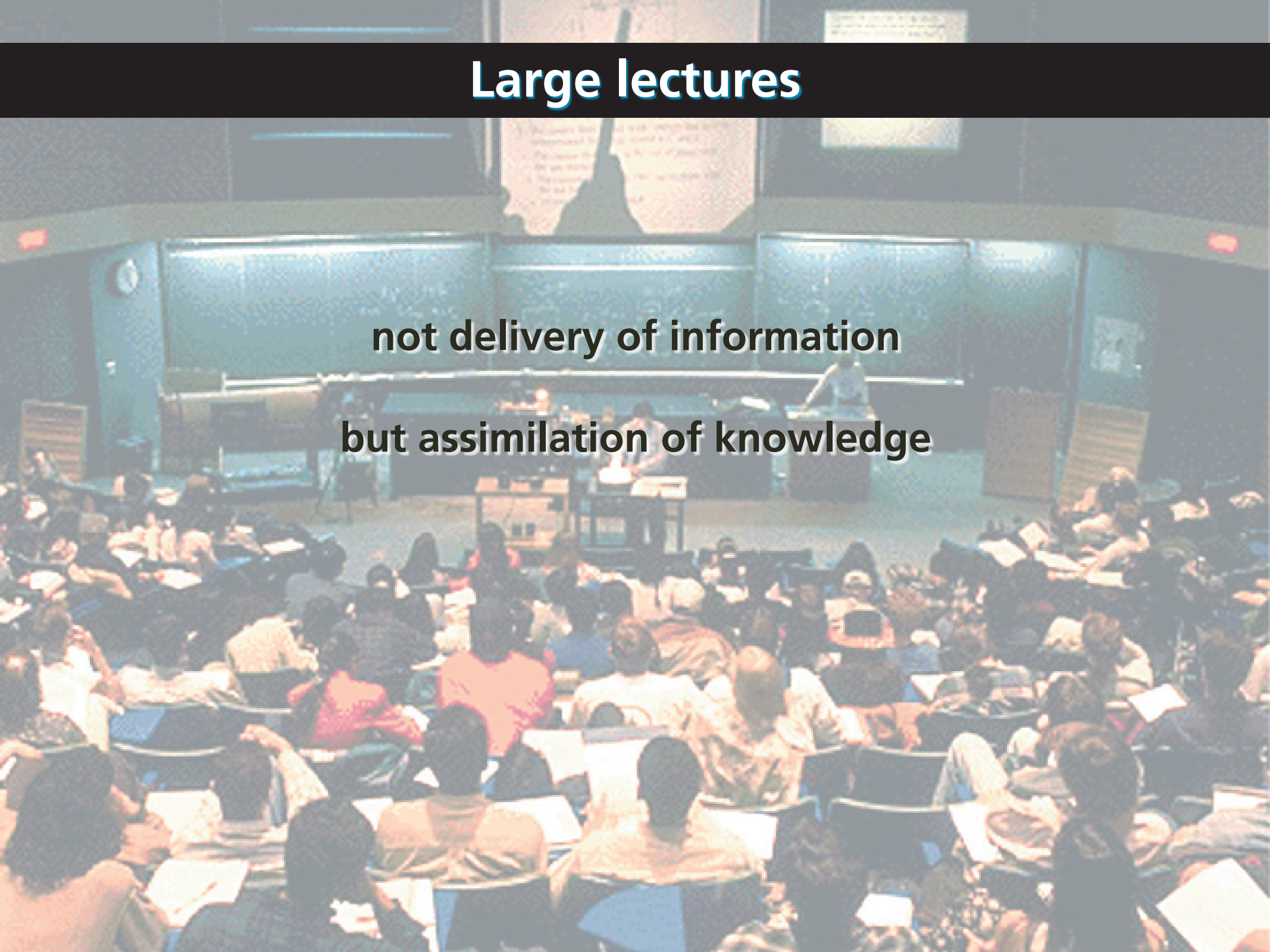
focus on delivery of information



Large lectures

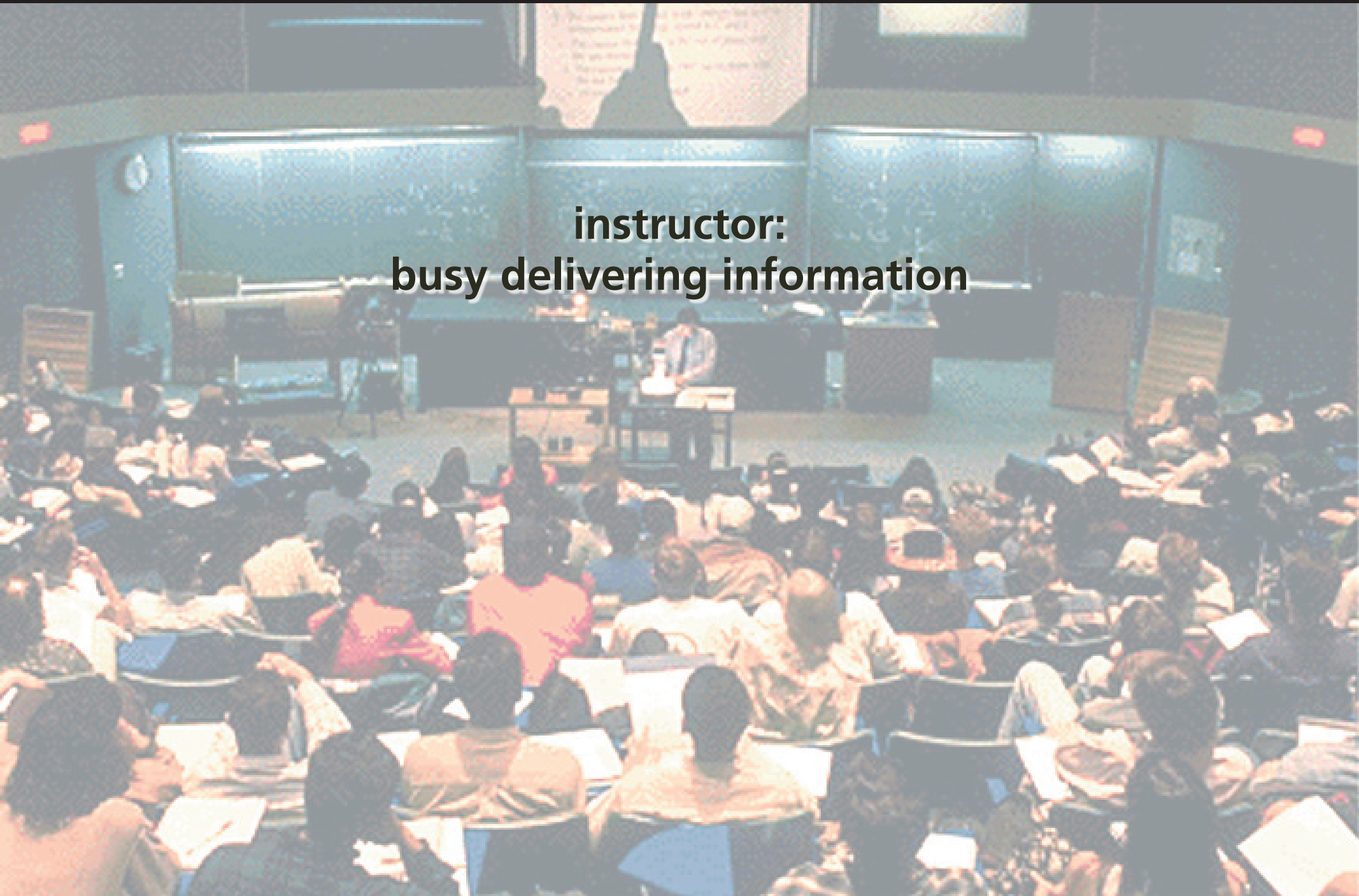
not delivery of information

but assimilation of knowledge



Large lectures

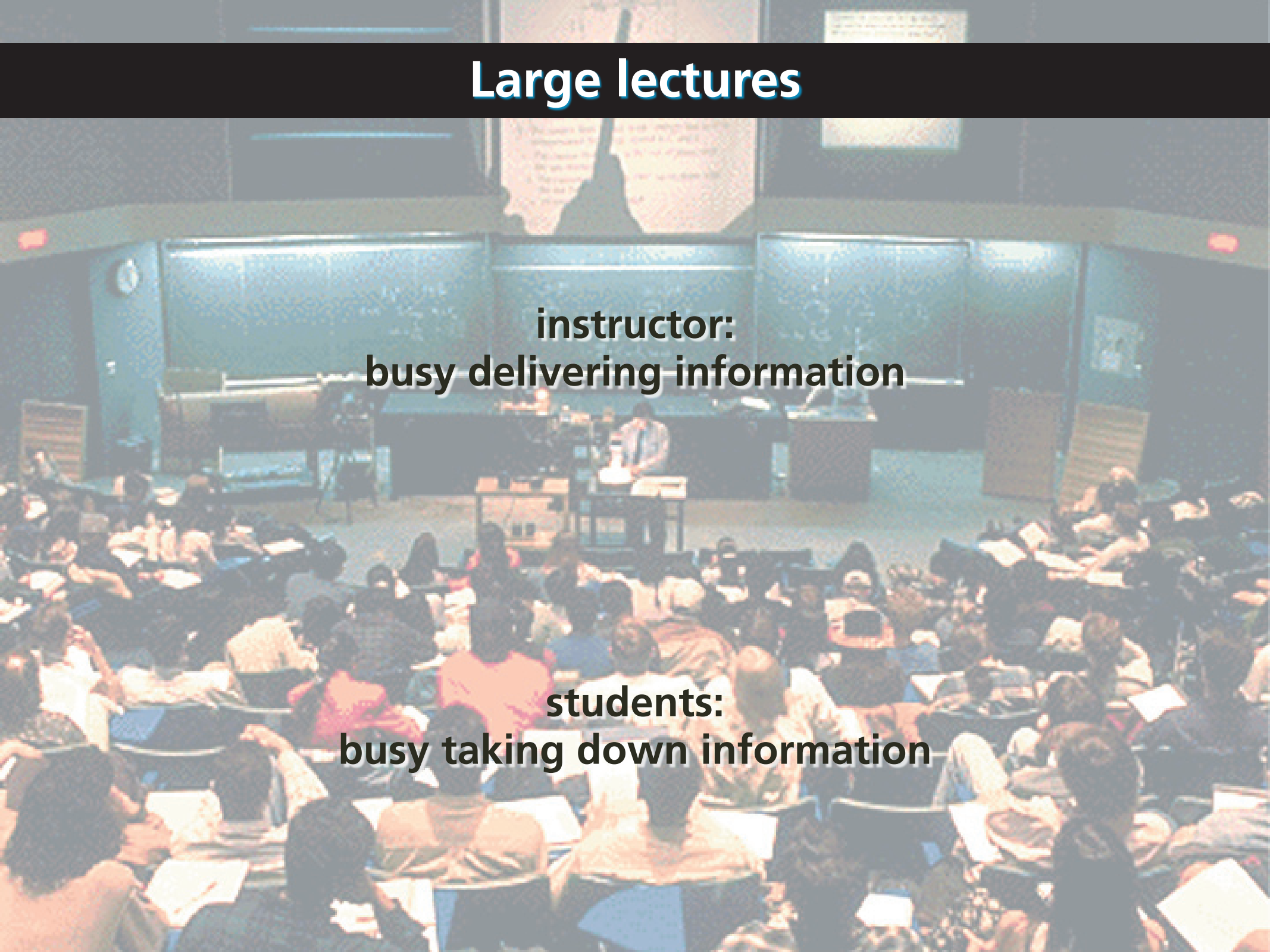
**instructor:
busy delivering information**



Large lectures

**instructor:
busy delivering information**

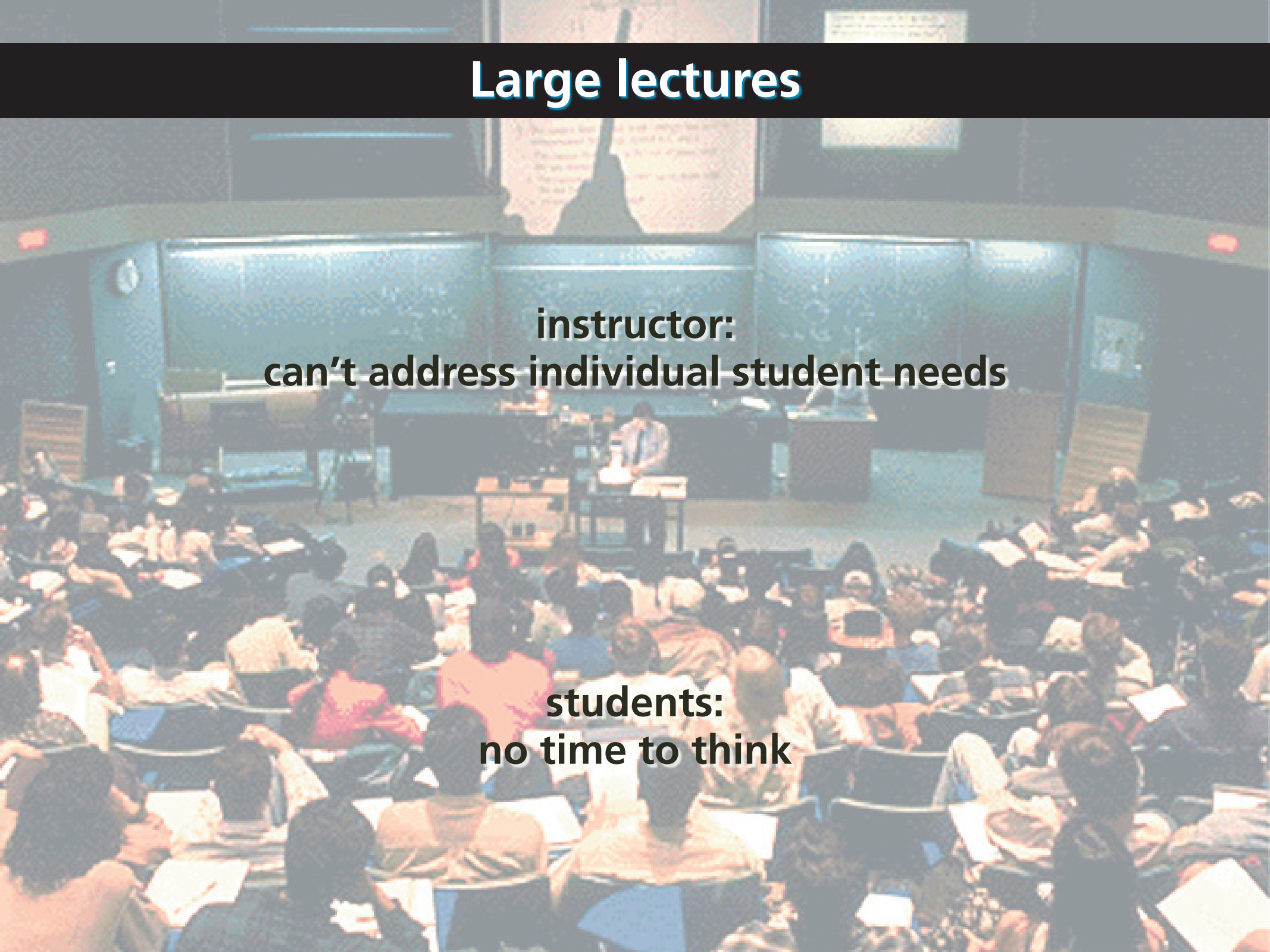
**students:
busy taking down information**



Large lectures

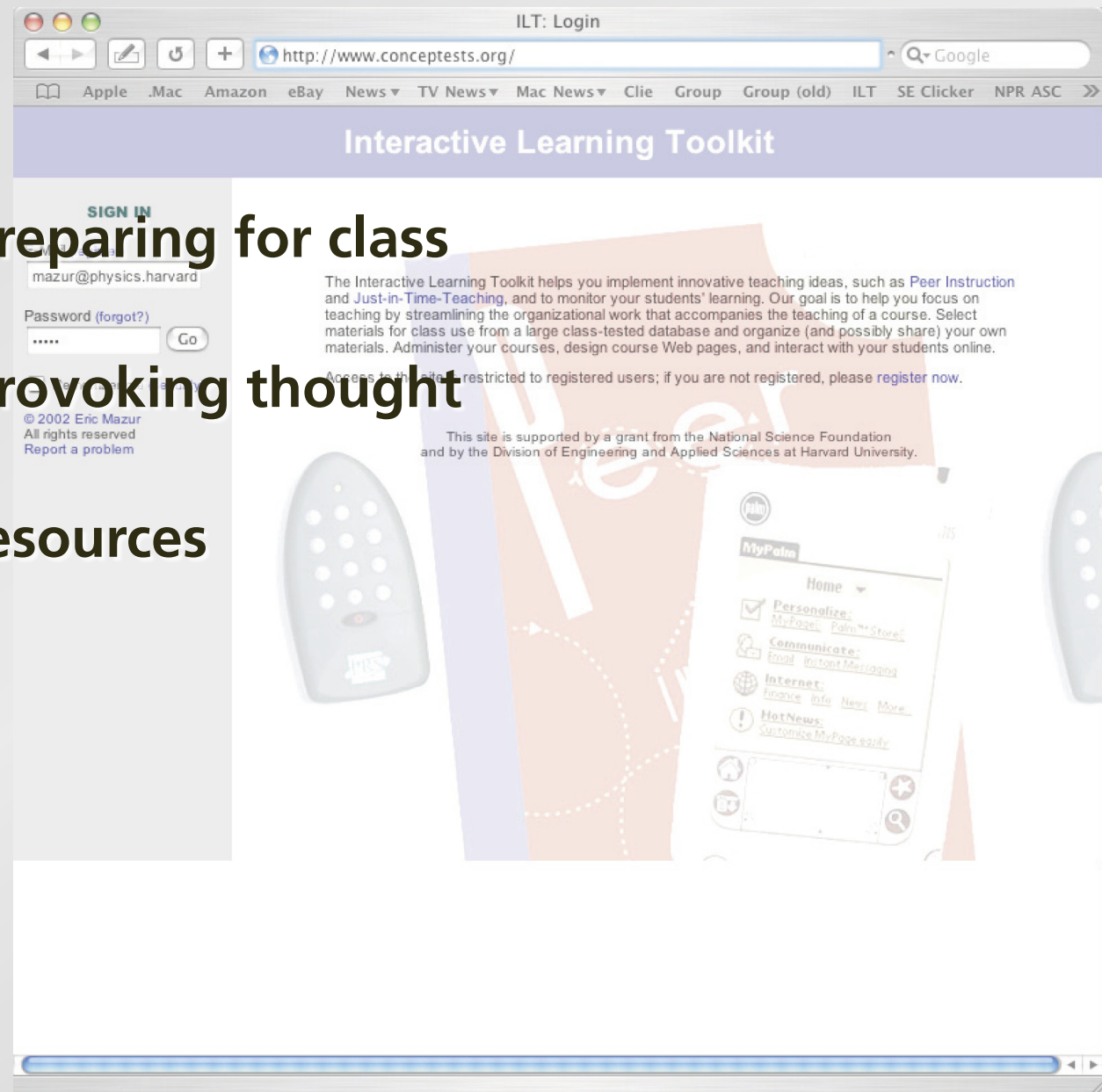
**instructor:
can't address individual student needs**

**students:
no time to think**

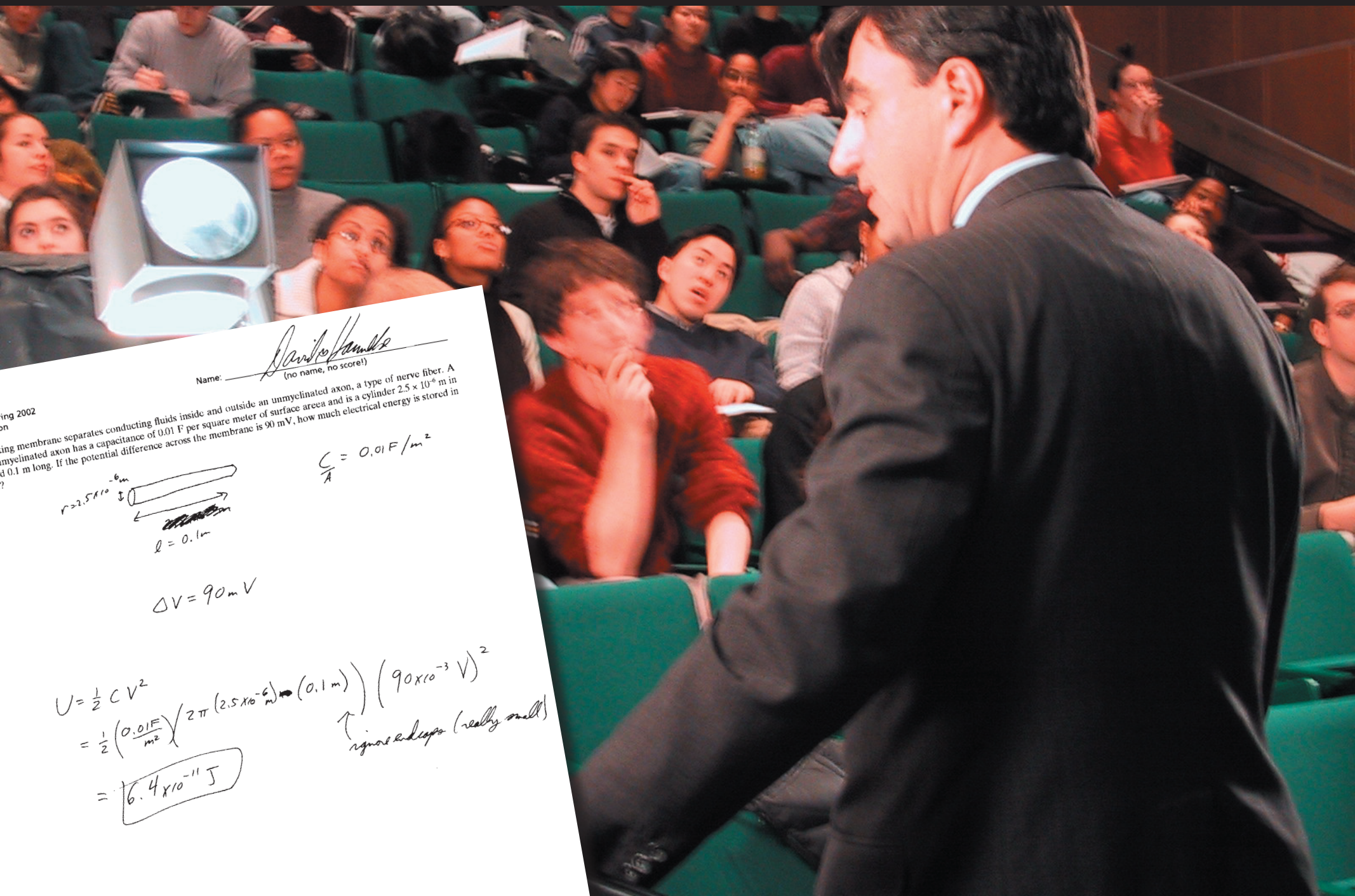


Outline

- preparing for class
- provoking thought
- resources

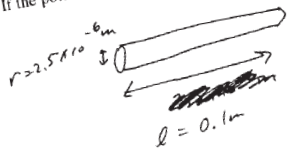


Preparing for class



Name: Daniel Samuels
(no name, no score!)

ing 2002
on
ing membrane separates conducting fluids inside and outside an unmyelinated axon, a type of nerve fiber. A
unmyelinated axon has a capacitance of $0.01 \text{ F per square meter of surface area}$ and is a cylinder $2.5 \times 10^{-6} \text{ m}$ in
d 0.1 m long. If the potential difference across the membrane is 90 mV , how much electrical energy is stored in
?



$$\frac{C}{A} = 0.01 \text{ F/m}^2$$

$$\Delta V = 90 \text{ mV}$$

$$\begin{aligned} U &= \frac{1}{2} C V^2 \\ &= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m}) \right) \left(90 \times 10^{-3} \text{ V} \right)^2 \\ &= \boxed{6.4 \times 10^{-11} \text{ J}} \end{aligned}$$

↑ ignore end caps (really small)

Preparing for class

nameless faces

Name: Daniel Samuels
(no name, no score!)

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$r = 2.5 \times 10^{-6} \text{ m}$
 $l = 0.1 \text{ m}$

$C_A = 0.01 \text{ F/m}^2$

$\Delta V = 90 \text{ mV}$

$U = \frac{1}{2} C V^2$
 $= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m}) \right) (90 \times 10^{-3} \text{ V})^2$
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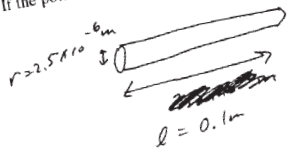
Preparing for class

nameless faces

faceless names

Name: Daniel Samuels
(no name, no score!)

ing 2002
on
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unmyelinated axon has a capacitance of 1 pF per square meter of surface area and is a cylinder $2.5 \times 10^{-6} \text{ m}$ in
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?



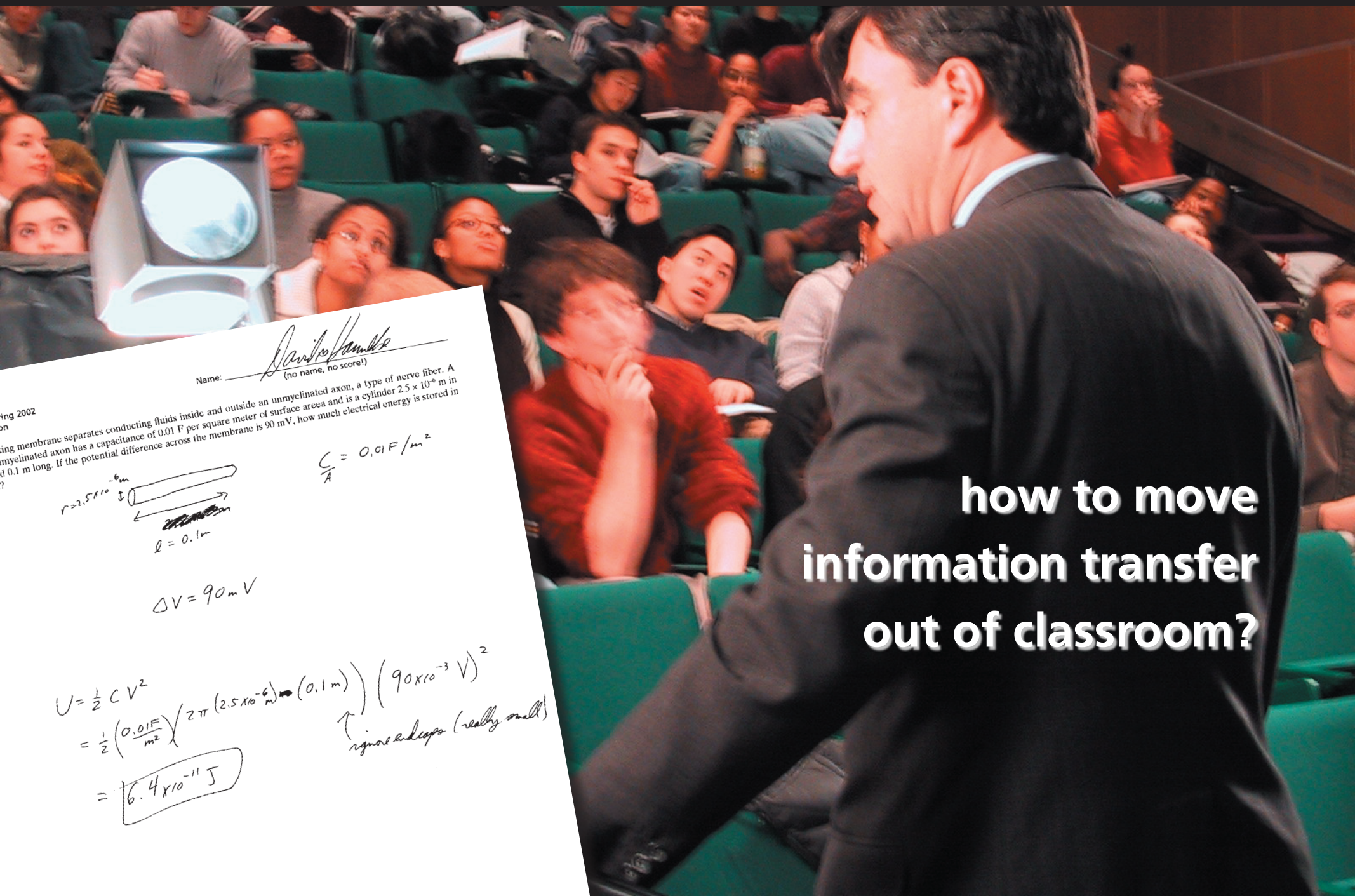
$$\Delta V = 90 \text{ mV}$$

$$U = \frac{1}{2} C V^2$$
$$= \frac{1}{2} \left(\frac{0.01 \text{ F}}{\text{m}^2} \right) \left(2\pi (2.5 \times 10^{-6} \text{ m}) (0.1 \text{ m}) \right) \left(90 \times 10^{-3} \text{ V} \right)^2$$

↑ ignore end caps (really small)

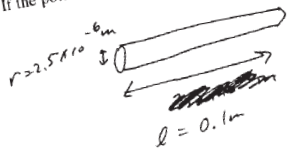
$$= \boxed{6.4 \times 10^{-11} \text{ J}}$$

Preparing for class



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$$\frac{C}{A} = 0.01 \text{ F/m}^2$$

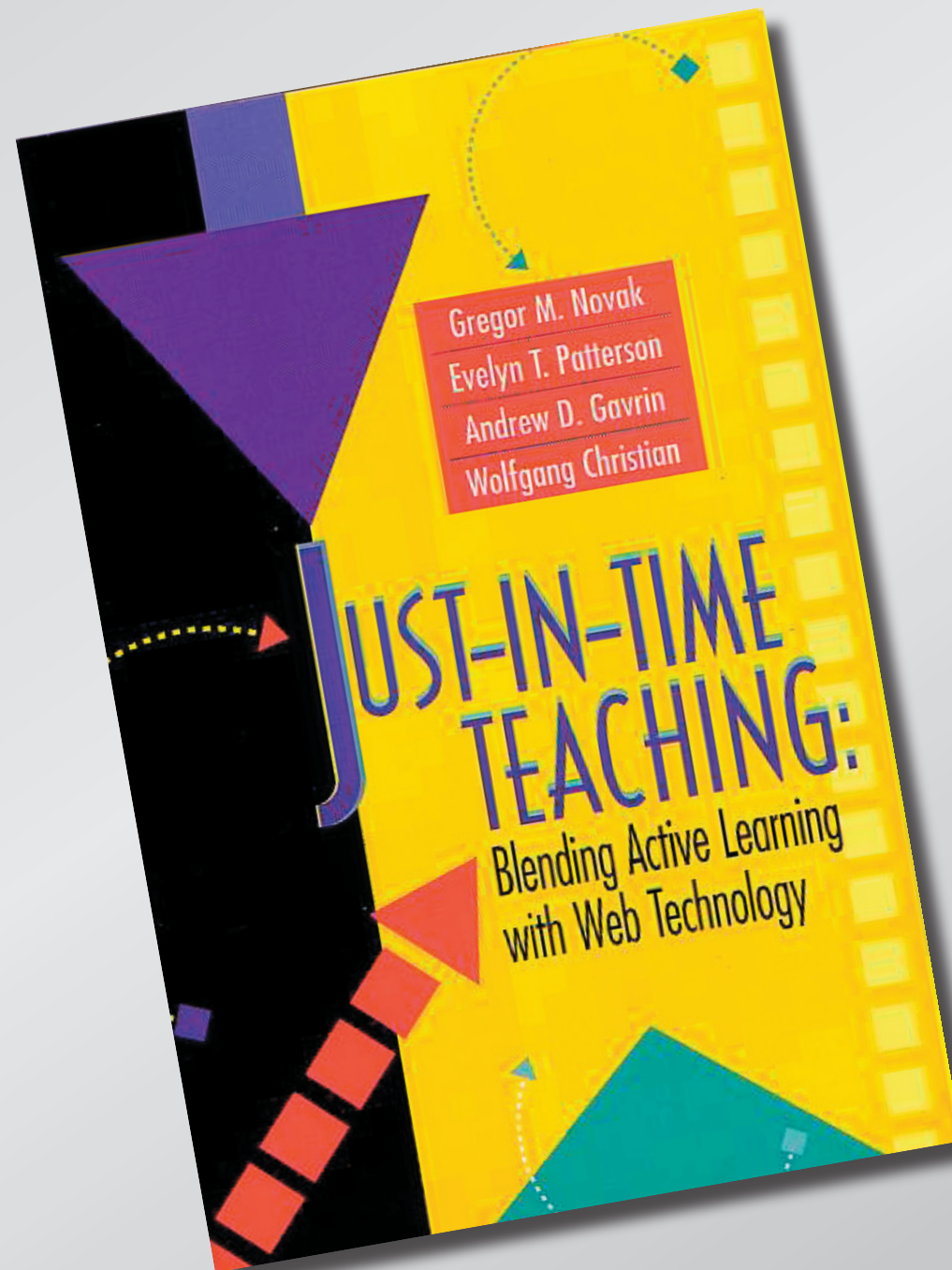
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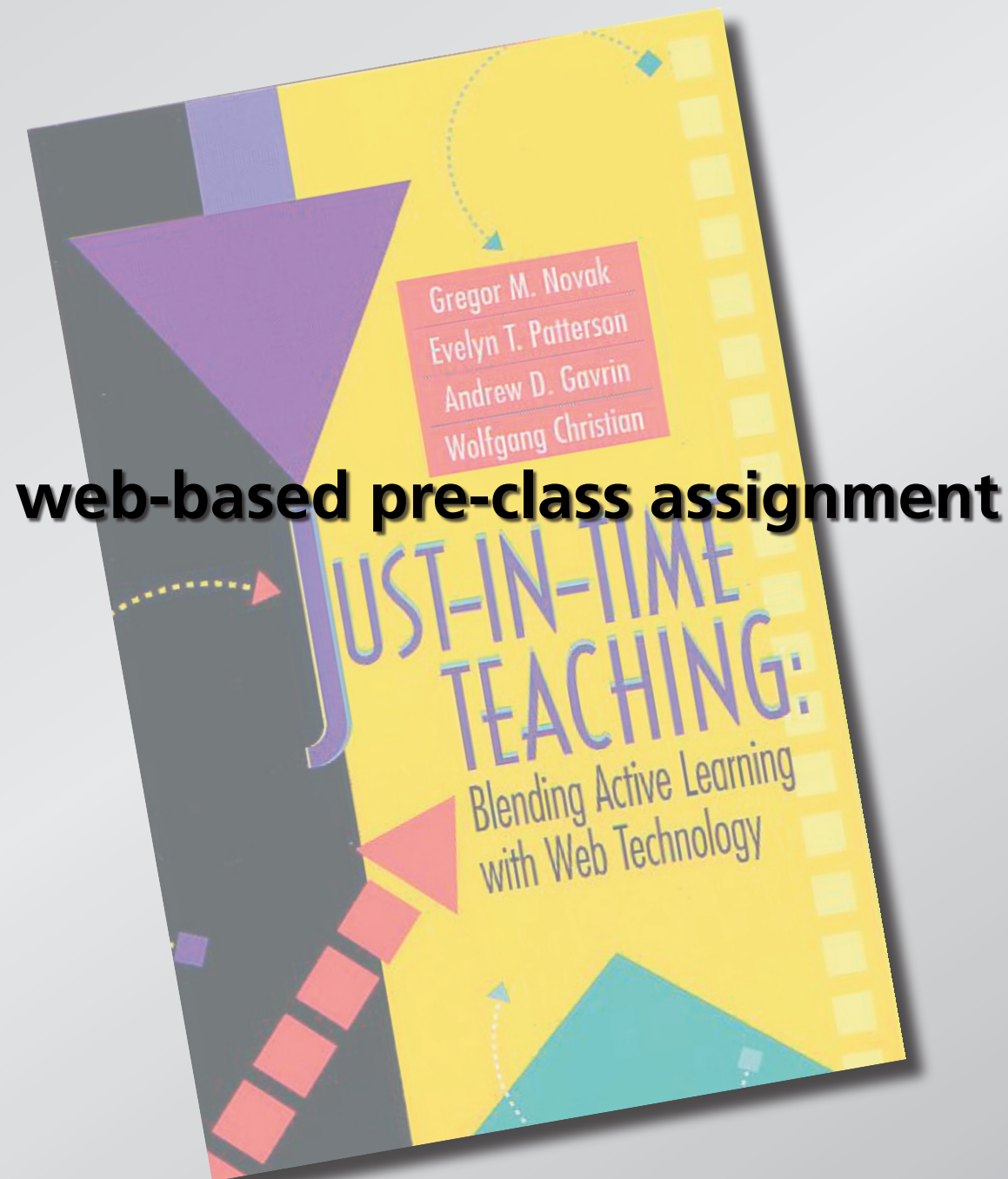
↑ ignore end caps (really small)

how to move
information transfer
out of classroom?

Preparing for class



Preparing for class



Preparing for class

ILT: Students

http://www.conceptest.org/

ILT DEAS Apple Visualization HPC Education Local Info IBM Culture General Computer Mazur

Physics 1b

Logged in as Eric Mazur Sign out

HOME READING LECTURES ASSIGNMENTS FORUMS NEWS HANDOUTS ?

E-MAIL
Manage email connection
Email (3)

COMING UP
5/2 Assignment 1

TOOLS
Run Similarity Check

QUICK LINKS
Standardized tests
Students

Sections
Select Section

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Report a problem

SITE ADMIN
Users
Conceptests
Topics
Bugs
Standardized test

Courses > Physics 1b > Reading > Changing magnetic fields II > < Student Responses

Please tell us briefly what **single** point of the reading you found most difficult or confusing. If you did not find any part of it difficult or confusing, please tell us what parts you found most interesting.






See notebook for an overview of common difficulties.

Click name to respond

Flag similarities closer than: go

1 - 100 of 153 answers > >|

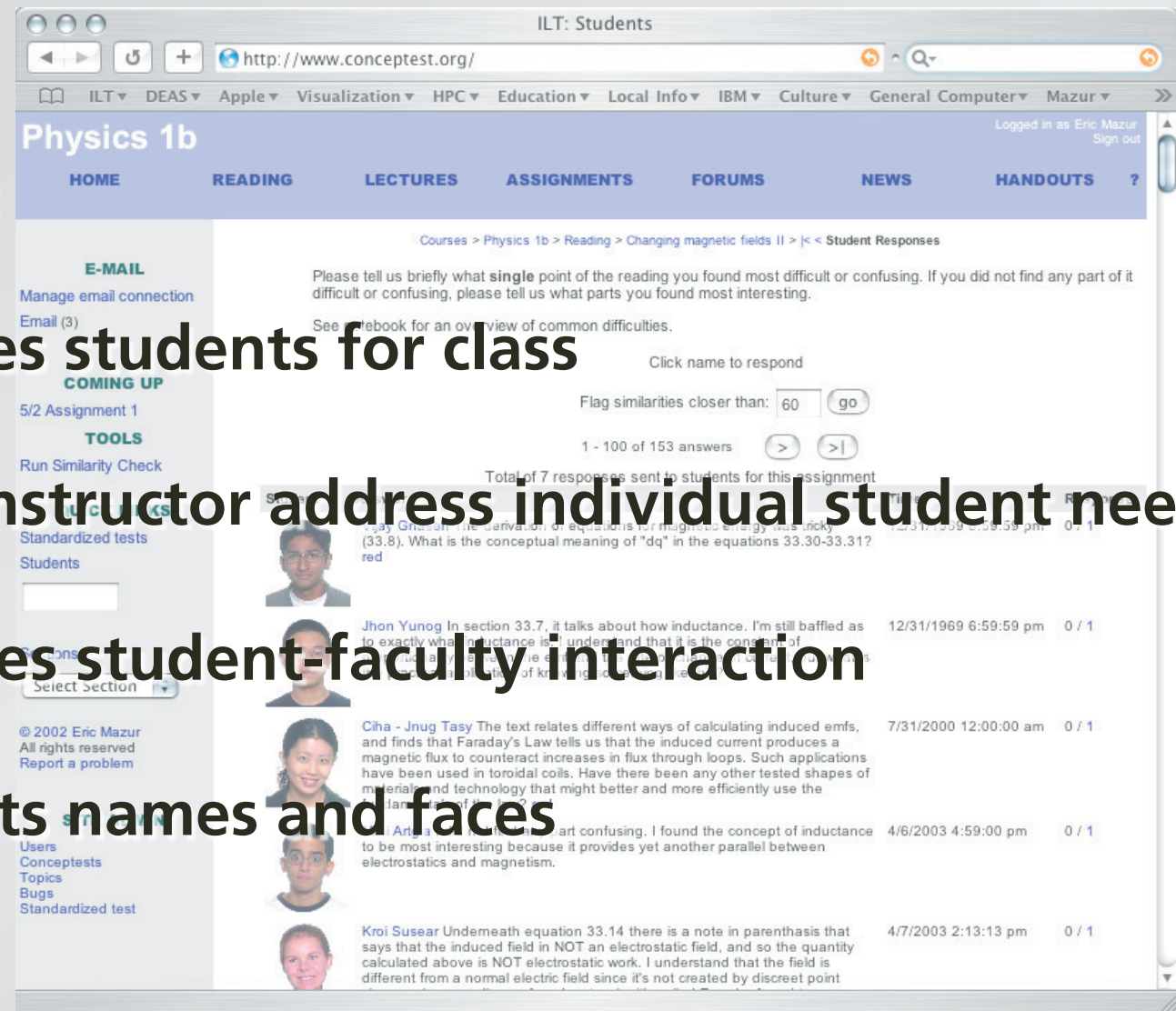
Total of 7 responses sent to students for this assignment

Student	Answer	Time	Response
	Vijay Gnaseh The derivation of equations for magnetic energy was tricky (33.8). What is the conceptual meaning of "dq" in the equations 33.30-33.31? red	12/31/1969 6:59:59 pm	0 / 1
	Jhon Yunog In section 33.7, it talks about how inductance. I'm still baffled as to exactly what inductance is. I understand that it is the constant of proportionality between the emf and the rate of change of current, but what is the practical application of knowing something like this?	12/31/1969 6:59:59 pm	0 / 1
	Ciha - Jnug Tasy The text relates different ways of calculating induced emfs, and finds that Faraday's Law tells us that the induced current produces a magnetic flux to counteract increases in flux through loops. Such applications have been used in toroidal coils. Have there been any other tested shapes of materials and technology that might better and more efficiently use the fundamentals of the law? red	7/31/2000 12:00:00 am	0 / 1
	Mlici Artgia I did not find any part confusing. I found the concept of inductance to be most interesting because it provides yet another parallel between electrostatics and magnetism.	4/6/2003 4:59:00 pm	0 / 1
	Kroi Susear Undemeath equation 33.14 there is a note in parenthesis that says that the induced field in NOT an electrostatic field, and so the quantity calculated above is NOT electrostatic work. I understand that the field is different from a normal electric field since it's not created by discreet point	4/7/2003 2:13:13 pm	0 / 1

Preparing for class

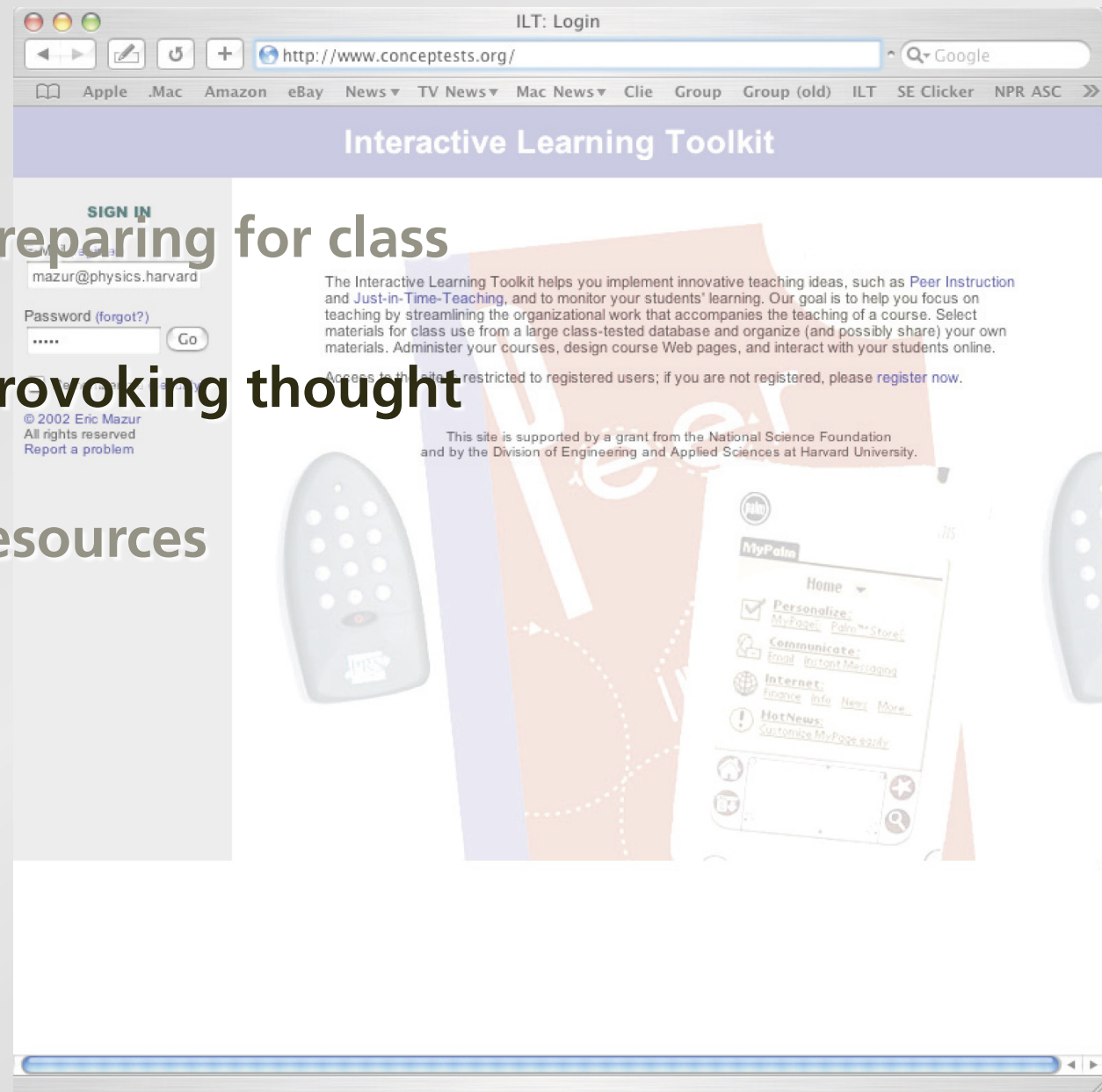
Benefits:

- prepares students for class
- helps instructor address individual student needs
- increases student-faculty interaction
- connects names and faces



Outline

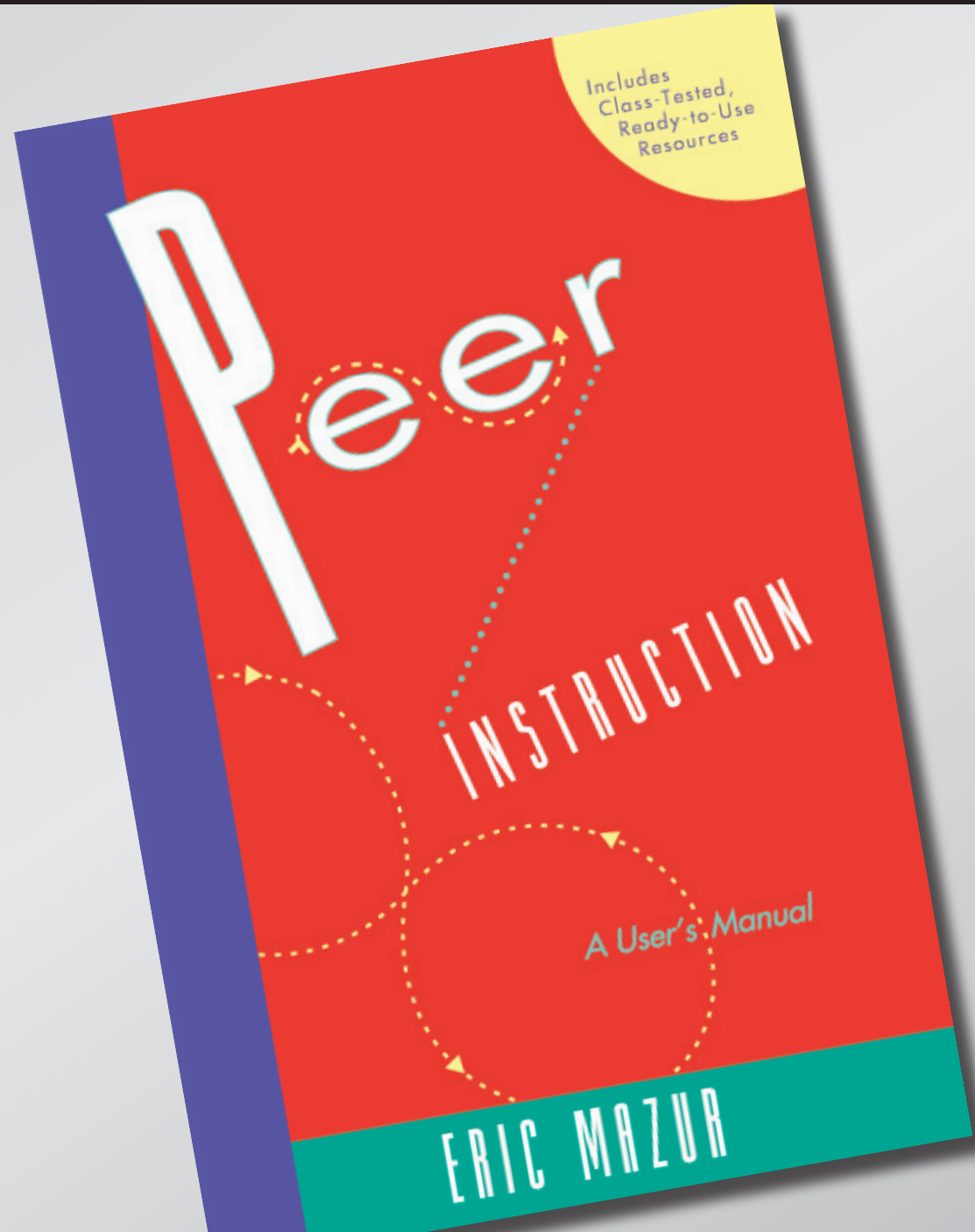
- preparing for class
- provoking thought
- resources



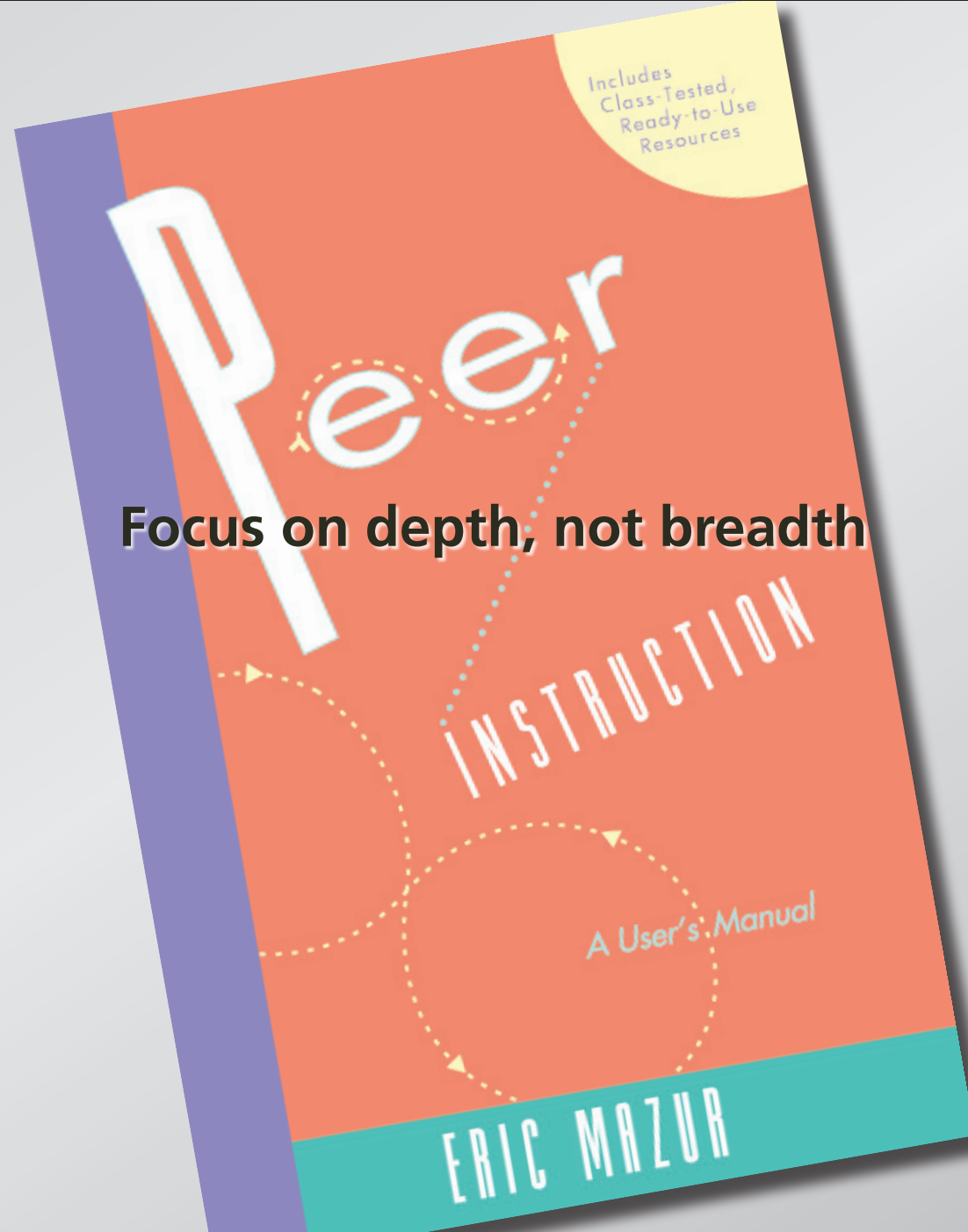
Provoking thought

What to do in class?

Provoking thought



Provoking thought



Focus on depth, not breadth

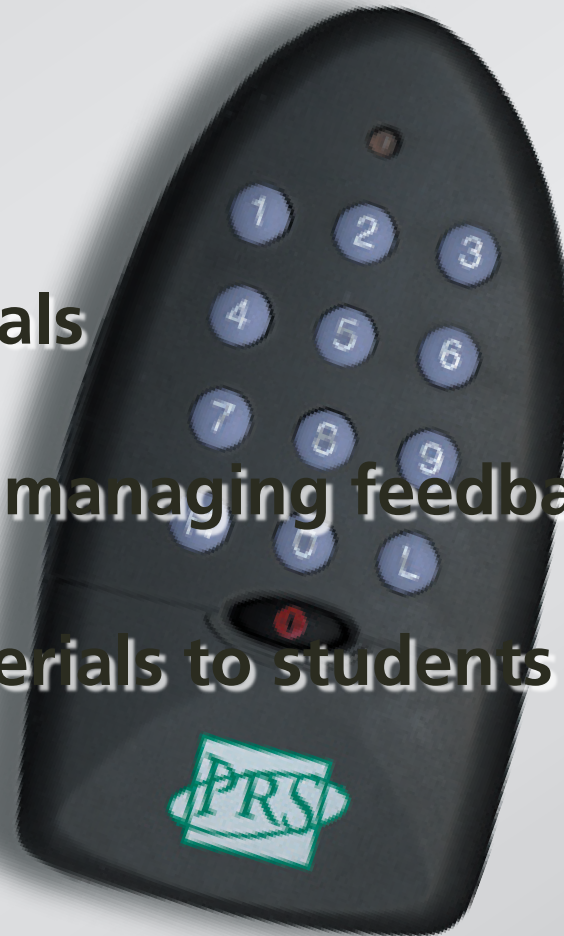
Provoking thought



Provoking thought

Some hurdles:

- finding materials
- collecting and managing feedback
- providing materials to students



Provoking thought

ILT: Manage

http://www.concepttest.org

ILT: Login local ILT: Lecture ILT: Reading

Physics 1b

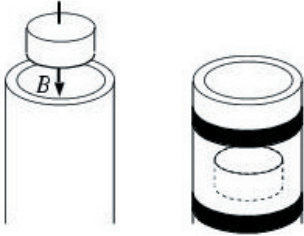
Logged in as Eric Mazur Sign out

HOME READING LECTURES ASSIGNMENTS FORUMS NEWS HANDOUTS ?

Courses > Physics 1b > Lectures > |< < Changing magnetic fields II 4/8 > >|

edit clone ↑↓ 🔍 📊 Physics > Introductory Electromagnetism > Magnetism > CT: 3691
October 25, 2001 00:55:08 am

1. A permanent magnet is dropped through a long aluminum tube, as shown. As the magnet drops, electric currents are induced around the tube. Compared to a freely-falling magnet, the magnet through the tube drops



1. more slowly.
2. exactly the same way.
3. faster.
4. Need more information.


Hint: consider the effects of induced currents through strips ahead of and behind the dropped magnet.

Answer: 1. In a loop of the aluminum tube just below the magnet, the flux is increasing as the magnet gets nearer. This induces a counterclockwise current producing an opposing magnetic field which repels the magnet. In a loop above the magnet, the flux is decreasing, so a clockwise current is induced, producing a magnetic field in the same direction as the magnet's field, thus attracting the magnet upward. So the net effect is to slow the magnet down.

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edit clone ↑↓ 🔍 📊 Physics > Introductory Electromagnetism > Magnetism > CT: 3756
October 12, 2001 05:55:06 pm

2. Consider the arrangement shown below. Conducting rod AB is lying on a U-shaped conductor, making good electrical contact. The arrangement is placed in a magnetic field (into page).



Provoking thought

Benefits:

- active engagement
- continuous feedback

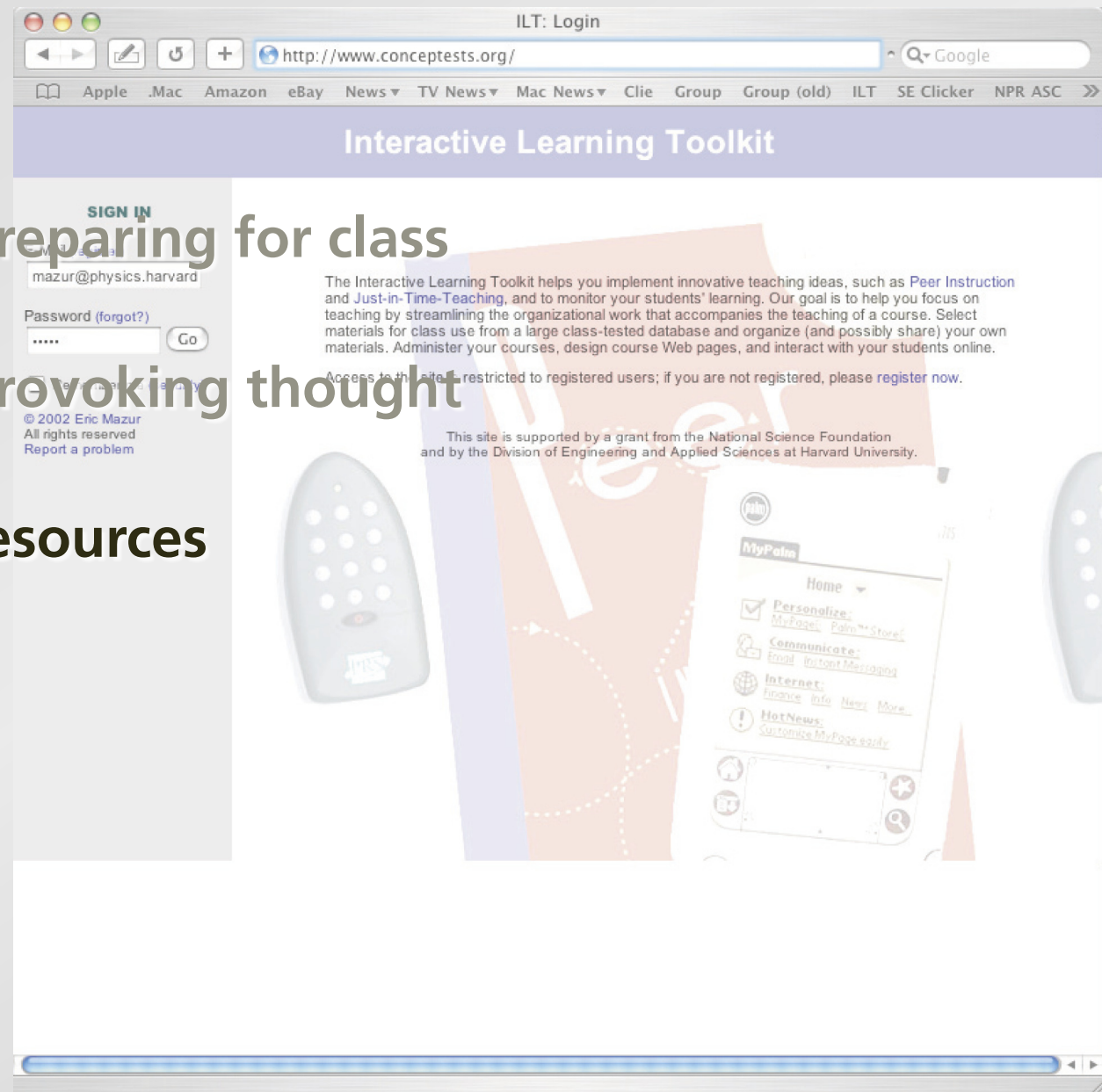
The screenshot displays the ConceptTest.org website interface. The browser window title is "ILT: Manage" and the address bar shows "http://www.concepttest.org". The page has a navigation bar with links: HOME, READING, LECTURES, ASSIGNMENTS, FORUMS, NEWS, and HANDOUTS. The main content area is titled "Physics 1b" and shows a problem about a magnet falling through an aluminum tube. The problem text states: "1. A permanent magnet is dropped through a long aluminum tube, as shown. As the magnet drops, electric currents are induced around the tube. Compared to a freely-falling magnet, the magnet through the tube drops". Below the text is a diagram of a magnet falling through a tube. The diagram shows a cylindrical magnet with a north pole (N) at the top and a south pole (S) at the bottom, falling through a long vertical tube. A magnetic field vector B points downwards from the magnet. The tube is shown with a dashed line indicating the magnet's path. Below the diagram are four multiple-choice options: 1. more slowly, 2. exactly the same way, 3. faster, 4. Need more information. A hint is provided: "Hint: consider the effects of induced currents through strips ahead of and behind the dropped magnet." The answer is given: "Answer: 1. In a loop of the aluminum tube just below the magnet, the flux is increasing as the magnet gets nearer. This induces a counterclockwise current producing an opposing magnetic field which repels the magnet. In a loop above the magnet, the flux is decreasing, so a clockwise current is induced, producing a magnetic field in the same direction as the magnet's field, thus attracting the magnet upward. So the net effect is to slow the magnet down." The page also includes a sidebar with links for "COMING UP", "TOOLS", and "QUICK LINKS". The bottom of the page shows a copyright notice: "Copyright © 2000, Eric Mazur. Unpublished copyrighted material."

Outline

- preparing for class

- provoking thought

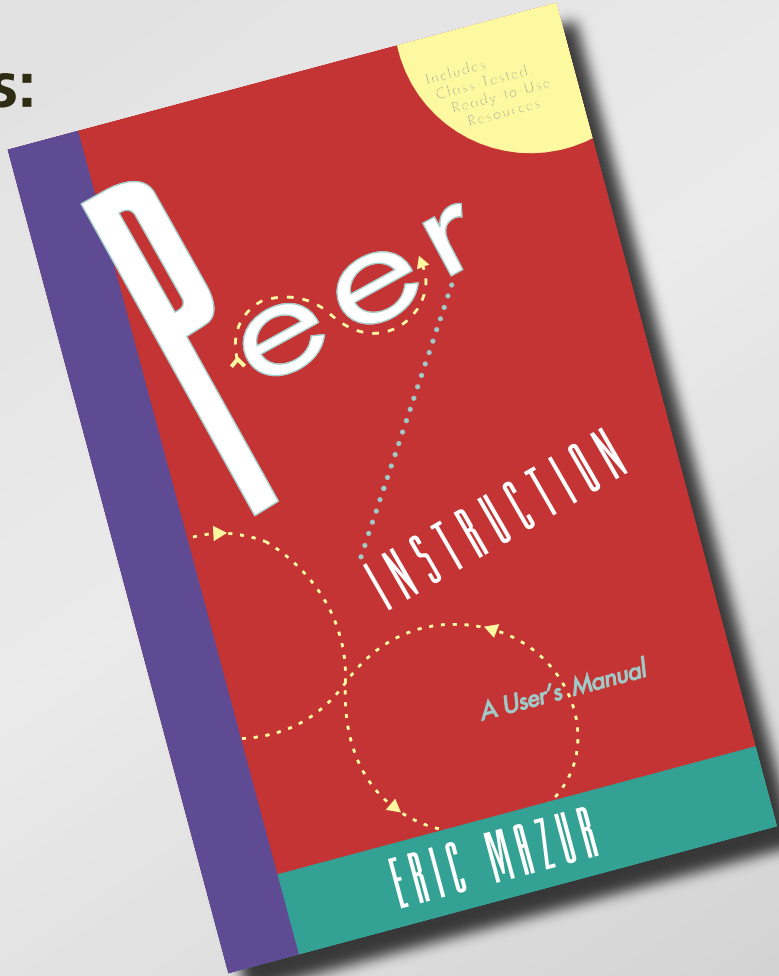
- resources



Resources

Books with ConcepTests:

- Physics (Prentice Hall)



Resources

Books with ConcepTests:

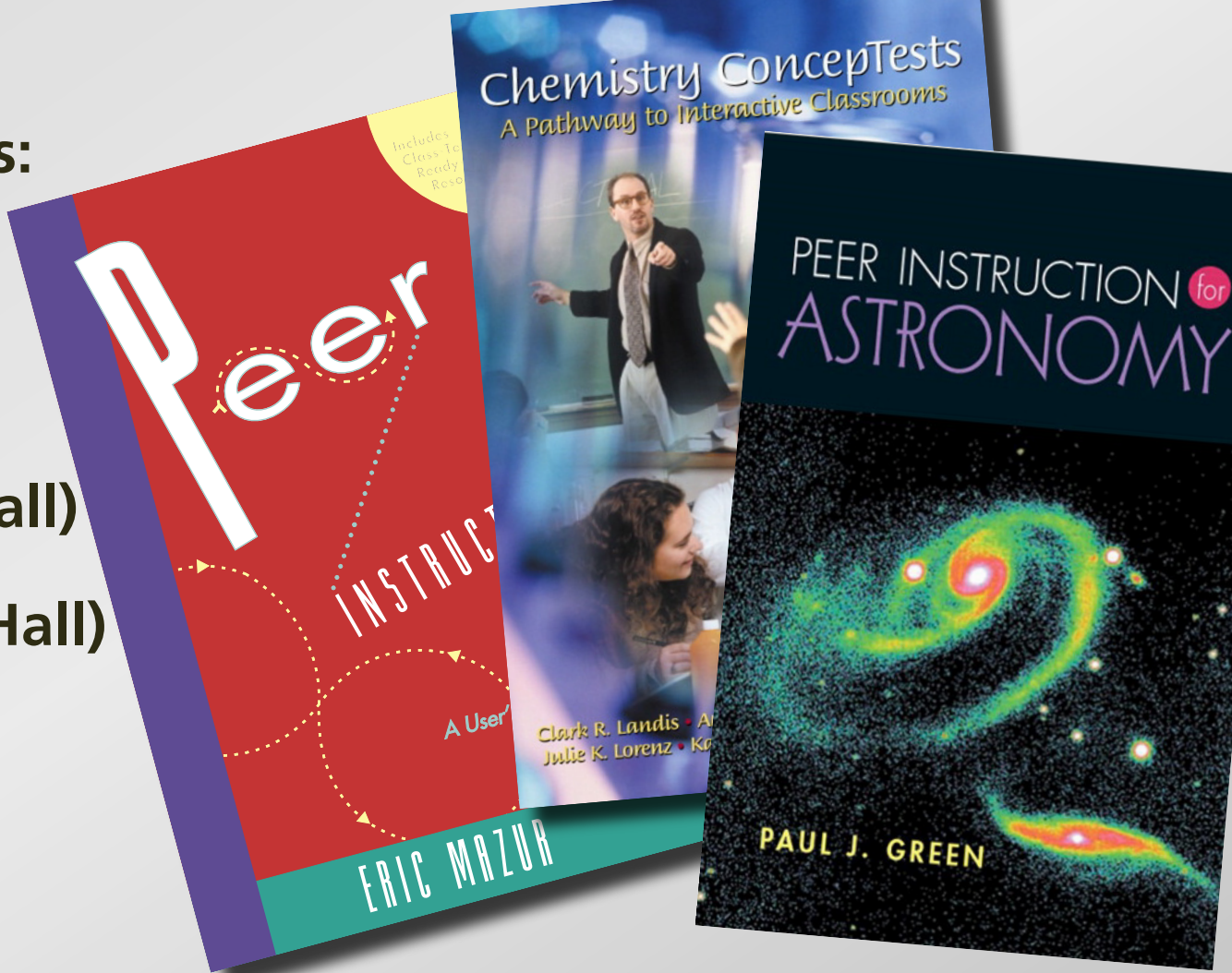
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)



Resources

Books with ConcepTests:

- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)



Resources

Books with ConcepTests:

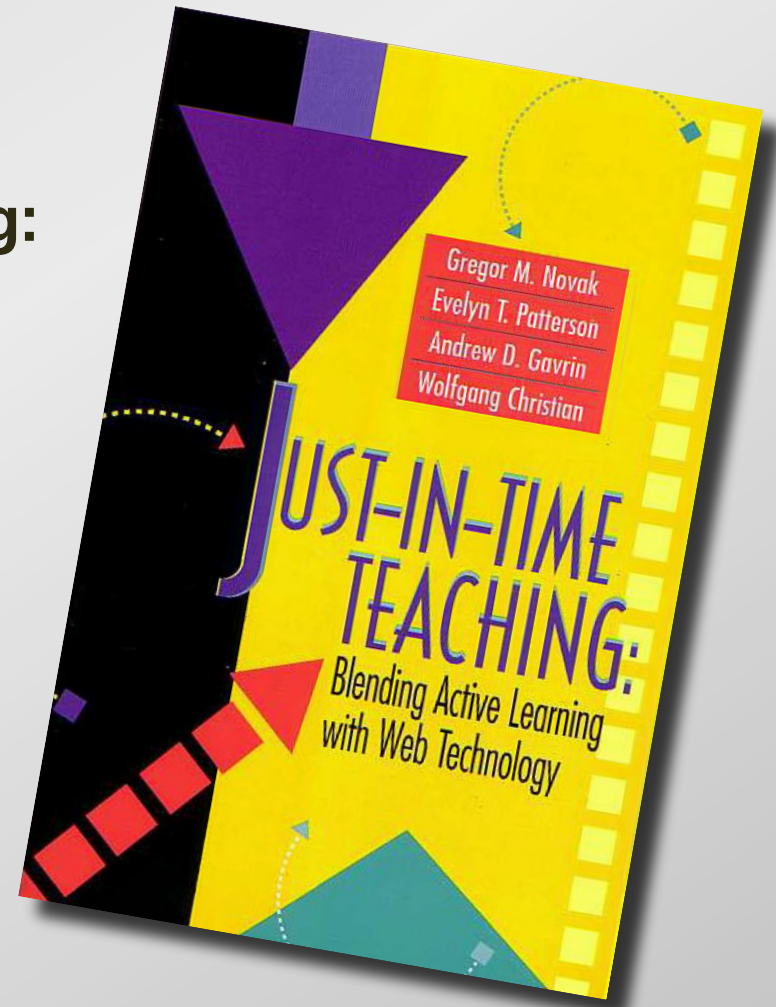
- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)
- Calculus (Wiley)



Resources

Information on Just-in-Time-Teaching:

- Prentice Hall book
- <http://www.jitt.org>

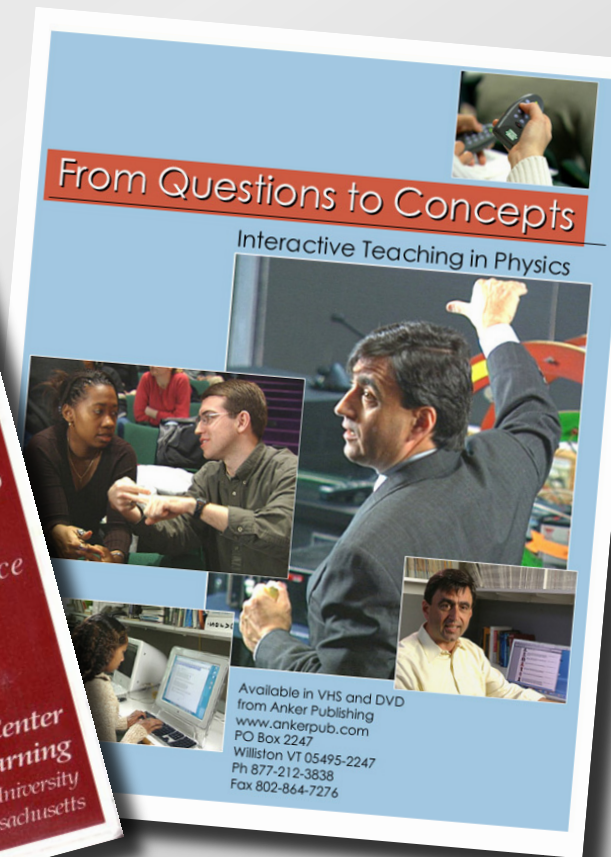
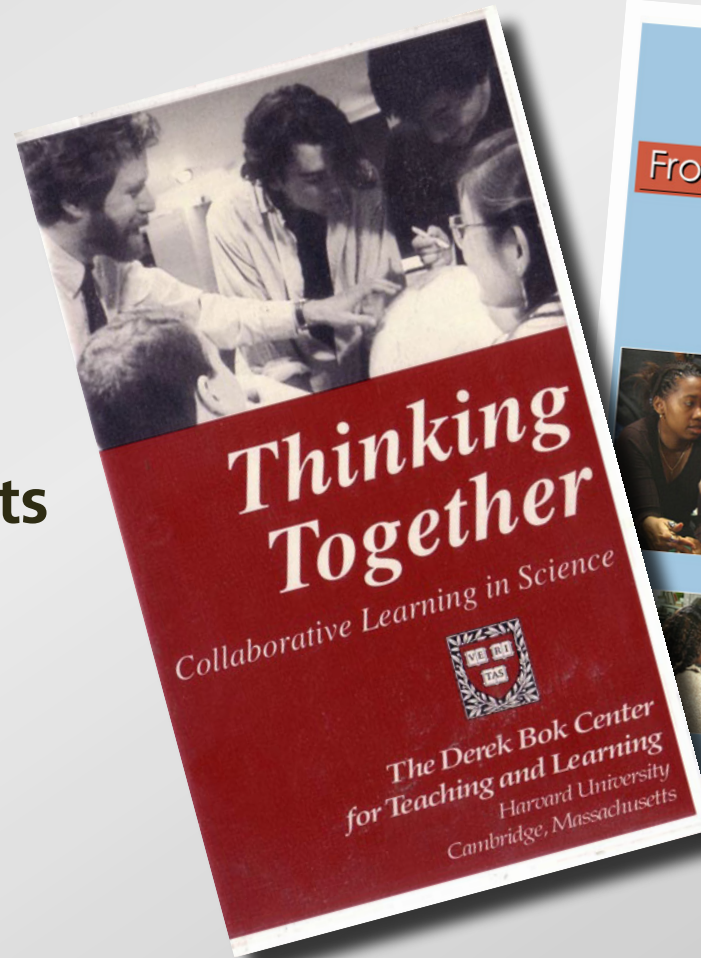


Resources

Videos:

- Thinking together
- From questions to concepts

<http://www.ankerpub.com>



Resources

Course management:

<http://deas.harvard.edu/ilt>

ILT: Manage

http://www.conceptest.org

ILT: Login local | ILT: Lecture | ILT: Reading

Physics 1b

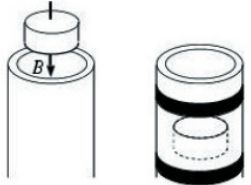
HOME | READING | LECTURES | ASSIGNMENTS | FORUMS | NEWS | HANDOUTS | ?

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Sign out

Courses > Physics 1b > Lectures > |< < Changing magnetic fields II 4/8 > >|

Physics > Introductory Electromagnetism > Magnetism > CT: 3691
October 25, 2001 00:55:08 am

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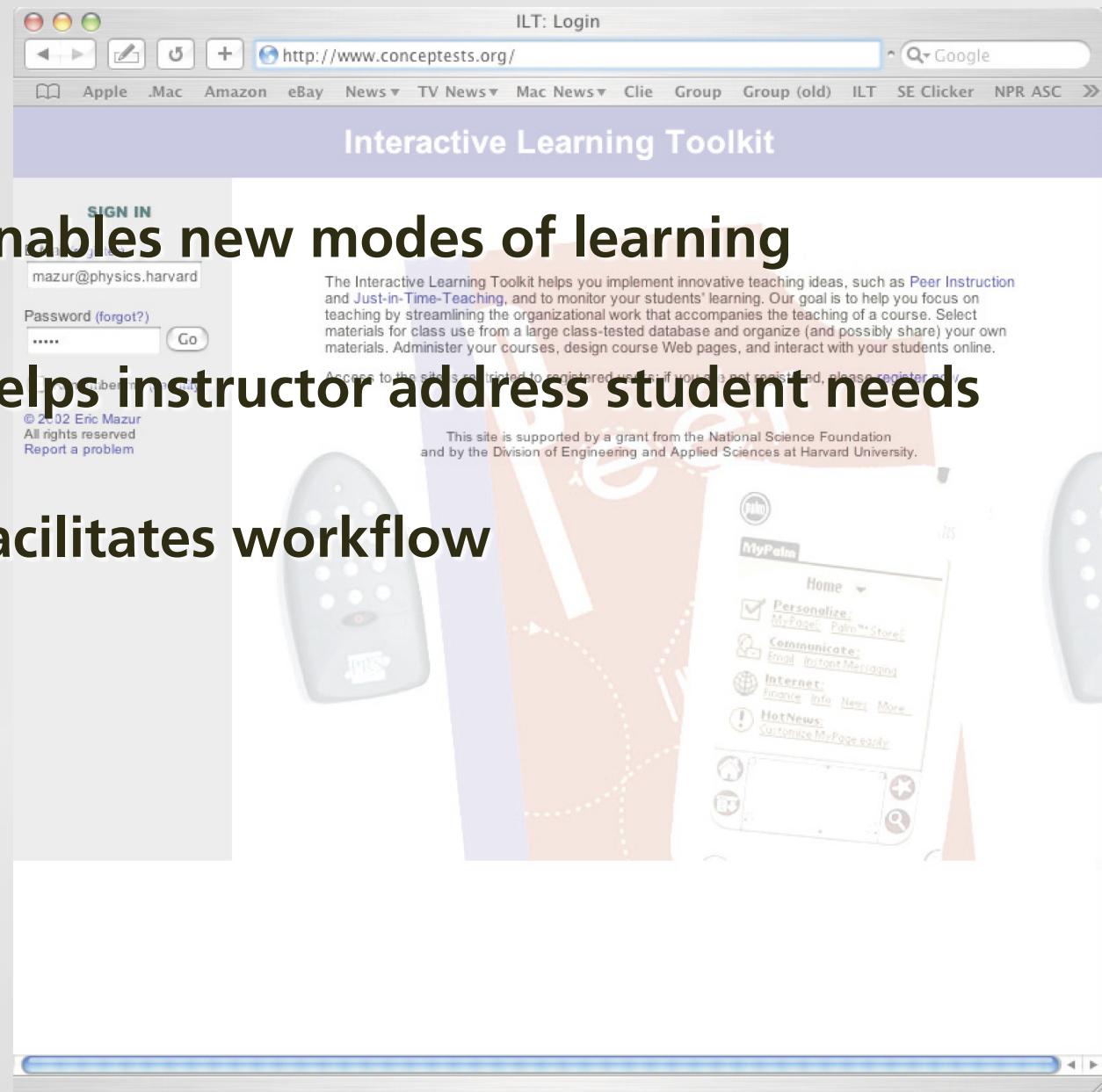
Physics > Introductory Electromagnetism > Magnetism > CT: 3756
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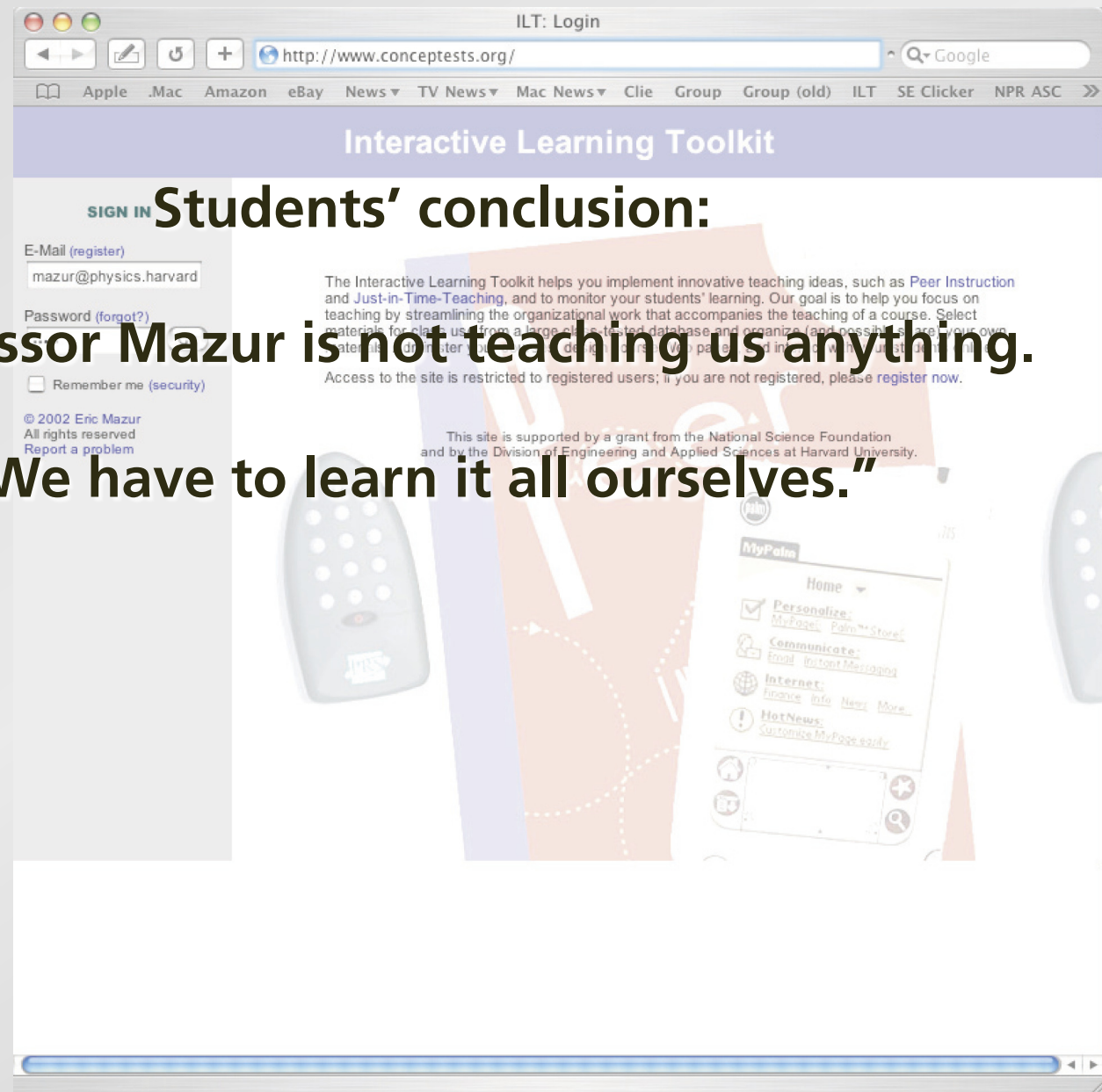
Summary

- enables new modes of learning
- helps instructor address student needs
- facilitates workflow



Summary

Students' conclusion:
**"Professor Mazur is not teaching us anything.
We have to learn it all ourselves."**



Support:

NSF Distinguished Teaching Scholar Award
NSF Assessment of Student Achievement Award
Harvard DEAS Information Technology Group
Prentice Hall
Apple Computer

for a copy of this presentation:

<http://mazur-www.harvard.edu>

