

**Fason yo anseye lasyans nan MIT:
Aprantisaj aktif ki baze sou teknoloji**

**Technology-Enabled Active Learning
(TEAL)**

**Atelye sou ansèyman ki baze sou
teknoloji ak resous ouvè**

Pòtoprens, Ayiti, 29–30 Mas, 2012

**Dr. Peter Dourmashkin
Physics Department MIT
padour@mit.edu**

Ki sa “TEAL” vle di?

Technology Enabled Active Learning

(Aprantisaj aktif gras ak sipò teknoloji)

Plis pase 10 lane eksperyans

Yon melanj prezantasyon, leson ak laboratwa pou eksperyans pratik. Melanj sa a bay bon jan anviwònman ki rich ak teknik epi kolaborasyon.



Istorik TEAL

Modèl:

RPI's Studio Physics (Jack Wilson)

NCSU's Scale-Up (Bob Beichner)

Harvard Peer Instruction (Mazur)

Otòn 2001-2
Pwototip
Off-term E&M 8.02

Prentan 2003-2012
Ajisteman pou gwo klas
E&M 8.02

Otòn 2003-4
Pwototip Mekanik
8.01

Otòn 2005-2012
Ajisteman pou gwo klas
Mekanik 8.01

Rezon ki fè nou sèvi ak metòd TEAL la

Pi fò klas fizik nan premye ane yo te gen menm kalite pwoblèm

1. Klas yo pasif
2. Anpil elèv te derefize pran klas sa yo tou
3. Anpil etidyan pa te pase klas sa yo
4. Matematik la te difisil pou vizyalize (sitou pou Elektrisite ak Mayetis)
5. Pa te gen eksperyans laboratwa. Ki fè pa te gen entuisyon.

Men objektif aprantisaj yo

Objektif aprantisaj sou edikasyon an jeneral

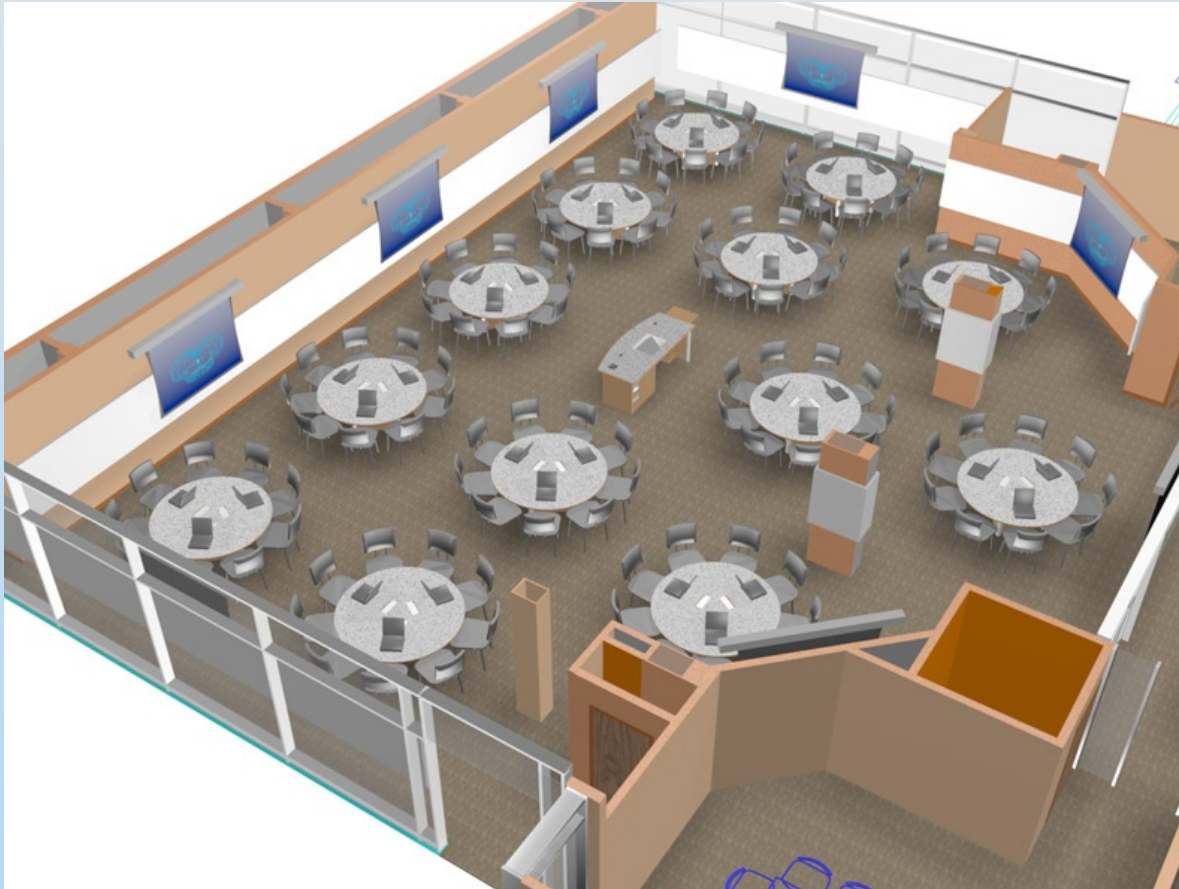
- Devlope konpetans kominikasyon nan domèn fondamantal lasyans
- Devlope kolaborasyon pandan n ap aprann
- Ankouraje etidyan yo anseye
- Devlope nouvo resous pou aprantisaj ak anseyman ki baze sou estanda rechèch syantifik

Objektif aprantisaj syantifik

- Kite metòd pasif yo (“pa kè”) pou nou rantre nan yon metòd aprantisaj aktif (ki chita sou refleksyon ak eksperyans)
- Amelyore konpreyansyon nou sou konsèp yo
- Amelyore kapasite nou pou rezoud pwoblèm
- Enkòpore pwojè ki chita sou travay pratik ak rechèch nan laboratwa pou devlope kapasite etidyan yo

Achitekti espas aprantisaj la

Transfòmasyon espas aprantisaj la: Sal klas TEAL la



Aprantisaj an gwoup (Menm modèl avèk sal klas NCSU a)
9 etidyan ap travay sou chak tab kote 3 gwoup 3 moun ap travay ansanm

Espas kote etidyan yo aprann



Dizpozizyon espas aprantisaj la

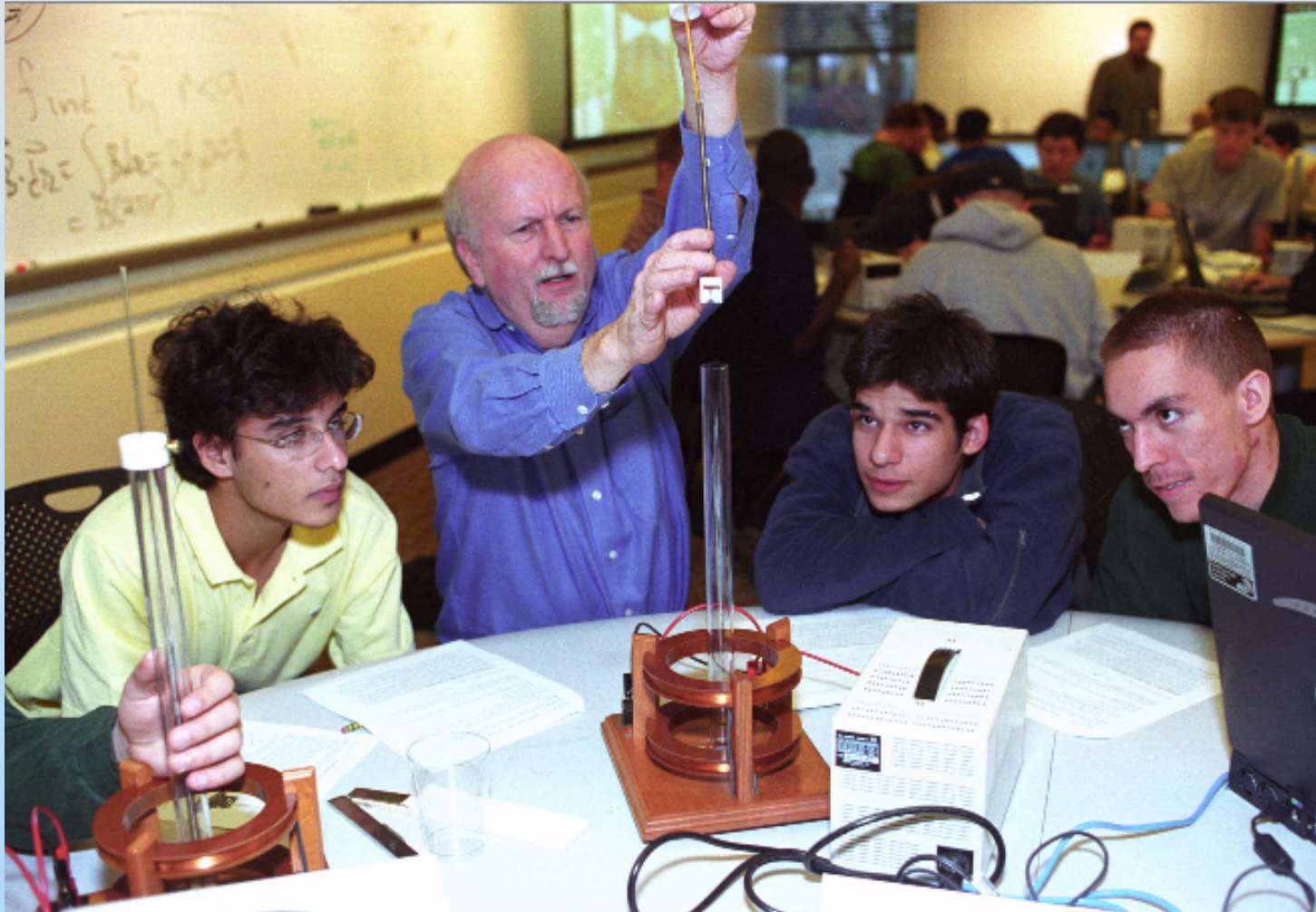
Achitekti espas la baze sou:

1) Fason moun fè echanj epi aprann

2) Modèl pedagogik

Òganizasyon ekip la: Fakilte, Gwoup sipò teknik,
Achitèk, Administrasyon

Nouvo wòl anseyan yo



Pwofesè John Belcher, Fondatè TEAL

Nouvo wòl anseyan yo

Pwofesè pa dikte elèv yo nòt kou yo ankò. Men, yo asire yo etidyan yo konprann kou a.

Asistan pwofesè yo (sa ki nan nivo metriz oswa doktora): Aprann ki jan pou yo anseye

Asistan pwofesè yo (sa ki nan nivo lisans yo): Ankouraje rès etidyan yo vin anseye

Enstriktè teknik yo: Tout moun wè yo kounyea.

Etidyan yo: Youn sèvi kòm enstriktè pou lòt

Aprantisaj aktif

Eleman ki nan klas aprantisaj aktif la: “TEAL”

- Demonstrasyon ki kapab pèmèt tout klas la patisipe nan prezantasyon yo
- Vizyalizasyon sou entènèt
- Tès sou konsèp: Etidyan yo, yonn bay lòt fidbak sou travay yo pou yo rive byen konprann konsèp yo
- Eksperimantasyon pratik sou òdinatè
- Bon jan opòtinite pou rezoud divès pwoblèm

“Ti prezentasyon” yo



Kesyon sou konsèp

Tès sou konsèp

Etidyan yo aprann nan tèt ansanm

- Modèl: Estrateji aprantisaj Eric Mazur envante a chita sou ki jan ou kapab itilize “Teknoloji Klikè” (“Clicker Technology”) nan metòd “Tès sou konsèp”.

Metòd:

- Tès sou Konsèp
- Refleksyon
- Repons endividyèl
- Fidbak la bay nan menm moman aprantisaj la ap fèt
- Diskisyon ant etidyan yo
- Revize repons yo an gwoup
- Eksplikasyon

Aprantisaj ki baze sou “Vizyalizasyon”

Vizyalizasyon ak “Matlèt”

<http://math.mit.edu/mathlets/>

MIT MATHLETS

HOME APPLETS COURSES ACTIVITIES FORUM

WELCOME!

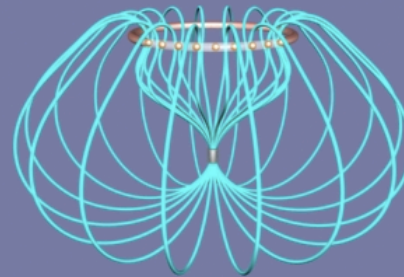


Welcome to the MIT Interactive Mathematics Site!

Here you will find a suite of dynamic Java applets for use in learning about differential equations and other mathematical subjects, along with examples of how to use them in homework, group work, or lecture demonstration, and some of the underlying theory.

We welcome your contributions, through the Forum.

TEAL Visualizing Electromagnetism



Visualizing E&M
Scalar and Vector
Fields

Electrostatics

Magnetostatics

Faraday's Law

Light

Notes

AAPT Workshop W34
Summer 2008

Copyright

Supported by the National Science Foundation under DUE Award 0618558, the Davls Educational Foundation, the d'Arbeloff Fund for Excellence in MIT Education, and the MIT/Microsoft iCampus Alliance. The content contained herein can be freely used and redistributed under liberal open source licenses, as indicated.

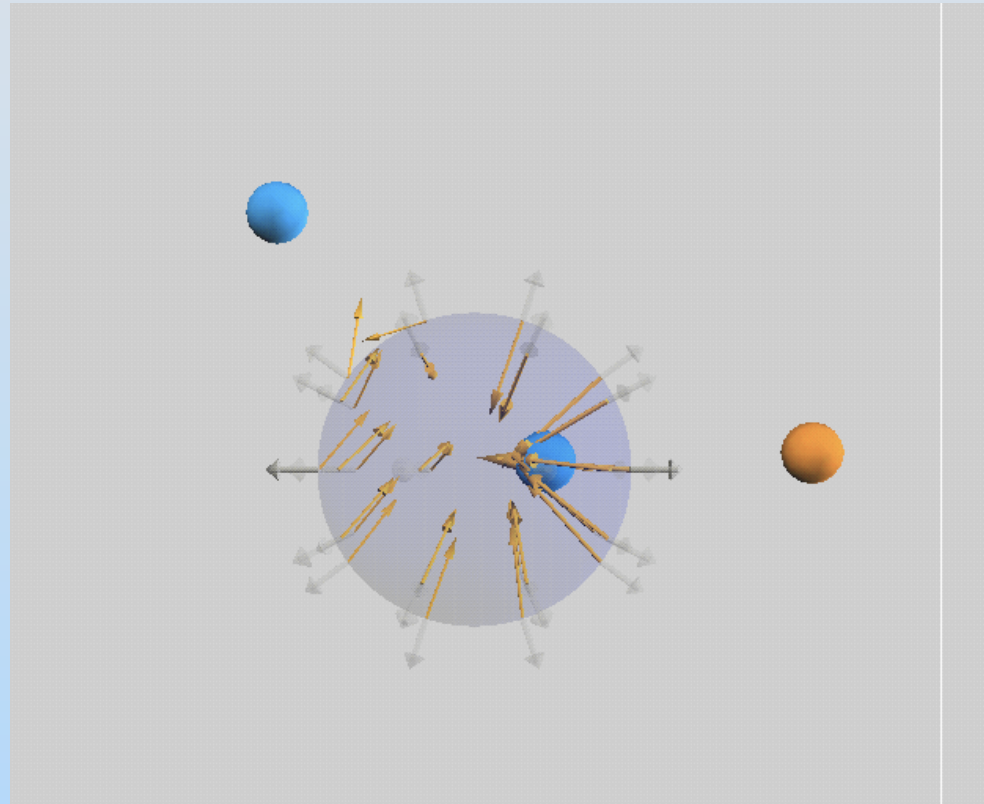
<http://web.mit.edu/viz/EM/>

Vizyalyasyon ak similasyon: Kat (4) je kontre, manti kaba

Eksplike definisyon
sa a

$$\oiint \mathbf{E} \cdot d\mathbf{a} = \frac{1}{\epsilon_0} \iiint \rho dV$$

(Lwa Gauss)



[http://web.mit.edu/viz/EM/visualizations/electrostatics/
GaussLawProblems/gausslawflux/gausslawflux.htm](http://web.mit.edu/viz/EM/visualizations/electrostatics/GaussLawProblems/gausslawflux/gausslawflux.htm)

Vizyalyasyon ak similasyon: Lojisyèl sou Lwa Gauss

Reset View

Reset View

Choose Gaussian Surface

Show Gaussian Cylinder

Show Gaussian Sphere

Gaussian Surface Position and Orientation

Y Position -3.0 0.0 3.0 0

X Position -3.0 0.0 3.0 0

Rotation An... -180.0 0.0 180.0 0

Choose E Field Scaling

Make All E Arrow Lengths the Same

Scale E Arrow Length by $(\text{Magnitude } E)^{0.3}$

Add Charges (Maximum Six Charges)

Add Random Positive (orange)

Add Random Negative (blue)

Delete All Charges

Field Visualization

Electric Field: Grass Seeds

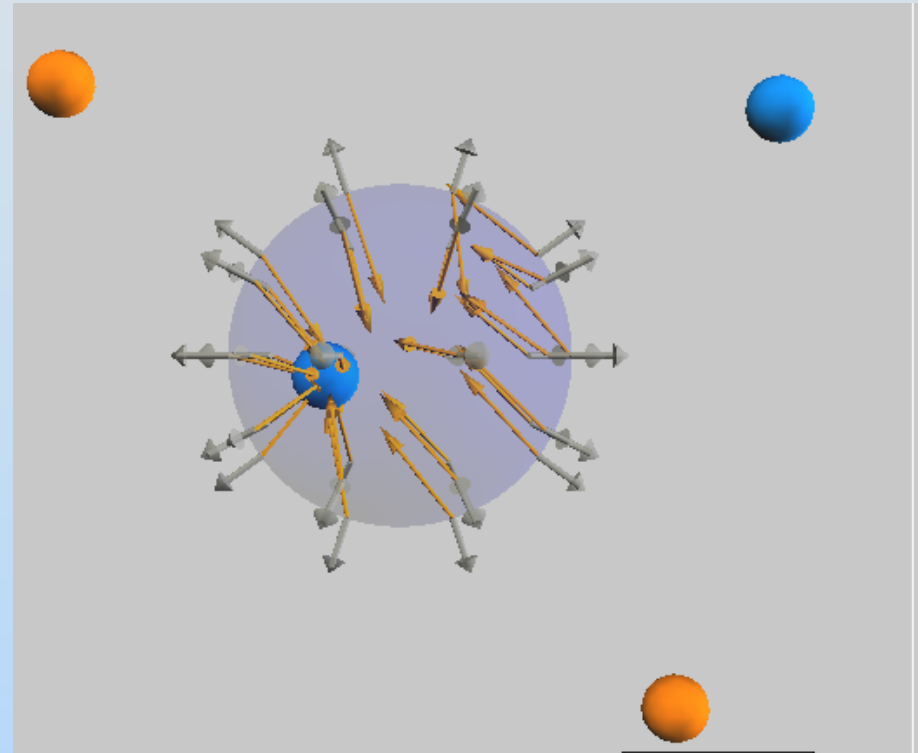
What is this?

[http://web.mit.edu/viz/EM/visualizations/electrostatics/
GaussLawProblems/gausslawflux/gausslawflux.htm](http://web.mit.edu/viz/EM/visualizations/electrostatics/GaussLawProblems/gausslawflux/gausslawflux.htm)

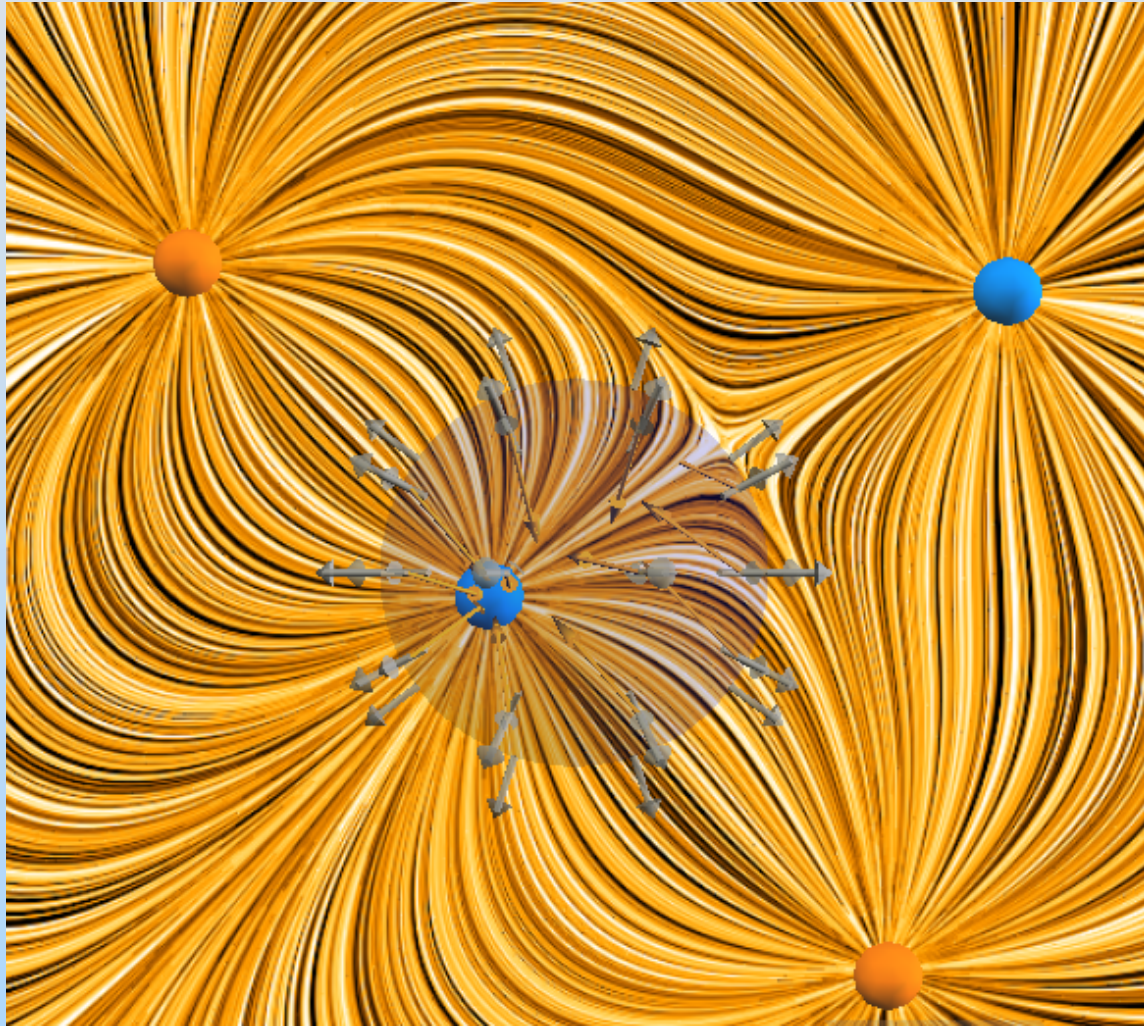
Kesyon sou konsèp: Lwa Gauss

Chan elektrik sou yon sifas esferik matematik pwodui gras ak eleman sa yo:

1. Objè ble ki anndan esfè a e ki gen chaj eletrik ladan l.
2. Tou lè kat (4) objè yo (yo tout gen chaj).
3. Objè ble ki anndan esfè a e ki gen chaj eletrik ladan l epi youn nan objè jòn yo ki gen chaj ladan yo.
4. Okenn nan objè ki gen chaj ladan yo.
5. Mwen pa konnen.



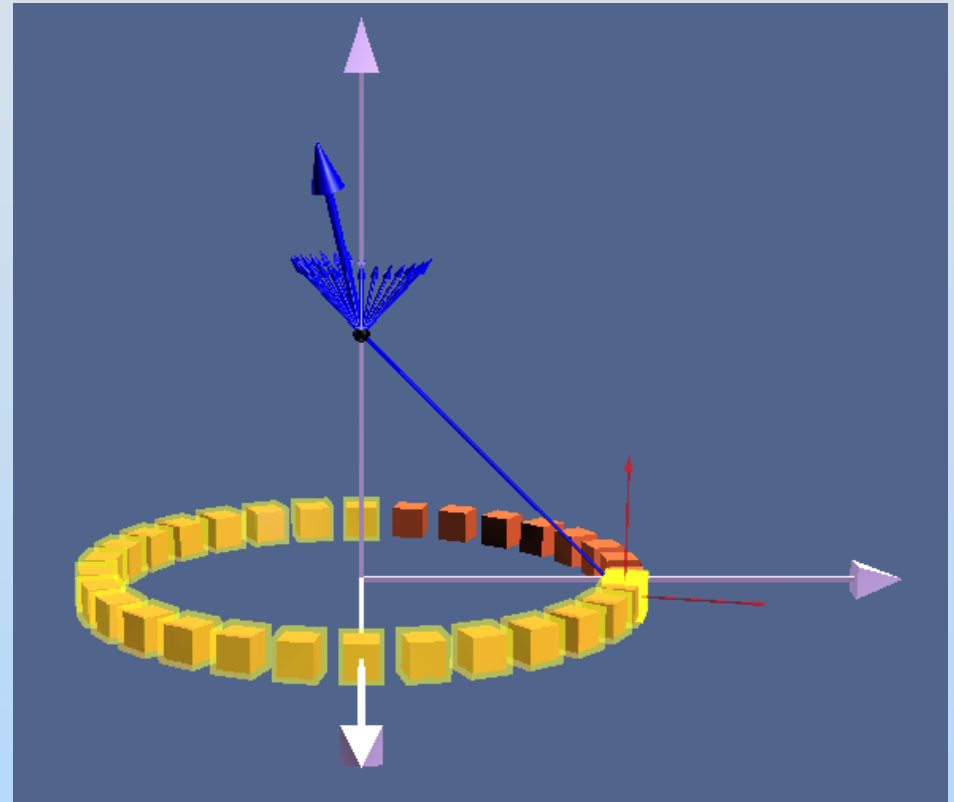
Vizyalyasyon ak similasyon: Kat (4) je kontre, manti kaba



Se pa nan chaj ki anndan an chan elektrik la soti

Vizyilizasyon: Analyze pou nou konprann

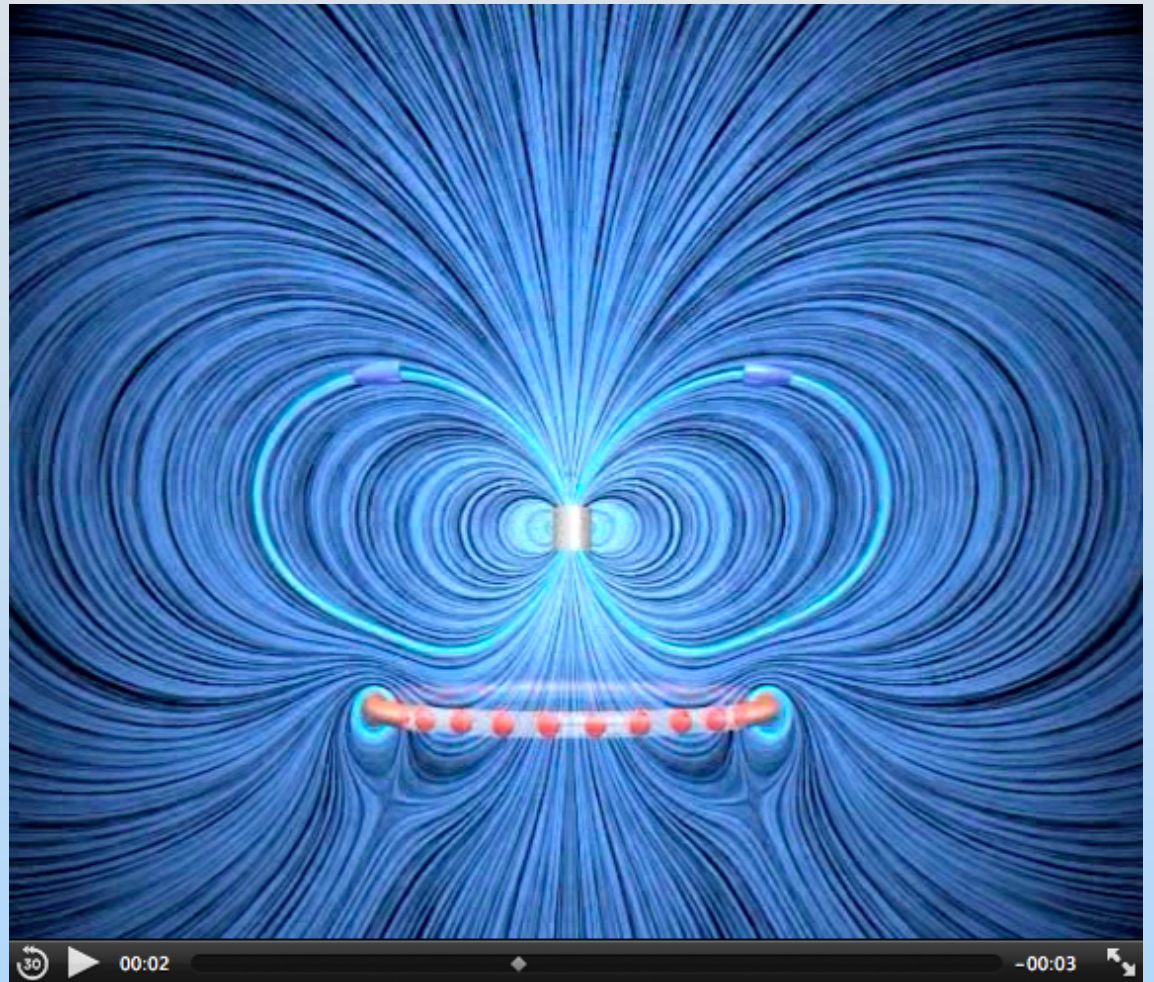
Ann sèvi ak Lwa Biot-Savart la pou nou kalkile chan mayetik



<http://web.mit.edu/viz/EM/visualizations/magnetostatics/calculatingMagneticFields/RingMagInt/RingMagIntegration.htm>

Vizyalyasyon: Chaj yo ap aji antre yo

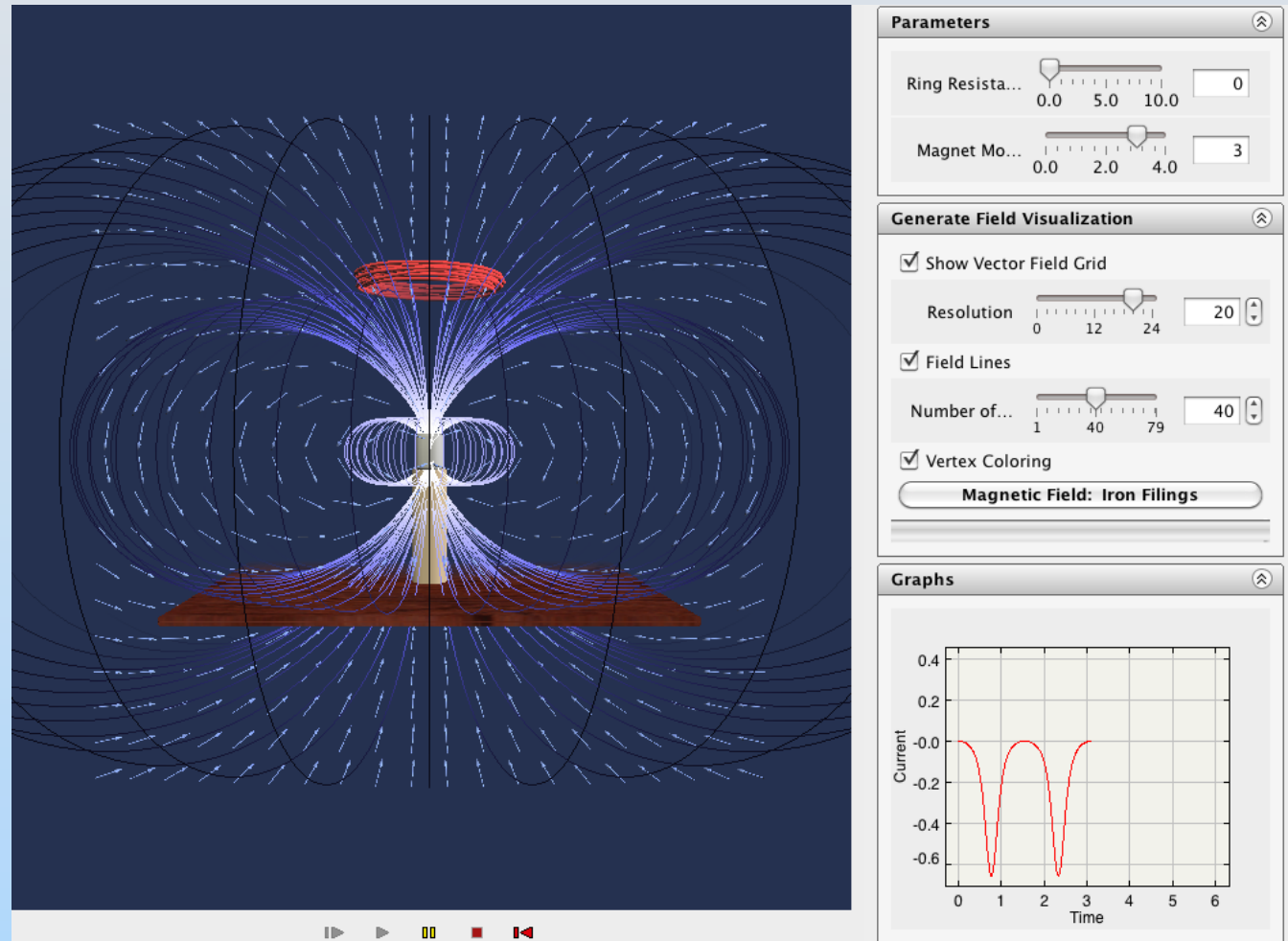
Leman k ap tonbe
a pwodui kouran



[http://web.mit.edu/viz/EM/visualizations/faraday/
fallingCoil/FallingRingResistive/FallingRingResistive.htm](http://web.mit.edu/viz/EM/visualizations/faraday/fallingCoil/FallingRingResistive/FallingRingResistive.htm)

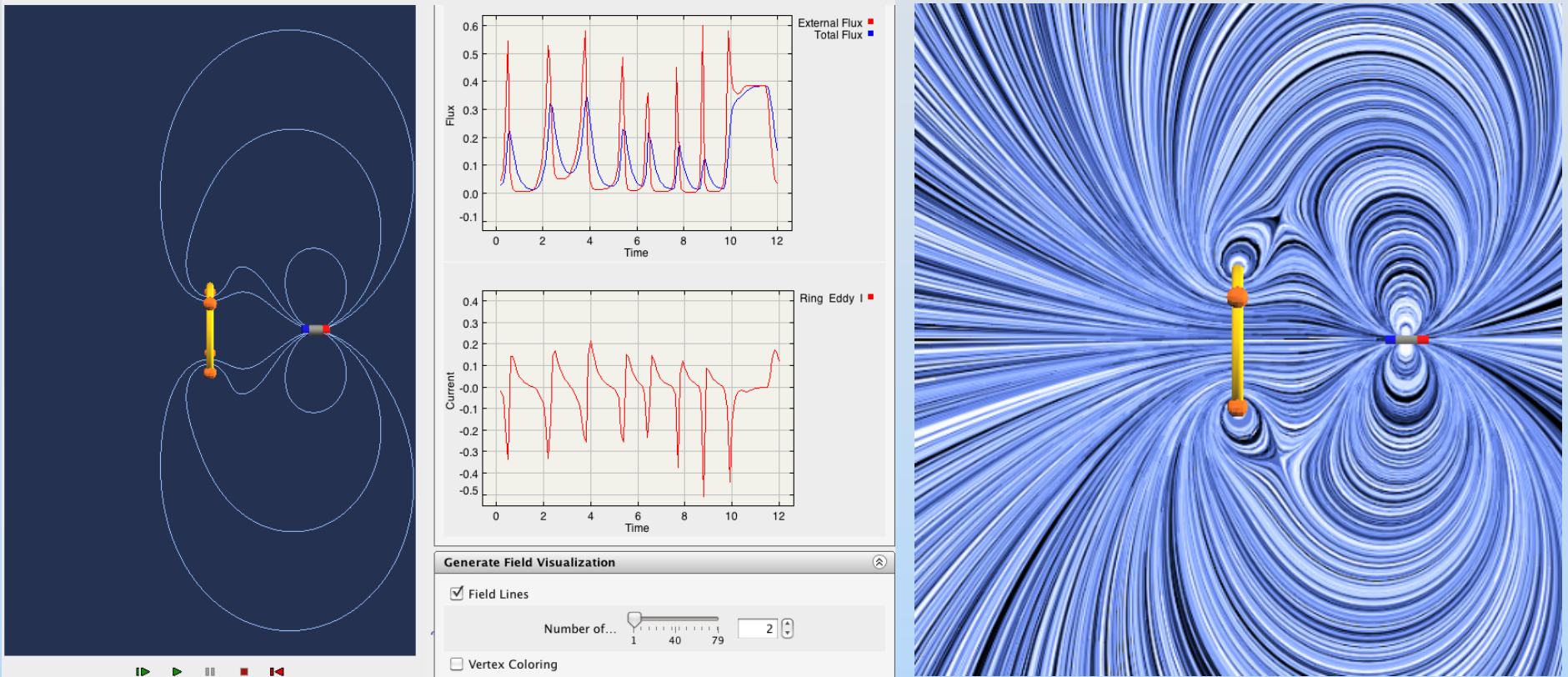
Vizyalizasyon: Entèraksyon ant chan mayetik

Applikasyon ki
fè simulasyon
sou leman k ap
tonbe e ki
pwodui kouran



<http://web.mit.edu/viz/EM/visualizations/faraday/fallingCoil/fallingcoilapp/fallingcoilapp.htm>

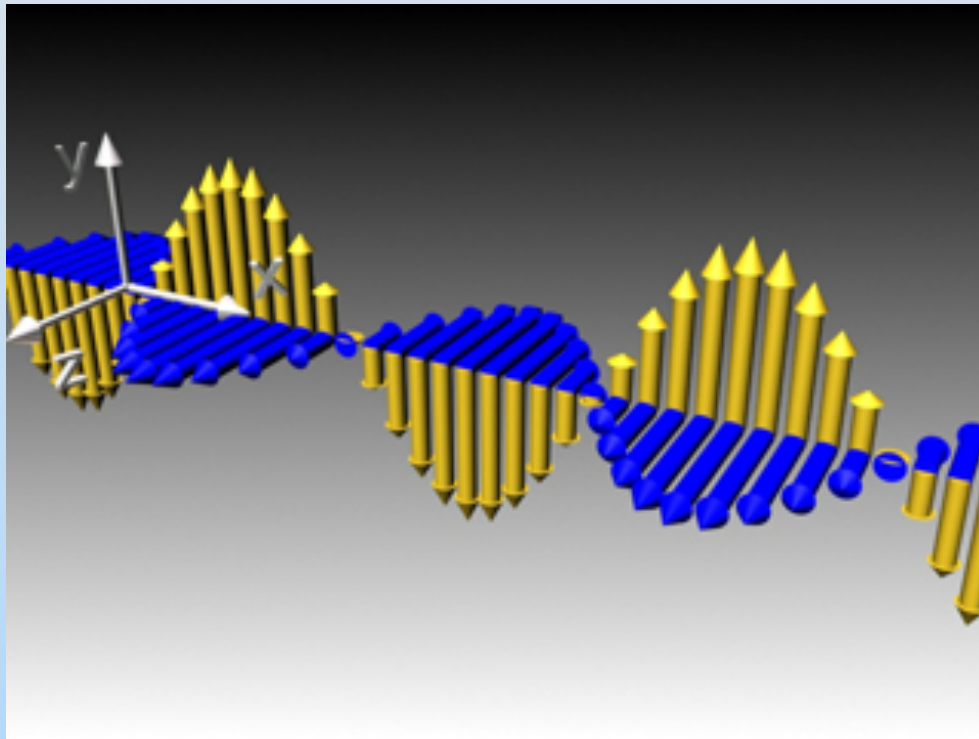
Vizyalyasyon ak similasyon: Aktivite rechèch



Chanjman nan chan mayetik pwodui kouran

<http://web.mit.edu/viz/EM/visualizations/faraday/faradaysLaw/faradayapp/faradayapp.htm>

Vizyalyasyon ak similasyon: Devlope kapasite pou konprann konsèp

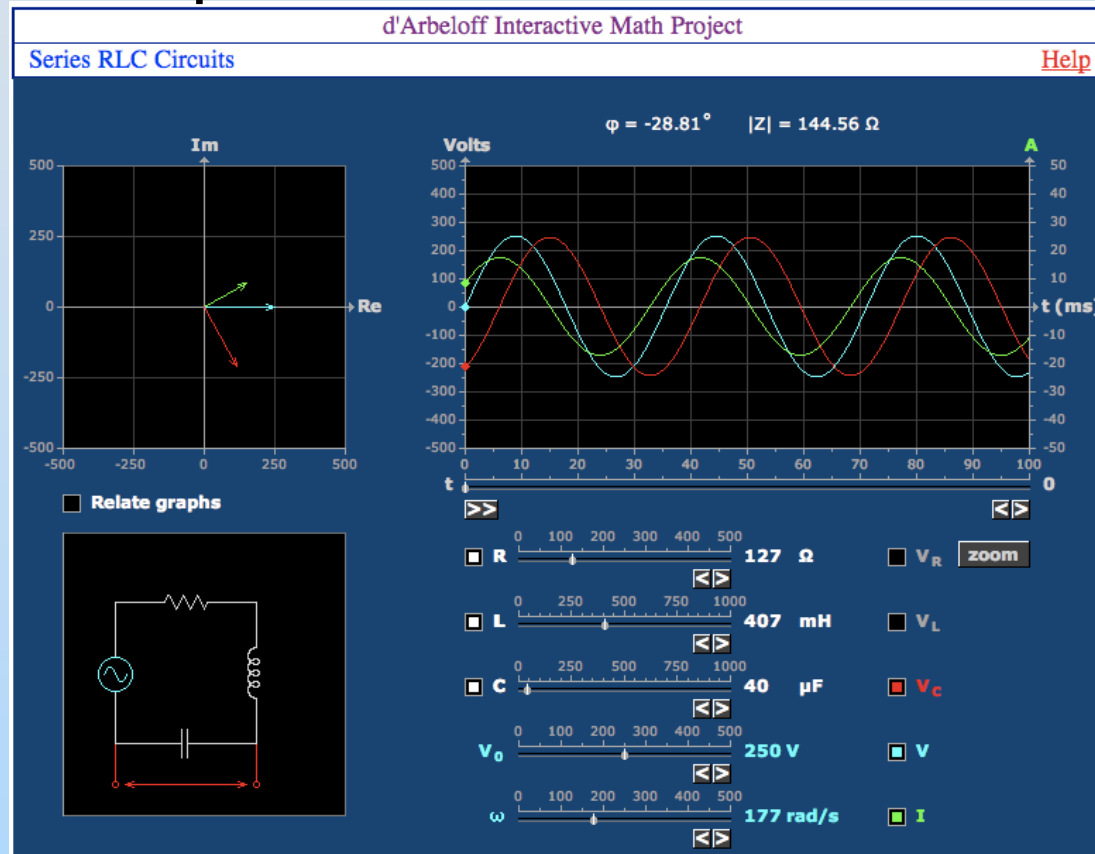


Chan elèktwo-mayetik
k ap deplase nan yon
sifas ki plat

<http://web.mit.edu/viz/EM/visualizations/light/EBlight/EBlight.htm>

“Mathlets” (“Matlèt”): Entwodiksyon sou konsèp matematik ki difisil

<http://math.mit.edu/mathlets/>



<http://math.mit.edu/mathlets/mathlets/series-rlc-circuit/>

Developers: Jean-Michel Claus, Prof. Haynes Miller (Math Department), Dr. Peter Dourmashkin

Eksperimantasyon sou òdinatè

Eksperimantasyon sou òdinatè



Mete laptop sou rezo entènèt kote etidyan ka marye done ak eksperimantasyon

Ann rezoud pwoblèm

Ann rezoud pwoblèm

Etidyan MIT rezoud prèske 10,000 pwoblèm pandan kat (4) ane

Etidyan yo vin maton nan rezoud pwoblèm

Eskperyans yo ba yo konfyans nan tèt yo

Sa nesesè pou kreyativite ak envansyon

Debitan k ap rezoud pwoblèm

- Yo pa kapab konprann konsèp fizik yo
- Yo pa kapab konbinen plizyè lide
- Yo pa kapab fè rezònman matematik
- Yo pa kapab manipile senbòl yo
- Yo pa kapab fè ni estimasyon, ni kalkil rapid

Pou vin ekspè nan rezoud pwoblèm

Aprann panse tankou yon fizisyen

- Konesans ki chita sou done ak sou pwosedi
- Konesans sou anpil modèl
- Ladrès pou rezoud pwoblèm an jeneral

Pwoblèm pa ta dwe “bat” elèv. Pwoblèm ta dwe ede yo devlope konesans ki baze ni sou sentèz ni nou analiz.

Evalyasyon

Zouti pou rechèch

Evalye Varyab	Enstriman
Rezoud pwoblèm	Tès ki gen pwoblèm ak chif
Konpreyansyon konsèp	<ol style="list-style-type: none">1. Pre-tès ak pòs-tès2. Tès sou espas
Atitud	<ol style="list-style-type: none">1. Kesyonè pandan kou epi apre kou2. Diskisyon an gwoup

Rezilta pre-/pòs-tès sou konsèp pou nou mezire pwogrè ki fèt

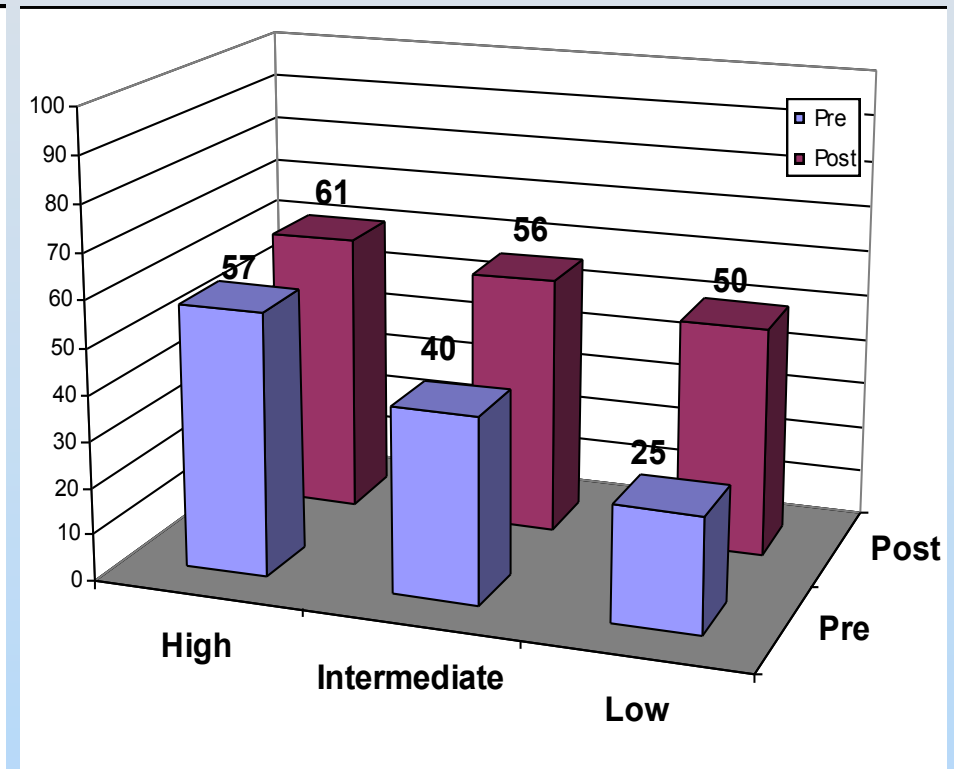
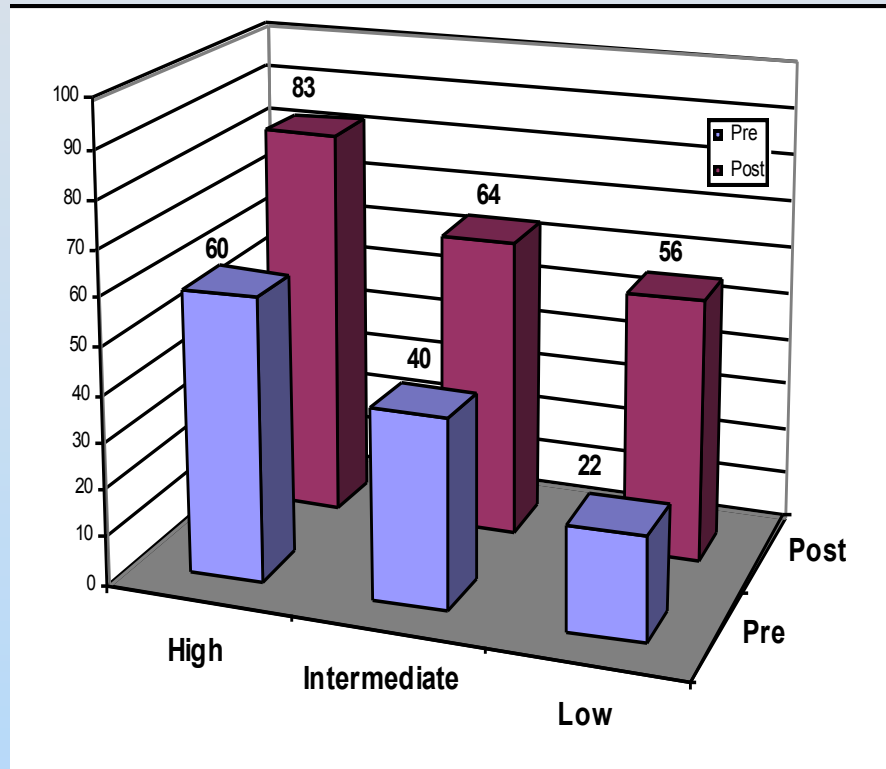
$$\langle g \rangle = \left(\frac{\%Kòrèk_{pòs-tès} - \%Kòrèk_{pre-tès}}{100 - \%Kòrèk_{pre-tès}} \right)$$

Gwoup	2001		Kontwòl 2002		Prentan 2003	
	N	g	N	g	N	g
Tout etidyan yo	176	0.46	121	0.27	514	0.52
Nivo avanse	58	0.56	19	0.13	40	0.46
Nivo mwayen	48	0.39	50	0.26	176	0.55
Nivo ba	70	0.43	52	0.33	300	0.51

Rezilta pou pre-/pos-tès sou konsèp

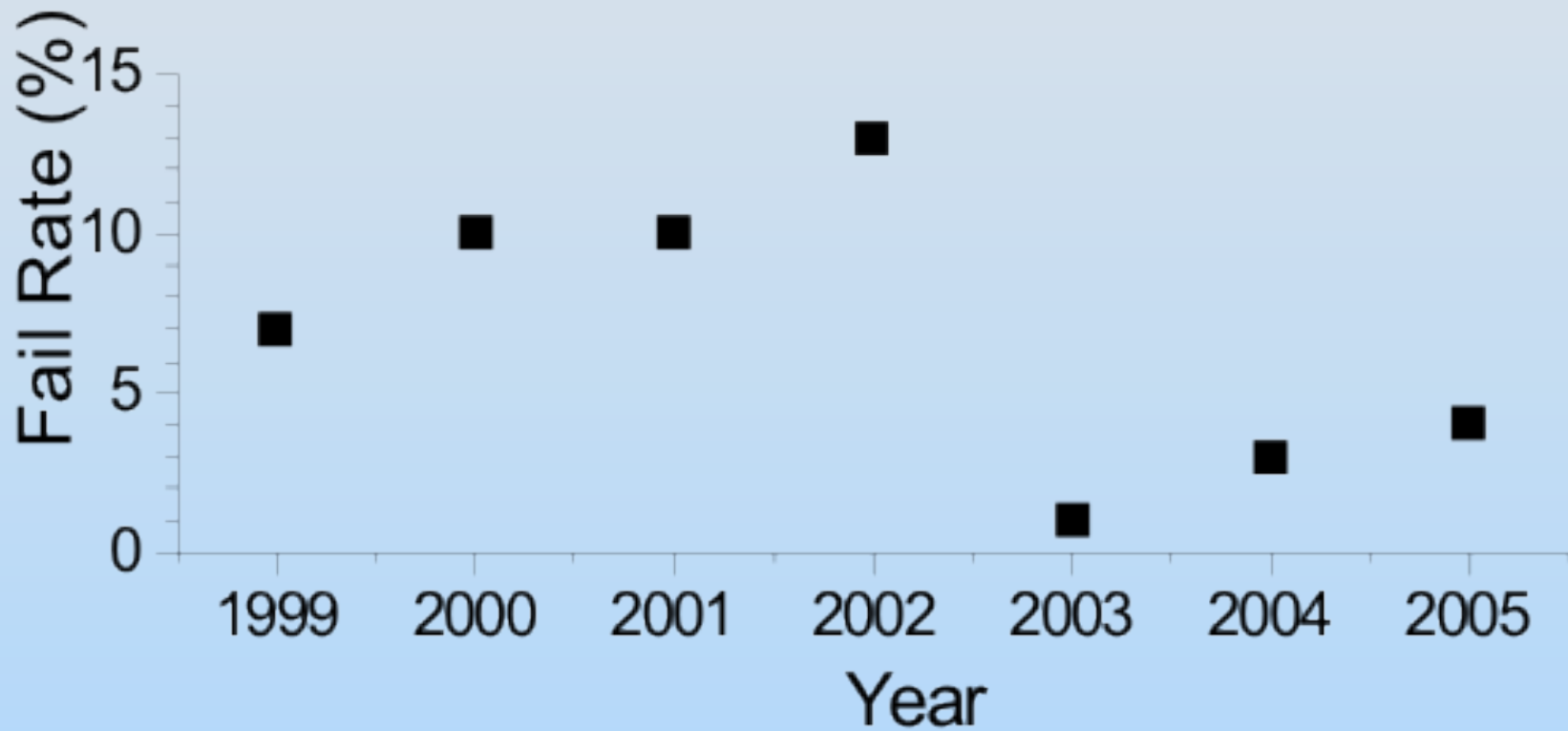
N etidyan=126

N etidyan = 121

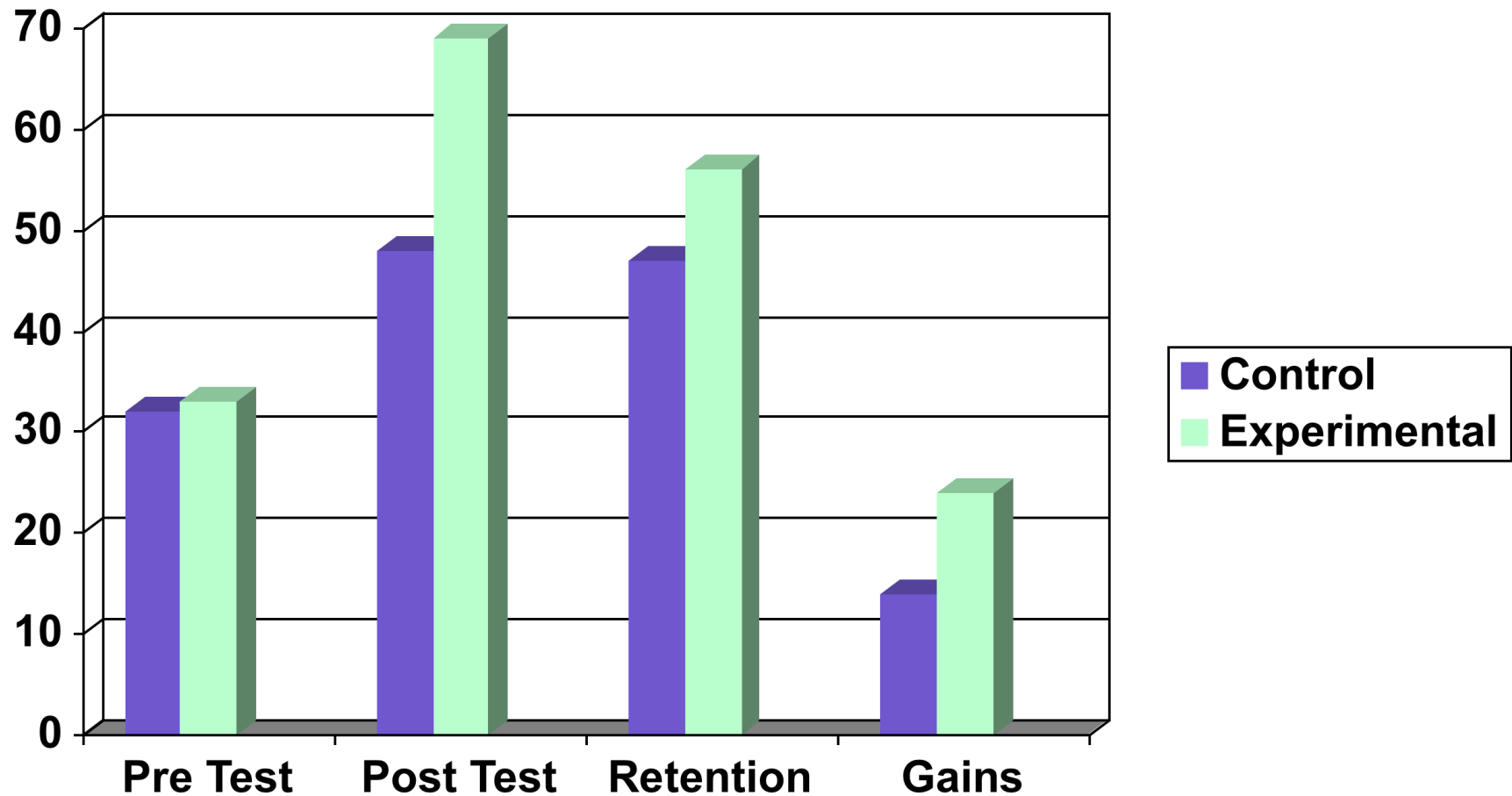


Gwoup Eksperimantal - Otòn 2001 Gwoup Kontwòl - Prentan 2002

Pousantaj echèk yo bese



Avantaj yo rete lontan

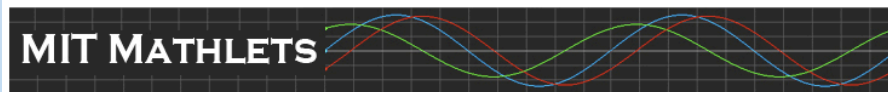


- Source: Dori, Y.J., E. Hult, L. Breslow, & J. W. Belcher (2005). "The Retention of Concepts from a Freshmen Electromagnetism Course by MIT Upperclass Students," paper delivered at the NARST annual conference.

Resous yo

TEAL: Vizyalizasyon nan “Matlèt”

<http://math.mit.edu/mathlets/>



HOME APPLETS COURSES ACTIVITIES FORUM

WELCOME!

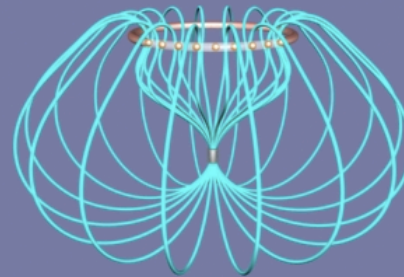


Welcome to the MIT Interactive Mathematics Site!

Here you will find a suite of dynamic Java applets for use in learning about differential equations and other mathematical subjects, along with examples of how to use them in homework, group work, or lecture demonstration, and some of the underlying theory.

We welcome your contributions, through the Forum.

TEAL Visualizing Electromagnetism



Visualizing E&M
Scalar and Vector
Fields

Electrostatics

Magnetostatics

Faraday's Law

Light

Notes

AAPT Workshop W34
Summer 2008

Copyright

Supported by the National Science Foundation under DUE Award 0618558, the Davls Educational Foundation, the d'Arbeloff Fund for Excellence in MIT Education, and the MIT/Microsoft iCampus Alliance. The content contained herein can be freely used and redistributed under liberal open source licenses, as indicated.

<http://web.mit.edu/viz/EM/>

OCW Scholar pou etidyan fizik

MIT **OPEN**COURSEWARE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Home > Courses > **OCW Scholar**

OCW Scholar

OCW Scholar courses are designed for independent learners who have few additional resources available to them. The courses are substantially more complete than typical OCW courses and include new custom-created content as well as materials repurposed from MIT classrooms. The materials are also arranged in logical sequences and include multimedia such as video and simulations.

Notify me of course updates via [RSS](#)

Physics I: Classical Mechanics



Physics I is a first-year, first-semester course that provides an introduction to Classical Mechanics. It covers the basic concepts of Newtonian Mechanics, Fluid Mechanics, and Kinetic Gas Theory.

Instructors: Dr. Peter Dourmashkin, Prof. Walter Lewin, Prof. Thomas Greytak, Craig Watkins, Andy Neely, Dr. Sahana Murthy, Prof. David Litster, Matthew Strafuss

» VISIT THE COURSE

<http://ocw.mit.edu/courses/ocw-scholar/>

Objèktif OCW pou aprantisaj

Bay elèv yo kont tan yo pou yo aprann modil ki sou Mekanik, Elektrisite ak Mayetis

Bay pwofesè yo modil konplè y ap bezwen pou klas yo

Estrikti modil OCW Scholar

Objektif Aprantisaj:

Preparasyon:

1. Gade nòt kou yo
2. Gade videyo klas yo

Aktivite gide

1. Li leson ki sou slayd yo.
pou
2. Travay sou pwoblèm yo
chak etap

Evalye pwòp tèt ou

1. Fè tèst sou konsèp yo
2. Rezoud pwoblèm difisil

Resous ki apwopriye pou divès sijè a

PhET

PhET: Free online physics, chemistry, biology, earth science and math simulations

11/9/11 2:00 PM

Sou sit wèb sa a
("PhET) Inivèsite
Kolorado mete yon
varyete similasyon
ki disponib nan
plizyè lang.

Over 50 million simulations delivered

PhET

Sign In / Register

Interactive Simulations

UNIVERSITY OF COLORADO AT BOULDER

Search

Interactive Science Simulations

Fun, interactive, [research-based](#) simulations of physical phenomena from the PhET project at the University of Colorado.

Play with sims... >

National Science Foundation | The William and Flora Hewlett Foundation | O'Donnell Foundation

Recipient of **The Tech Award 2011**
honoring technology benefiting humanity

Applied Materials presents **The Tech Awards**

Join us on [f](#) | Follow us on [t](#) | Read our blog | Subscribe to our newsletter


How to Run Simulations	For Teachers	About	PhET is supported by...
<ul style="list-style-type: none">On LineFull InstallationOne at a TimeTroubleshootingFAQs	<ul style="list-style-type: none">Browse ActivitiesContribute ActivitiesWorkshops / MaterialsTranslate simulationsTranslate the website	<ul style="list-style-type: none">What's New?About PhETContact UsDonate	<p>OREGON DEPARTMENT OF EDUCATION</p> <p>and our other sponsors, including educators like you.</p>

English | العربية | 正體中文 | Dansk | Engels | Suomi | Galego | ქართული | Ελληνικά | Magyar | Bahasa Indonesia | 한국어 | كوردی | Македонски | فارسی | Português | Português do Brasil | Српски | Türkçe | Tiếng Việt

© 2011 University of Colorado. Some rights reserved.

<http://phet.colorado.edu/>

“Compadre”



The Physics Front

Physics and Physical Science Teaching Resources

[login](#) - [create an account](#)

Editor selections by Topic and Unit

- **K-8 Phys. Science**
- **Physics First**
- **Conceptual Physics**
- **Algebra-based**
- **AP-Calculus**


- **Browse Collection**
- **Shared Folders**
- **Get Involved**
- **For New Teachers**
- **Standards**
- **Contact the Editors**
- **About Physics Front**

The Physics Front is a free service provided by the [AAPT](#) in partnership with the [NSF/NSDL](#).

Welcome to the Physics Front!

Here you can find teaching resources for your physics and physical science classes.

[Login](#) - [Register to Participate](#) - [Take a Survey](#)




Our Top Picks

[Particles & Interactions: Build Your Unit](#)

Grade Level: 9-12

Featured Resource



WISE: The Web-based Inquiry Science Environment

These ready-to-use, free modules for K-12 science education offer students a highly-engaging blend of video clips, interactive simulations, digital note...

[Featured Resource Archive >](#)

Lesson Plan Central

Scientific Inquiry for Elementary Students

Problem Based Learning: Get Out! Designing a Highway Exit

Middle School Portal: Measurement Sliced and Diced


Science Educator's Guide to Assessment

National Science Education Standards

Kathy Schrock's Guide for Educators: Assessment & Rubric Information

[Lesson Plan Archive >](#)

Technology Tools



Science Buddies - Science Fair Project Resources

AAAS has developed "Science Buddies" to help teachers and students develop science fair projects. There is a host of online tools to use on this site. So, if... [more >](#)

[Tech Tool Archive >](#)

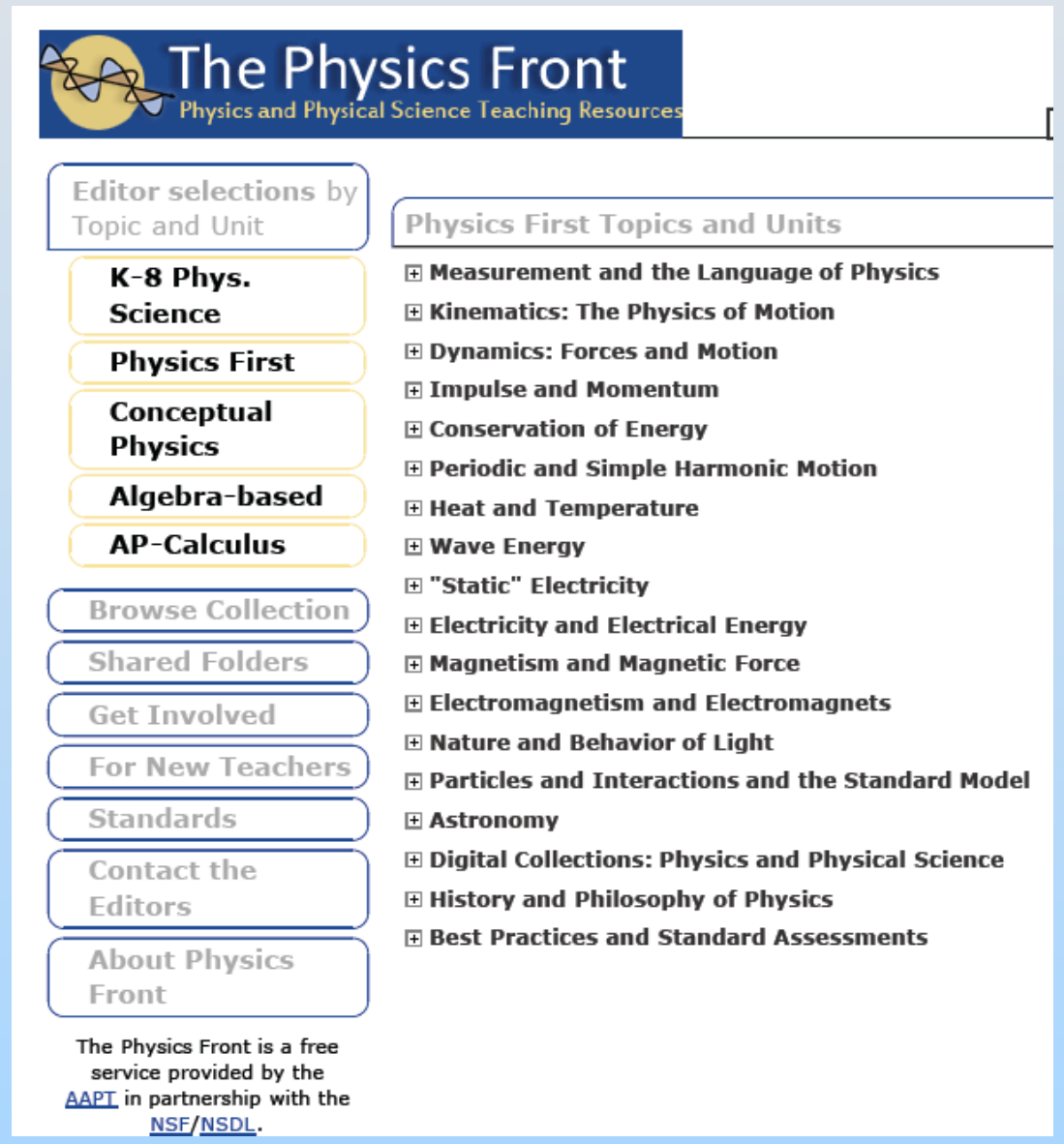
<http://www.compadre.org/>

“Compadre”

Fizik soti nan kindè rive nan 12^e ane

- Fizik K-8
- Fizik de baz
- Konsèp fizik
- Fizik ki baze sou aljèb
- Fizik pou elèv segondè ki avanse

[http://
www.compadre.or
g/precollege/](http://www.compadre.org/precollege/)



The Physics Front
Physics and Physical Science Teaching Resources

Editor selections by Topic and Unit

- K-8 Phys. Science
- Physics First
- Conceptual Physics
- Algebra-based
- AP-Calculus

Browse Collection

Shared Folders

Get Involved

For New Teachers

Standards

Contact the Editors

About Physics Front

Physics First Topics and Units

- ⊕ Measurement and the Language of Physics
- ⊕ Kinematics: The Physics of Motion
- ⊕ Dynamics: Forces and Motion
- ⊕ Impulse and Momentum
- ⊕ Conservation of Energy
- ⊕ Periodic and Simple Harmonic Motion
- ⊕ Heat and Temperature
- ⊕ Wave Energy
- ⊕ "Static" Electricity
- ⊕ Electricity and Electrical Energy
- ⊕ Magnetism and Magnetic Force
- ⊕ Electromagnetism and Electromagnets
- ⊕ Nature and Behavior of Light
- ⊕ Particles and Interactions and the Standard Model
- ⊕ Astronomy
- ⊕ Digital Collections: Physics and Physical Science
- ⊕ History and Philosophy of Physics
- ⊕ Best Practices and Standard Assessments

The Physics Front is a free service provided by the [AAPT](#) in partnership with the [NSF/NSDL](#).

Sitwèb pou TEAL ak Matematik nan MIT

TEAL pou kou Fizik nan MIT

<http://web.mit.edu/8.01t/www>

<http://web.mit.edu/8.02t/www>

Vizyalizasyon ak similasyon pou kou Elektwo-Mayetik nan MIT

<http://web.mit.edu/8.02t/www/802TEAL3D/>

<http://web.mit.edu/viz/EM/index.html>

Similasyon pou kou Matematik nan MIT

<http://math.mit.edu/mathlets/>

Sitwèb OCW

Sit Open Course Ware (OCW)

OCW Scholar: Bon jan kou—chaje ak detay—pou debitan

<http://ocw.mit.edu/courses/ocw-scholar/>

Katalòg jeneral pou kou MIT ki nan OCW (Mwens detay)

<http://ocw.mit.edu/courses>

Materyèl OCW pou lekòl segondè

<http://ocw.mit.edu/high-school/>

MIT Blossoms

<http://blossoms.mit.edu/>

Yon lis sit nan “Compadre”

Compadre: Similasyon ak vizyalizasyon pou pwoblèm fizik

<http://www.compadre.org/>

Compadre: Dokiman pou lekòl segondè (fizik)

<http://www.compadre.org/precollege/>

Compadre: Amizman pou fizik enfòmèl

<http://www.compadre.org/informal/>

Compadre: Resous pou syans fizik

<http://www.compadre.org/psrc/>

Sitwèb “Phet”

Sou sit wèb sa a (“PhET) Inivèsite Kolorado mete yon varyete simulasyon ki disponib nan plizyè lang.

<http://phet.colorado.edu/>