A close-up photograph of a scientist with short blonde hair and glasses, wearing a white lab coat. The scientist is focused on pouring a white, opaque liquid from a glass beaker into a funnel. The funnel is held in place over a round-bottom flask. The background is a soft, out-of-focus laboratory setting. The text on the left is overlaid on a semi-transparent white background.

**Technology-  
Enhanced STEM –  
Learning Objects,  
MOOCs, and OER**

*Daphne Figueroa  
Michelle Pilati*

# Questions to be Answered

- How can STEM faculty enhance their teaching with readily available learning objects?
- What might MOOCs do for you and your students?
- Are there OER that are right for you?



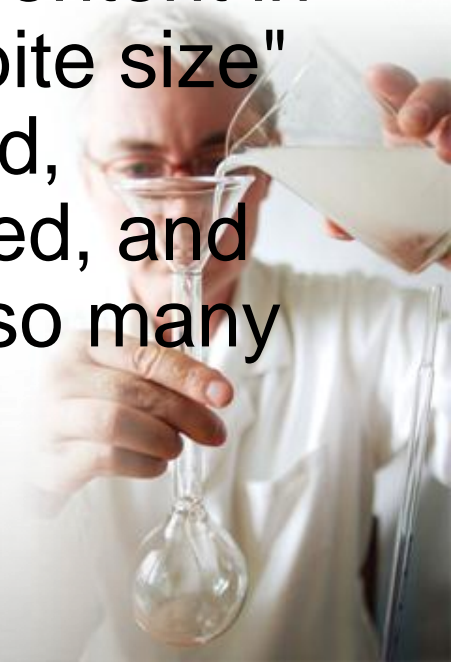
# Overview

- Learning Objects – What and Where?
- MOOCs (Massive Open Online Courses)
  - Approaches
  - Exploration
- OER (Open Educational Resources)
- Questions and Discussion



# What is a “learning object”?

- Wikipedia – “A learning object is a resource, usually digital and web-based, that can be used and re-used to support learning..”
- Eduworks – “Learning objects are the core concept in an approach to learning content in which content is broken down into "bite size" chunks. These chunks can be reused, independently created and maintained, and pulled apart and stuck together like so many legos.”





# Characteristics of Learning Objects

- Variable size
- Variable detail
- Reusable
- Facilitate learning



# Learning Objects

Where?



Search

# DNA FROM THE BEGINNING

An animated primer of 75 experiments that made modern genetics.

CLASSICAL GENETICS

MOLECULES OF GENETICS

GENETIC ORGANIZATION AND CONTROL



### DNA FROM THE BEGINNING

An animated primer of 75 experiments that made modern genetics.

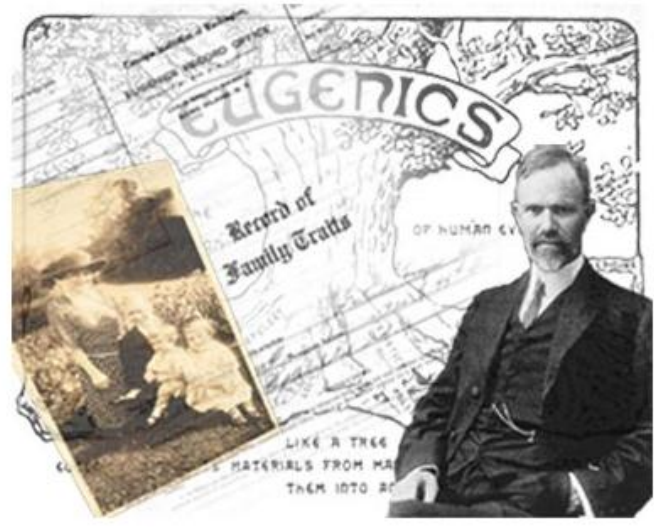
Concept 14

## Mendelian genetics cannot fully explain human health and behavior.

- CONCEPT
- ANIMATION
- GALLERY
- VIDEO
- BIO
- PROBLEM
- LINKS

There was obvious interest in applying Mendel's laws to agriculture. Mendel's ideas were also embraced by the eugenics movement, the goal of which was to improve the human species by better breeding. Eugenecists encouraged marriages between people of "good" genetic stock, and discouraged reproduction of the "genetically unfit."

Eugenecists wrongly used simple dominant/recessive schemes to explain complex behaviors and mental illnesses — which we now know involvemany genes. They also failed to account for environmental effects on human development. In the United States, restrictive eugenecis legislation reflected political and social prejudices, rather than genetic facts. The eugenecis description of human life was finally



### CLASSICAL GENETICS

- 1 Children resemble their parents.
- 2 Genes come in pairs
- 3 Genes don't blend.
- 4 Some genes are dominant
- 5 Genetic inheritance rules.
- 6 Genes are real things
- 7 All cells arise from pre-existing cells.
- 8 Sex cells have one set of chromosomes; body cells have two.
- 9 Specialized chromosomes determine gender.
- 10 Chromosomes carry



# MERLOT

- Not a repository – a “referatory”
- Peer-reviewed
- Free
- Anyone can join
- “Collections”
- Discipline “communities”
- **Caution – always available??**



# MERLOT Chemistry Portal

Etudes : FH PSYC 040 ... x Michelle Pilati - Outlo... x How to do Print Scree... x Communities x MERLOT Chemistry P

chemistry.merlot.org

Most Visited Make Y! My Hom... Guidelines avail... Getting Started Etudes : My Wor... AOL Mail



Search:

[advanced search materials](#) | [advanced search members](#) | [search other libraries](#)

## MERLOT Chemistry Portal

[Visit Main MERLOT](#)

[\(Click here to see](#)

[JCE's Featured Molecules in 3D\)](#)

Welcome to the MERLOT Chemistry Portal, an educational resource for teaching and learning. See what we have to offer. [Become a member](#) of MERLOT – membership is free – and become part of the Chemistry Community.

MERLOT Chemistry has partnered with the [Journal of Chemical Education](#) to provide you with the best in chemical education resources. Click on the molecule shown above to visit our partner and to learn about the current [JCE's Featured Molecules of the Month!](#)



## CHEMISTRY

What's New In MERLOT

- [Browse Learning Materials](#)
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- [Browse Members Directory](#)
- [Browse Virtual Speakers Bureau](#)
- [Visit the Journal of Online Learning and Teaching \(JOLT\)](#)

### TEACHING



### PEOPLE



### LEARNING MATERIALS



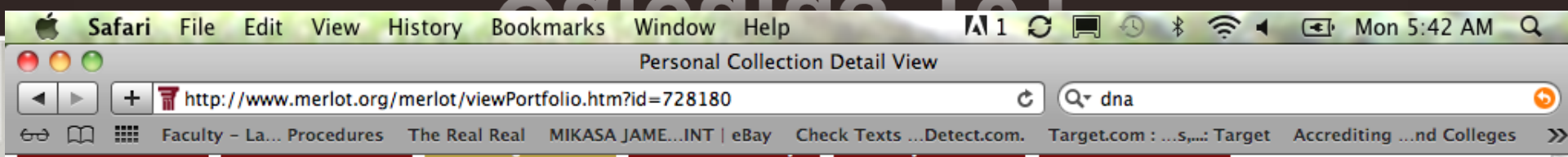
### BEYOND MERLOT



### SHOWCASE



# Calculus 101



## Personal Collection Detail View

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**Calculus 101**  
by [Cathy Swift](#)

SHARE    ...

**Description:** These are resources that can be used for a college calculus course. The subject in this first course is differential calculus. Beginning with functions and limits, this course includes techniques and applications of differentiation, indefinite and definite integrals and applications of integration. Topics include functions, limits, continuity, differentiation of algebraic and trigonometric functions, mean value theorem, and applications of derivatives. A suggested textbook would be "Calculus" by Howard Anton, Sixth Edition, Vol. 1, Wiley

Authorized users only:  
[Copy this Personal Collection to my profile](#)

**Course:** Beginning Calculus

**Prerequisites:** Math placement exam; completion of high school algebra and trigonometry

**Learning Outcomes:** 1. To master algebraic topics introduced in precalculus and trigonometry. 2. To understand limits and investigate some of their basic properties. 3. To understand the basic relationship between tangent lines, rates of change, and the derivative. 4. To master the techniques of differentiation. 5. To become familiar with the standard applications of the derivative in physics, engineering, biology, chemistry, and economics. 6. To become familiar with parts of the theoretical framework that are appropriate at this level. 7. To understand the integral and its relation to the derivative. 8. To master techniques of integration for simple integrals. 9. To learn how to use a graphing calculator.

**Pedagogy Approach:** Various

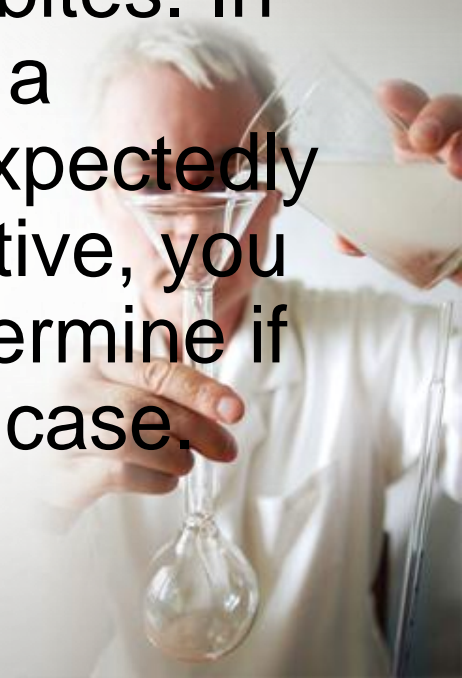
**Assessment Methodology:** Problem completion

- [Numerical Integration Rules](#)  
Added: 01/28/2013  
Limited functionality, but very clear depiction of integration and the error involved with different integration methods. This applet provides a visual representation of various techniques of numerical integration including left rectangle, right rectangle, midpoint, Simpson's, and trapezoidal. The absolute value of the error is reported for each requested partition. This makes it easy to evaluate the effectiveness of changing the number of subintervals, and makes it possible to compare the accuracy of the various methods of integration.
- [Numerical integration simulation](#)  
Added: 01/28/2013



<http://collective.chem.cmu.edu/mr/>

- **Gather clues - Interview suspects - Analyze evidence - Solve a mysterious death**
- This activity is set in a research group that is developing an antivenom for spider bites. In the opening scene, Nelson Pogline, a talented graduate student, dies unexpectedly at a university reception. As a detective, you must use chemistry concepts to determine if this was murder and if so, solve the case.



# Solve a Mysterious Death

- This activity requires basic knowledge of formula weight, stoichiometry, and the scientific method.
- Additional concepts that are discussed include molecular recognition, limiting reagents, and mass spectrometry.
- **NOTE: Downloadable**



# Random Web Search

- [http://www.wwnorton.com/college/physics/om/\\_content/\\_index/tutorials.shtml](http://www.wwnorton.com/college/physics/om/_content/_index/tutorials.shtml)
- <http://www.physicstutorials.org/pt/index.php?m=2>
- <https://sites.google.com/site/physicsflash/home/intrinsic-components>





# Chemistry Animations

- <http://www.learnerstv.com/animation/Free-chemistry-animations-page1.htm>
- <http://www.mhhe.com/physsci/chemistry/essentialchemistry/flash/flash.mhtml>



Michelle Pilati - Outlook Web A... x Etudes : ECC PSYC 5 9189 MP S... x Flash Animations x Etudes x +


www.mhhe.com/physsci/chemistry/essentialchemistry/flash/flash.mhtml ☆ Google

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## Essential Chemistry, 2/e

by Raymond Chang

© 2000



### Flash Animations

[Chapter 2](#) - Rutherford's Experiment

[Chapter 3](#) - Limiting Reagent

[Chapter 4](#) - Molecular View

[Chapter 5](#) - Properties of Gases

[Chapter 7](#) - Line Spectra

[Chapter 8](#) - Atomic Radii

[Chapter 10](#) - Hybridization

Chapter 11

[1](#) - Vapor Pressure

[2](#) - Sphere Packing - Simple Cubic Packing

[3](#) - Sphere Packing - Body Centered Cubic Packing

[4](#) - Sphere Packing - Cubic Close Packing

Chapter 14

[1](#) - Activation Energy

[2](#) - Orientation of Collision

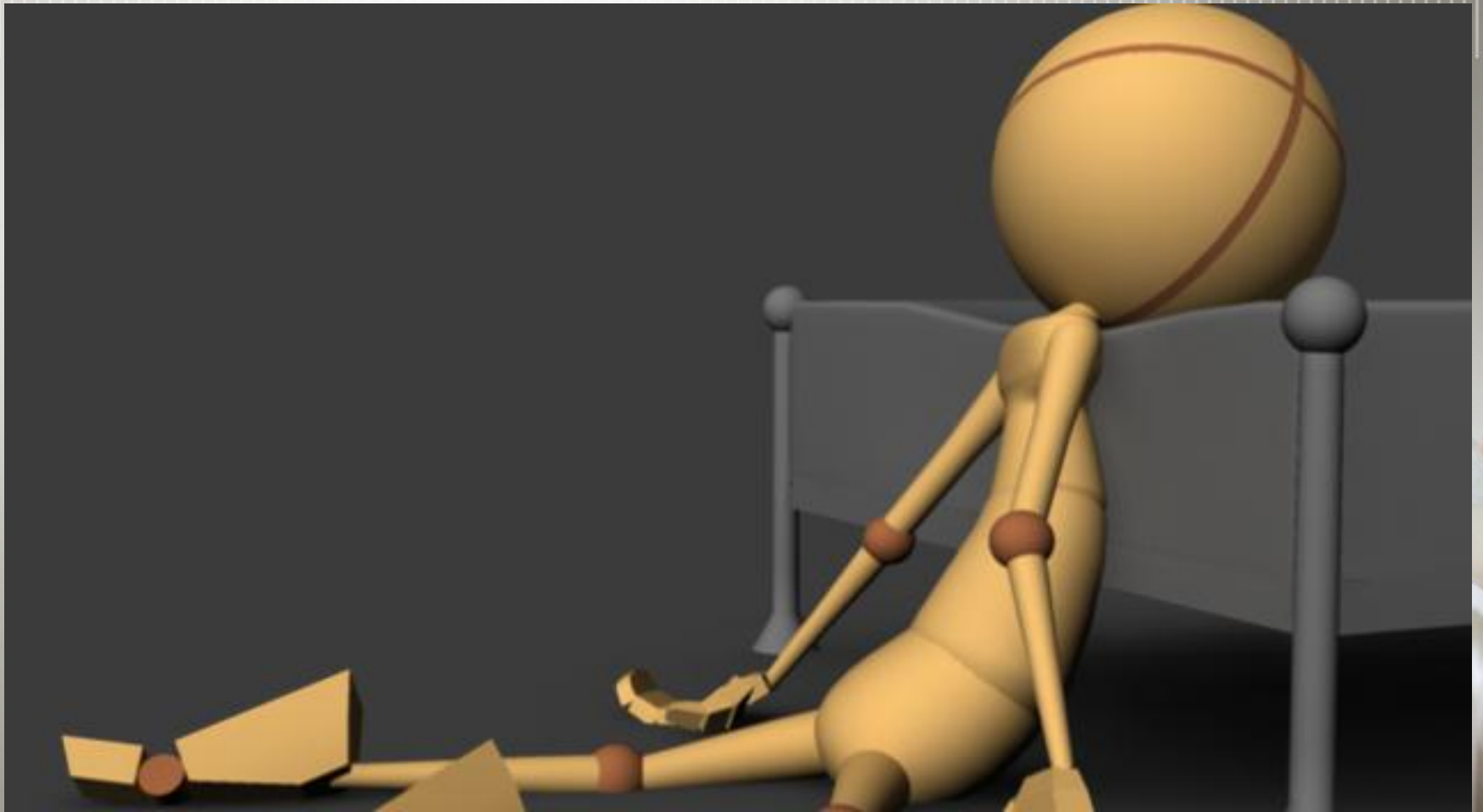
# Take-home message?

- There are many very interesting things that you can integrate into your teaching





# MOOCs



# MOOCs

- Massive Open Online Course
- Do-it-yourself education
- Increasing access to education?
- Changing education?



# MOOCs

- <https://www.coursera.org/>
  - “Take the World's Best Courses, Online, For Free.”
- <https://www.udacity.com/>
  - “Invent your future through free interactive college classes. ”
- <https://www.edx.org/>
  - “The Future of Online Education For anyone, anywhere, anytime”



# MOOCs

- What does it mean to “take” a course
- Should we be seeking ways to award credit for MOOC completion?
- How much, if any, of a certificate or degree should a student be able to complete via “alternative mechanisms”?
- Currently, how much can students do?
- Which students are most likely to benefit from MOOCs?





<https://www.coursera.org/>

- “Join 2,920,809 Courserians”
- Facilitate course development by faculty at major universities
- Difficult to view all courses
- Starting Soon Vs Newest



# Coursera

- Courses are “real” courses
- True start and stop time
- Interested in using technology to explore how students learn
- Expectation that students know best
- Appears to address accessibility issues
- Interested? Become a “Courserian”



<https://www.udacity.com/>

- Udacity develops
- Beginner, Intermediate, Advanced
- Business, CS, Math, Physics
- <https://www.udacity.com/course/ph100>



# Syllabus

- **Unit 1: How can we measure the circumference of the Earth?**
- Basics of geometry and trigonometry
- **Unit 2: How do objects move?**
- Data analysis and kinematics
- **Unit 3: What causes motion?**
- Forces, acceleration, and Newton's Laws
- **Unit 4: How can we use motion?**
- Work, energy, and simple machines
- **Unit 5: How can we determine our longitude at sea?**
- Simple harmonic motion
- **Unit 6: What is electricity?**
- Charge and electric fields
- **Unit 7: What is left to discover?**
- Modern physics and open questions





# EdX

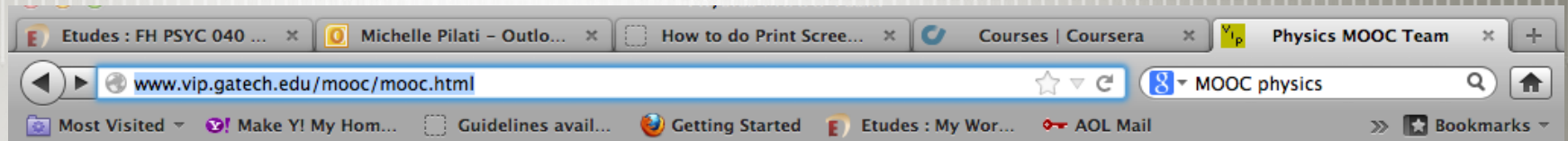
- Introduction to Biology
- Quantum Mechanics
- Introduction to Statistics
- Intro to CS and Programming



- **Introduction to Biology - The Secret of Life**
- [https://www.edx.org/courses/MITx/7.00x/2013\\_Spring/about](https://www.edx.org/courses/MITx/7.00x/2013_Spring/about)
- Although this course has been designed exclusively for edX, the course content reflects the topics taught in the MIT introductory biology courses and many biology courses across the world.



# MOOC Physics



## Vertically-Integrated Projects

|              |            |           |
|--------------|------------|-----------|
| Introduction | Teams      | Resources |
| Facilities   | Affiliates | Papers    |



## The Physics-MOOC VERTICALLY INTEGRATED PROJECTS (VIP) TEAM

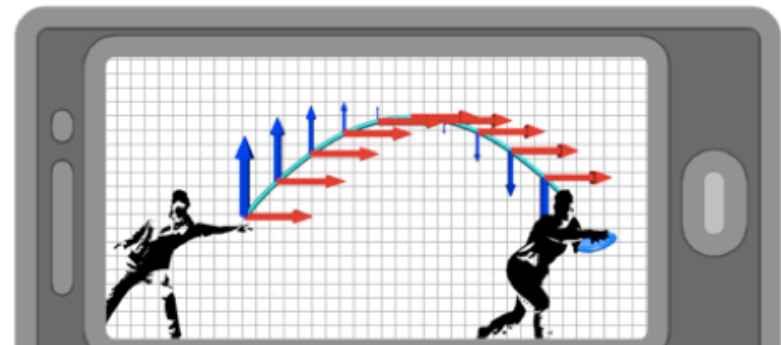
TEAM TITLE: Physics MOOC VIP Team

[Physics MOOC Video Intro](#)

GOALS: To develop course materials and software for teaching hands-on, inquiry-based introductory physics in a Massive Online Open Course (MOOC). We will use a novel combination of open-source software, calibrated peer review, and interactive online lectures to create a complete physics course, labs and all, available to anyone with a smartphone and an internet connection.

TECHNOLOGIES: Video analysis software, multi-media web applications, video production, in-browser IDEs (à la [glowscript.org](#)), in-browser 3D graphics, databases, and user interfaces.

RESEARCH ISSUES: Scalability of peer review; pedagogy in



# Physics MOOC Video Intro

- <http://www.vip.gatech.edu/mooc/mooc.htm>  
!





# You and MOOCs

- How might you “use” a MOOC?
- Develop a credit by exam option?
- Send student who need more time on a topic to a MOOC?
- Teach your own students within a MOOC?
- Do we need to really consider MOOCs?



# OER

- Open Educational Resources
- Any users?
- Challenges with using OER?
- Would you be willing to use OER if you were supported to do so?
- Legislation calls on us to give it a try
  - SB1052 and 1053



# OER Resources

- <http://www.oercommons.org/>
- <http://www.hewlett.org/programs/education-program/open-educational-resources>
- “Open Educational Resources (OER) are high-quality, openly licensed, online educational materials that offer an extraordinary opportunity for people everywhere to share, use, and reuse knowledge.”



# http://www.oercommons.org/

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www.oercommons.org/search?f.search=physics oer resources


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**Physics to Go**   
(Complete Item Description) ★★★★★  
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Actions ▾


**Subject:** Science and Technology  
**Grade Level:** Secondary, Post-secondary  
**Collection:** [American Physical Society](#)

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**Discover Physics**   
**Abstract:** Discover Physics is a conceptual physics textbook intended for students in a nonmathematical one-semester general-education course. ☆☆☆☆☆  
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**Subject:** Science and Technology  
**Grade Level:** Secondary, Post-secondary  
**Collection:** [Light and Matter - Physics and astronomy resources](#)

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**Conceptual Physics**   
(Complete Item Description) ☆☆☆☆☆  
Remix and Share  
Actions ▾

**Subject:** Science and Technology  
**Grade Level:** Post-secondary  
**Collection:** [Light and Matter - Physics and astronomy resources](#)

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[MIT Open Course](#)  
MIT OpenCourseWare (OCW) is a web-based publication of virtually all MIT course content. OCW is open and available to the world and is a permanent MIT activity. What is MIT OpenCourseWare? MIT OpenCourseWare is a free publication of MIT course materials that reflects almost all the undergraduate and graduate subjects taught at MIT.

[National Science Teachers Association](#)  
The Learning Center is NSTA's e-professional development (PD) portal to help you address your classroom needs and busy schedule. You can gain access to more than 7,000 different resources, of which [over 2,100 are free](#). A suite of practical tools such as *My Library*, *My PD Record*, and *My PD Plan and Portfolio* help you organize and document your PD growth. [Create your free account](#) and watch the [overview](#).

[HippoCampus](#)  
HippoCampus is a project of the Monterey Institute for Technology and Education (MITE). The goal of HippoCampus is to provide high-quality, multimedia content on general education subjects to high school and college students free of charge.

[Khan Academy](#)  
The Khan Academy is an organization on a mission. We're a not-for-profit with the goal of changing education for the better by providing a free world-class education to anyone anywhere.  
All of the site's resources are available to anyone. It doesn't matter if you are a student, teacher, home-schooler, principal, adult returning to the classroom after 20 years, or a friendly alien just trying to get a leg up in earthy biology. The Khan Academy's materials and resources are available to you completely free of charge.

[iTunes U](#)  
(Need iTunes) More than 800 universities have active iTunes U sites. About half of these institutions — including Stanford, Yale, MIT, Oxford, and UC Berkeley — distribute their content publicly on the iTunes Store.  
In the Beyond Campus section of iTunes U, students and faculty can access a wealth of content from distinguished entities such as MoMA, the New York Public Library, Public Radio International, and PBS stations.

[OERCommons](#)  
and build a knowledge base around the use and reuse of open educational resources (OER). As a network for teaching and learning materials, the web site offers engagement with resources in the form of social bookmarking, tagging, rating, and reviewing. OER Commons has forged alliances with over 120 major content partners to provide a single point of access through which educators and learners can search across collections to access over 24,000 items, find and provide descriptive information about each resource, and retrieve the ones they need. By being "open," these resources are publicly available for all to use, and principally through Creative Commons

# Khan Academy

- <https://www.khanacademy.org/>
- <https://www.khanacademy.org/science/physics>
- [https://www.youtube.com/watch?v=ihNZlp7iUHE&feature=player\\_embedded](https://www.youtube.com/watch?v=ihNZlp7iUHE&feature=player_embedded)



# Why technology?

- Multiple ways to illustrate concepts.
- Allow students who need more time with a concept to spend more time with it.
- Potential cost-savings.



