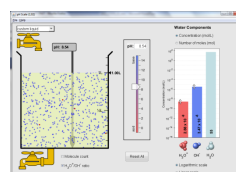
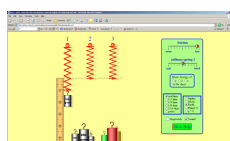
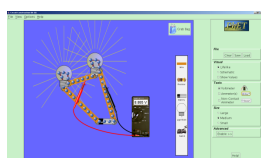


Using PhET for Science Inquiry



A suite of free interactive simulations



PhET Interactive Simulations,
University of Colorado
<http://phet.colorado.edu>

1

Pages and sims to have open before presentation

- Phet webpage <http://phet.colorado.edu> or have downloaded the website using the installer and use from desktop (search will not be available)
- [Circuit Construction Kit DC](#)
- [The Moving Man](#) and the [Tips](#)
- [Force and Motion Basics](#) (Forces 1D is the older version)
- [Energy Skate park](#) and [Energy Skate Park Basics](#)
- [Build an Atom](#)
- [Graphing Lines](#)
- [Density](#)
- [The Moving Man](#)
- [Radioactive Dating Game](#)
- [Alpha Decay](#)
- [Beta Decay](#)
- [States of Matter](#)



2



Handouts

- #1 Table of Contents
- #2 How we Learn
- #3 PhET Creating PhET Interactive Simulations Activities
- #4 Moving Man- Example of Guideline Aligned Lessons
- #5-8 Skater example unit: Lesson, Tips, Student Directions, Sample clicker questions
- #9 Solutions Sample Unit: Unit plans, Lesson Plans and Student directions for Salts and Solubility, Molarity, and hands-on lab, Clicker questions

3



Workshop Goals

- **Discover PhET and example simulations**
- **How are the simulations created?**
- **How does PhET help students learn?**
- **How can PhET be used?**

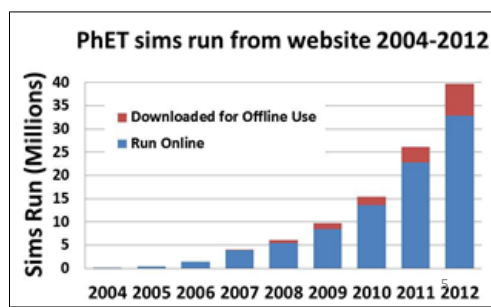
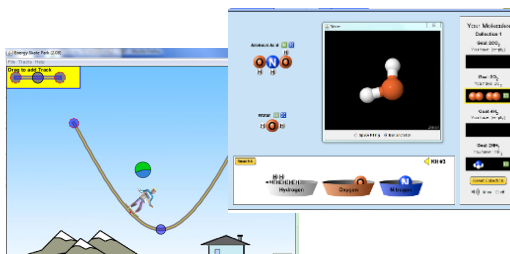


C. Pribyl, Alabama

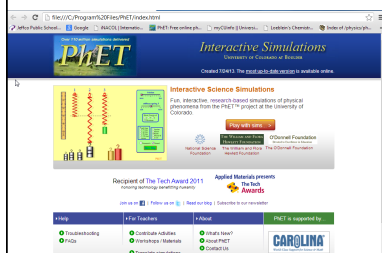
Discover PhET



- Suite of >130 interactive science and mathematics simulations
- Free at <http://phet.colorado.edu>
- Run online or download for offline use (~320 MB)
- Over 25 million sims run in 2012



Discover PhET slide for presenter



- This is how the home page looks if it is installed locally. There is no search function



- This is the page that shows after selecting the "Play with the sims" orange button.

Discover PhET slide for presenter



➤ If you are online, you can use the Search at the top of the webpages with keywords to find sims and activities

Join us on [Facebook](#) | Follow us on [Twitter](#) | 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 Line Full Installation One at a Time Troubleshooting FAQs 	<ul style="list-style-type: none"> Browse Activities Contribute Activities Workshops / Materials Translate simulations Translate the website 	<ul style="list-style-type: none"> What's New? About PhET Contact Us Donate 	<p>and our other sponsors, including educators like you.</p>

English | العربية | Bosanski | 简体中文 | 正體中文 | Český | Dansk | Nederlands | Eesti | Suomi | Français | Galego | ગુજરાતી | Deutsch | Ελληνικά | Magyar | Bahasa Indonesia | Italiano | 日本語 | 한국어 | گۆنډی | Македонски | मराठी | فارسی | Português | Português do Brasil | Română | Српски | Español | Español (Perú) | Türkçe | Українська | Tiếng Việt

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Explain that the website with the sims, individual sims, or website with teaching activities can be downloaded, so if web access is poor or unavailable, the sims can still be used. This is the bottom of the Home page

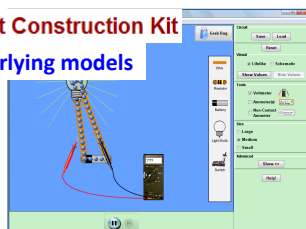
7

Discover PhET



Variety of simulations with different goals & features

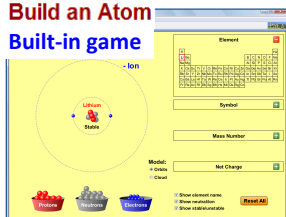
Circuit Construction Kit Underlying models



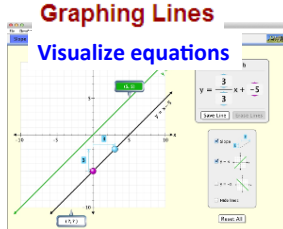
Density Lab with unknown quantities



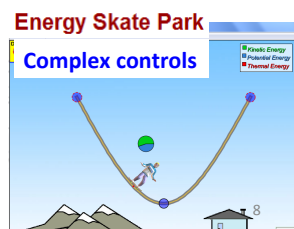
Build an Atom Built-in game



Graphing Lines Visualize equations



Energy Skate Park Complex controls



Why is PhET Successful ?



PhET is Accessible

- Open-use License: Creative Commons - Attribution
- Easy to translate for World-wide Use:
Over 4700 translated sims in 76 languages
- Website in 30 languages
- 34% of use outside US
- Free Open Source Lessons for Teachers
- More browser based sims for Chromebooks and tablets like iPads

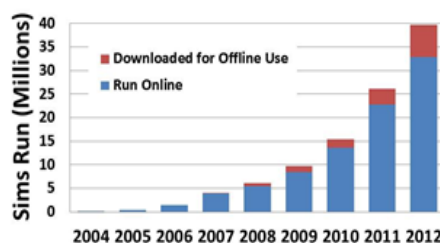
Energy Skate Park in

Chinese 竞技场: 基础



下载 大小: 2,790 KB 直接运行!
嵌入代码 版本: 2.13 (修改记录)

PhET sims run from website 2004-2012



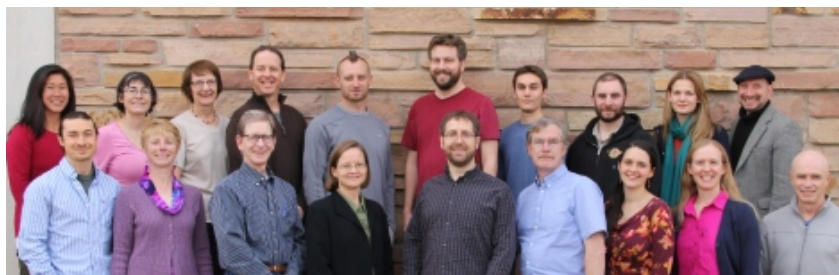
9

Why is PhET Successful ?



Dedicated Team Mission:

Build and study simulations and approaches for helping students and teachers improve science learning. Provide materials for free and open-source.



University Faculty, Post-docs,
K-12 Teachers, Computer Developers

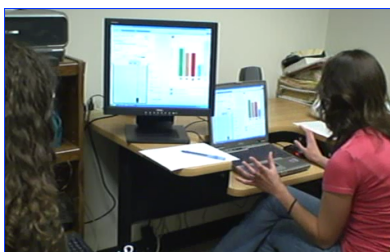
10

Why is PhET Successful?



PhET is based in research & user design

- User interviews
- Classroom testing
- Research-based
- Diverse design team



Why is PhET Successful?



PhET is free thanks to Funders

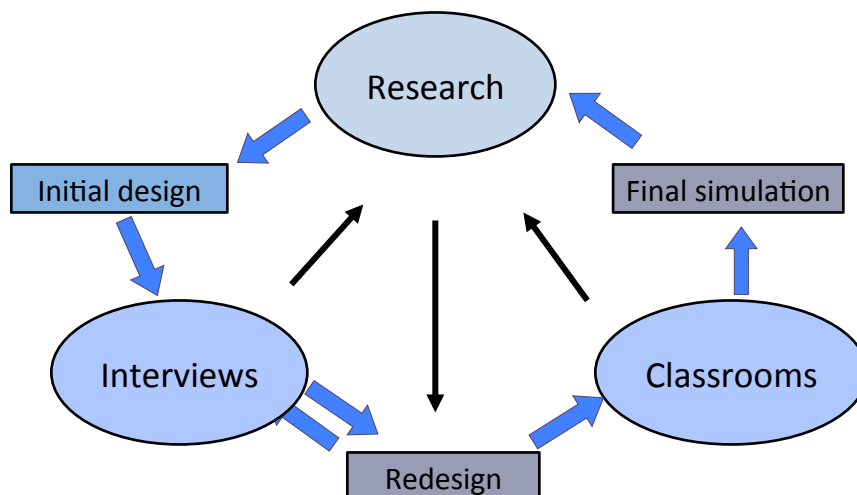
- NSF
- Hewlett Foundation
- The O'Donnell Foundation
- Collaborative agreement with King Saud University
- University of Colorado
- Carl Wieman & Sarah Gilbert
- And others, including individual teachers, you, schools, districts, and corporate and foundation sponsors



THE WILLIAM AND FLORA HEWLETT FOUNDATION



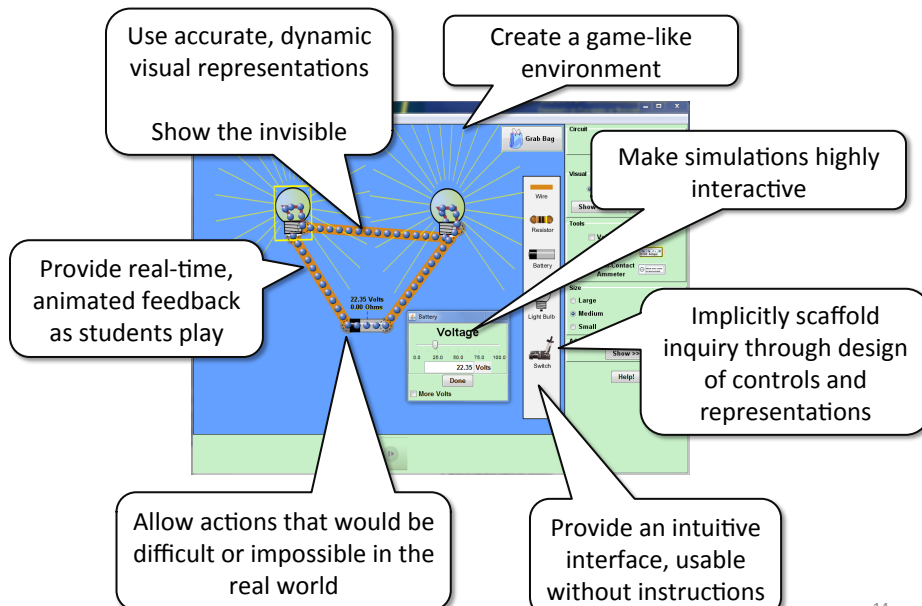
How are the simulations created?



Simulation design is an iterative process, integrating research
Taking 2-12 months about \$50,000/sim

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Designed to support inquiry learning

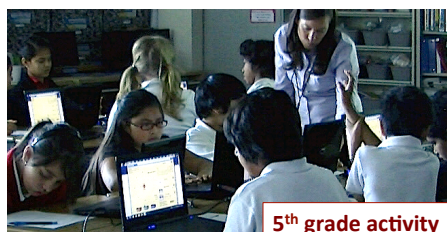


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How does PhET help students learn?

Adaptable for a variety of learners

- Pick and choose sims by topic, keyword, or grade level
- Customize to your environment and your goals
- Search database of over 900 activities by PhET and teacher-users



How does PhET help students learn? For presenter

Home

- **Simulations**
 - New Sims
 - Physics
 - Biology
 - Chemistry
 - Earth Science
 - Math
 - Cutting Edge Research
 - By Grade Level
 - All Sims

Interactive Simulations
University of Colorado at Boulder
Created 7/24/13. The most up-to-date version is available online.

Simulations > By Grade Level

<p>Elementary School</p>	<p>Middle School</p>
<p>High School</p>	<p>University</p>

Home
 Simulations
 New Sims
 Physics
 Biology
 Chemistry
 Earth Science
 Math
 Cutting Edge Research
 By Grade Level
 Elementary School
 Middle School
 High School
 University
 All Sims
 Translated Sims
 For Teachers
 Stay Connected
 Troubleshooting
 FAQs

- Note that the sims can be browsed by selecting categories on the left side.

➤ This is the page that shows after selecting the By Grade level.

How does PhET help students learn?

Adaptable for a variety of learners

Circuit Construction Kit

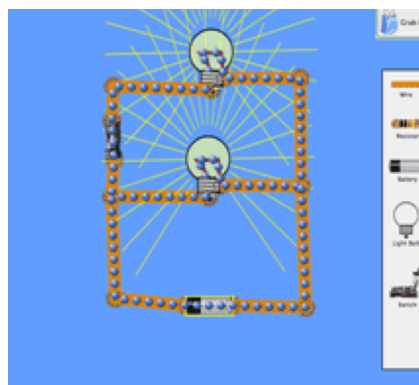
Sample student prompts

CCK in middle school:

“Make the light bulb light.”

CCK in high school:

“Explain why the light dims when you turn the heater on.”



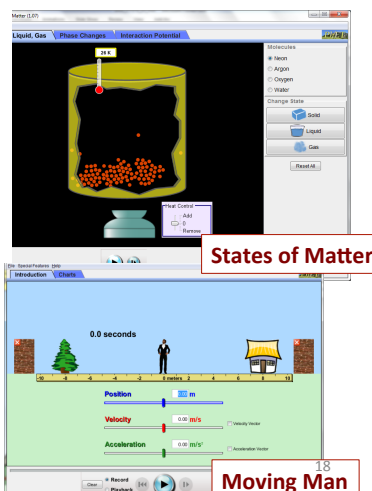
Circuit Construction Kit

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How does PhET help students learn?

The design of PhET simulations supports productive student exploration

- “Productive constraints”: Provide limited choice of controls
- Dynamic feedback links interactive and animated elements
- Explicitly shows visual & conceptual models that experts use
- Based on research on how people learn



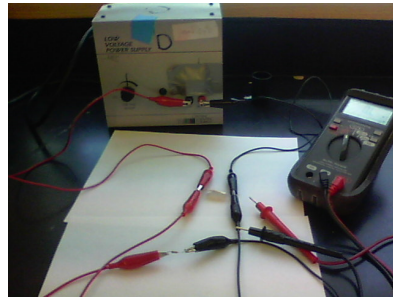
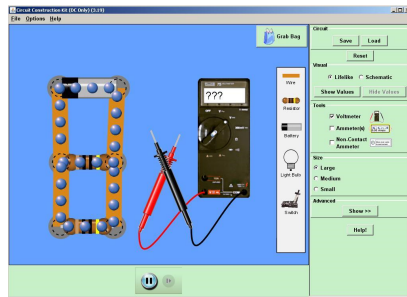
States of Matter

Moving Man

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How does PhET help students learn?

What are the advantages of simulations vs. real equipment?



Thoughts on these tools ...

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How does PhET help students learn?

Group activity, exploration and discovery



What does inquiry look like? Check out videos at

- www.youtube.com/PhETInteractiveSims

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How can PhET be used?

Teachers use the sims in a variety of situations

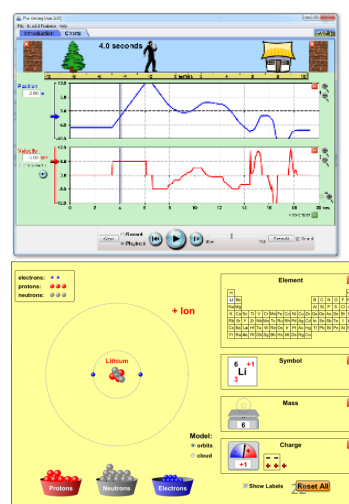
- **Lecture and class discussion**
Visual Aid, Demo complement,
Interactive Lecture Demos, & Concept tests
- **Labs**
Group activity, Exploration and discovery
- **Homework**
Pre-class assignment – introduce new ideas
Post instruction – develop robust understanding

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How can PhET be used?

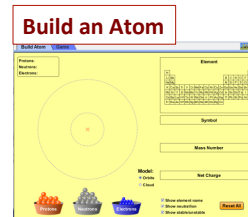
Implicit Scaffolding & Activity Design can Support Productive Exploration

- Choice of Controls.
Productive Constraints
- Dynamic feedback linking
interaction and animation.
- Explicit visual & conceptual
models (that experts use)



How can PhET be used?

Activity Comparison



Find out the charge of an atom that has 6 protons / 5 neutrons/ 6 electrons. Show the full symbol for this atom.

Investigate to find what determines the mass of an atom. Test your ideas and change if needed. Show examples that fit your rule.

1. What will students be doing in each activity?
2. What will students learn in each activity?
3. What's the teacher doing?

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How can PhET be used?



Activities using PhET strategies: Examples

- **Moving Man**
 - demonstrates alignment
- **Energy Skate Park**
 - Lesson Plan
 - Teacher Tips
 - Activity (compare to Strategies)
 - Formative Assessment concept questions
- **Solutions Unit**
 - Similar materials but uses 2 sims & a lab

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How can PhET be used?



Tips for productive inquiry

- **5-10 minutes of open play at start**
 - Establishes student ownership for sim
 - Students get familiar with controls
- **Avoid explicit instruction on how to use the sim**
 - Sims are easy to use; focus students on exploration
- **Use open, investigative questions**
 - “Design an experiment,” or “How can you make an orbit with the longest year?”
- **Use “Creating PhET Activities” handout**
 - <https://phet.colorado.edu/en/for-teachers/activity-guide>

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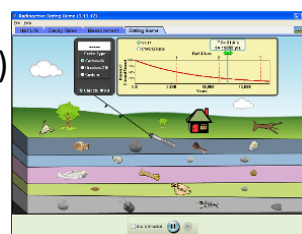
How can PhET be used?



Think outside the box! Sims are very flexible in terms of content & grade level.

e.g. Radioactive Dating Game

- **Chemistry** (compare half-life and use)
- **Biology** (identify fossils)
- **Earth Science** (age of layers)
- **Math** (exponential relationships)
- **Variety of grade levels** (elementary, middle, HS, AP)
- **Combine with other sims** (Use Alpha and Beta Decay sims to explain underlying model)



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Stay in touch



**PhET Interactive
Simulations**
<http://phet.colorado.edu>

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

Thanks for coming!

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