PhET INTERACTIVE SIMULATIONS
University of Colorado Boulder

# Transforming STEM Learning for All Students


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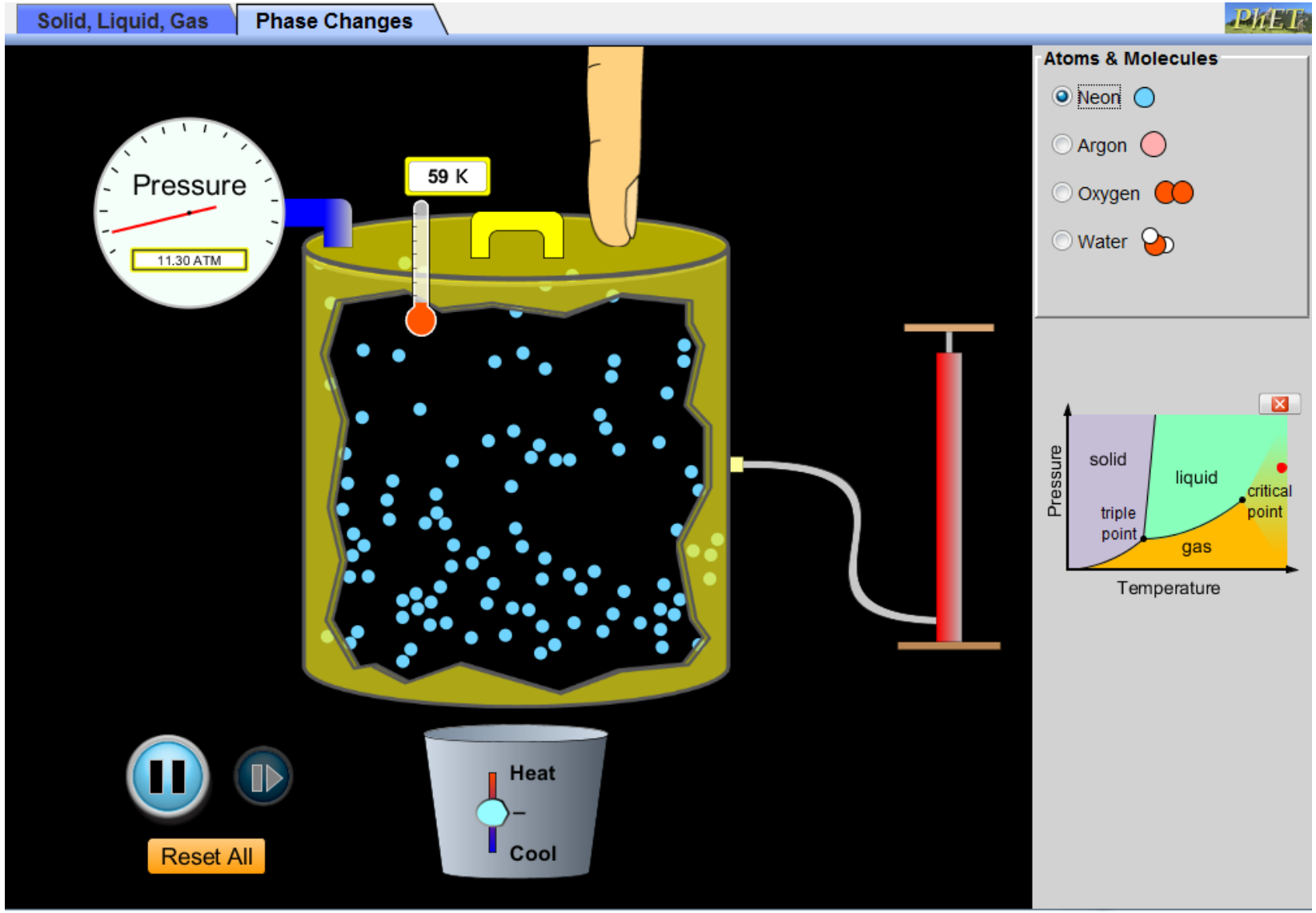
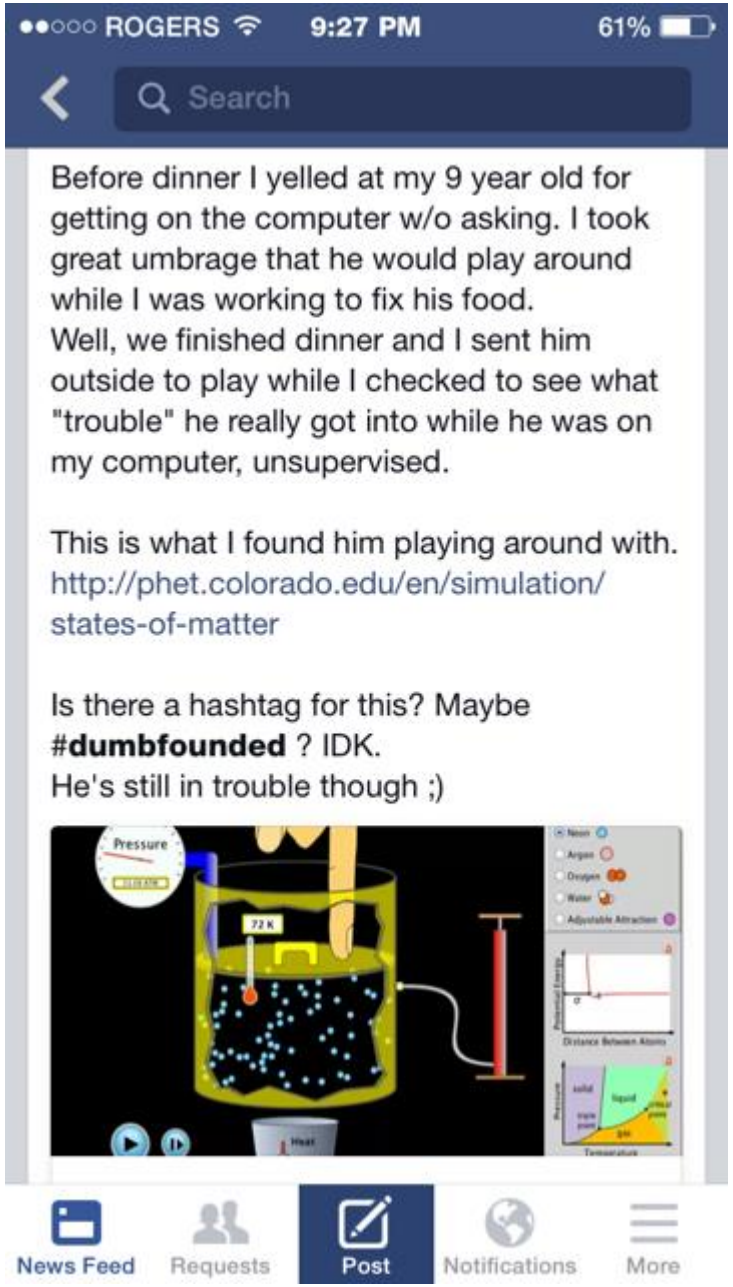
NSF Grant Support (2002-2015):
1503439, 1503510, 1226321, 1020362,0817582, 0442841, 0123561

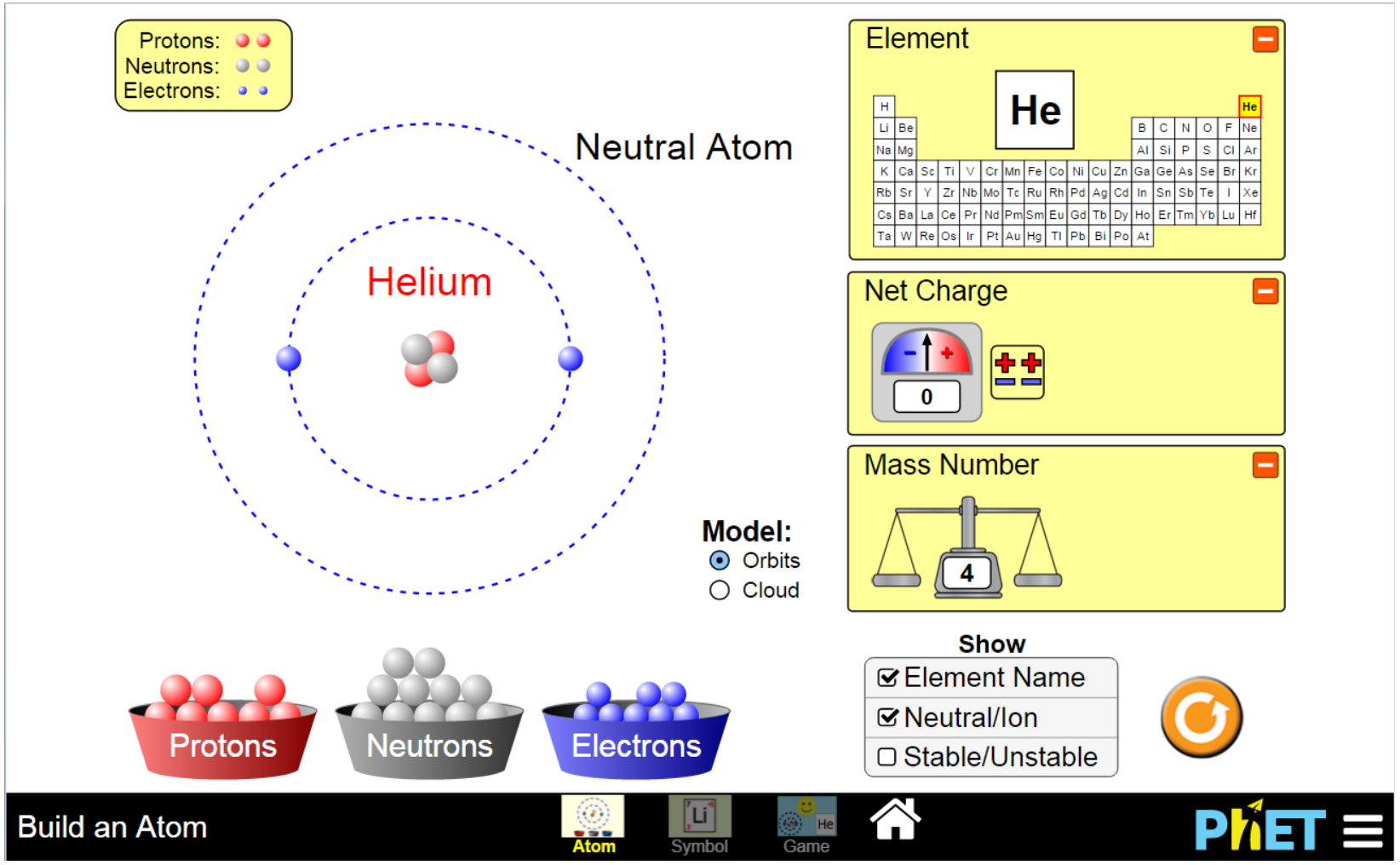



# STATES OF MATTER

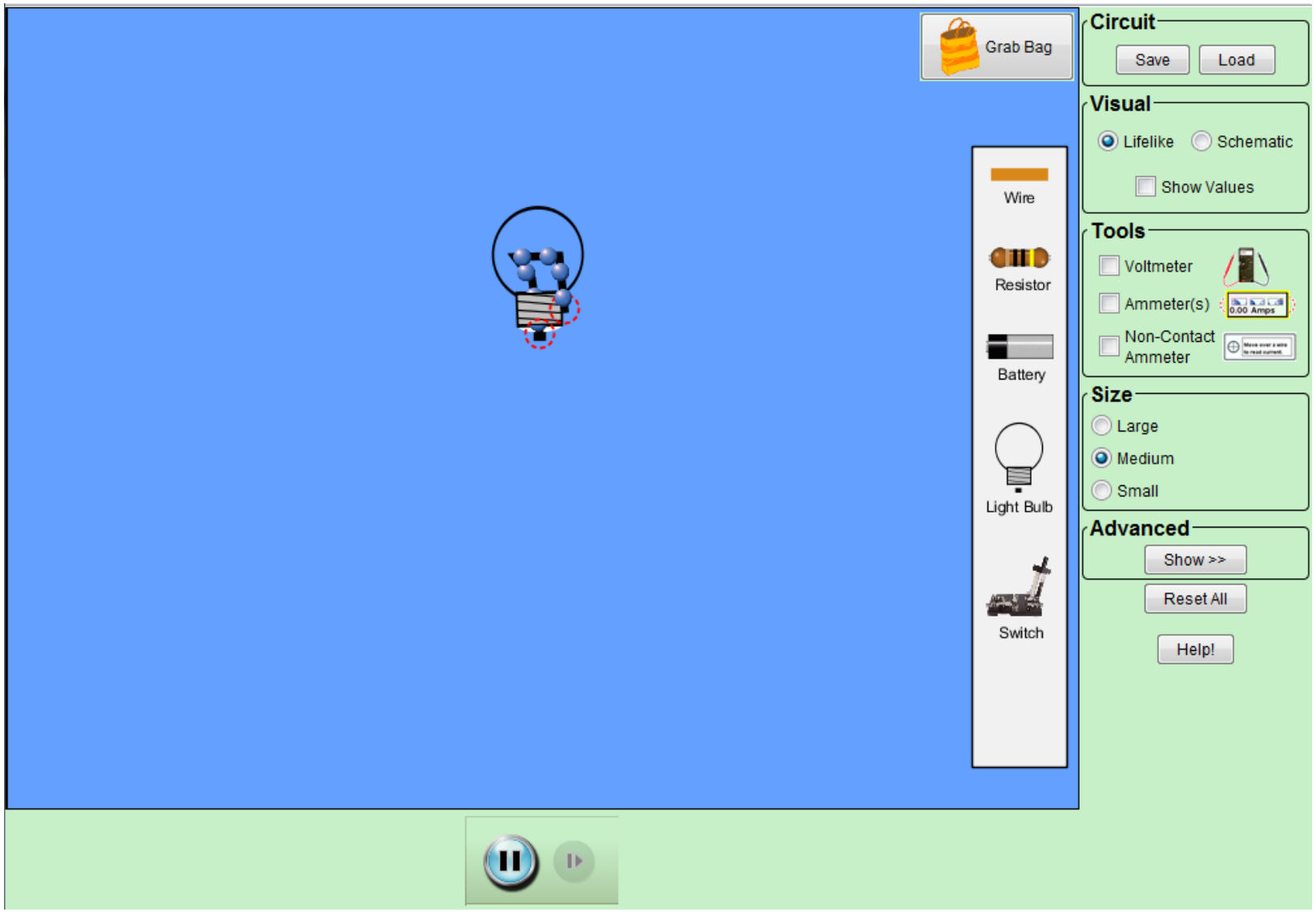



# #dumbfounded

# ENGAGEMENT

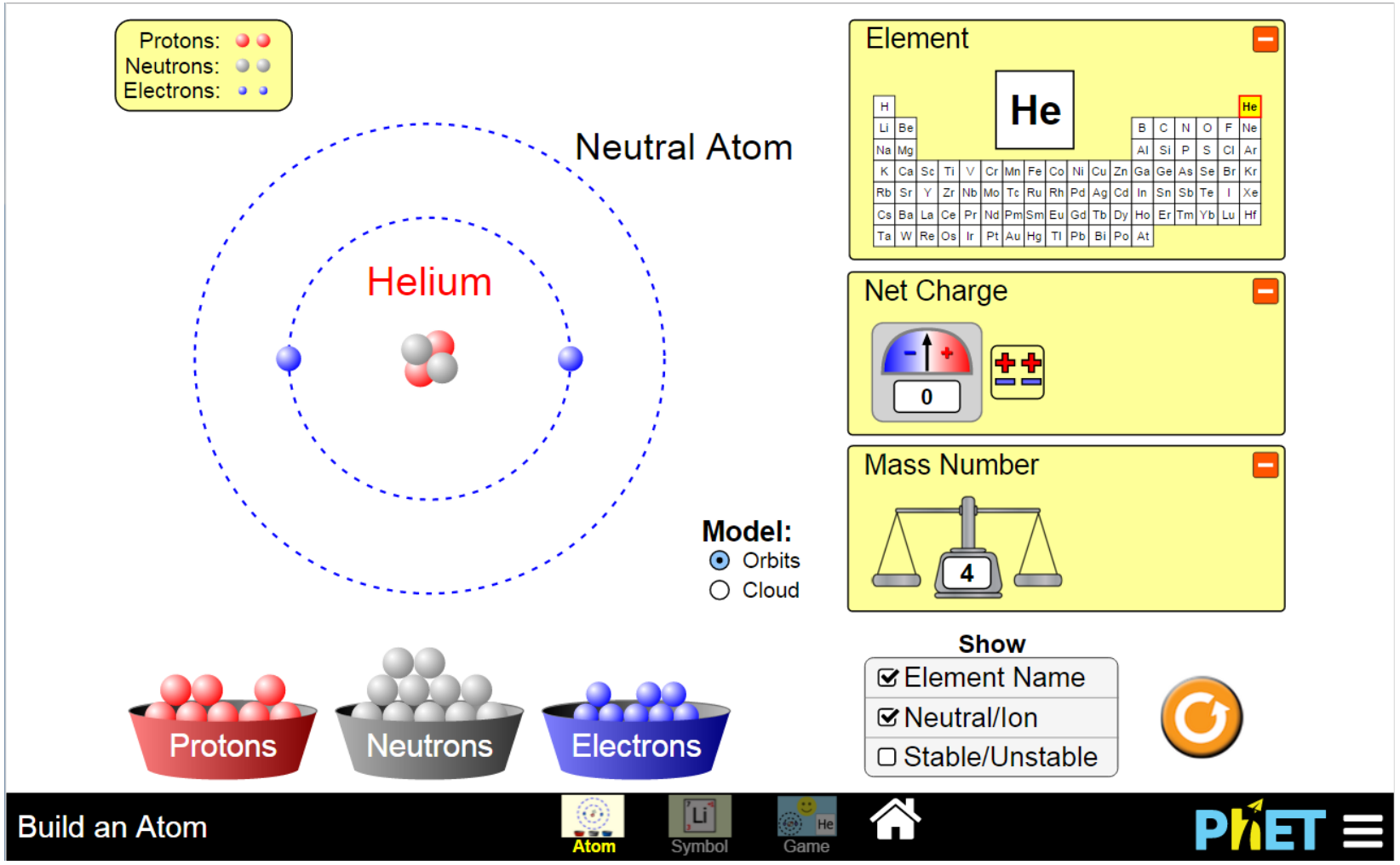



# BUILD AN ATOM




# CIRCUIT CONSTRUCTION KIT

# ENGAGEMENT → LEARNING
# IMPLICIT SCAFFOLDING

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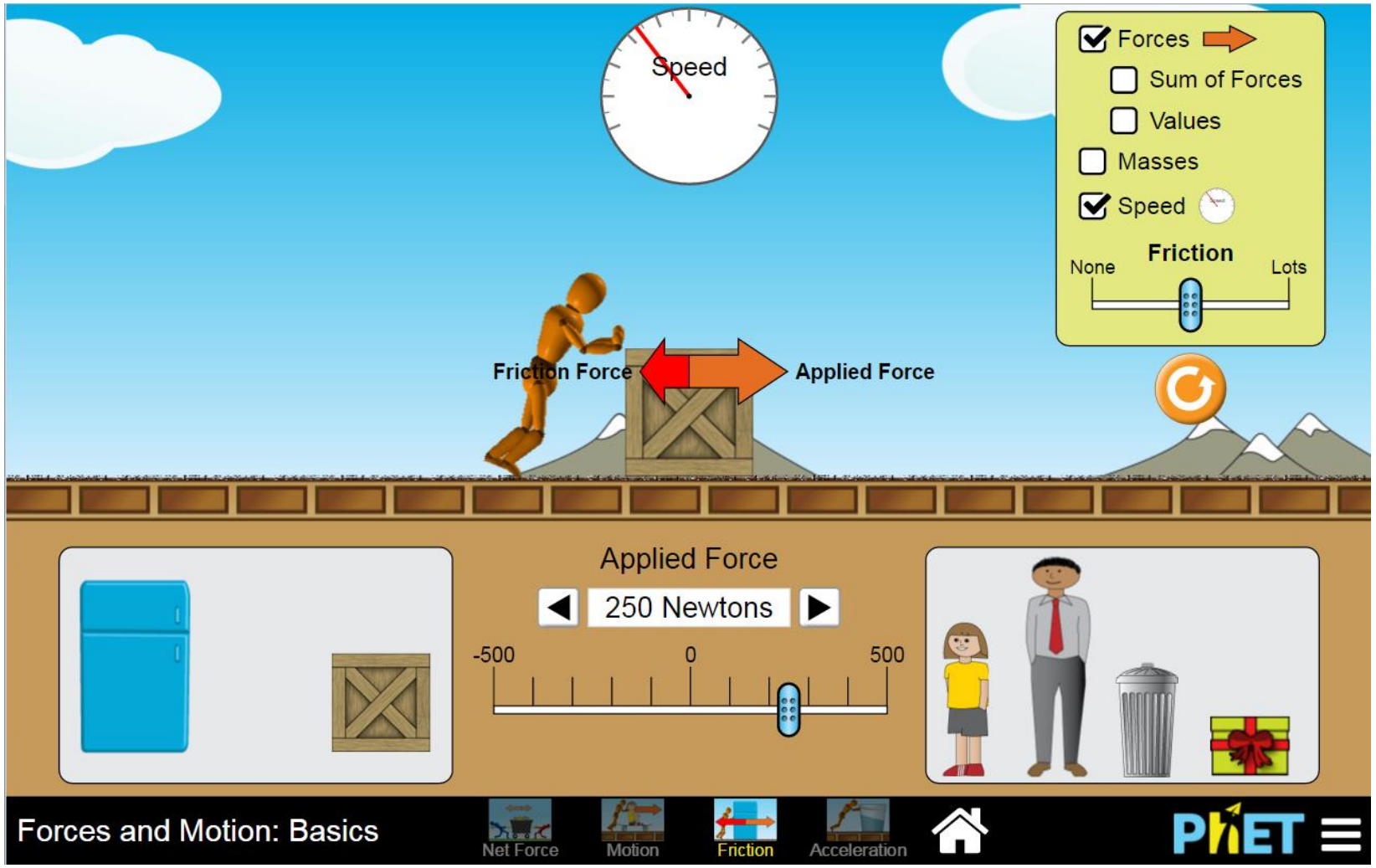



# FORCES AND MOTION: BASICS

# TODAY


Acid-Base Solutions


Area Builder


Balancing Act


Balancing Chemical Equations


Balloons and Static Electricity


Beer's Law Lab


Build an Atom


Color Vision

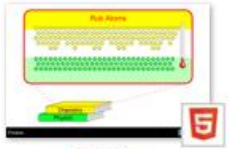

Concentration


Energy Skate Park: Basics


Faraday's Law


Forces and Motion: Basics


Fraction Matcher


Friction


Graphing Lines

131 Simulations

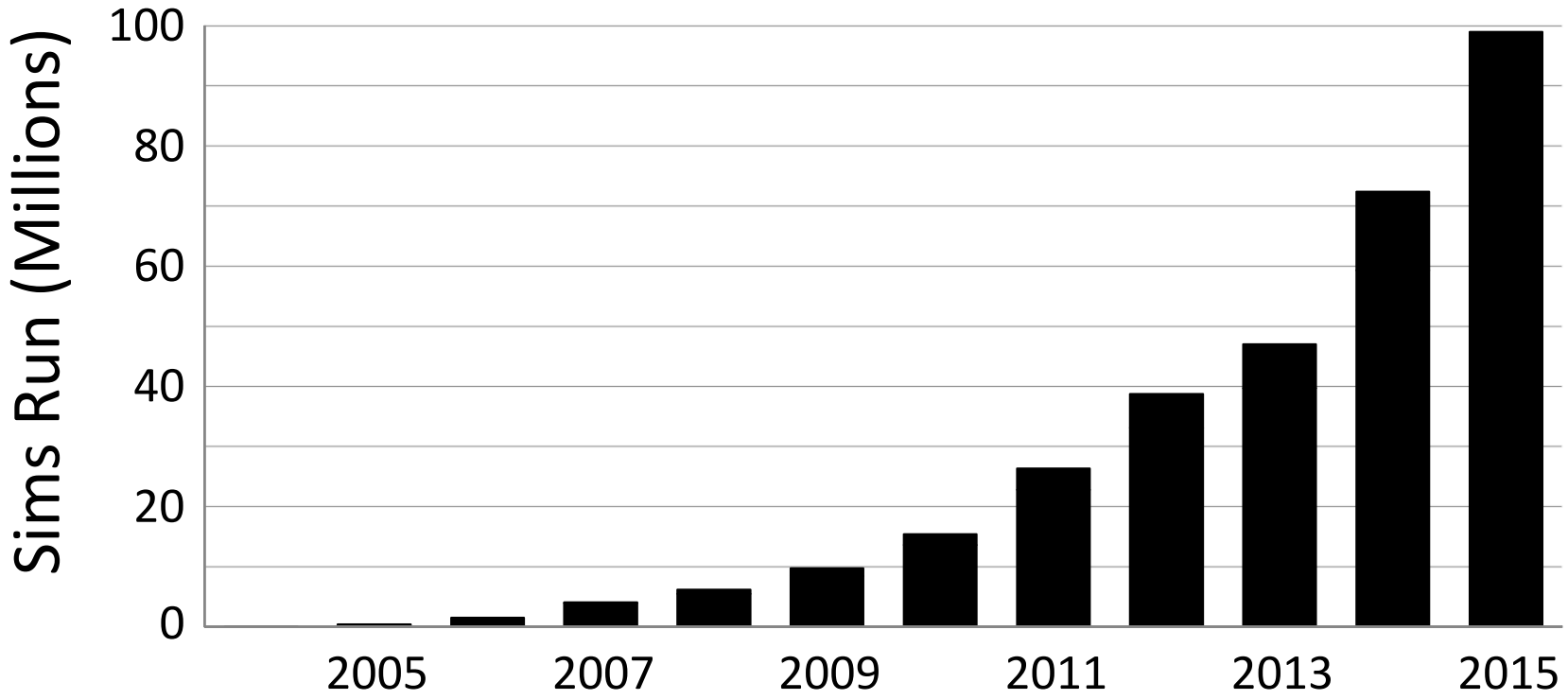
Physics, Chemistry, Math,
Biology, Earth Science

3rd grade to college

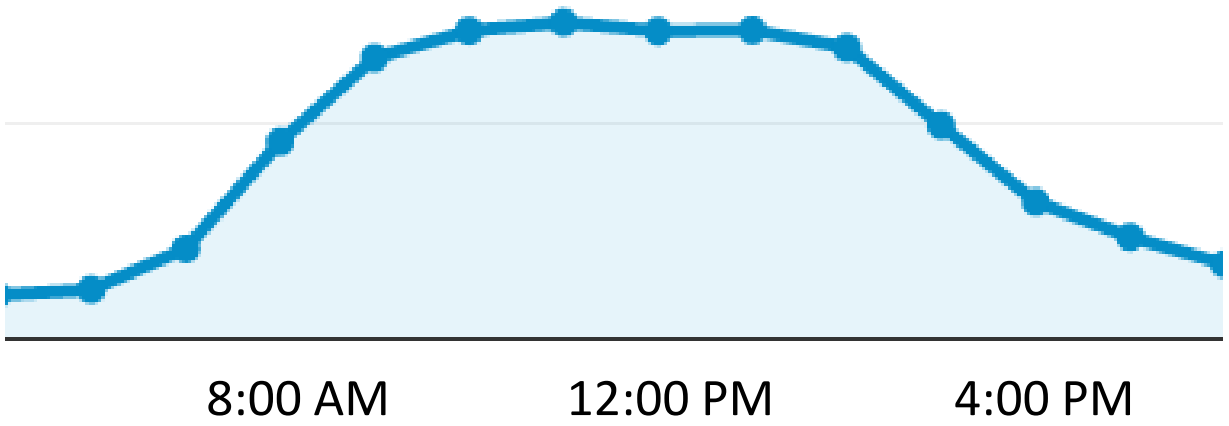
1200+ Sim-based lessons

All FREE open educational resources

# FOR MILLIONS OF LEARNERS…



# IN SCHOOL


8:00 AM
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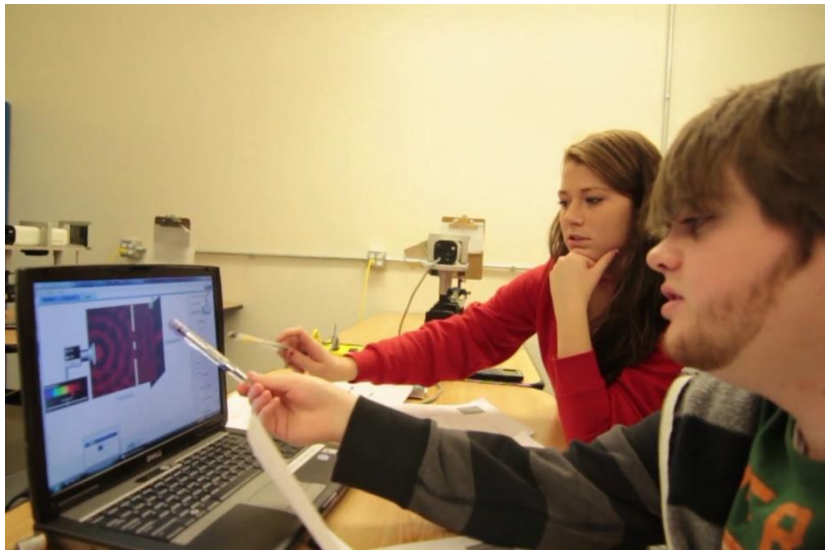
4:00 PM




Unit 5: Plate Tectonics
Are we forced to live the way we do?

# WITH DIVERSE STUDENTS

## Minority and low-income populations

Of teachers surveyed:
40% of their classrooms serve
>50% minority/low-SES students

# WITH DIVERSE STUDENTS

With under-achieving students

– 66% of teachers

With average-achieving students

– 91% of teachers

With high-achieving students

– 87% of teachers

# WITH DIVERSE STUDENTS

Deaf students

**Shay Taylor**, MA, MEd, is a K-12 technology integration and e-learning specialist at Gallaudet University. She hails from the Washington, D.C., area and works with the Laurent Clerc National Deaf Education Center. Taylor is a freelance video editor and a nationally certified teacher with 12 years of teaching experience. Follow her on Twitter: @*teachertaylor2k*.

**Right:** Many websites, such as PhET, offer a wealth of visual and interactive resources to support students.

## Powering Up Technology
### from Passive Access to Active Integration

*By Shay Taylor*

For over 30 years, the rallying cry of many adults who worked with students who were deaf or hard of hearing was *access*. Finally we established the right of deaf and hard of hearing students to equal access in every academic space they entered, whether in a residential school surrounded by deaf peers or in a public school surrounded by those who hear. Technology was the tool of choice for providing the surest access in almost every situation.

Now 15 years into the 21st century, our community is global—and a lot more accessible to all. Alpha-numeric pagers, captions, the Internet, and videophones have, in the most general sense, connected—or potentially connected—all of us. The call for technology to provide "access" has become myopic at best. Once the wave of the future, technology is now standard in most classrooms.

We need to raise the bar. *Access* means merely putting students in the presence of technology. *Action* means students and educators working with technology and making the technology work for them. We are moving from *access* provided through *incorporation of technology* to *action* inherent in the *integration of technology*. This is the framework we must claim for 2015 and beyond.

**Incorporation to Integration**

In a superficial sense incorporation and integration are synonymous, but the dictionary tells us differently. *To incorporate* is to include a thing, an individual, or an event as part of something else. *To integrate*, however, is to combine whole systems into an existing system that then becomes so changed in the combination that it becomes something new (*www.merriam-webster.com*). Today it is taken for granted that students use a computer to type a paper or use a website to watch a video. These activities are technology incorporation—but they are just the beginning. The electronic device is part of the learning process, but it does not affect the outcome. A computer may be easier to work with, but it makes no more impact on the students' learning than a typewriter would have 40 years ago. It may be cool to have the latest iDevice in the classroom, but a worksheet on an iPad is still just a worksheet.

*Illustrations courtesy of Shay Taylor*



Effective technology integration is so much more than gadgets. It is intercurricular—math software incorporates reading, science websites support language skills. It is multimodal—requiring not just clicking and reading but filled with visual, kinetic, and interactive information. It requires students to think more critically, not only to connect to content but to get more from the content than they would if they didn't have technology.

It's important to remember: The *how* of educational technology should be peripheral to the *why*. The key is integrating technology that supports and enhances learning goals and follows the four key components of learning (adapted from *www.edutopia.org*, 2015):

- **ACTIVE ENGAGEMENT**—Students retain more information and process it better when they are actively involved with their learning.
- **PARTICIPATION IN GROUPS**—Students work together, fostering collaboration and teamwork.
- **FREQUENT INTERACTION AND FEEDBACK**—This allows for independent self-monitoring and increases active engagement.
- **REAL-WORLD CONNECTIONS**—How can students apply their new knowledge to something they know/use/do?

At the Model Secondary School for the Deaf in Washington, D.C., for example, high school students use the discussion board feature of the Blackboard Learning Management System to develop critical commentary on historical and political issues and current events. Students share their own thoughts and questions and respond to those of their peers, posting their commentary in English and American Sign Language (ASL). Themes of social justice, oppression, and the American political system are contextualized historically but applied to modern-day events and situations.

As they pursue their discussions, students use technology not for technology's sake but as a tool to develop a sense of understanding of the world around them. Through discussions in English and ASL, they develop empathetic approaches to social groups and discuss critical readings about social systems. Further, by presenting information through writing and video using the tools in Blackboard, they develop skills for blogging and vlogging.

Each of these activities fosters critical thinking and allows students to express themselves in expository and persuasive ways. Technology integration also allows teachers and students to extend their conversations beyond the context of the classroom. Students are expected to provide real-world examples to clarify a point or direct a discussion; they are encouraged to connect images, videos, and websites to their text.

In mainstream classrooms, students



ODYSSEY

# PHET SIMULATIONS → INCLUSIVE PHET SIMULATIONS

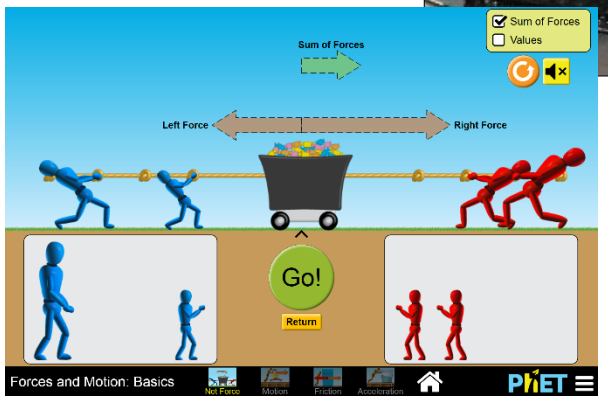
**NSF GRANT #1503439, 2015-2017:** Ramping Up Accessibility in STEM: Inclusively Designed Simulations for Diverse Learners

# INCLUSIVE PHET SIMULATIONS

Enable **ALL** students to **EXPERIENCE** science

Mobility, sensory, or learning disabilities

In integrated classrooms

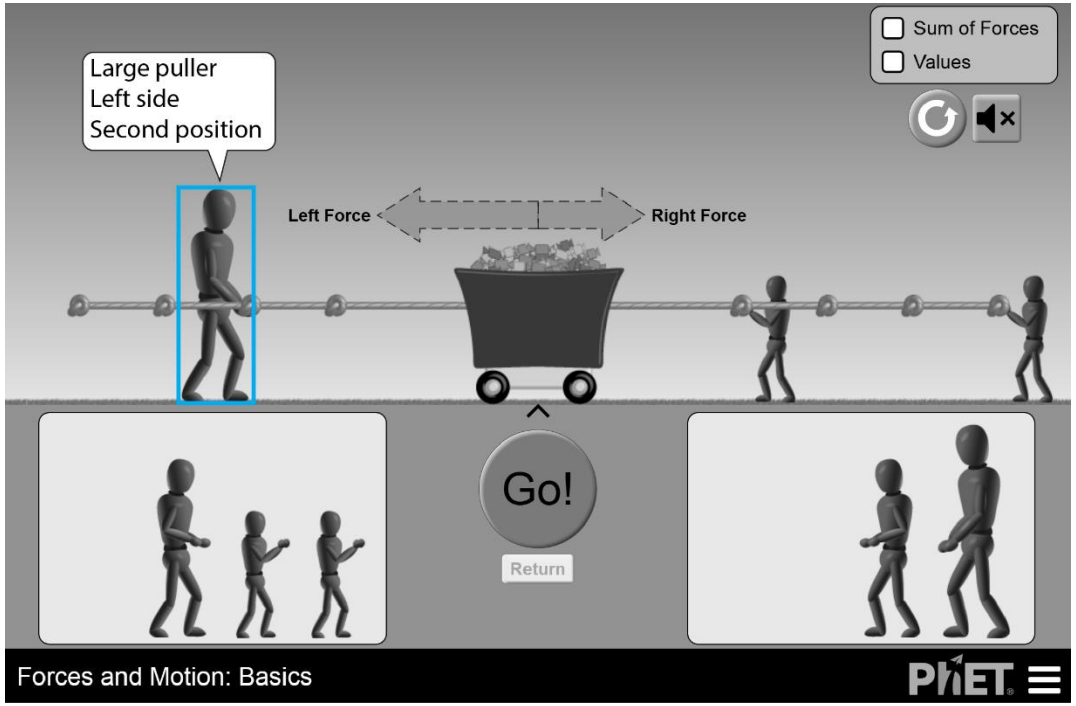


# INCLUSIVE FEATURES

Alternative Navigation

Verbal descriptions and feedback

Sound and Music (Sonification)

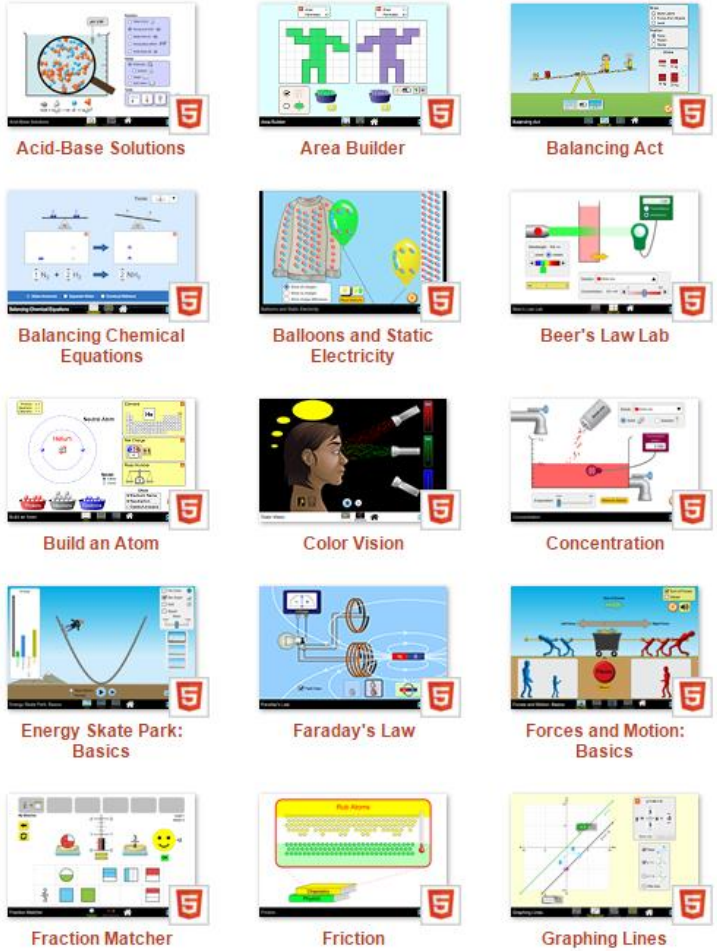


# TECHNICAL CHALLENGES

Simulations are not webpages

Few standards in these environments

Generalizable and customizable



# DESIGN CHALLENGES

Pedagogically useful, intuitive accessibility features

Layers must all “play well together”

KayLynne Yarbrough (Flickr.com)

# LOOKING FORWARD

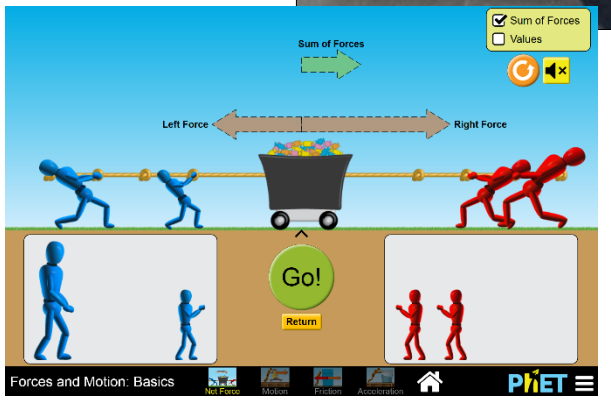
Enable **ALL** students to **EXPERIENCE** science

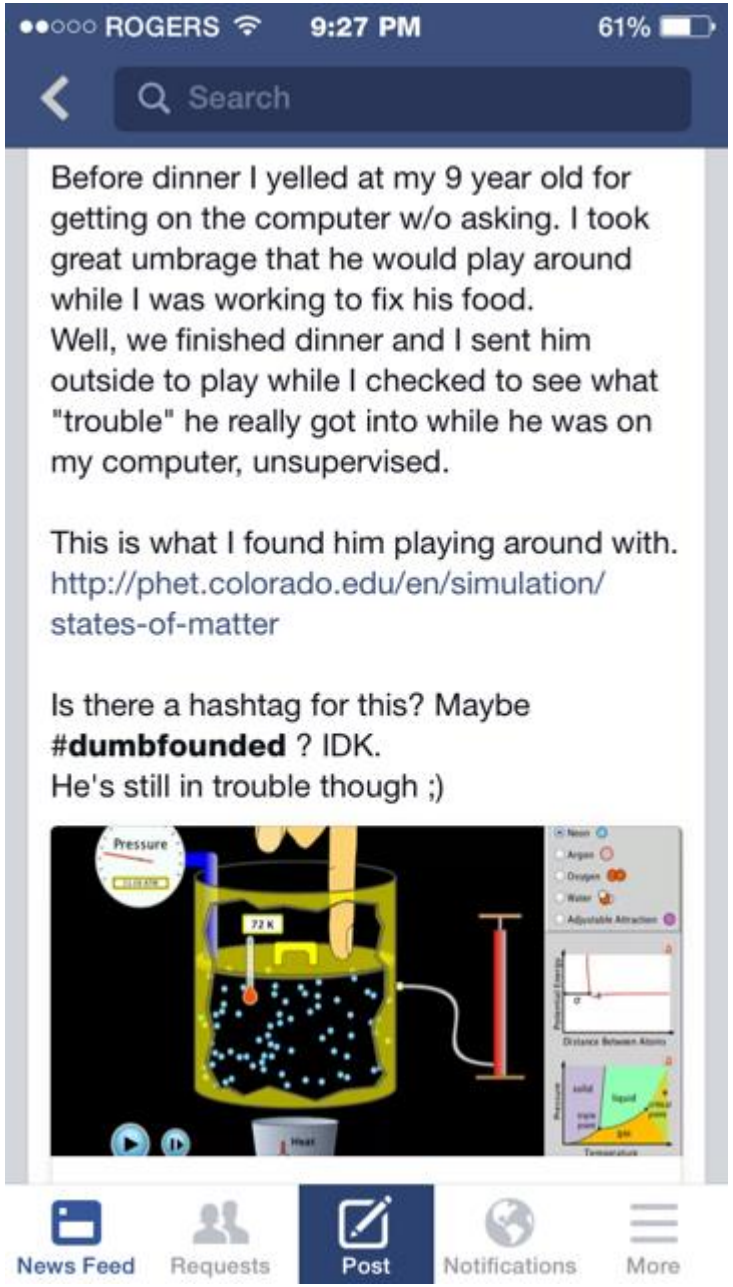
Suite of research-based, free, and accessible sims

With inclusive design features

That benefit students with disabilities, and more

In integrated classrooms, and beyond




●●○○○ ROGERS 9:27 PM 61%
Search
Before dinner I yelled at my 9 year old for getting on the computer w/o asking. I took great umbrage that he would play around while I was working to fix his food.
Well, we finished dinner and I sent him outside to play while I checked to see what "trouble" he really got into while he was on my computer, unsupervised.
This is what I found him playing around with.
http://phet.colorado.edu/en/simulation/states-of-matter
Is there a hashtag for this? Maybe #dumbfounded ? IDK.
He's still in trouble though ;)
Pressure
72 K
Heat
News Feed
Requests
Post
Notifications
More

# #STEMforALL