



INCREASING THE ACCESSIBILITY OF PhET SIMULATIONS: CHALLENGES, PROGRESS, AND POTENTIAL

Emily Moore | DBER | February 23, 2016

PhET Sims: Ubiquitous Learning Resource

Need to ensure ALL students can access and benefit from this learning resource

Background

- 2013 – Transition to HTML5 enabled new accessibility infrastructure
- 2014
 - Began partnering with experts in accessibility
 - Prototyping approaches
 - Seeking funding

Progress

To Date We Have:

- Overcome significant technical challenges
- Started an accessible simulation design community
- Developed working, and effective, prototypes of accessibility features
- Engaged in research on the design and student use of these features

1. Inclusive Design
2. Challenges to Accessibility
3. Design of Accessibility Features
4. Early Research Findings

Inclusive Design

- Sees disability as a mismatch between a person and their environment.
= design challenge
- Seeks a One-Size-Fits-One approach
= goal is flexibility
- Design through diverse collaboration
= process includes diversity

For more details on Inclusive Design:

<http://idrc.ocadu.ca/about-the-idrc/49-resources/online-resources/articles-and-papers/443-whatisinclusivedesign>

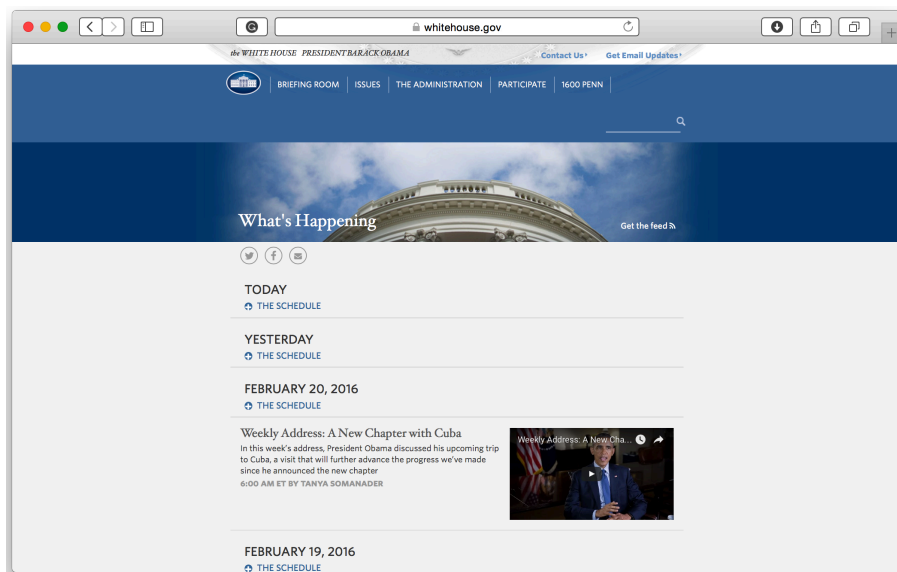
Challenges

- Technical
- Design
- Research

Accessibility Features

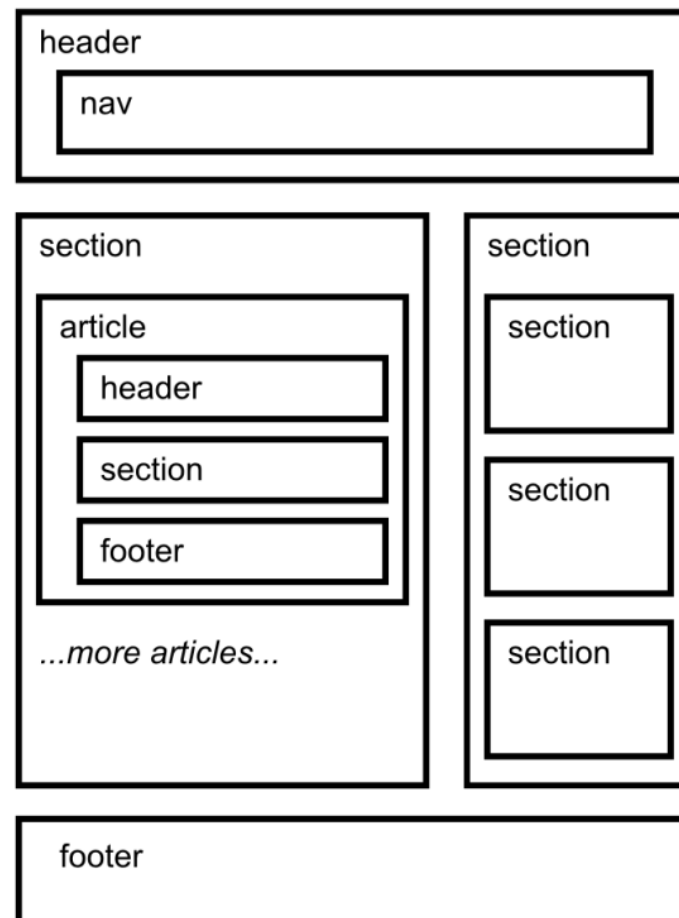
- Keyboard Navigation
- Auditory Descriptions (for screen readers)
- Sonification
- Text-to-speech
- Pinch-to-zoom

HTML & Accessibility



- Assistive technology recognizes this internal structure
- Allows navigation (and “skimming”) through content

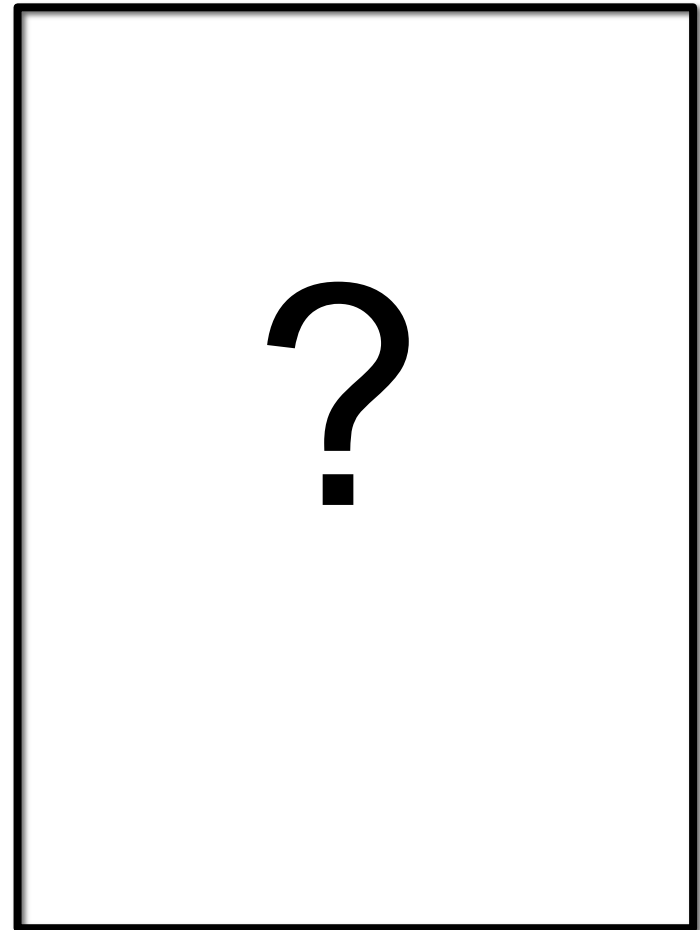
Semantic Structure Wireframe multiple blog posts view



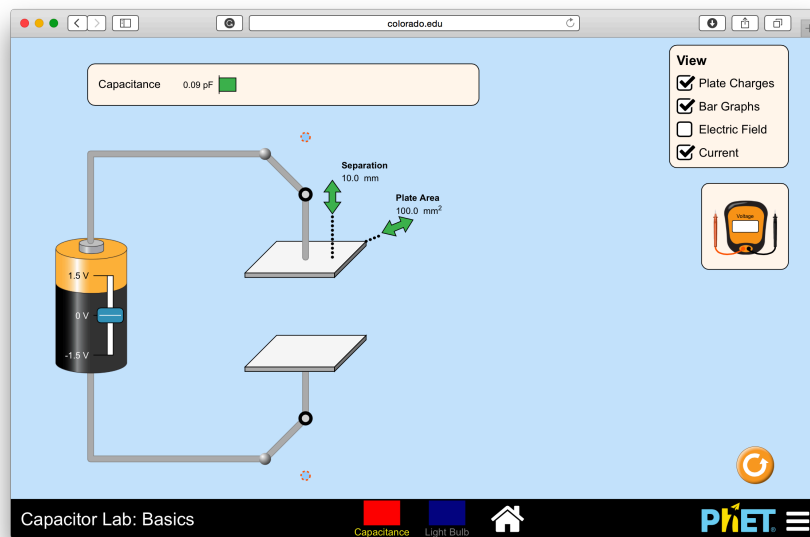
Interactive HTML Sims & Accessibility

- Interactive HTML learning resources are not structured like web pages!
- Assistive devices cannot recognize any internal structure
- Assistive devices cannot provide access to content

PhET Sim – No Accessibility



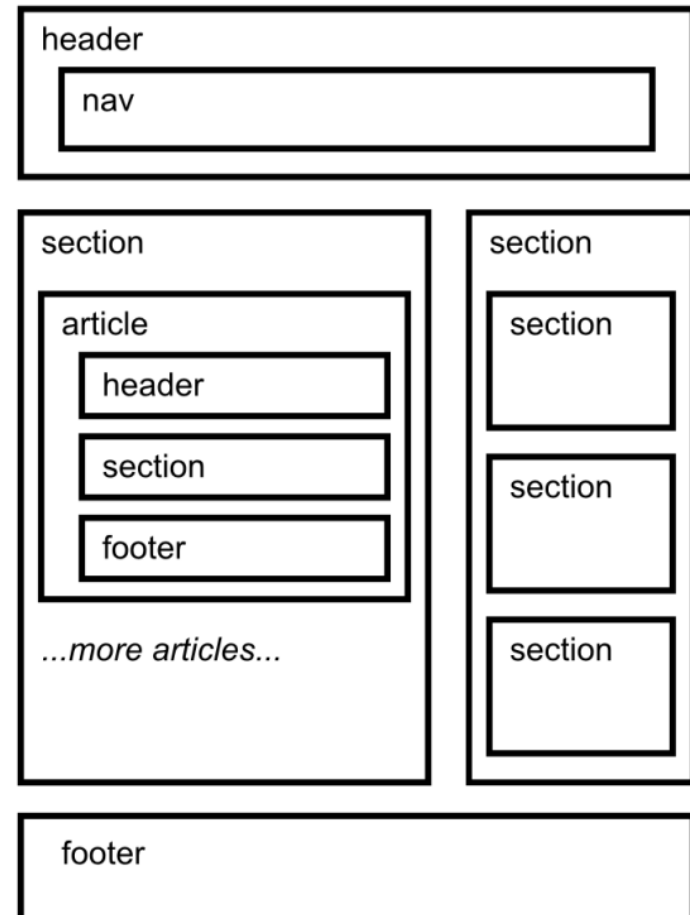
PhET's Approach - Parallel Structure



Capacitor Lab: Basics



Semantic Structure Wireframe multiple blog posts view



Benefits to this Approach

- Supports standards-based implementation (where standards exist)
- Allows us to keep accessibility structure consolidated Easier updates and maintenance

Design Challenges

- Designing consistent, intuitive accessibility features
- Designing layers to “play well together”



Challenges = Opportunities

- Breaking new ground in accessible interactive learning resources
- Freely sharing our code, process, & designs with the educational technology community

Design

Current Feature Priorities

- Keyboard Navigation
 - Full access to sim elements from keyboard
 - Beneficial for students who are blind, low vision, or have mobility issues
- Auditory Description
 - Descriptions of sim elements, interactions, and changes
 - Beneficial for students who are blind, low vision, or who have some learning disabilities

PhET Accessibility Team

PhET Interactive Simulations

- Emily Moore
- Jesse Greenberg
- Emily Randall
- Elise Morgan

OCAD University (Canada)

- Taliesin Love Smith
- Clayton Lewis (CU)

Inclusive Design Research Centre (Canada)

- Jonathan Hung
- Justin Obara
- Colin Clark
- Jutta Treviranus

Benetech/DIAGRAM+ Center

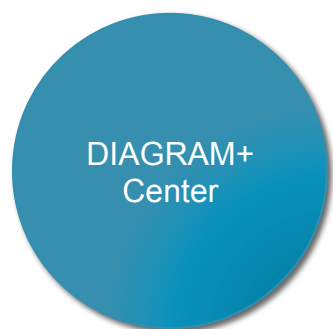
- Sue-Ann Ma

Sonification Lab (Georgia Tech)

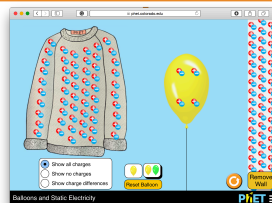
- Bruce Walker
- Carrie Bruce

Screen Reader Users

- Amelia Dickerson
- Vince (Canada)



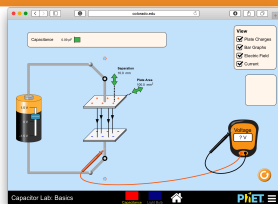
Taliesin & Clayton



Sonification Lab

PhET
(Emily & Jesse)

Emily R. & Elise



IDRC



+ Weekly Community Meeting

Research

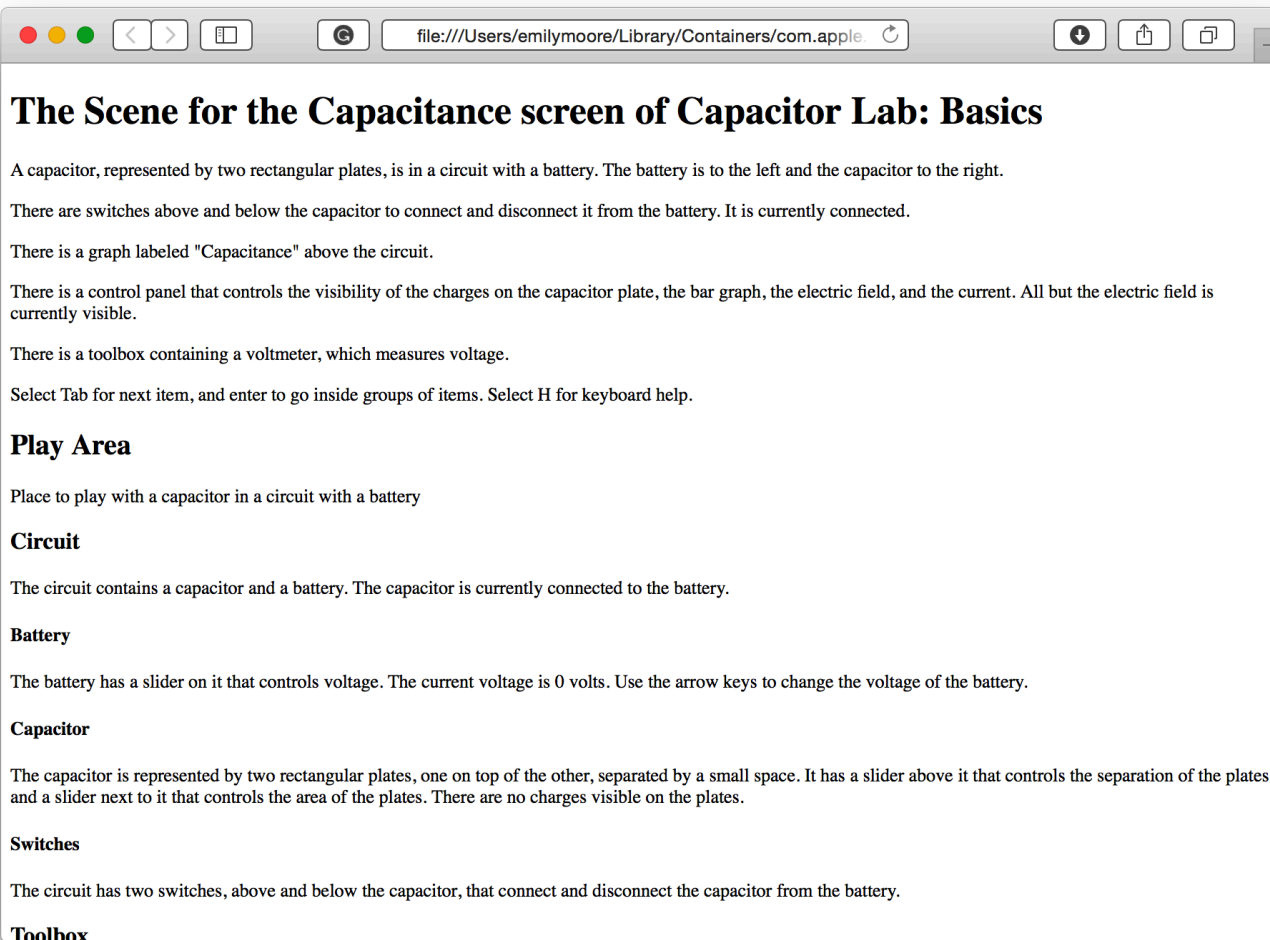
Research

- Interviews (Blind participants)
 - Colorado – 4 Interviews
 - Canada – 14 Interviews
- Methods:
 - Think aloud protocol
 - Some using “Wizard of Oz” based method
- Data Analysis:
 - Design Refinements
 - Screen Reader User Interaction Patterns & Evidence of Learning
 - Generalizable Design Strategies

Interaction Patterns

- Listening & Orienting
- Transition to Interacting
- Interacting & Exploring
- Determining a Goal
- Systematic Experimentation

Listening & Orienting



The screenshot shows a web browser window with the address bar containing the file path: file:///Users/emilymoore/Library/Containers/com.apple.... The page content is as follows:

The Scene for the Capacitance screen of Capacitor Lab: Basics

A capacitor, represented by two rectangular plates, is in a circuit with a battery. The battery is to the left and the capacitor to the right.

There are switches above and below the capacitor to connect and disconnect it from the battery. It is currently connected.

There is a graph labeled "Capacitance" above the circuit.

There is a control panel that controls the visibility of the charges on the capacitor plate, the bar graph, the electric field, and the current. All but the electric field is currently visible.

There is a toolbox containing a voltmeter, which measures voltage.

Select Tab for next item, and enter to go inside groups of items. Select H for keyboard help.

Play Area

Place to play with a capacitor in a circuit with a battery

Circuit

The circuit contains a capacitor and a battery. The capacitor is currently connected to the battery.

Battery

The battery has a slider on it that controls voltage. The current voltage is 0 volts. Use the arrow keys to change the voltage of the battery.

Capacitor

The capacitor is represented by two rectangular plates, one on top of the other, separated by a small space. It has a slider above it that controls the separation of the plates, and a slider next to it that controls the area of the plates. There are no charges visible on the plates.

Switches

The circuit has two switches, above and below the capacitor, that connect and disconnect the capacitor from the battery.

Toolbox

Summary

1. Inclusive Design
2. Challenges to Accessibility
3. Design of Accessibility Features
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Upcoming Work - Sonification

- Partner with Sonification Lab (Georgia Tech)
- Faraday's Law Example

Predictions

- 2010 Kindle Cases - Resulting Dear Colleague Letter:
Requiring use of an emerging technology in a classroom environment when the technology is inaccessible to an entire population of individuals...is discrimination prohibited by Section 504 and the ADA unless those individuals are provided accommodations or modifications that permit them to receive all the educational benefits provided by technology in an equally effective and equally integrated manner.
- Kindle Cases Article:
<https://www.insidehighered.com/news/2010/06/30/kindle>
- Dear Colleague Letter:
<http://www2.ed.gov/about/offices/list/ocr/letters/colleague-20100629.html>
- Article describing evolution of disability law (Grossman & Moore, 2015):
<http://confchem.ccce.divched.org/2015SpringConfChemP6>

Thank you!

Resources

- PhET Interactive Simulations - <http://phet.colorado.edu>
- PhET & Accessibility - <http://phet.colorado.edu/en/about/accessibility>
- Using PhET Sims - <http://phet.colorado.edu/en/teaching-resources>

Get Involved!

- Contact me: emily.moore@colorado.edu
- Follow our progress: Twitter, Facebook, Blog, Newsletter

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- University of Colorado Boulder
- The Hewlett Foundation

Special Thanks To:



Jesse Greenberg
Lead Accessibility Developer