

Integrating PhET Interactive Simulations

Introduction

Penda now features “PhET Simulations” where teachers and students alike can conduct experiments quickly and easily with no set-up and minimal preparation. This new inquiry-based learning feature aligns itself with the 5E Model of Instruction. The 5E Model of Instruction includes five phases: Engage, Explore, Explain, Elaborate, and Evaluate. It provides a carefully planned sequence of instruction that places students at the center of learning. Penda’s PhET simulations allow teachers to engage students at the start of a new lesson and encourages students to explore new concepts through inquiry. According to Carl Weiman, professor at Stanford’s Graduate School of Education, students do not learn from watching a simulation; instead, “student learning occurs when they generate questions that guide their exploration of the simulation and their discovery of the answers. When students engage in such self-driven exploration, they learn better.”

Classroom/Instructional Practice

Teachers no longer have to spend precious time gathering materials for experiments or demonstrations. With a few keystrokes, teachers can quickly browse Penda’s PhET simulation page to find a simulation that meets the desired concept/topic. PhET simulations lend themselves to inquiry-based learning and the 5E model of instruction within a whole-class setting. Engaging students has never been easier for teachers. Using PhET simulations to introduce a topic will appeal to a wide array of learning modalities and help hook or capture students’ attention. Exploration is initiated by the teacher, with variables being manipulated, guiding questions asked, and possible outcomes discussed with students. Further exploration is student-led with established norms, allowing them to navigate and experience the new concept with purpose. Continuing with the 5E model, teachers can then assign differentiated Penda activities that target a specific standard for students to complete the explain, elaborate, and evaluate phases of the 5E model of instruction.

Impact on Student Learning

PhET simulations are intelligently designed to cater to a variety of learning modalities, including visual learners, allowing them to piece together their understanding. PhET’s ease of use and intuitive controls allow students to focus on the concept as opposed to learning how to manipulate the simulation (inquiry-based vs. performance-based learning). PhET simulations create student buy-in at the onset, encouraging them to engage more deeply in their learning. Student exploration is encouraged through animation and interactivity, allowing learners to simultaneously ask questions and make connections by observing and interacting with the simulation. The little puzzles or clues feature, with questions that stimulate the learner to figure things out, encourages exploration in productive directions. PhET simulations are fun and mimic real-world scenarios, which draw in students and make it an enjoyable experience. Students’ understanding of concepts improves when they are engaged in thoughtful exploration or inquiry-based learning.

Give It A Try - Here's How:

Using the 5E model of instruction whole-class:



1. ENGAGE - View the “Sims” page within your Penda account and select a PhET simulation (i.e. Balancing Act). Project the PhET simulation for students, and manipulate a set of variables while students watch and wonder.
2. EXPLORE - [Provide students with ‘open playtime.’](#) Ask students for input on which variables to manipulate, probe their thinking with questions, and ask for predictions on possible outcomes. Then, [provide students with an opportunity to explore](#) the same simulation by answering a set of teacher-made questions (similar to claim-evidence-justification).
3. EXPLAIN, ELABORATE, EVALUATE - Assign differentiated Penda activities (i.e. Force and Motion) for independent student work. At the conclusion, provide an opportunity for students to produce artifacts as evidence of understanding and synthesis of new knowledge.

Artifact/Example:

Build an Atom, PhET Simulation Worksheet

Name: _____


EXPLORE

1. START by clicking the link:
https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html
2. EXPLORE the simulation by clicking on all the buttons.
3. When directed, click the 'reset'  and  buttons to reset the simulation and open the Net Charge and Mass Number boxes.

**You will use the Periodic Table, Net Charge and Mass Number boxes to complete the tables below.*


ENGAGE

4. Experiment by putting some protons into the nucleus of the atom, on the 'X'.

 Fill in the table to record what you are learning about protons.


Net Charge:	Mass Number:	Element on the Periodic Table:	Circle one:
			Stable
			Unstable

5. Experiment by putting some neutrons into the nucleus of the atom, on the 'X'.

 Fill in the table to record what you are learning about neutrons.

Net Charge:	Mass Number:	Element on the Periodic Table:	Circle one:
			Stable
			Unstable

6. Experiment by putting some electrons into the nucleus of the atom, on the 'X'.

 Fill in the table to record what you are learning about electrons.

Net Charge:	Mass Number:	Element on the Periodic Table:	Circle one:
			Stable
			Unstable

7. Look over the data you recorded for protons, neutrons, and electrons. List 2 things you noticed:

a. _____



b. _____



STOP and have your teacher check you work.




EXPLORE

- START by clicking the link:
https://phet.colorado.edu/sims/html/build-an-atom/latest/build-an-atom_en.html
- EXPLORE the simulation by clicking on all the buttons.
- When directed, click the 'reset'  and  buttons to reset the simulation and open the Net Charge and Mass Number boxes.

*You will use the Periodic Table, Net Charge and Mass Number boxes to complete the tables below.


ENGAGE

- Experiment by putting some protons into the nucleus of the atom, on the 'X'.

 Fill in the table to record what you are learning about protons.


Net Charge:	Mass Number:	Element on the Periodic Table:	Circle one:
+6	6	C= Carbon	Stable <u>Unstable</u>

- Experiment by putting some neutrons into the nucleus of the atom, on the 'X'.

 Fill in the table to record what you are learning about neutrons.

Net Charge:	Mass Number:	Element on the Periodic Table:	Circle one:
+6	10	C= Carbon	Stable <u>Unstable</u>

- Experiment by putting some electrons into the nucleus of the atom, on the 'X'.

 Fill in the table to record what you are learning about electrons.

Net Charge:	Mass Number:	Element on the Periodic Table:	Circle one:
-4	10	C= Carbon	Stable <u>Unstable</u>

- Look over the data you recorded for protons, neutrons, and electrons. List 2 things you noticed:

- Carbon is unstable until number of protons and neutrons are equal.
- Electrons will not stay in the nucleus.



STOP and have your teacher check your work.

