

Teacher: Calvin Sprouse
Date: 2023 December 01
Subject / Grade level: PHYS 183
Topic: The Pendulum Circuit
Materials:
Lesson Objective(s): <ul style="list-style-type: none"> • Students will learn basic circuit design and component selection to achieve a purpose. • Students will learn about physics analogues: situations where two seemingly unrelated physical systems are governed by the same equations.
ENGAGEMENT: Students will be presented with a theoretical pendulum and calculate the period and velocity as a function of time.
EXPLORATION: Students will then be presented with the schematic of a voltage divider circuit. Given an AC input students will need to find a pair of resistors such that the graph of output voltage is identical to their theoretical pendulum (they can configure the period of the AC source).
EXPLANATION: Students will then build the pendulum and circuit (does the cart software do circuits? if so they can do the graphs on the same window! Otherwise most software can to a csv export and they can use excel to plot the curves over one another? The goal here is just to demonstrate that it works.
ELABORATION: Students will then find an equation the relates their pendulum mass and length to a resistor value such that for any length and mass pendulum they can pick a resistor pair to make an analogous circuit.
EVALUATION: Students will be given a new mass and length and must build a circuit and demonstrate they are analogues.

I know theres a lot here and I have no idea if this goes above and beyond the 183 level. I really wanted to touch on analagous physical systems because I think they are tremendously important and highlight the power of both physics and math. I also wanted to do something with EM since I think its a really fun topic and the more students can link it to real life experience the easier it will be. I had another idea of having students build a rope out of a series of magnets and plastic spacers. Students could figure out that the rope could theoretically pull an infinite force (in a frictionless world). By giving

them a surface with particular friction students could be tasked with figuring out what length spacer is the maximum allowed to pull a certain mass. Both are fun ideas!