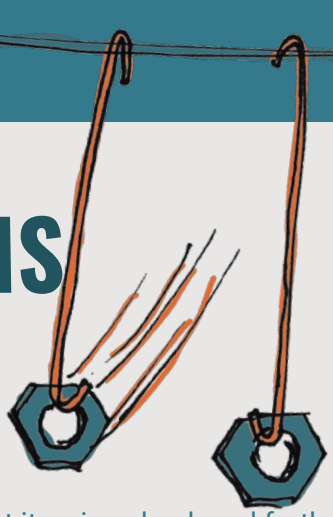
COUPLED RESONANT PENDULUMS

MIDDLE SCHOOL LEVEL 2



The *resonant frequency* of a pendulum is the number of times that it swings back and forth in a second. With coupled resonant pendulums, the frequency of one pendulum affects the other as they both swing from the same string. These frequencies interact by transferring energy from the swing of one pendulum to the next, and back eventually to the first.

EDUCATIONAL STANDARDS:

NGSS CONNECTION:
MS-PS3-2. Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
MS-PS3-5. Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.

COMMON CORE CONNECTION:
ELA/Literacy
SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest.

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

WHST.6-8.1 Write arguments focused on discipline content.

Mathematics
6.RP.A.1 Understand the concept of ratio and use ratio language to describe a ratio relationship between two quantities.

6.RP.A.3 Use ratio and rate reasoning to solve real-world and mathematical problems.

7.RP.A.2 Recognize and represent proportional relationships between quantities.

8.F.A.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear.

MP.2 Reason abstractly and quantitatively.

MP.4 Model with mathematics.

DOK:
Level 3: Strategic Thinking
Level 4: Extended Thinking

MATERIALS NEEDED:

- ❑ String
- ❑ Wood
- ❑ Screws
- ❑ Paperclips
- ❑ Large hex nuts

DIRECTIONS:

1. You will first need to build a stand to suspend your pendulums from. You can use wood, PVC, or even the backs of two chairs.

2. When you've come up with a suitable stand, suspend a string across the gap.

3. Bend two paperclips open and lay them flat. Make a hook on one end of the paperclips for the nuts.

3. Bend the other end of the paperclip and place it over the string. Bend it against itself, over the string, to hold it in place.

4. Be sure to bend the clips to the same length, this will keep the resonant frequency the same on both of the nuts.

OBJECTIVE:

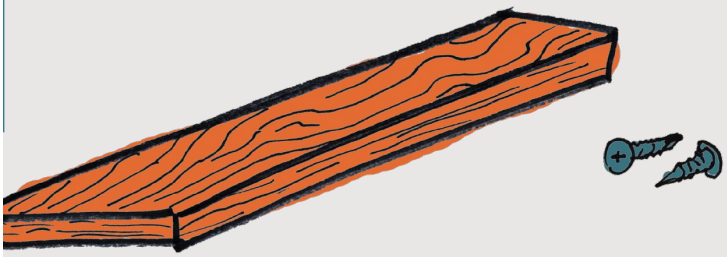
Students will be able to construct arguments and models to describe the potential and kinetic energy in various systems.

ESSENTIAL QUESTIONS:

- How does a pendulum work?
- What is potential and kinetic energy and how are they related?

ENGAGE:

1. Display the coupled resonant pendulum.
2. Ask students to predict what will occur when you lift one of the sides of the pendulum.
3. Allow students to make predictions.
4. Demo the pendulum for the students.
5. Have students create an initial model of the pendulum on paper.
6. From observations ask students to explain how the motion in one side stops and allows the other side to begin moving.



EXPLORE/EXPLAIN:

1. Allow students to explore the PhET Simulation Skate Park.
2. Allow students to synthesize the meaning of potential and kinetic energy based on their experience with the simulation
    a. “Potential energy” in this model is gravitational potential energy.
    b. Students should identify gravity as force pulling things downward and the reason for potential energy.
3. Review with students the concept of energy and its conservation.
    a. Use the simulation to provide examples of potential and kinetic energy, and how energy converts from one form to another.

ELABORATE:

1. Allow students to revise their initial models to explain how potential and kinetic energy change forms and transfer from one object to another
2. Evaluate students’ models for comprehension and argumentation for energy and its conversions