

Conor Hunt

Elective #9 (Physport Resource - [The Phenomenon Master List](#))

Identify one new technique, tool, or assessment

This year, I've been trying to be more intentional about modeling real life phenomena. The Methods of STEM course I took in the summer pushed me to think more about how I'm incorporating these phenomena on a consistent basis to push for coherence and understanding. Namely, are students able to use multiple representations, such as graphs, pictures, and equations to describe real life experiences. In addition to this, are they using scientific reasoning to describe, in writing, how these phenomena occur.

I want to use this elective to create a plan for how I'm going to support students through their understanding of phenomenon. I'm going to show how I've done this in my energy unit, and how I can build off of this in the waves unit which I will roll out in January and February. The tool I want to use/incorporate into my unit is the [The Phenomenon Master List](#) I want to use this resource to encourage more student choice.

Describes why the inclusion of this new technique, tool, or assessment is important, and what you and your students might gain from it

Phenomenon based instruction is an important and almost critical feature for implementing three dimensional learning in the classroom. It can push students to make connections across science and engineering practices, cross cutting concepts, and disciplinary core ideas. IN my energy unit, I've used phenomena to promote scientific modeling and multiple representations. Namel, I've used to it teach into this NGSS performance expectation:

[HS-PS3-1 - Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component\(s\) and energy flows in and out of the system are known.](#)

On the first day of the unit, I showed students [this video](#) and asked them to describe how the tennis ball bounces higher than its original drop height. Students were prompted, not only to describe how it happened with words, but also to provide a picture of a diagram. After they were given 10 minutes to do so, we looked at 3 student models to get a sense of what text features to include in order to accurately describe what happened and how it happened. These features include multiple pictures, showing the passage of time, arrows showing the direction of the tennis ball and basketball, and the usage of physics appropriate language. At the end of the lesson, we identified that many students described what happened, but needed more support to describe HOW it happened. This was our motivation for the next two weeks and we learned about different energy storage modes, as well as how to represent energy transfer with LOL diagrams. After two weeks, students were asked to remodel the phenomenon, using new vocabulary and new representations that they learned in the unit. They were also asked to reflect on how their thinking about energy transfer changed after two weeks. Here are some of the samples:



DISCUSSION POST

Directions: Describe how your thinking about energy transfer has changed after this activity. If it hasn't, explain why.

I don't think my thinking about energy has changed but the LOL Diagrams help me understand how the energy is being transferred. The diagrams visably show me how the energy is being transferred

Directions: Use your knowledge of energy types and energy transfer to construct a graphical model (LOL diagram) as well as a computational model (i.e. an equation) to describe how the stacked ball set up results in the smaller ball bouncing higher than where it was dropped from. Use the same template as before (reprinted below) to construct this model

Developing and Using Models

1 Describe the Phenomenon

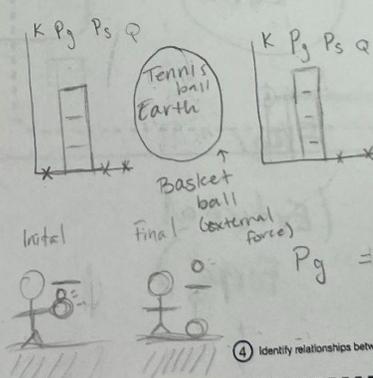
stacked ball bounce



5 Use the model to Explain

2 Define the Boundary

System



3 Draw and label the Components

4 Identify relationships between the Components

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 it's original height which is why there is more potential energy.

Adapted from: George Stiekel, Amy & Jeremy Peacock

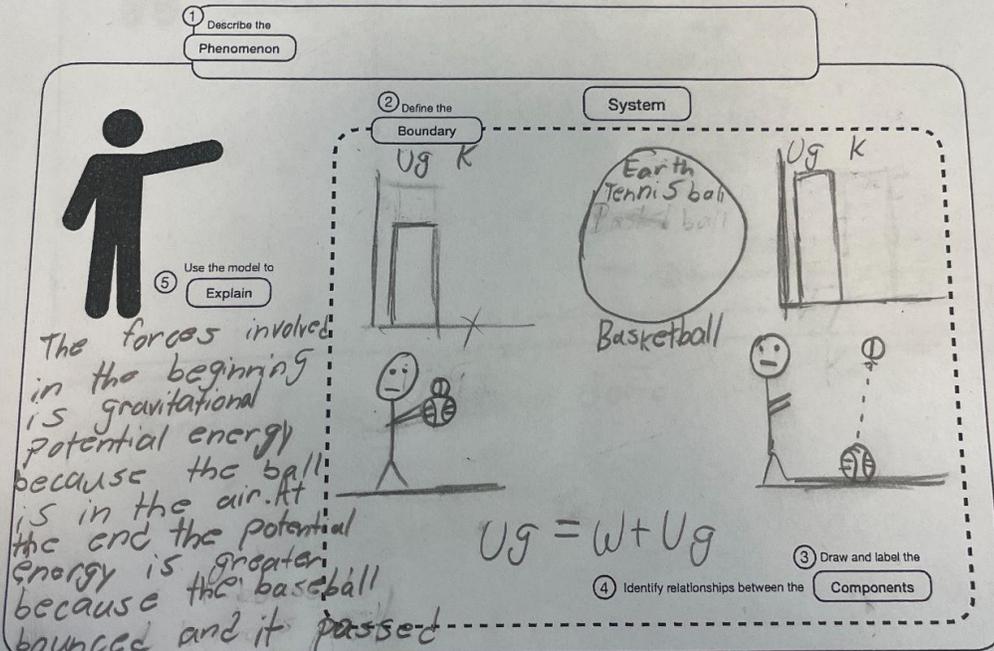
Evaluate - What Have We Learned?

DISCUSSION POST

Directions: Describe how your thinking about energy transfer has changed after this activity. If it hasn't, explain why. *My thinking has changed because I realized the multiple perspectives of viewing energy transfer*

Directions: Use your knowledge of energy types and energy transfer to construct a graphical model (LOL diagram) as well as a computational model (i.e. an equation) to describe how the stacked ball set up results in the smaller ball bouncing higher than where it was dropped from. Use the same template as before (reprinted below) to construct this model

Developing and Using Models

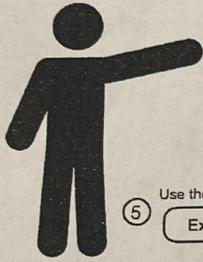


Directions: Use your knowledge of energy types and energy transfer to construct a graphical model (i.e. a free-body diagram) as well as a computational model (i.e. an equation) to describe how the stacked ball bounce results in the smaller ball bouncing higher than where it was dropped from. Use the same information as before (reprinted below) to construct this model

Developing and Using Models

1 Describe the Phenomenon

stacked ball bounce

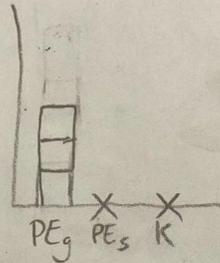


5 Use the model to Explain

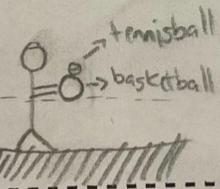
2 Define the Boundary

System

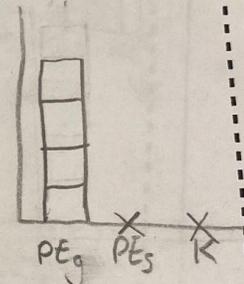
person's hand



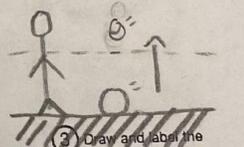
PE_g PE_s K



tennisball
basketball



PE_g PE_s K



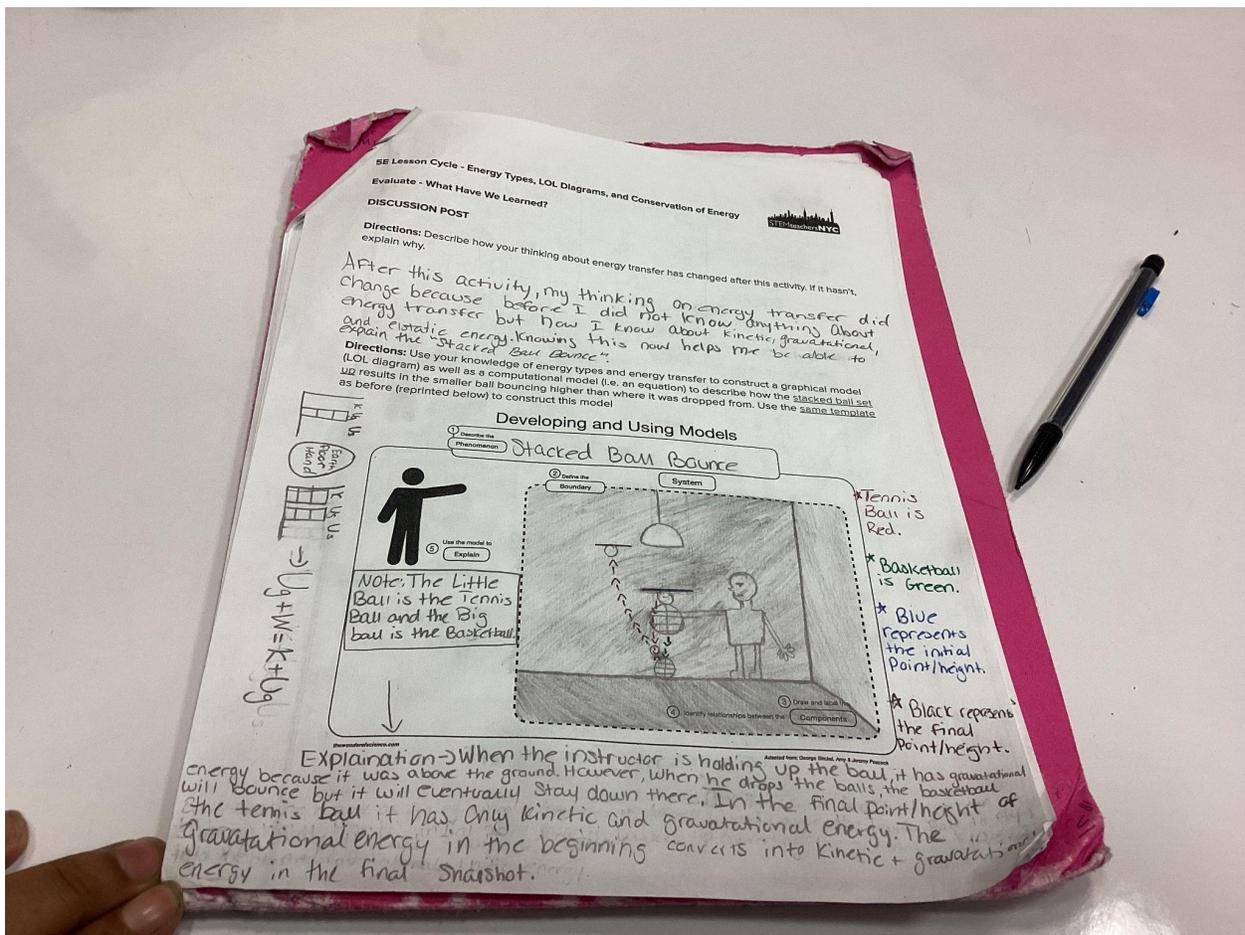
3 Draw and label the Components

4 Identify relationships between the Components

In the initial stage, the tennis rests on top of the basketball above the ground. In my final snapshot, the tennis ball is at its peak & will soon come down. This is why there are 4 bars because PE_g is greater at its peak. The tennis

ball absorbed the basketball's energy to bounce higher. When at its peak, there is no KE. The work in our system is the person's hand. It is the external force because in our diagram, we are looking at the tennis ball only.

Adapted from: George Stckel, Amy & Jeremy Peacock



“Reflection: After this activity, my thinking on energy transfer did change because before I did not know anything about energy transfer but now I know about Kinetic, gravitational, and elastic energy. Knowing this helps me able to explain the “Stacked Ball Bounce.” For example: The diagram that I drew was an example of what was happening in the video and the energy transfer that was happening in the initial and final snapshots. Because of what I’ve learned on energy transfer, I am able to explain how in the first snapshot (when the person is holding the balls) that the energy that is currently going on is gravitational energy because the basketball and tennis ball are above ground. In the final snapshot the tennis ball is above ground yet again which means that it is gravitational energy, but now we also add kinetic energy since it’s moving. The tennis ball is able to go higher than its initial point because of the basketball. My final snapshot will not show you exactly how the tennis ball lands so high but if I were to make my final snapshot where the basketball finally hits the ground in which the tennis ball hits the basketball at the same time, then we would also be adding elastic energy because the pressure/energy from the basketball as it hits the ground gets transferred into the tennis ball when the tennis ball hits the basketball. This is energy transfer.”

NOTE: I need to teach into what’s expected in these reflection questions. Ideally, I want students to explicitly identify how their Model changed from Day 1 to Day 14. This students above did so, but the others only touched upon the differences.

Professional Learning Plan

Create a short learning plan that includes (1) goal for using the new resource, (2) next steps for implementing it, and (3) a community, website, or colleague who can provide more support and information if you need it.

I want to continue to incorporate phenomenon learning in my class, and I've been thinking of a way to do so in my next unit on Waves. The unit covers general wave characteristics (frequency, wavelength, amplitude, etc) for transverse and longitudinal waves. The first half of the unit is more focused on mechanical waves, and the second half of the unit focuses on electromagnetic waves. One of my issues with the regents curriculum is that, every year, teaching waves can feel like covering a wide variety of different topics/phenomenon, sometimes without cohesion.

There are three ways that I am going to use this resource: In the first two weeks of the unit, where students are looking to describe how a singer can break glass. This sequence will follow a similar trajectory as what we did in our energy unit with the stacked ball bounce demonstration. The second way is The third way is for the end of unit synthesis narrative. This is an end of unit project that each subject does and it follows a number of guidelines and criteria (will explain this more below).

Unit Pacing Guide

Week #1-2 - Introduction to [Sound Phenomenon](#) and General Wave Characteristics. Students will attempt to model the Phenomenon (how sound breaks glass) on Day 1 and will revisit it at the end of the second week. Students will use the same modeling template as shown above in their energy units

Week #3 - Wave Interference

Week #4-5 - Introduction to the Electromagnetic Spectrum via [Ultraviolet Camera Video](#). This video will serve as the motivation for these two weeks, where our focus is to understand the "effects that different frequencies of electromagnetic radiation have when absorbed by matter." This language is taken from the **HS-PS4-4** NGSS standard. Moreover, students will learn about mechanisms for how the sun "burns" human skin, the role that sunscreen plays, and ultimately how to "Evaluate the validity and reliability of claims in published materials" for how effective certain sunscreen products are.

Week #6-7 - Reflection and Refraction (Snell's Law)

Week #8 - Wave-Particle Duality and Models of the Atom

Week #9 - Synthesis Narrative Writing. Next Page for Synthesis Narrative Guidelines

Write a 3-page synthesis narrative that:

- CREATES a thesis that presents a solution to the Module Problem
- EVALUATES alternative solutions or counterclaims
- ANALYZES evidence from a variety of sources to support or counter your thesis
- CITES textual evidence and identify sources properly APA format
- APPLIES accurate academic and disciplinary vocabulary
- WRITTEN in your own words, is grammatically correct, and coherent.

As mentioned above, each unit, in every subject, ends with a synthesis narrative where students synthesize their learning throughout the unit to present some type of solution to an identified problem. So far this year, these problems have been identified by the teacher. We want to move to a place where students are choosing and identifying these problems. For this unit, I want students to choose a phenomenon from the "[Phenomenon Master List](#)" (Page 98-99) and describe it using at least 3 representations (pictures, words, equations, graphs, diagrams, etc). They will have to analyze evidence form a number of sources, use accurate academic language, and possibly address misconceptions (aligned with bullet point #2 above). In addition to accurately describing the phenomenon, students will be given an opportunity to reflect on how their thinking about waves and wave phenomenon has changed throughout the unit