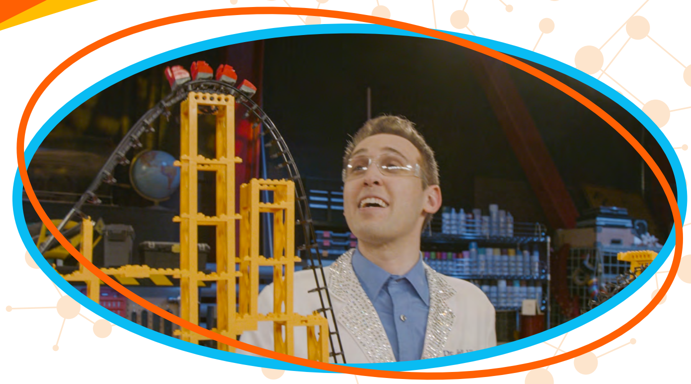
GENERATION**GENIUS**

ALWAYS QUESTION. ALWAYS WONDER.



LESSON PLAN

POTENTIAL VS KINETIC ENERGY

GRADES 6-8

SUMMARY

Students use science ideas of energy transfer and evidence to construct an explanation for how a comeback can works.

NEXT GENERATION SCIENCE STANDARDS CORRELATION

MS-PS3-1. Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

Science & Engineering Practices	Connections to Classroom Activity
Constructing Explanations and Designing Solutions	• Students will use scientific ideas of energy transfer and conversion and evidence collected from observations to construct an explanation for how a comeback can works.

Disciplinary Core Ideas	Connections to Classroom Activity
PS3.A: Definitions of Energy Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed. A system of objects may also contain stored (potential) energy, depending upon their relative positions.	• Students use their understanding of kinetic energy and potential energy and conversion between each in order to explain how a comeback can works.

Cross Cutting Concepts	Connections to Classroom Activity
Matter and Energy	• Students use their understanding that energy can be transferred and tracked in a designed system to explain the system's (the comeback can) behavior.

DURATION

Two 45-minute class periods.

MATERIALS

Materials per group:

- Can with lid (e.g., coffee can, oatmeal canister, paint can)
- 2 heavy duty rubber bands
- 2 paper clips, twist ties, or pipe cleaners
- Washers or hex nuts (different sizes)
- Scissors
- Tape

ENGAGE

Tell students that sometimes the simplest things can be pretty phenomenal. Ask students to record things they **notice**, things they **wonder**, and things they **think** as they watch this short video clip of a comeback can (show clip from 2:15 to 3:09). (Alternative: make a comeback can and use it instead of the video clip.) Have students share their noticings (N), wonderings (W), and thoughts (T) with their small group. Have each small group share one N, W, and/or T (no repeats); prepare a chart for the whole class to reference. Question we are trying to answer: How does the comeback can work?

EXPLORE

Tell students they are going to build a comeback can and test it to figure out how it works. Assign students to small groups.

Directions for building a comeback can:

1. Punch a small hole in both ends of the can and thread the first elastic band through the hole at the base. Using tape, secure a paperclip to the band outside of the can to prevent the elastic from slipping through the hole.
2. Thread the weight or washer onto a piece of string and use that string to tie the two elastic bands together. This should result in the string holding the weight and also joining the free end of the elastic you secured to the can in step 1 to the second elastic band.
3. Take the other end of the second elastic band up through the hole in the lid and use a paperclip to prevent it from slipping through the hole. Close the lid and secure the paperclip with tape.

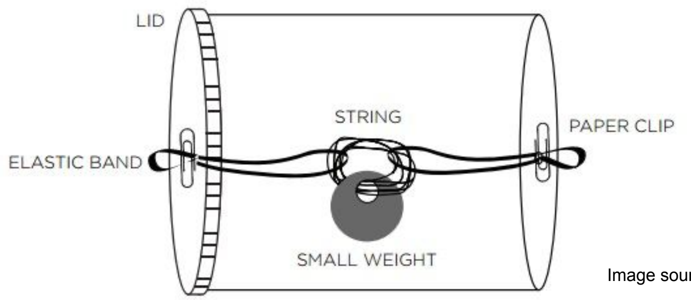


Image source: https://www.scienceworld.ca/resource/come-back-can/

Encourage students to test their comeback cans by asking questions like: Who can get their can to roll the farthest? Whose can comes back most quickly? What variables might you change to control the distance and speed? Who can most accurately predict how far his/her can will roll each time?

Ask each student group to develop an initial model of their comeback can to explain how it works. Prompt students to identify any energy transfers and conversions. Refer back to the initial ideas from the NWT chart and ask students what they might add or change and why.

End of Day 1

EXPLAIN

WATCH THE GENERATION GENIUS POTENTIAL VS. KINETIC ENERGY VIDEO AS A GROUP

Ask students to state the question they are trying to answer. Refer to the class's thinking on the NWT chart. Ask students if they have any ideas or wonderings to add. Use the "Before Video" questions to gauge current student understanding of energy concepts. Make sure students jot down any ideas from the GG video that might help them with their explanation of how the comeback can works.

After watching the GG video, have students revisit their initial model for explaining how the comeback can works. Use these questions to probe student understanding and to push their thinking as they work in small groups to revise their model. Students may want/need to retest/observe their can.

- What are some of your claims?
- What are some of the key components of your model/solution?
- How does this model explain the evidence we have so far about this phenomenon?
- What evidence do you have that kinetic energy was converted to potential energy and vice versa?
- What variables affect the amount of kinetic energy? Potential energy?
- So, let me see if I understand this aspect of your model here. Are you saying...?
- Predict what would happen if you increased the number of washers used. How does a change in mass affect the amount of kinetic energy? Potential energy?

Students' explanations should contain ideas similar to this: The "secret" to the comeback can is in the weight that hangs from the rubber band. The weight hangs down as the tin rolls in one direction (and doesn't flip). The kinetic energy of the rolling can will be stored as potential energy in the tightly twisted rubber band—some will not be stored as the rubber band is wound; instead it is transferred to friction (heat) and sound. Once the band has reached its storage limit, the stored energy is released and the can moves backwards towards its starting point.

ELABORATE

Provide each group with a different challenge:

- Increase the distance the can travels.
- Increase or decrease the speed at which the can rolls back.
- Increase the time the can stays motionless before rolling back.

Have additional materials available:

- range of washers/hex nuts
- rubber bands of different thickness
- stopwatches
- metersticks

Limit trial and error by having students explain their design modifications and rationale based on energy conversions prior to testing. Also limit the number of modifications and trials that students can make in order to meet their challenge.

EVALUATE

There are multiple ways to assess your students' understanding of this topic. The exit ticket is an opportunity for students to use the science ideas they built in the lesson in a new context. Alternatively, you can use the Kahoot! quiz (which provides downloadable scores at the end of the game) and/or the paper quiz. All these resources are located right below the video in the assessment section.

EXTENSION

Have students calculate the kinetic energy of their comeback can. Challenge them to measure energy lost from the system as sound and heat. Have them use their calculations to modify the design to meet one of the elaboration challenges.