Engineering Design Challenge – Investigation 2

Plan Investigation 2

In Day 1, students were introduced or re-introduced to a set of concepts related to the transformation of motion energy to thermal energy, but once they started working on the redesign of their cars, their attention may well have switched to using a trial-and-error approach to addressing the design challenge. That's expected. Day 2 returns the focus to energy.

Today's class has three sections: 1) a short introduction; 2) time for pairs of students to "cube" the energy story of their altered car and to record that story; and 3) time for students to share their work with the class.

Hopefully all teams were able to successfully address the challenge on Day 1, but even if they weren't, they'll be ready to focus on energy today. Everyone is by now familiar with the Energy Tracking Lens questions and with using energy cubes to track the flow of energy through a system and should be poised to apply their understandings about energy to their car and its braking system, regardless of their success on Day 1.

Learning Targets

- Use the Energy Tracking Lens questions and energy cubes representation to tell the energy story of the rubber band propelled car and its braking system.

Sequence of Experiences		
1. Introduction	 All Class	 10 Minutes
2. Tell the Energy Story	 Pairs	 25 Minutes
3. Share and Make Meaning	 All Class	 15 Minutes
4. Add to the Model of Energy and Wrap-Up	 All Class	 10 Minutes

Materials

For the class:

- 6 class sized energy cubes with stickers that were added during the Focus on Energy units.

For each small group of 2 students:

- 6 student-sized energy cubes with stickers that were added during the Focus on Energy units.
- Large sheet of paper and markers, or a whiteboard and erasable markers.

For each student:

Engineering Design Challenge Student Notebook

Preparation

- Read the Summary Sheet Instructions in the Appendix.
- If students are working on large sheets of paper vs whiteboards, have extra sheets available in case a team really needs it, but also assure students that you can accept revisions on their sheets as long as the changes are clear. The goal is to use cubes to figure out the energy story of their car.
- Just a reminder: Unlike their work in the Focus on Energy curriculum, pairs will not be investigating the exact same system, so the range of system components identified (via circles) will reflect their different designs.

1. Introduction

All class – 10 Minutes

Remind students that in the previous class, each team worked on making changes to its car, changes that in different ways transformed some of the car's motion energy into thermal energy, so that the car traveled less than the 12 feet it would usually travel. And even if some teams did not make their car stop in the Target Area, most likely everyone was able to transform some of their car's motion energy into thermal energy by having components rub against one another.

Would someone volunteer to tell us what kind of energy the car's motion energy was transformed into?

➔ Thermal energy

Did anyone try to feel parts of the car or the braking system to see if they felt warmer?

➔ (Students may not be able to expand on this – that's OK. You may be able to return to this question later in the class, but an answer might be… For tiny amounts of thermal energy, the temperature change might be very small and we would not notice or perceive it.)

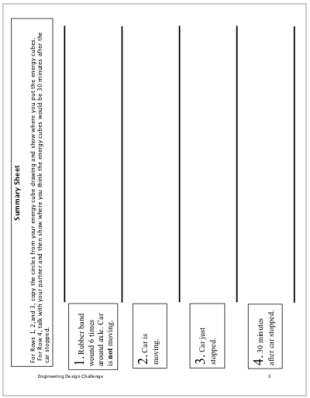
Explain that the class will continue to work on the car challenge, but today the focus will be on the energy story of the car.

You have three main tasks today:

1. Use cubes, markers, and a whiteboard or paper to tell the energy story of your car. Remember to answer the Energy Tracking Lens questions as you "cube" the energy story.

Teams can do this even if the car did not stop in the Target Zone. If students decide that 6 cubes are not enough, they can imagine putting half-cubes in places.

2. Use the Summary Sheet in the Student Notebooks (Page 6, with an extra copy on Page 7 if you need it) to record where the cubes would be for 4 different points in time. Draw half-cubes if you need to.



Student Notebook – Pg. 6

Review the Summary Sheet with students. The circles (system components) they draw for each of the four points in time should be the same circles they used on the large sheet or whiteboard when they were moving the cubes. They are just copying information from the large sheet to the Notebook page.

The 4th point in time—30 minutes after the car has stopped—is a new idea and something students will have to think about. Where would they put the cubes 30 minutes after the car has stopped?

3. We will save 15 minutes of class time for sharing energy stories with one another.

Teams should bring their whiteboards or large sheets of paper with the circles as well as their notebooks to the meeting and be prepared to share their energy story with the rest of the class.

2. Tell the Energy Story

Pairs – 25 Minutes

Distribute whiteboards or large sheets of paper, six energy cubes, and markers to each team.

After 15 minutes, make sure students have at least begun to summarize their energy story in their Student Notebooks and encourage them to use the final ten minutes to do that.

As students work, ask them to explain their decisions: what circles did they include? How did they decide how to

distribute the cubes? if there was a transformation, where did it occur? Were there energy transfers? What was the evidence?

Think about two or three examples of cube stories that differ in some interesting way. Ask these groups to kick off the sharing.

3. Sharing and Make Meaning

All class – 15 Minutes

The focus of the discussion today is on the energy story, but the one performance question that is pertinent for each team that shares is, "What does your evidence (data) tell you about the success of your braking system?"

Have students bring their whiteboards or papers and Student Notebooks to the discussion circle.

Select a team to tell their energy story, moving cubes through their system components. Once the team has finished moving cubes, have the team share their Summary Sheet.

Ask the observers to notice:

1. How this story is the same or different from theirs?
2. *Were there any big differences in how you moved the cubes or how you recorded things on your Summary Sheet?*
3. Have the presenters addressed all of the Energy Tracking Lens question?

Is there a team that used a very different type of braking system?

Repeat as time permits.

4. Add to the Model of Energy and Wrap-Up

All class – 10 Minutes

Although the key concepts that are highlighted in this investigation are not new, they may not have been identified by students as they constructed their Model of Energy. This is an opportunity to add some or all of the key ideas, or just as importantly, to go back and underline them if they are already included in the Model of Energy.

Let students know that the Engineering Design Challenge gave them a chance to apply their understandings about energy to a completely new system, and that they can now continue to do that for other new systems…maybe not always with the cubes, but by asking the Energy Tracking Lens questions and remembering the ideas that are part of the Model of Energy they have developed.