

# Focus on Energy: Preparing Elementary Teachers to Meet the NGSS Challenge

**Project Team:** Sara Lacy (PI), Sally Crissman, Nick Haddad and, Lisa Miller at TERC, Cambridge MA (617-873-9600)  
Roger Tobin (co-PI), Tufts University; Nathaniel J. S. Brown (co-PI), Boston College; Jim Minstrell, FACETS Innovations  
Stamatis Vokos (PI), Lezlie DeWater, Kara Gray (co-PI), Amy Robinson (co-PI), Rachel Scherr (co-PI), and Lane Seeley (co-PI) at Seattle Pacific University

## ADDRESSING THE CHALLENGE

Elementary teachers feel unprepared to teach about energy. They need a solid understanding of the science content and tested classroom activities and materials.

**Our Goal:** to provide elementary teachers and students with **resources, representations, and a framework** to reason about forms and flows of energy in all disciplines of science and in phenomena they encounter in everyday life.

**Research Question:** *What characterizes experiences, resources and supports that can improve teachers' (1) disciplined application of representations and energy reasoning to make sense of everyday phenomena in terms of energy, (2) ability to interpret student ideas about energy to make instructional decisions, and (3) ability to help students use representations and energy reasoning to develop and refine models of energy forms and flows?*

**Design Phase Testing:** Materials tested with 14 teachers and in 17 classrooms in Seattle and the Boston area.

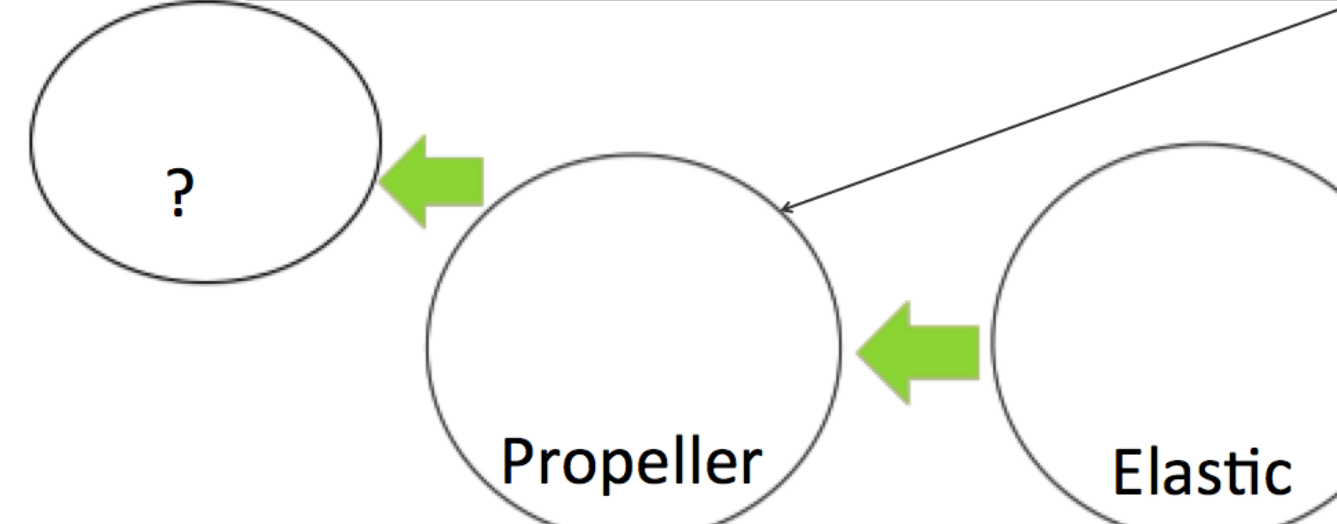
Focus on Energy is a 4-year DRK-12 development project, 2014-2018.

This research was funded by The National Science Foundation under Grant No. #1418052 (TERC) and #1418211 (Seattle Pacific University).



## The Energy Tracking Lens: A Framework for Reasoning about Energy

The Energy Tracking Lens provides a framework and language that allow teachers and students to learn an interdependent network of ideas about energy at the same time they learn to take a scientific stance about phenomena involving energy. Looking through the Energy Tracking Lens involves asking the same sequence of questions about diverse phenomenon—from colliding balls to global warming:



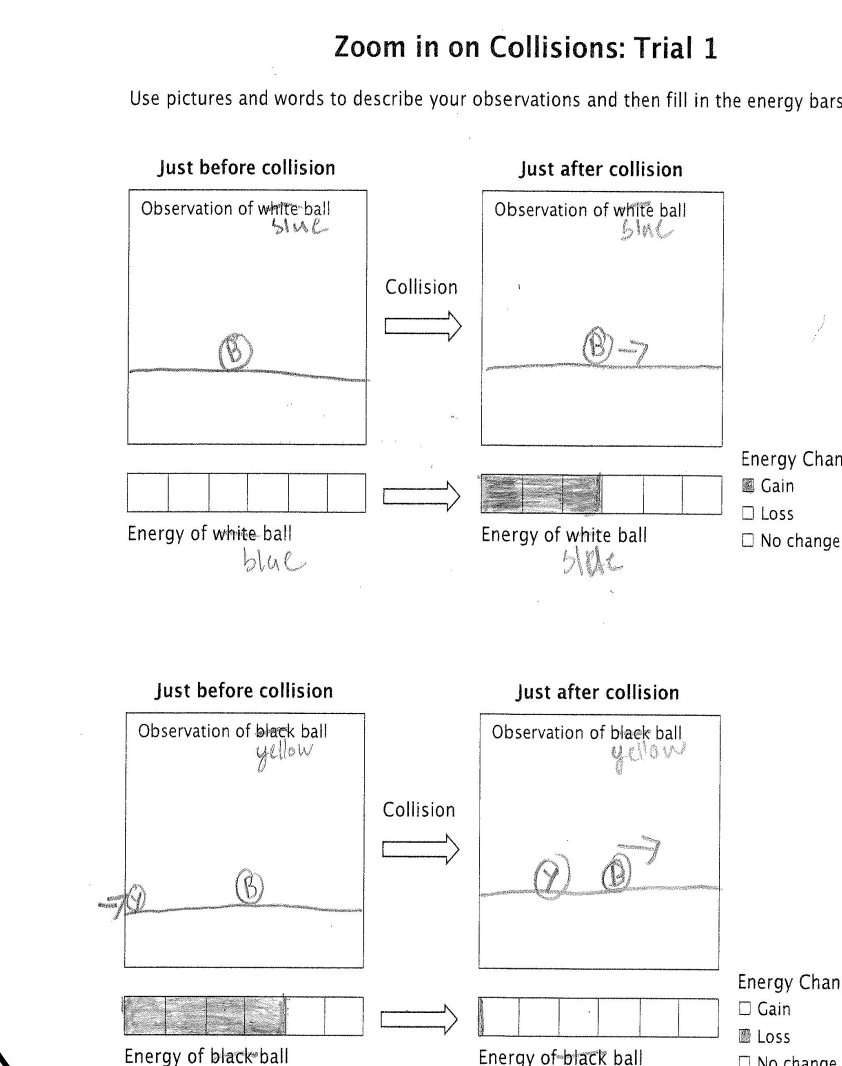
- *What's happening?*
- *What are the components of the system?*
- *Where are there energy changes?*
  - Increase in motion energy
  - Decrease in elastic energy
  - Transformation from elastic to motion energy
- *Where does the energy come from?*
- *Where does the energy go?*
- *What is the evidence?*

## Representation: A Critical Tool for Reasoning about Energy

Teachers become skilled at using a variety of representations to reason about forms and flow of energy. In the classroom, teachers facilitate students' use of representations and use them as opportunities for formative assessment. Students use representations to make the invisible visible, to reason together about forms and flow of energy, and to communicate their ideas.

### Energy Bars

Students begin to reason about energy quantitatively.



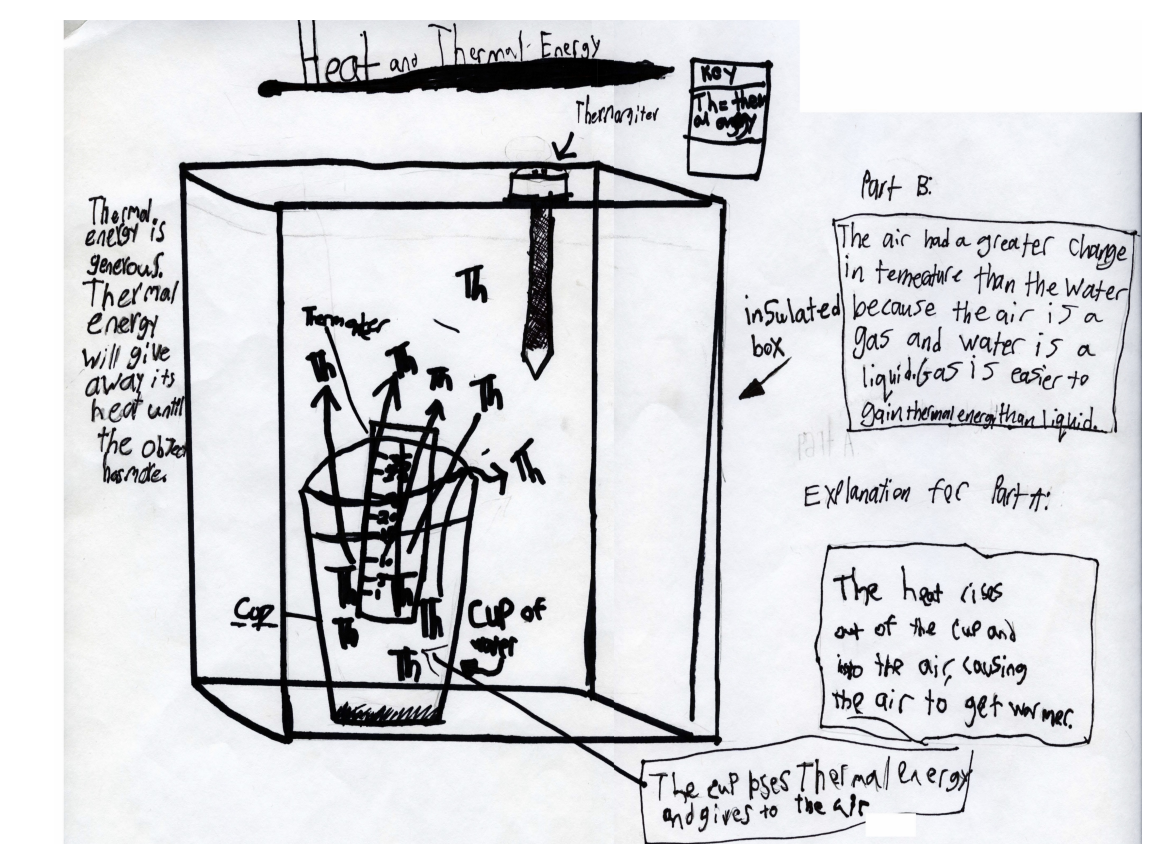
### Energy Cubes

Students begin to Reason about transfer and transformation.



### Annotated Drawings

Students communicate their understanding of energy forms and flow.

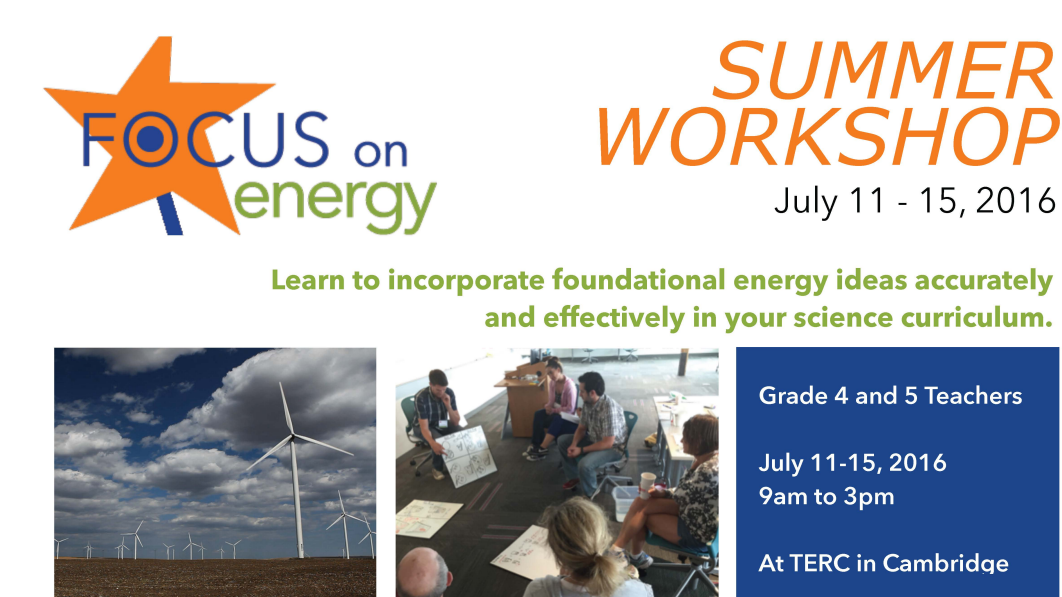


## A System of Resources

Focus on Energy is developing a system of resources and support for teaching and learning about energy in elementary school:

### Teacher Professional Learning

- Summer workshop - Teachers experience being learners themselves.
- School year follow-up



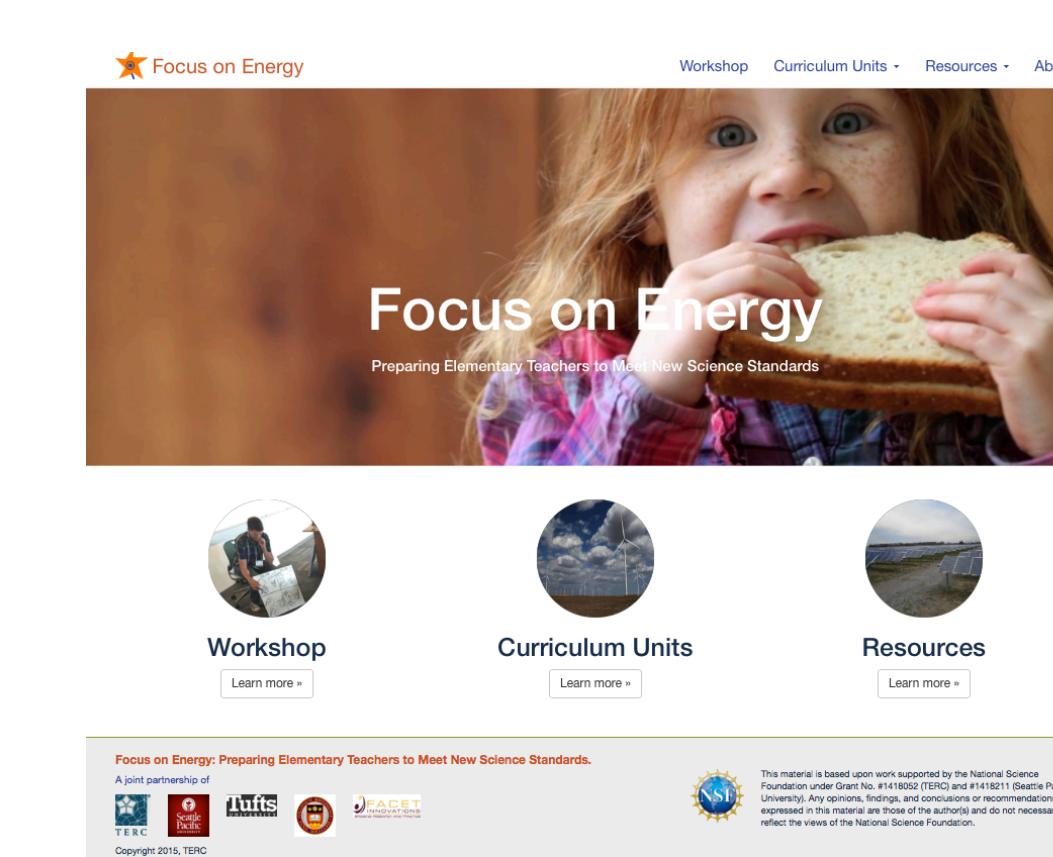
### Classroom Activities

- A coherent sequence
- Students use science practices to investigate scenarios and and develop a scientific account of the flow of energy.



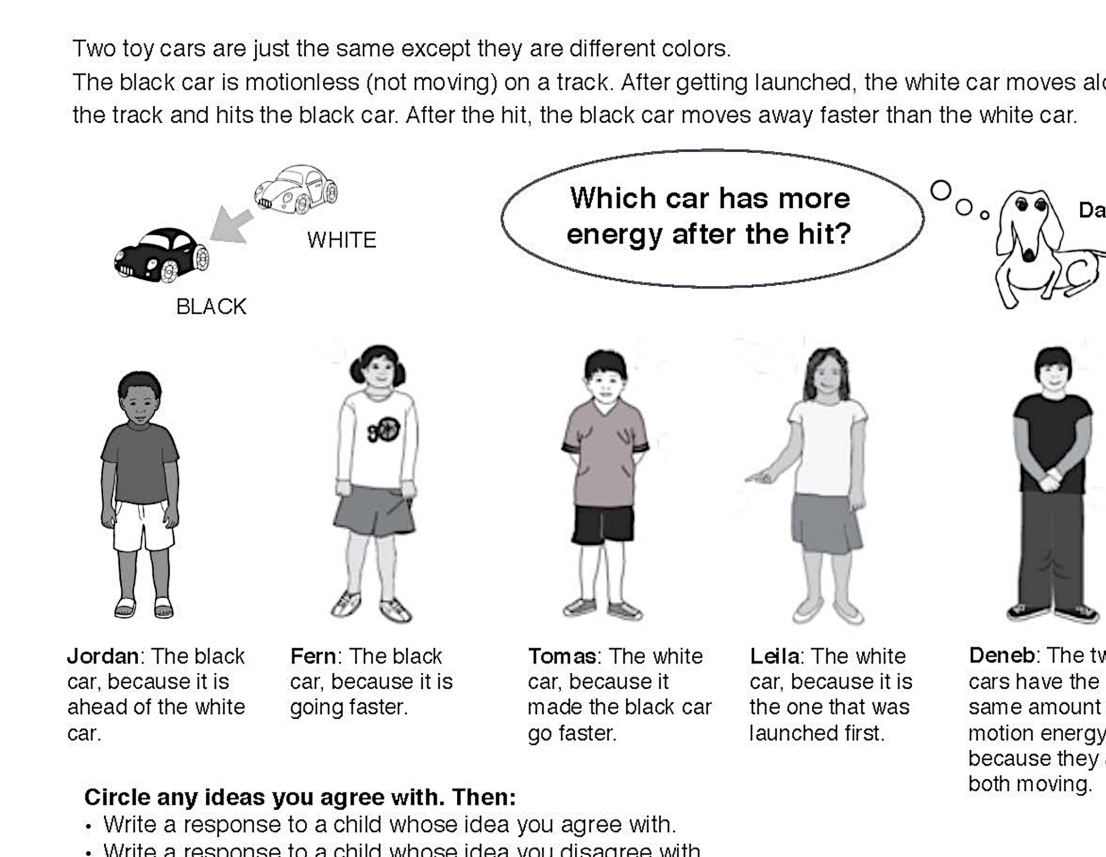
### Web-Based Resources

- Teacher guides
- Video resources and cases
- Workshop material



### Formative Assessments to

- interpret,
- evaluate, and
- productively cultivate student ideas about energy



### Summative Assessments

- Entertaining scenarios
- Responses mapped to a progress variable
- Computer based

