



Good Thinking! The Science of Teaching Science

Professional Development Discussion Guide

About *Good Thinking!*

Good Thinking! is an original animated series developed by the Smithsonian Science Education Center (SSEC) and FableVision Studios as a professional development resource for K-12 science educators. The series brings viewers into the classroom of science educator Isabella Reyes as she explores “the science of teaching science.” Drawing from peer-reviewed research in science, cognition, and pedagogy, *Good Thinking!* distills valuable findings from hard-to-access journal articles to reveal common student misconceptions and promote effective classroom practices.

How to use this guide:

This format was designed to flexibly fit into PLC meetings, PD workshops, or any time that you and your colleagues can meet to absorb some new ideas and discuss your experiences as educators.

The students in the *Good Thinking!* classroom were designed as 5th graders, but research has shown that student ideas about major topics in science are remarkably similar across K-12 grade levels, mainly due to common misconceptions being inadequately addressed or unintentionally reinforced during formal education. While the content of the series is relevant to all levels of instruction, teachers working at the oldest and youngest ends of the K-12 range may need to include additional discussion during the post-viewing conversation that addresses the implications of the videos for their specific grade level.

Requirements:

- Access to a strong internet connection for streaming video
- A screen large enough for group viewing
- Copies of this guide for each participant

Discussion objectives: *Good Thinking! – Fired Up About Energy*

- Develop a more nuanced understanding of the way energy moves through systems, including: energy conservation, transfers, and dissipation
- Learn to discuss energy with students more clearly by using precise language
- Identify common sources of student confusion surrounding energy and pick up strategies for effective methods to build student understanding

The mission of the Smithsonian Science Education Center is to improve K-12 teaching and learning of science for all students in the United States and throughout the world. The center is nationally and internationally recognized for the quality of its programs and its impact on K-12 science education.

Procedure

1. Establish ground rules to create an environment conducive to professional development:
 - a. Introduce yourself to any participants you may not know. In a large group it may be helpful to select one individual to serve as the facilitator for the session.
 - b. Agree upon a brief outline of session length, goals and structure. This module is designed to promote exchanges of knowledge between a group of peers, so it may be helpful to divide participants into smaller subgroups by similar academic levels or content area.
 - c. Establish guidelines for productive participation and distribute writing materials to each participant.
2. **Before Viewing** – Each participant should take some time to respond to the questions below on their paper. The amount of time needed to answer these questions may vary, but thorough responses are encouraged, as they will be helpful to the discussion later in the session:
 - How would you best explain the phrase “conservation of energy” to students?
 - What are the different ways that the word “energy” is used in popular culture? How do these applications relate to the scientific concept of energy?
 - Do you
3. **Watch the Episode:** *Good Thinking! – Fired Up About Energy*
Streaming video links available via:
 - a. YouTube
 - b. Smithsonian Science Education Center
 - c. PBS LearningMedia
4. **After Viewing** – Once you have finished watching the episode, begin a discussion using the following questions as a framework. For larger groups, it may be helpful to have the PD facilitator read the prompts aloud and actively manage the time and flow of the conversation:
 - What difficulties have you had in conceptualizing or discussing energy, either personally or with your students?
 - What tools can help teachers to explain the concepts of conservation of energy and energy transfer to students?
 - **Option:** Return to the video and re-watch section: **1:09-3:14**. How did Ms. Reyes’ questioning strategy help to draw out her students’ ideas about energy? What factors likely influenced her students’ conceptions of the topic?
 - **Option:** Return to the video and re-watch section: **4:34-5:37**. How could Ms. Reyes’ choice of wording contribute to the development of student misconceptions? What are some examples of precise language you have used to keep your meaning clear to your students.
 - Do you see any similarities between the student misconceptions about energy shown in this video and misconceptions you’ve encountered while teaching other areas of science?

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5. **After the Discussion** – Once your group has finished discussing the prompts and exchanging experiences, give a brief recap of the major takeaways from the conversation. For larger groups, it may be useful for the facilitator to collect one or two salient points from each subgroup's discussion to share on a large sheet of paper. Conclude the session by highlighting any suggestions for effective practices that were shared by the group.

Thanks for tuning in to Good Thinking! We hope you found this session to be informative, and appreciate the contribution of your experience, time, and ideas.

References:

AAAS (2014) Misconception References – Topic: Energy. Retrieved from: <http://assessment.aaas.org/topics/EG#/>

Herrmann-Abell, Cari & DeBoer, George. (2011). Investigating Students' Understanding of Energy Transformation, Energy Transfer, and Conservation of Energy Using Standards-Based Assessment Items. Presented at the Annual Meeting of the *National Association for Research in Science Teaching*. Orlando, Florida.

Kruger, C. (1990). Some primary teachers' ideas about energy. *Physics Education*, 25(2), 86–91.

Magnuson, Shirley & Krajcik, Joseph. (1993). Teacher Knowledge and Representation of Content in Instruction about Heat Energy and Temperature. Presented at the Annual Meeting of the *National Association for Research in Science Teaching*; Atlanta, Georgia.

Nordine, Jeffrey; Krajcik, Joseph; & Fortus, Davide. (2010). Transforming Energy Instruction in Middle School to Support Integrated Understanding and Future Learning, *Science Education*. 670-699.

Papadouris, N., Constantinou, C. P., & Kyratsi, T. (2008). Students' use of the energy model to account for changes in physical systems. *Journal of Research in Science Teaching*, 45(4), 444–469.

Pinto, Roser; Cuoso, Digna; & Gutierrez, Rufina. (2005). Using Research on Teachers' Transformations of Innovations to Inform Teacher Education. The Case of Energy Degradation, *Science Education*. 89 (1), 1-12.

Trumper, R. (1990). Being constructive: An alternative approach to the teaching of the energy concept—Part one. *International Journal of Science Education*, 12, 343–354.

Suggested Resources:

Millar, Robin. (2005). Teaching About Energy. *University of York Department of Educational Studies*.