Smithsonian
Science Education Center

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! – Falling 101*

- Refresh your understanding of gravity, inertia, acceleration and air resistance
- Gain exposure to common student misconceptions about how and why things fall
- Develop a deeper understanding of how the life experiences of students can affect their ability to understand new scientific topics
- Pick up new strategies for using common experiences to introduce abstract scientific concepts

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 describe the difference between mass and weight?
    - If a leaf and a marble were dropped from the same height at the same time, which would hit the ground first? Why?
    - Do you think that students' life experiences help or hinder their understanding of scientific concepts? How?

3. **Watch the Episode**: *Good Thinking! – Falling 101*
    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:

- **Option**: Return to the video and re-watch section: **2:42-3:31**. In the clip, Shawna demonstrates a misconception grounded in her life experience. In your time teaching science, what other misconceptions have you observed that were shaped by the life experiences of your students.
- **Option**: Return to the video and re-watch section: **7:25-8:16**. In the clip, Albert explains the difference between real and ideal situations and how this disparity can be confusing to students. Have you experienced this dynamic while teaching in your content area? If so, what strategies did you use to address this situation with your students?
- **Option**: Return to the video and re-watch section: **8:17-8:53**. In the clip, Ms. Reyes plans to use a common experience as an example to introduce the topic of air resistance to her students. Do you have any similar examples that have worked well to introduce your class to abstract topics?

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:

Berg, Terrance & Brouwer, Wytze. (1991). Teacher Awareness Of Student Alternate Conceptions About Rotational Motion and Gravity.*Journal Of Research In Science Teaching*, 28 (1), 3-18.

Cahyadi, M. Veronica & Butler, Philip H. (2004). Undergraduate Students' Understanding of Falling Bodies in Idealized and Real-World Situations. *Journal Of Research In Science Teaching*, 41 (6), 569–583.

Galili, Isaac. (2001). Weight versus gravitational force: Historical and educational perspectives. *International Journal of Science Education*, 23 (10), 1073- 1093.

Gönen, Selahattin. (2008). A Study on Student Teachers' Misconceptions and Scientifically Acceptable Conceptions About Mass and Gravity. *Journal of Science Education and Technology*, 17, 70-81.

Morrison, Richard C. (1999). Weight and Gravity: the Need for Consistent Definitions. *The Physics Teacher*, 37 (51), 51-52.

Newton, Issac. (1687). *Philosophiæ Naturalis Principia Mathematica*.

Smith, Robin G. & Peacock, Graham. (2009). Tackling contradictions in teachers' understanding of gravity and air resistance.*Evaluation & Research in Education*, 6 (2-3), 113-127.