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! – Conceptual Change: How New Ideas Take Root*

- Develop a more nuanced understanding of how student ideas are formed both in and outside of the classroom
- Build a conceptual framework for the sources of student ideas and ways that these ideas can affect student learning
- Identify strategies to elicit and use student misconceptions to enhance classroom practices

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. If time allows, participants may benefit from briefly discussing their responses in small groups:

    - How would you describe a scientific misconception?
    - In your experience, to what extent are students "blank slates" when they enter your classroom?
    - How do you think student preconceptions could affect their understanding of new scientific concepts?

3. **Watch the Episode**: *Good Thinking! – Conceptual Change: How New Ideas Take Root*
    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:

    - Students are almost never "blank slates" in terms of academic subject matter, particularly in science. How do student ideas affect the way they learn new material, and how does this dynamic influence your teaching practice?
    - Student misconceptions can be a useful entry point to facilitate learning. How have you experienced student misconceptions during your teaching career, and what strategies did you use to overcome or embrace them?
    - In the video, the process of conceptual change is shown occurring over several weeks. Do you feel this is an accurate representation of the learning process? What steps could a teacher take to sustain the impact of new ideas throughout the school year?
    - What suggestions can you share for strategies to better elicit student ideas, and address student misconceptions?

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:

Chi, M. T. H. (2005). Common sense conceptions of emergent processes: Why some misconceptions are robust. *The Journal of the Learning Sciences*, 14, 161-199.

diSessa, A. A. (1993). Toward an epistemology of physics. *Cognition and Instruction*, 10(2 & 3), 105-225.

Limón, M. & Mason, L. (Eds.) (2002). Reconsidering conceptual change: Issues in theory and practice. Dordrecht, The Netherlands: Kluwer.

Posner, G. J., Strike, K. A., Hewson, P. W., & Gertzog, W. A. (1982). Accommodation of a scientific conception: Toward a theory of conceptual change. *Science Education*, *66*(2), 211-227.

Schneps, M., & Sadler, P. M. (1989). A private universe [Video]. Santa Monica, CA: Pyramid Film and Video.

Suggested Resources:

Keely P. (2012) Misunderstanding misconceptions. Science Scope (4/5): pp. 12-15