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! – Photosynthesis: Blinded by the Light*

- Gain a better understanding of photosynthesis reactions and how plants use light energy for nutrition and growth
- Improve questioning strategies to elicit student ideas about photosynthesis and plant growth
- Learn about common sources of student misconceptions about photosynthesis and pick up new strategies for addressing and embracing these ideas

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 describe photosynthesis to a group of students in simple terms?
    - A California redwood tree can grow more than 3 feet in height each year in favorable conditions. Where does most of this new mass come from?
    - Most students arrive at school having heard some information about photosynthesis. How do you think this prior knowledge can affect learning of the topic?

3. **Watch the Episode**: *Good Thinking! – Photosynthesis: Blinded by the Light*
    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:

- As Blossom explains in the video, misconceptions can provide great starting points for learning. How have you used student misconceptions as a teaching tool in your own practice?
- The language we use as shorthand to explain scientific processes can significantly affect the development of student ideas — and can be a source of misconceptions. **Option**: Return to the video and re-watch section: **1:53-3:03**. How did the narration from the nature documentary contribute to Amar's misconception? What strategies can teachers use to address misleading information with their students?
- **Option**: Return to the video and re-watch section: **5:18-6:27**. In this clip, Blossom explains that students tend to compartmentalize their thinking about topics within chemistry and biology, which can promote the development of misconceptions. Have you observed similar disconnects in your teaching practice? How can teachers better connect the subject matter from different scientific topics for their students?

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:

American Association for the Advancement of Science. (2011). Project 2061 science assessment website. Retrieved December 03, 2014 from: http://assessment.aaas.org/pages/home

Eisen, Y., & Stavy, R. (1988). Students' understanding of photosynthesis. *The American Biology Teacher*, 208-212.

Stern, L., & Roseman, J. E. (2004). Can middle-school science textbooks help students learn important ideas? Findings from Project 2061's curriculum evaluation study: life science. *Journal of Research in Science Teaching*, 41(6), 538-568.

Kesidou, S., & Roseman, J. E. (2002). How well do middle school science programs measure up? Findings from Project 2061's curriculum review. *Journal of Research in Science Teaching*, 39(6), 522-549.

Wandersee, J.H. (1985).Can the history of science help science educators anticipate students' misconceptions? *Journal of Research in Science Teaching*, 23, 581–597.

Roth, K., & Anderson, C. W. (1987). *The Power Plant: Teacher's Guide to Photosynthesis*. The Institute for Research on Teaching, College of Education, Michigan State University.

Suggested Resources:

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