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! – Natural Selection: Common Misconceptions*

- Gain a more nuanced understanding of the main drivers of evolution – including natural variation, evolutionary fitness, inherited traits and natural selection
- Improve questioning strategies to better elicit student ideas about evolution
- Identify common sources of student confusion surrounding the concept of natural selection and pick up tips for using precise language and avoiding reinforcing student misconceptions

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 is "survival of the fittest" similar or different from natural selection? What does it mean to be biologically "fit"?
    - How is an understanding of evolution important to other key areas in science such as ecology, conservation and medicine?
    - What barriers to student understanding have you encountered in teaching evolution to your students?

3. **Watch the Episode**: *Good Thinking! – Natural Selection: Common Misconceptions*
    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:

- Have you experienced misconceptions about evolution in your teaching practice? If so, what were these ideas, and how did they influence your students' ideas about other areas of science?
- **Option**: Return to the video and re-watch section: **5:49-7:36**. How did Ms. Reyes' choice of language during her lesson affect Dimitri's concept of biological "fitness"?
- **Option**: Return to the video and re-watch section: **7:51-8:31**. In this clip, Blossom explains that natural variation is a central driver of evolution. When do you think students should first be introduced to these types underlying concepts? How can teachers incorporate an awareness of evolutionary principles throughout formal education?
- Many misconceptions about evolution and natural selection stem from confusing or misunderstood language. What strategies teachers use to keep discussions of natural selection focused and clear for 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:

AAAS (2014) Misconception References – Topic: Evolution and Natural Selection. Retrieved from: http://assessment.aaas.org/topics/EN#/

Bishop, B. A., & Anderson, C. W. (1990). Student conceptions of natural selection and its role in evolution. *Journal of Research in Science Teaching*, *27*(5), 415–427.

Carr, E.C. (1928) Orchid Pollination Notes. *Journal of Malayan Branch of the Royal Asiatic Society*. Vol 6. No.1 (102): 49-73.

Gregory, R. (2009) Understanding Natural Selection: Essential Concepts and Common Misconceptions. *Evolution Education and Outreach*. 2:156-175.

Lehrer, R. Schauble L. (2012) Seeding Evolutionary Thinking by Engaging Children in Modeling Its Foundations. *Science Education*, Vol. 96, No. 4, pp. 701–724

Speth, E. Shaw, N. Momsen, J. Reinagel, A. Le, P. Tagieddin, R. Long, T. (2014) Introductory Biology Students' Conceptual Models and Explanations of the Origin of Variation. *Life Sciences Education*. 13(3): 529-539.

Suggested Resources:

Berkeley (2014) Evolution 101 - *Understanding Evolution*: http://evolution.berkeley.edu/evolibrary/article/evo_01