



## **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 5<sup>th</sup> 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! – Tis the Season for a Reason***

- Refresh your understanding of Earth’s seasons and their relationship to observable phenomena throughout the year
- Identify common misconceptions about the causes of Earth’s seasons and pick up tips to elicit and address these ideas with your students
- Discover helpful references and classroom models for teaching Earth’s seasons in a classroom setting
- Share advice and experience about teaching complex phenomena of the natural world

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 describe the cause of Earth’s changing seasons to a group of students in simple terms?
  - Do you think the majority of your students have a firm grasp on the relative positions of the Earth and the sun throughout the year? Why do you think this is?
  - Why is it important for students to understand the causes of everyday natural phenomena (e.g. Earth’s seasons, phases of the moon)? What impact, if any, do you think mastery of these concepts has on a student’s academic success?
3. **Watch the Episode:** *Good Thinking! – Tis the Season for a Reason*  
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:
  - Many misconceptions about the causes of common natural phenomena, such as the reason for Earth’s seasons, are inadequately addressed during formal education and often persist into adulthood. Why do you think this is? What can teachers do to improve these understandings?
  - **Option:** Return to the video and re-watch section: **3:30-4:02**. In the clip, Ms. Reyes asks Shawna to illustrate her concept of Earth’s seasons to expose her misconception. What techniques do you use to elicit student ideas in your classroom? Why are these methods effective?
  - The small size of Ms. Reyes’ class is helpful for allowing her to work with students individually to address their misconceptions. How can these practices be scaled up to a larger class size? What strategies do you use to identify and address individual misconceptions among larger groups of students?

- Having students actively participate in modeling scientific processes can be a useful way to help them engage with difficult subject matter. **Option:** Return to the video and re-watch section: **8:46-11:08**. In the clip, Ms. Reyes asks Shawna and Amar to model Earth's path around the sun over the course of a year to help them understand the causes of Earth's seasons. Do you use any similar modeling activities to teach scientific phenomena in your classroom? If so, please share how you carry out the activity and why it is effective for promoting student understanding.
- 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:

- Atwood, R. & V. Atwood (1996). Preservice Elementary Teacher's Conceptions of the Causes of Seasons, *Journal Of Research In Science Teaching*, 33 (5), 553–563.
- Bulunuz, N. (2007). *Understanding of Earth and Space Science Concepts: Strategies for Concept Building in Elementary Teacher Preparation*, Dissertation, Georgia State University.
- Kikas, E. (2004). Teachers' Conceptions and Misconceptions Concerning Three Natural Phenomena, *Journal of Research in Science Teaching*, 41 (5), 432–448.
- Lee, V. (2010). How Different Variants of Orbit Diagrams Influence Student Explanations of the Seasons, *Science Education*, 94 (6), 985–1007.
- Plummer, J.D., & L. Maynard (2014). Building a Learning Progression for Celestial Motion: An Exploration of Students' Reasoning About the Seasons, *Journal of Research in Science Teaching*, 51 (7), 902–929.
- Schneps, M., & Sadler, P. M. (1989). *A Private Universe* [Video]. Santa Monica, CA: Pyramid Film and Video.
- Schwarz, C. V. & Y. N. Gwekwerere (2007). Using a Guided Inquiry and Modeling Instructional Framework (EIMA) to Support Preservice K–8 Science Teaching, *Science Education*, 91, 158–186.