

## Lesson Four: The Scientific Process

**Background:** How do scientists create new knowledge, and why should we have confidence in their conclusions? At the heart of the matter is the community of scientists and scientific organizations that manage and conduct peer review. Over time peer review hones past understandings of the natural world and replaces them with better ones. Although the development of scientific knowledge can be slow (for example, we are still trying to understand cancer even after many decades of research), nonetheless the benefits of science are visible almost anywhere we look. (See Appendix 5 for further information about the nature of science.)

One goal of Lessons 3 and 4 is to illustrate the value of scientific organizations (the American Academy of Pediatrics and other groups) in reviewing and synthesizing scientific research, and then communicating it in useful forms. Practice 8 of the Next Generation Science Standards (NGSS) is “obtaining, evaluating, and communicating information.” Scientific organizations have been critically important to that practice for centuries.

**Preparation:** If you want additional information about the peer review process, here is a useful three-minute [YouTube video](#). Review optional Lesson 5 (below) and decide whether to use it. Download “Resisting Scientific Misinformation Part 4.mp4.”

**Procedure:** This lesson has 3 parts. Total class time is about 45 minutes.

- **SHOW THE VIDEO (4 minutes):** *How* do scientists reach consensus, providing reliable conclusions about the way the natural world operates? *Why* does the scientific process produce trustworthy information? Are there modern parallels to people accepting false claims about blood-letting? [Example: anti-vaccination advocates.]
- **DISCUSS PEER REVIEW (7 minutes):** Ask students: What is peer review? Why is peer review important? Can you give an example of a scientist making a mistake? How are scientific errors corrected? What are examples of knowledge gained by scientists? Is it sufficient to have “a natural instinct for science” to know which claims are true?
- **CONDUCT RESEARCH AND WRITE A SHORT NOTE ABOUT INCREASING INFANTS’ IQ (25 minutes)\*:** Ask students to imagine that their aunt or a friend of the family has a new baby and wants advice. Students should write a note and in a few paragraphs provide advice to parents of very young children, ages zero to 18 months, who want their child to grow up to be intelligent, specifically addressing whether video or other media use will help babies and toddlers under 18 months old develop their minds better and more quickly. (See resource list below.)

Students could work individually, in small groups, or as a whole class. We recommend starting with a **whole-class approach** to conduct research online under the teacher’s direction so all students are engaged, not off topic. (Which approach you use depends on the availability of computer devices, on how well your students read and write

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\* The subject of vaping, or e-cigarettes, would be a good alternative topic for research by students. See Appendix 4.

English, and other factors.) (Tip: You may want your students to include in the written note a list of the sources they used, perhaps in a standard format for references.)

**Background:** For more than 20 years, media products have been marketed that promise to raise babies' IQ scores, increase their brain capacity, teach them language at an earlier age, or otherwise improve their cognitive development. One of the earliest product lines was called Baby Einstein. Even now, new products (apps, in this case) are being marketed that make claims like the following: “[This product] *literally opens infant brain receptors resulting in increased attention span, profound expansion of memory, greater affinity for language development and dramatically increases your child's ability to rapidly process auditory information.*” (See Appendix on last page of this Guide for information about this product. However, it does not seem appropriate to name the product in class because the company's claims are not credible, and you do not want to promote the product.)

Here are several online sources of information about very young children and media that can be referenced during class (and surely there are others):

- 2016 [recommendations](#) from the American Academy of Pediatrics (AAP) about media and young minds. (An Adobe Acrobat version of the same set of recommendations is [here](#).) Because this document is long, help students focus on the Abstract, Conclusions, and Recommendations—those sections that most concisely provide information about using media with very young children. For example, here is one pertinent paragraph in Recommendations to Families:  
“*Avoid digital media use (except video-chatting) in children younger than 18 to 24 months.*”
- A [Wikipedia article](#) about Baby Einstein
- A 2017 article from *Slate*, [The Rise and Fall of Baby Einstein](#)

Here, for another example, is one paragraph from the AAP's 2016 recommendations for all young people (not just infants) (see [this URL](#)):

*“The AAP recommends parents prioritize creative, unplugged playtime for infants and toddlers. Some media can have educational value for children starting at around 18 months of age, but it's critically important that this be high-quality programming, such as the content offered by Sesame Workshop and PBS. Parents of young children should watch media with their child, to help children understand what they are seeing.”*

**Additional information:** Vaping, using e-cigarettes or other devices, has quickly become popular among high school students. There is a great deal of misinformation circulating about vaping, such as that vaping is not addictive even if the vapor includes nicotine. At the end of this unit (Lesson 4 or 5) some teachers may want their students to learn more about vaping. One good, short resource is an NBC News video: <https://www.nbcnews.com/think/video/how-e-cigarettes-like-the-juul-are-co-opting-the-language-of-wellness-1259469891755>

## Lesson 5: The Scientific Process, Part 2 (Optional)

**Background:** For some teachers, four lessons about scientific misinformation are sufficient. Others may want to devote more time, a fifth lesson, in order to accomplish any of several goals: highlighting high-quality work on the “advice note” students wrote in Lesson 4; expanding class discussion of peer review as a fundamental part of the scientific process<sup>\*</sup>; and, assessing students’ understanding of this unit. (Again, Appendix 5 includes more information about the nature of science.)

**Preparation:** At the conclusion of Lesson 4, collect the notes that students wrote to their aunt or a friend that provided advice about raising an intelligent infant or toddler. Choose one or more examples of notes that you think are of high quality. Also, watch this YouTube video, The Peer Review Process in 3 Minutes: <https://www.youtube.com/watch?v=rOCQZ7QnoN0>. Lastly, use the Learning Goals for this unit (page 2) to create a brief test or assessment, or use the one provided in Appendix 7. (You might also find actual examples of scientific information or misinformation for students to investigate and write about as a final project for grading, similar to what they did as part of Lesson 2.)

**Procedure:** This lesson has four parts.

- **REVIEW ONE OR MORE NOTES STUDENTS WROTE IN LESSON 4 (10 minutes):** Display one or more notes (probably without students’ names) so the class can see them. Ask the class: What makes the advice credible? Why should a recipient believe this advice is any good? What do you think about the trustworthiness of any sources cited in the note?
- **SHOW CLASS THE YouTube VIDEO ABOUT PEER REVIEW AND DISCUSS IT (10 minutes):** The video is about 3 minutes long. After they watch it, ask the class questions like: What is a “referee” for a scientific journal? What is the role of the editor of a scientific journal? What percentage of articles submitted to prestigious journals might be rejected, and what percentage accepted? What are examples of knowledge gained through scientific research that might appear in a scientific journal article?
- **ASK FOR FEEDBACK ABOUT THIS UNIT (5 minutes):** Ask students in what ways they believe this unit was useful to them. What was interesting to them, and why? How might the lessons be improved? (Note: any suggestions you provide to us, the developers, after using this unit would be appreciated.)
- **ASSESS STUDENTS’ LEARNING (20 minutes):** Using test items you develop, or topics you identify that students are asked to investigate (to find out if the claim is true or not), or the test included in Appendix 7, assess what students have learned.

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<sup>\*</sup> In recent years some “scientific” journals have appeared that do not use peer review, or that have lax standards for accepting articles. High-quality journals are essential to science and some accept as few as 10% of the manuscripts they receive.