

Popular Science Nonfiction and the Connection Between Literacy and the *NGSS* by Elizabeth Lamond Price

*Every science or engineering lesson is
in part a language lesson, particularly
reading and producing genres of texts.*

—National Research Council, *A Framework
for K–12 Science Education*



My personal heroes are writers who combine science and popular culture by skillfully communicating complex concepts in ways that allow general audiences a deeper appreciation and understanding of science. Writers such as Bill Bryson, Mary Roach, and Rebecca Skloot reignite my passion for teaching science, and I wanted to expose my students to these authors' inspirational works. To do so, I created an assessment requiring students to read a non-fiction science book of their choice and then critique it through a written reflection and an oral presentation in the form of a video. The purpose of this assignment was to have advanced students work independently to read and critique a book and share their evaluation with the teacher, but this activity can be adapted for a variety of academic levels.

Choosing the books

The school librarian helped me put together a large selection of science nonfiction best sellers using books from the school library and ones purchased to supplement the school's collection (see Figure 1 for a list of the books we included). In addition to asking a school librarian for help, teachers can consult NSTA's list of Outstanding Science Trade Books or NSTA Recommends for ideas (see Resources). Goodreads, a book-recommendation website, features a useful section devoted to lists of science nonfiction books (see Resources). Teachers should look for engaging, well-written books that have been popular with the general public, and they should account for reading level and ensure a broad range of topics.



An entire class period was allotted for book talks, during which the librarian and I spoke passionately about each book and the reasons why it was part of the selection. These brief “commercials,” which lasted approximately one minute per book, were crucial to the assignment's success; enthusiasm spread among students as they heard about the books and the science message within each. Students were encouraged to think about their areas of personal interest and to find a book they would actually enjoy reading. The assessment was also differentiated according to students' reading levels: They could opt for more challenging, abstract content (e.g., James Gleick's *Chaos* or Stephen Hawking's *A Brief History of Time*), or they could read about a more concrete topic (e.g., Neil deGrasse Tyson's *The Pluto Files*). Most students borrowed their books from the school library, although they had the option of purchasing the e-reader version for themselves. Logistically, there were not enough books to cover more than one class at a time, which could prove challenging for teachers who want to run this type of assignment simultaneously with more than one class. This problem can be addressed by limiting the project to a few students per class period.

Reading and critiquing the books

Students were given three weeks to read their book independently, and most carried their book with them throughout the day to take advantage of unstructured time within the school schedule. A set of reflection questions was supplied ahead of time (Figure 2), and students were made aware they needed to find sections from the book they found significant to answer each question. Students used sticky notes to mark off interesting passages in their book as they progressed.

The *Next Generation Science Standards (NGSS)* require that middle school students “gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each...and describe how they are supported or not supported by evidence” as part of the science and engineering practice of Obtaining, Evaluating, and Communicating Information (NGSS Lead States 2013). After reading each book, students answered reflec-

FIGURE 1**A list of nonfiction science books**

| Title | Author |
|--|-------------------------------------|
| <i>Science Versus Pseudoscience</i> | Aaseng, Nathan |
| <i>The Fragile Earth</i> | Amdur, Richard |
| <i>Where the Germs Are: A Scientific Safari</i> | Bakalar, Nicholas |
| <i>The Handy Anatomy Answer Book</i> | Balaban, Naomi E. and James Bobick |
| <i>The Great Influenza: The Story of the Deadliest Pandemic in History</i> | Barry, John M. |
| <i>Technology</i> | Bridgman, Roger |
| <i>A Short History of Nearly Everything</i> | Bryson, Bill |
| <i>The American Plague: The Untold Story of Yellow Fever, the Epidemic That Shaped Our History</i> | Crosby, Molly Caldwell |
| <i>The Selfish Gene</i> | Dawkins, Richard |
| <i>The Brain That Changes Itself: Stories of Personal Triumph from the Frontiers of Brain Science</i> | Doidge, Norman |
| <i>The Attacking Ocean: The Past, Present, and Future of Rising Sea Levels</i> | Fagan, Brian |
| <i>The Weather Makers: How Man Is Changing the Climate and What It Means for Life on Earth</i> | Flannery, Tim |
| <i>When Plague Strikes: The Black Death, Smallpox, AIDS</i> | Giblin, James Cross |
| <i>Outliers: The Story of Success</i> | Gladwell, Malcolm |
| <i>The Tipping Point: How Little Things Can Make a Big Difference</i> | Gladwell, Malcolm |
| <i>Chaos: Making a New Science</i> | Gleick, James |
| <i>A Brief History of Time</i> | Hawking, Stephen |
| <i>The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements</i> | Kean, Sam |
| <i>Mountains Beyond Mountains: The Quest of Dr. Paul Farmer, a Man Who Would Cure the World</i> | Kidder, Tracy |
| <i>Salt: A World History</i> | Kurlansky, Mark |
| <i>This Is Your Brain on Music: The Science of a Human Obsession</i> | Levitin, Daniel J. |
| <i>Freakonomics: A Rogue Economist Explores the Hidden Side of Everything</i> | Levitt, Steven and Stephen Dubner |
| <i>Oil and Honey: The Education of an Unlikely Activist</i> | McKibben, Bill |
| <i>An American Plague: The True and Terrifying Story of the Yellow Fever Epidemic of 1793</i> | Murphy, Jim |
| <i>Kill or Cure: An Illustrated History of Medicine</i> | Parker, Steve |
| <i>The Omnivore's Dilemma: A Natural History of Four Meals</i> | Pollan, Michael |
| <i>The Demon in the Freezer</i> | Preston, Richard |
| <i>The Hot Zone</i> | Preston, Richard |
| <i>Panic in Level 4: Cannibals, Killer Viruses, and Other Journeys to the Edge of Science</i> | Preston, Richard |
| <i>Gulp: Adventures on the Alimentary Canal</i> | Roach, Mary |
| <i>Packing for Mars: The Curious Science of Life in the Void</i> | Roach, Mary |
| <i>Spook: Science Tackles the Afterlife</i> | Roach, Mary |
| <i>Cosmos</i> | Sagan, Carl |
| <i>The Demon-Haunted World: Science as a Candle in the Dark</i> | Sagan, Carl |
| <i>Fish Facts & Bird Brains</i> | Sattler, Helen Roney |
| <i>Fast Food Nation: The Dark Side of the All-American Meal</i> | Schlosser, Eric |
| <i>Generation Green: The Ultimate Teen Guide to Living an Eco-Friendly Life</i> | Sivertsen, Linda and Tosh Sivertsen |
| <i>The Immortal Life of Henrietta Lacks</i> | Skloot, Rebecca |
| <i>Sharks Have No Bones: 1001 Things Everyone Should Know About Science</i> | Trefil, James |
| <i>The Pluto Files: The Rise and Fall of America's Favorite Planet</i> | Tyson, Neil deGrasse |
| <i>Biomedical Ethics</i> | Wagner, Vigi |
| <i>Green Illusions: The Dirty Secrets of Clean Energy and the Future of Environmentalism</i> | Zehner, Ozzie |

tion questions regarding the main idea of the book and were asked to provide the evidence the author used to support these points. The science standards also outline in Appendix M the connections between the *Common Core State Standards* and the *NGSS's* science and engineering practices for grades 6–8, particularly the practice of Obtaining, Evaluating, and Communicating Information: “The demand for precision in expression is an essential requirement of scientists and engineers...a focus on clearly communicating complex ideas and information by critically choosing, arranging, and analyzing information” (NGSS Lead States 2013). The standards reinforce the practice of evaluating the merit of scientific claims as critical to scientific literacy.

It is essential for students to present information in both written and oral forms to accommodate their diverse learning styles. I assessed the written reflection questions formatively so that student understanding could be checked prior to video creation. A few students needed to go into more depth in their critiques, and I made comments on their written reflections or spoke to them personally. This allowed me to differentiate levels of interven-

tion for students who needed extra guidance and derive stronger oral results in the summative video assignment.

Then students filmed a book talk, focusing on the questions found in Figure 2 (see Figure 3 for the video grading rubric). Students can use their smartphone to film the video, or they can borrow video equipment from the school if it is available. Once students completed their video, they shared it with me through a secure network. Depending on the school district's acceptable-use policy, options include uploading the videos to sites such as SchoolTube or YouTube or connecting phones to a district computer and placing the files in a cloud folder accessible to the teacher.

Conclusion

As I watched the videos, I found it rewarding to see students (some of whom were very passive in class) speak eloquently about the complex ideas contained in the books (Figures 4 and 5). Many students brought a level of enthusiasm for science that I had not seen in class, and these results validated the extra step of creating a video. Although the videos were originally shared only with me, I showed the best examples to the class.

FIGURE 2

Reflection questions for nonfiction adapted from LitLovers 2014

1. What is the **central idea** discussed in the book?
2. Do the issues **affect your life**? How so—directly, on a daily basis, or more generally? Now or sometime in the future?
3. What **evidence** does the author use to support the book's ideas? Is the evidence convincing, definitive, or speculative? Does the author depend on personal opinion, observation, and assessment? Or is the evidence factual—based on science, statistics, historical documents, or quotations from credible experts?
4. What kind of **language** does the author use? Is it objective and dispassionate? Or passionate and earnest? Does the language help or undercut the author's premise?
5. What are the **implications** for the future? Are there long- or short-term consequences to the issues raised in the book? Are they positive or negative, affirming, or frightening?
6. What **solutions** does the author propose?
7. How **controversial** are the issues raised in the book?
8. Talk about **one specific passage** that struck you as significant—or interesting, profound, amusing, illuminating, disturbing, sad. What was memorable?
9. What have you **learned** after reading this book? Has it broadened your perspective about a scientific issue—personal or societal?

FIGURE 3**Video grading rubric**

| Criteria | Advanced | Proficient | Basic | Below basic | Points |
|--|--|---|--|--|----------|
| Preparation | 5 | 4 | 3 | 2 | ____/ 5 |
| | Strong evidence that book was read and understood | Evident preparation | Some preparation | Inadequate preparation | |
| Content | 19–20 | 17–18 | 15–16 | <15 | ____/ 20 |
| <ul style="list-style-type: none"> Approx. 1–2-minute book talk that discusses the following: <ul style="list-style-type: none"> What is the central idea discussed in the book? What evidence does the author use to support the book's ideas? What <i>specific</i> passage did you find significant? In summary, what have you learned after reading the book? | Thorough and accurate analysis of the book Superior critical review of the central idea in the book | Satisfactory analysis of the book Sufficient critical review of the central idea in the book | Adequate analysis of the book Basic review of the central idea in the book | Does not meet requirements for a basic assignment | |
| Organization | 5 | 4 | 3 | 2 | ____/ 5 |
| | Highly effective introduction that captures audience's attention Strong, effective conclusion | Effective introduction that captures audience's attention Effective conclusion | Somewhat effective introduction; an attempt to capture audience's attention Inadequate conclusion | Ineffective introduction; little or no attempt to capture audience's attention | |
| Delivery | 5 | 4 | 3 | 2 | ____/ 5 |
| *make sure to display the book | Superior control enhances delivery (pace, enunciation, inflection, volume); employs correct grammar and usage Excellent eye contact | Control enhances delivery (pace, enunciation, inflection, volume); employs correct grammar and usage most of the time Good eye contact | Some control of delivery (pace, enunciation, inflection, volume); employs correct grammar and usage some of the time Some eye contact | Little or no control of delivery (pace, enunciation, inflection, volume); little or no correct grammar and usage Little or no eye contact | |

FIGURE 4**Quotations from student videos**

Most of Malcolm Gladwell's evidence is speculative but very convincing. His evidence depends on a mixture of things—such as by observing statistics from experts' discoveries...he is constantly focusing on stories that support his findings.

—Devon P. (*Outliers* by Malcolm Gladwell)

This book has taught me a lot about music. It's taught me more than I have learned in any music class I've ever taken or any music group I've been a part of. Music theory can be a complex thing to understand, but I've learned so much about it from this book.

—Caitlin R. (*This Is Your Brain on Music* by Daniel Levitan)

The author uses a lot of evidence to support his claims. In the back of the book, there's a long list of references... throughout the book he uses factual information and credible statistics.

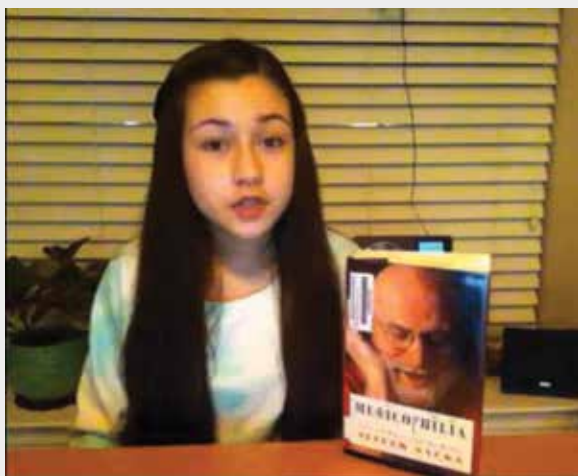
—Leah P. (*How the Mind Works* by Steven Pinker)

The author often uses the source the Centers for Disease Control, or the CDC, to prove his statements. I consider this as evidence because all major illnesses are reported [to] this organization, and when Bakalar gives a true story, he says, in a way, that he got his story from the CDC...Also Bakalar quotes from many scientists and organizations like the American Society of Microbiology and the Food and Drug Administration.

—Andrew S. (*Where the Germs Are* by Nicholas Bakalar)

The author shows both sides of the argument on fast food, though. Every fact he states is based off of interviews with workers or statistics from scientists.

—Matt S. (*Fast Food Nation* by Eric Schlosser)

FIGURE 5**Musicophilia video screenshot**

The key to this assignment is allowing students to pick their own books from a preselected list, a measure of choice that fosters student motivation to build scientific literacy using topics they find interesting. The use of smartphone videos adds a 21st-century dimension, and students overwhelmingly preferred making a video to presenting orally to the class. This assignment required my brightest students to challenge themselves and stretch beyond their usual comfort level and in the end, that is every teacher's goal. ■

Acknowledgment

The author would like to thank Tamanend Middle School librarian Kristi Holloway for her help and support with this project.

References

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- National Research Council. 2012. *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: National Academies Press.
- NGSS Lead States. 2013. *Next Generation Science Standards: For states, by states*. Washington, DC: National Academies Press. www.nextgenscience.org/next-generation-science-standards.

Resources

- Goodreads's lists of science books—www.goodreads.com/genres/science
- NSTA Recommends—www.nsta.org/recommends
- Outstanding Science Trade Books for Students K-12—www.nsta.org/publications/ostb
- SchoolTube—www.schooltube.com
- YouTube—www.youtube.com

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