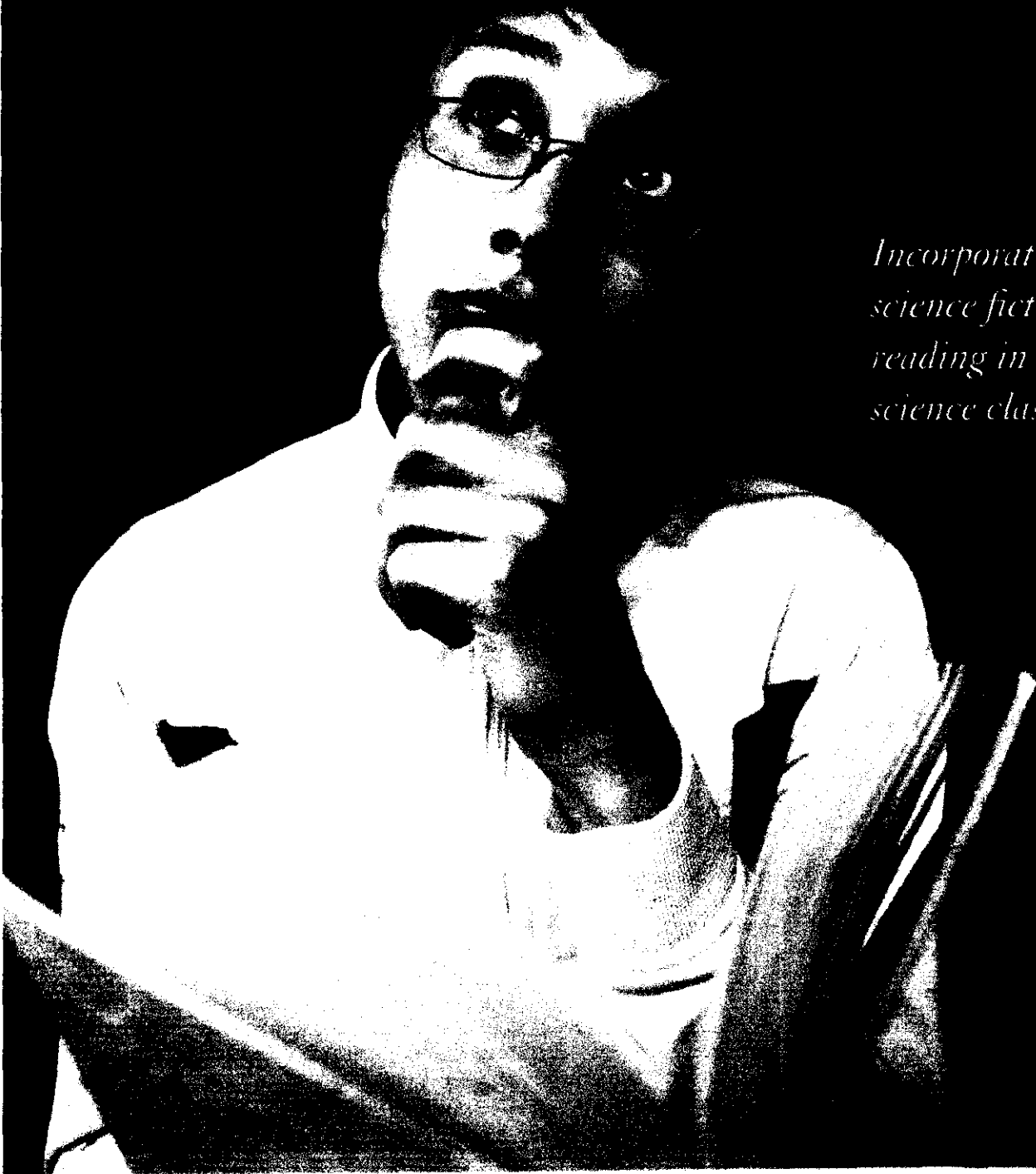


Science Fiction & Scientific Literacy

*Incorporating
science fiction
reading in the
science classroom*



The term *science fiction* has become synonymous, in the media at least, for any discovery in science too incredible or unexpected for the nonscientist to imagine. This without a doubt annoys many scientists because the "fiction" label has the popular connotations of "willingly false or misleading." This image also bothers those who know that in good science fiction the "science" is often to be taken seriously.

One of the most common classroom uses of science fiction is for students to pick out flaws in science fiction movies or television shows. Unfortunately, in my experience, this approach can result in students who come to distrust anything that sounds like science.

Science fiction has so much more to offer in terms of good science and how science works, while at the same time addressing the basics of literacy. Take, for instance, short fiction such as "A Man's Place," by aerospace engineer Eric Choi, originally published in *Space Inc.* (2003). This short story, like all of the stories in the book, focuses on science and the future of work in orbit or outer space. [Editor's note: Teachers can read this story at www.sciencenewsforkids.org/pages/scifizone/choi.asp.] Another good example is *The Cold Equation* by Tom Godwin (2000) that looks at the unalterable and potentially tragic constraints of space travel. These books show why science fiction is an ideal medium for exploring issues in science and society.

In this article I make a case for why science fiction should be a part of science curricula and I provide an all-purpose activity to help teachers use science fiction in the classroom.

The opportunity for literacy skills

Science fiction is read not only for enjoyment, but because it digs into scientific concepts with imagination, creativity, and a thorough appreciation of consequence. Most science fiction authors ask, "What if?" and speculate about what could happen if a certain aspect of science or technology existed—or did not exist. By bringing science into the realm of individual lives as well as entire cultures, these stories are thought experiments about anything we can imagine, from global warming to evolution.

In the past, science fiction stories, with few exceptions, have been viewed as little more than entertainment for young readers, something to whet the appetite for "real books" later in life or to encourage a reluctant student. But they can do much more. I have worked to incorporate science fiction into curriculum with experts at many levels including the Wright Center for Innovations in Science Education, Wayne

State University, Pennsylvania Science Teachers Association, and Science Teachers of Ontario. In many cases individuals most comfortable with the flood of new technologies and scientific discoveries and most able to see past the novelty to the potential for good or ill, have been prepared by their choice of literature. We are living in a world that seems science fictional, and science fiction readers have the advantage of knowing the terrain.

Science fiction internet resources.

- *Oxford English Dictionary's Science Fiction Citations* (www.jessesword.com/sf): Fascinating look at the vocabulary that has come from science fiction.
- Reading for the Future Project (www.sff.net/rff): Maintained by a group of educators, authors, and interested individuals to promote literacy through the use of science fiction.
- Science Fiction Museum and Hall of Fame (www.sfhomeworld.org): Hosts educator resources and events. Provides curriculum guides and activities for several science fiction novels and stories.
- Science Fiction Youth Program (www.ku.edu/~sfcenter/young-SF.htm): Encourages reading, with extensive links to science fiction sites of interest to librarians and young readers.
- Science Fiction and Fantasy Writers of America (www.sfwa.org): Provides resources and contact information, including information on awards.
- SciFiZone (www.sciencenewsforkids.org/articles/SciFiZone.asp): Provides student challenges and teacher support for using science fiction in the classroom.
- SF Site (www.sfsite.com/scribe/scribe01.htm): Excellent searchable database of science fiction, fantasy, and horror writers, with links to author sites and book reviews.
- Speculative Literature Foundation (www.speculativeliterature.org): K-12 resource material for educators as well as resources for writers and academics.
- The Merril Collection of Science Fiction, Speculation, and Fantasy (www.tpl.toronto.on.ca/merril/home.htm): An academic library dedicated to science fiction literature and researchers; able to provide recommendations to educators for specific needs.

Scientific literacy activity: Improving critical reading skills in science using science fiction.

Students have analyzed literature for years in English classes but just never thought, in most cases, of applying those skills to reading science. Teachers can use science fiction author Eric Choi's story and biography (at www.sciencenewsforkids.org/pages/scifizone/choi.asp) as source material for this activity. Teachers should provide the biographical information after students have reached a consensus about the author.

Teacher preparation

- ◆ Prepare the Analysis Cards (Figure 1a), either as reusable stand-alones or handouts. Each card should be on a separate page.
- ◆ Obtain a science fiction short story (3,000–5,000 words) for the class to analyze. To find a story matched to your current science topic or issue, contact a source such as the Science Fiction Museum and Hall of Fame, the Science Fiction and Fantasy Writers of America, or the Merrill Collection of Science Fiction, Speculation, and Fantasy (see "Science fiction internet resources" on p. 39). Review the cards and prepare answers to the questions for this story yourself.
- ◆ Obtain science nonfiction such as articles from *Discover*, *Popular Science*, and *Science News* magazines, newspaper "science" columns, brochures from varying sources, print versions of media broadcasts, or documentaries (ideally both current and older than 20 years) for students to analyze. A wide variety is preferable to allow a comparison of credible and some less credible sources while honing critical reading skills. Students could bring in articles or request news transcripts. Excerpts from science textbooks can also be used effectively.

Procedure

[**Note:** I prefer that students work in small groups to allow discussion and consensus. However, this can be done as a class activity.]

Part I: Science fiction

1. Provide students with the short story and allow them time to read to themselves. If time does not permit a full story, or if reading levels vary greatly, choose an excerpt to read aloud to the class. (Provide interested students with the complete story later.)
2. Give each group a different Analysis Card. Allow 10 minutes for student groups to discuss and answer the questions on their card. Encourage students to make their best guess. You want them to pick up impressions from the writing presented to them. After discussion, you can share more detailed information about the author.
3. Have a member of each group read aloud their card to share their group's response with the class. Discuss the answers as a class.

[**Note:** Students should gain an awareness of source, in terms of influences on the author and what the author wishes to convey through the story. As well, they should have an awareness of context. While great stories transcend time or setting, the social and scientific landscapes of when and where the story was written, and its context, have a profound impact.]

Part II: Nonfiction science

1. Once you feel students have successfully applied critical reading skills to one (or more) science fiction stories, move immediately to the nonfiction part of this activity. It is important to have students read this material while still in the mindset of analyzing the story.
2. Give each group a copy of a nonfiction science article and Analysis Cards 3, 5, and 6. Focus class discussion of student results per article on credibility of source and assumptions by the various authors about the scientific knowledge of readers.

[**Note:** If students have difficulty learning about a nonfiction author, they should rely on the reporting source as part of their criteria for credibility. Students should be able to list the clues they would use to help them rank such sources including apparent bias in surrounding materials, reputation and history of the publication process (e.g., was the material peer reviewed?), and funding. This can be an important lesson in assessing the credibility of materials taken from the internet. As for context, you will likely be using material written within students' own social and scientific experience. Again, point to the publication itself as an indicator. An interesting extension is to repeat with older material.]

FIGURE 1b

Analysis Cards.

(Analysis Cards from Czerneda 1999)

Analysis Card 1

Based on this story, how would you describe the author? Think about: age; sex; physical description; occupation (other than writing); education; attitude toward science; and attitude toward people.

Analysis Card 2

1. What area of science is the author exploring in this story (biology, chemistry, physics, other)? How do you know?
2. What is the scientific premise of this story? Express the main idea in a "what if" statement.

Analysis Card 3

1. When do you think this story was written? What clues did you use to make this decision?
 - What effect might this have had on the author's approach to this story's scientific premise?
2. Where do you think this story was written? What helped you decide?
 - What effect might this have had on the author's approach to this story's scientific premise?

Analysis Card 4

What point(s) is the author trying to make about science in this story? Do you agree or disagree? Why?

Analysis Card 5

1. How did the author present the scientific information needed as background to this story?
 - an expert witness (a character who knows and talks about the science)
 - narrative (description)
 - assumption (assumed a certain level of scientific knowledge from readers)
2. If there was an "expert witness," how did the author convince you that this character could be believed?

Analysis Card 6

What was the role of science presented in this story? Think about:

- If any of the characters in the story were scientists, how were they portrayed?
- What role did science play in the problem that the characters faced in the story?
- What role did science play in the resolution of that problem?
- What does the author have to say about the role of science to society (either today's or that portrayed in the story)?

This is true because science fiction stories, particularly the short form readily available in "Year's Best" anthologies in libraries (Hartwell 2005; Dozois 2005), speculate from known concepts. The authors of these stories ask: "What if this happens?" "What if that continues or even stops?" From this start, good science fiction stories do not violate scientific principles, but rely on them to guide thought experiments through to possible consequence.

Good science fiction is story, science, and speculation all wrapped up in a package custom-made for improving literacy and critical-thinking skills – it does not get more convenient. Literacy concerns the communicating of ideas from one mind to another, including component skills such as vocabulary, language structure, reading, and writing to elicit comprehension. Critical thinking blends with literacy in the interpretation and extrapolation of ideas. There should be an understanding of source as well as context, which is particularly important to students sifting their way through myriad print and visual resources on science.

How can science fiction be used in an already busy classroom? Figure 1(a and b) provides a scientific literacy activity that can easily be worked into any portion of teacher planning. This activity is one I use to develop critical reading skills related to science articles. Students prepare by analyzing a work of science fiction and examining the underlying science idea in terms of the attitude and knowledge conveyed through the story about the author, following this with research on the author. Students examine their own preconceptions, which can be useful to reveal stereotypes.

Next is a very similar analysis of a popular science article which, like any literature, has an author who brings specific knowledge and intention to that writing, as well as works within a certain societal context and time. The end result of this activity is to expand student appreciation of the source of the science they read, as well as improve their ability to assess its credibility. Figure 2 (p. 42) supplies a quick self-assessment tool, to be applied before and after the activity.

Developing scientific literacy is an ongoing process. For this reason, it is helpful to have students participate in assessment. For example, students can complete the quiz in Figure 2 to establish their current scientific literacy and create a baseline. Following the activity in Figure 1, or any other activities that similarly bolster scientific literacy skills, teachers can once again administer the same quiz. Students will readily see which areas they have strengthened due to their participation in the activity in Figure 1 and where they could use more work.

Share the wonder

If there is anything frustrating about writing an article

FIGURE 2

Scientific literacy quiz.

Are you a scientifically literate person? Complete the quiz below to find out. Circle the answer that best applies to you.

(Permission granted to reproduce for classroom use from Czerneda 1999)

1. Can you identify the scientific issues underlying personal and societal decisions?

Most of the Time *Sometimes* *Rarely*

2. Are you able to express your views on those issues in appropriate scientific terms?

Most of the Time *Sometimes* *Rarely*

3. When you evaluate the quality of scientific information, do you consider both its source and the methods used to obtain it?

Most of the Time *Sometimes* *Rarely*

4. Do you feel you make and evaluate arguments based on evidence and apply conclusions from such arguments appropriately?

Most of the Time *Sometimes* *Rarely*

5. (a) Do you ask questions about what makes you curious in everyday life?

Most of the Time *Sometimes* *Rarely*

(b) Do you determine or find the answers to those questions?

Most of the Time *Sometimes* *Rarely*

6. Do you read and understand articles about science in the popular media?

Most of the Time *Sometimes* *Rarely*

7. Do you discuss with peers the validity of the conclusions in such articles?

Most of the Time *Sometimes* *Rarely*

8. Can you distinguish between what is and what is not a scientific idea?

Most of the Time *Sometimes* *Rarely*

like this, it is that I am barely scratching the surface of what science fiction reading and writing can do to help students become scientifically literate—to develop the flexibility of thought and reasoned imagination they will need to succeed in our society. Beyond reading, having students consider a potential impact through writing science fiction lets them work through different points of view in a meaningful way—they start telling stories...about science.

A love of reading produces a person who is literate. A love of reading science fiction produces a literate person open to new ideas, critically aware of the consequences of change, and ready for the future. ■

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