

Textbooks for K-12 Astronomy

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Abstract. I report on American textbooks for kindergarten through high-school grades. Middle school, up through approximate age 15, is the last time American students are required to take science, and I provide statistics on the narrowing of the funnel containing those taking physics. I describe some recent curriculum and standards projects, and I discuss the recent "less is more" trend. I conclude with comments on whether textbooks are necessary and useful and discuss possible content and style of an ideal textbook.

Astronomy is orphaned in many American schools, though it can find its way into classes through earth science or physical science courses or textbooks from age 13 up. Some form of astronomy is a small part of elementary-school texts.

1. Standardized testing and the scientific funnel

A national trend in the United States in the last two years has been an increase in required standardized testing. The unforeseen consequences include the abandoning of topics of secondary importance – like astronomy – in favor of reading, writing, and arithmetic. The National Center for Educational Statistics has provided graphs that show that, most recently for 1999, the percentage of science courses taken through the age of 17 is 88% for general science (the middle-school course, over by age 15), 93% for biology (usually the first course in high school), 57% for chemistry, and only 17% for physics. Since high-school astronomy is most closely related to physics, the magnitude of the problem is obvious.

2. "Less is more"?

Several projects in the United States in the last decade continue to exert influence through their evaluation of prospective science content, if not curriculum. "National Science Education Standards" were drafted by a committee of the National Research Council and "Project 2061," part of the American Association for the Advancement of Science (and named after the date of the next return of Halley's Comet, on the hope that science education will be reformed by then) puts out a variety of documents of varying specificity. The "less is more" philosophy places more emphasis on method than on specific knowledge. As Partridge (2003) writes, "...why do I not describe the emergence of a cadre of professional astronomy educators as an unalloyed good? Here are some concerns.... The

danger that the educator may drive out the astronomer... Balance is needed.” See also Pasachoff (2002) for comments on the emphasis (mistaken in my view) on moon phases and seasons that apply to both K-12 education and to college education.

3. Current textbooks

I have participated in several K-12 projects, originally the *Physical Science* and *Earth Science* texts of Scott, Foresman and Co. (Pasachoff, Pasachoff & Cooney, 1983, 1989). I was able to increase the astronomy content, and to move some of it into *Physical Science* from the other book. There is at least some astronomy content in each chapter of grades K-9, except for *Life Science*. The number of American publishers has been diminishing, as publishers merge or are taken over. Only a handful of middle-school science texts remain. Prentice-Hall tried revamping their middle-school series into a set of a dozen individual-topic books, including *Science Explorer: Astronomy* (Pasachoff, 2000). Since that series was issued, though, the individual chapters were reshuffled and re-released as general science books, sometimes with special content for individual states. Reviews, mostly negative, of middle-school science texts are available at www.textbookleague.org and at www.science-house.org:8530/middleschool/.

4. The value of textbooks

In this World Wide Web-based age, the question is widespread whether students should have a textbook at all. Shouldn't they just use inquiry-based methods, experimenting in class? But can students really figure out by themselves, with whatever guidance, what Kepler, Galileo, Newton, and others accomplished over the years? Current middle-school and elementary-school texts – there are no specific high-school astronomy texts, though college-level survey texts like my own (Pasachoff & Filippenko, 2004) are sometimes used in high schools – contain a mixture of text, labs of varying difficulty and length, notes for teachers, writing activities, math activities, graphing activities, etc. Highly illustrated in color, they can be and are criticized for trying to jam in too much and for providing distracting layouts. Still, the ability of a student to have a reference to a set of things to be learned is invaluable. Furthermore, a large percentage of middle-school and elementary-school teachers are untrained in science in general and astronomy in particular, so it makes sense to at least have substantial material available to all in the classroom.

What is the ideal science text? It would have a mixture of activities to intrigue students with scientific methods that would not be so lame or cook-booky as to turn them off. It would treat material that the students will find interesting, including modern topics. It would be written by professional scientists, who would have a chance to shape the final version or at least vet it for accuracy – something that is now the purview of editors. It would be thoroughly reviewed by a team of scientists before publication, to make certain that everything that is said is correct. It would be marketed to schools and state adoption committees by accuracy rather than readability. Most current texts fail in the last two of these desiderata. But finally, learning is

most affected by the interaction of students in a classroom with teachers. So the training of teachers in science is all-important, and relatively few school teachers are well trained in science. Salaries and working conditions should improve in order to attract students with better academic records into teaching at the school level. Projects like the Astronomical Society of the Pacific's ASTRO, pairing astronomers with teachers, are models of teacher training. See www.astrosociety.org/education/astro/about/partnerships.html. But how to bring such high-quality training to the majority of school teachers remains unknown.

References

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