Science 101

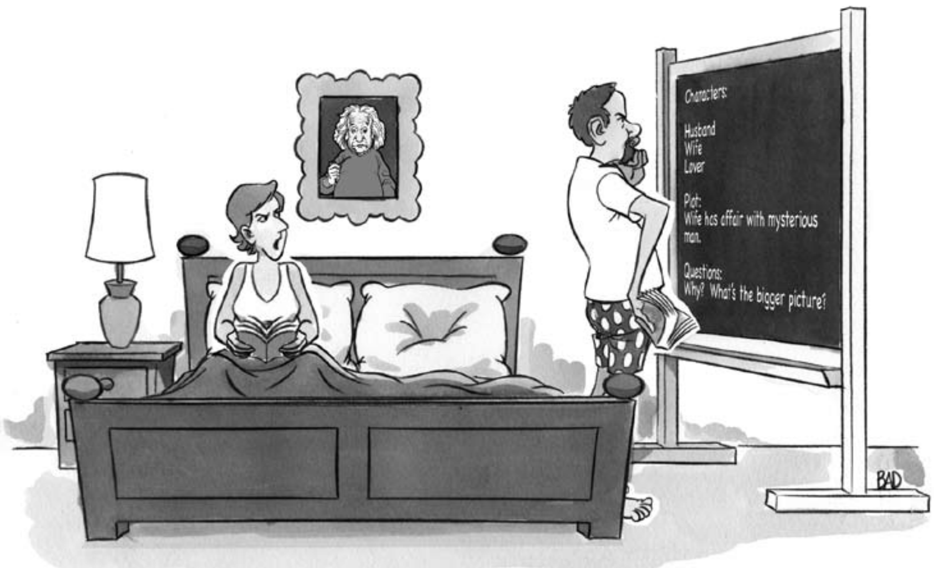
Background boosters for elementary teachers

Q: How is reading science books different from reading other kinds of books?

By Bill Robertson

A: One short answer to this question is that, for many people, there *is* no difference. My wife and I make a good case study for different ways of reading books. Being the nerd I am, I try to analyze such everyday things as different reading speeds and look for a reason. First, here's the difference between our reading styles: My wife can read a novel in about half the time it takes me to read the same novel. Within a year's time, she can pick up the same novel and read it a second time. Me, I read novels once and look at reading one a second time as a tedious task.

Explaining the difference in our reading speeds is pretty simple. I've spent a good deal of time reading science books. My wife's experience is primarily in history and political science reading. A good history book tells a story, much like a good novel. In reading those stories, one is able to read through the text relatively quickly and still get the main points. Science reading is a much slower process. You read science texts to understand specific concepts, and usually few of the words on a page are wasted; just about every word can be significant for understanding the concept at hand. Suffice it to say that my wife has a difficult time with science texts, while I'm so slow I never get through history texts.



"It's a romance novel. Stop analyzing it."

The Research Says So

Backing up this view of science reading is a fair amount of psychological research. For example, there are lots of studies that compare experts (those who have studied or even taught a subject for a long period of time) and novices (those new to a subject) in many areas. One of the earliest such studies was done in chess (Chase and Simon 1973). The researchers found that experts organized their knowledge of chess in a fundamentally different way from how novices looked at the game. The experts saw patterns the novices didn't see and organized their knowledge in "chunks"—large collections of chess-piece positions and possible moves arising from those positions. Similar studies in science problem solving reveal that experts have a rich connection of science concepts and a knowledge of the important features of problems, while novices tend to focus on the surface features of a problem that are often unimportant when considering how to solve those problems (Chi, Feltovich, and Glaser 1981).

For example, it's common for novices to classify problems as a "spring problem," an "elevator problem," or a "pulley problem." Experts, on the other hand, classify problems according to the major principals—Newton's second law, conservation of energy, conservation of momentum—one uses to solve the problems. So, novices often see details but not the big picture while experts see the big picture and use the details as necessary.

Reading Like an Expert

Well, how do you become an expert and see the big picture? You have to understand the important concepts, know all of the subconcepts that are related to the important concepts, and keep everything in the proper hierarchy. Surprise, surprise; this takes time! To develop this richly connected understanding of concepts, you need to read explanations slowly, reflecting on what you have read and how it fits into what you already know. Personally, I can easily spend an hour ruminating over a page or two of reading that covers a particularly difficult science concept. As I ruminate, I ask myself questions, such as, "How does this new material fit in with concepts I've already learned?" and "Are there any real-world experiences to which this material applies?" Perhaps the most important question, though, is "Does this make sense to me?"

An example I often use in teacher workshops is the second part of Newton's first law, which states that objects in motion tend to keep moving in a straight line unless acted upon by an external force. I challenge people to provide an everyday example of a thing moving in a straight line without slowing down or stopping. Of course, there *isn't* an everyday example of this, unless you're an astronaut who spends a lot of time in the Space Shuttle. To understand this part of Newton's first law and have it make sense to you, you have to understand how Galileo (not Newton) came up with this concept. With a couple of other people, I wrote an article on this for *Science and Children*, and I'll refer you to that for an explanation (Robertson, Gallagher, and Miller 2004). But, I digress…back to the main point, which is that if the science you're reading about doesn't make complete sense to you, then you are unlikely to add it to your collection of science concepts that do make sense. You'll either leave the new concepts as unconnected ideas that you are likely to forget, or you'll simply memorize the new concepts and make them last awhile before you then forget them. And again, making sure the concepts make sense takes more time than reading the material as if it were a novel.

It Takes More Than Reading

Of course, reading alone isn't the best way to learn science (Robertson 2006/2007). You need to connect the reading to real-world experiences, as detailed by Perspectives in this issue (p. 56). Teaching Through Trade Books provides a great example of connecting activities to reading (p. 14). Interposing activities and reading helps people understand concepts better, but only if they go slowly enough in the reading to make the connections between activity and concept.

Adding to the slow reading you have to do with science books is the fact that the pages often contain equations and series of equations. To understand what the author is doing, you have to follow his or her math steps, and that takes time. Some books are really good at helping you follow these equations, and others are really good at letting you figure it out on your own. Ironically, some authors seem to believe that the more difficult the material, the less the need for explanation of the equations.

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References

Chase, W.G., and H.A. Simon. 1973. Perception in chess. *Cognitive Psychology* 4: 55–81.

Chi, M.T.H., P. Feltovich, and R. Glaser. 1981. Categorization and representation of physics problems by experts and novices. *Cognitive Science* 5: 121–152.

Robertson, B. 2006/2007. Getting past "inquiry versus content." *Educational Leadership* 64(4): 67–70.

Robertson, W.C., J. Gallagher, and W. Miller. 2004. Newton's first law: Not so simple after all. *Science and Children* 41(6): 25–29.

Importance of Reading Books. Reading is important because it develops our thoughts, gives us endless knowledge and lessons to read while keeping our minds active. Reading books can help us learn, understand and makes us smarter.Â Why Is Reading Important? Books can hold and keep all kinds of information, stories, thoughts and feelings unlike anything else in this world. Can words, paragraphs, and reading fiction be all that great for you and your health?Â Our minds are thinking of a million different things all the time. Reading at least a little each day can improve your focus and your memory function. In this instance as well, it stimulates the brain, particularly the part of the brain that helps with memory and attention. What kinds of books do children like to read? Where can you find cheap or discount books? Do you buy books at a bookstore or at an online bookstore? Idioms. "bookworm" = someone who loves to read "My daughter is a bookworm, and she reads at least two hours a day." "be an open book" = be a person who hides nothing about your life "Please ask me anything. I'm an open book." Listening Exercise.Â What types of material are best for learners of different ages to understand the content they are reading? How can students learn to read without the help of a dictionary? Online Investigation. Reading is a popular activity. Now, many devices such as Amazon Kindle and the iPad make reading even easier. Compare these two electronic readers. How much do they cost?