

# Differentiation in the Science Classroom An Overview of Strategies to Aid in General Science Instruction

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**Abstract:** One could argue that the hardest part about science is reading the material. The vocabulary within the text is difficult, there are many graphs, pictures, equations, diagrams, and tables of information all added to enhance the text, but can be overwhelming (Mason & Hedin, 2011). With all of these various factors contributing to the complexity of science texts, how can students ever read a science text successfully? Through the utilization of literacy accommodations provided by the teacher, students in the regular education science classroom are capable of improving their academic achievement, especially in reading science texts. In this article, accommodations for science texts will be examined, and how these accommodations can fit into various types of instruction within a classroom.

*Keywords: science literature, accommodations, content area literacy, differentiation, instruction*

## Introduction

When considering how to help students read science literature to a regular education science classroom, there are many ways to dissect the problem to find a solution. The best way to go about this task is to take into consideration the audience of the literature, which would be the students and their grade level. In guiding students as they read through various passages, teachers will need to employ various reading strategies to complete this task. This can be completed in a multitude of different ways depending upon the needs of the students individually and the needs of the class as a whole. In any science classroom, students represent a variety of academic abilities and background knowledge. Some students may arrive in the classroom with a firm foundation of previous knowledge and superior reading skills while others may arrive with little to no previous knowledge and poor reading skills that are grade levels behind their peers. Still even other students may be a composite of the two students previously described or have a list of accommodations and services that need to be fulfilled, making the task of assisting students with reading science literature difficult to even the veteran teacher.

In a conversation with a veteran intervention specialist, Kathy Herman, she explained that if there was a technique that helped a student to be more successful in the classroom, try it. If it works, share the technique and the student success with the intervention specialist so they can amplify that success and incorporate the technique into the student's IEP or 504 Plan (personal communication, September 14, 2015). After having this conversation with her, I decided to try new accommodations with my students who have identified needs. After trying various instructional methods throughout the school year, I began to see an increase in both student success and student motivation in all of students. I found that my students put forth more effort into their science studies because I developed rapport with them and recognized their potential to do well in school.

For students that enter a classroom with a disdain for science altogether, whether or not they have a special learning disability, the challenge of helping them learn provides a more complex task for the general education teacher. Not only does the teacher need to figure out how each student learns best, but he/she also needs to implement various practices into his/her lessons. This could be done by having "blanket" accommodations for the entire class, such as reading each question on a test or quiz aloud, or scaffolding a lab activity prior to the students beginning the lab. In this example, the needs of multiple students are met at the same time, it provides support to students who would normally struggle otherwise on various activities, and it does not single any student out.

There is a negative aspect to using "blanket" accommodations in this manner. There is no single, cure-all teaching method or strategy that will lead to success for every student; the learning needs in any classroom are much too diverse. Identifying a specific strategy that works for students could take weeks, months, or sometimes even years in order to see measurable success, and for the students to actively participate and assist with using that strategy. All students in a general education science classroom are capable of improving their academic achievement, especially in reading science texts. Their success depends upon which accommodation can be utilized to take them to the next level in their reading performance.

## The Complexity of Science

Ability and limitations are a common topic of debate when discussing mathematics instruction and learning. There are many misconceptions regarding ability and learning thresholds in mathematics. Such misconceptions lead to negative dispositions and attitudes toward mathematics that directly affect how students view their limitations of mathematical achievement. According to Boaler and Dweck (2016), new studies have proven that the brain can grow and adapt throughout all stages of development in a human's life. They state that "the new evidence

from brain research tells us that everyone, with the right teaching and messages, can be successful in math, and everyone can achieve at the highest level in school” (Boaler & Dweck, 2016, p. 4).

Another common misconception regarding mathematics is that some individuals are naturally “good” at math. Many students have uttered the phrase, “I’m just not good at math and do not have a math brain.” Boaler and Dweck (2016) believe that “there is no such thing as a ‘math brain’ or a ‘math gift.’ No one is born knowing math, and no one is born lacking the ability to learn math” (p. 5). This is vital information for mathematics teachers to consider because it may change how teachers approach instruction regarding low-achievers. All students will not be mathematicians, statisticians, or actuaries, but Boaler and Dweck (2016) argue that all students have the ability to do well in mathematics with the correct mindset and support.

### **Varying Levels of Vocabulary**

To add to the complexity of the nature of science vocabulary there are three levels of how vocabulary can be classified as Beck, McKeown, and Kucan (2002) explained. The difficult nature of the vocabulary along with the complexity of reading science texts and applying that knowledge in a laboratory setting, can prove difficult for students at all levels. In any classroom, students may be affected by the difficult nature of science content, as well as the integration of other subjects, such as mathematics, that are a major part of science curriculum.

There is a large need to stress the understanding of science vocabulary due to the complexity of the field of science. Science content has three levels of vocabulary which are words that have common everyday meanings, words that have common meanings and scientific meanings, and words with only scientific meanings (Beck et al., 2002). To help students understand the meaning of words in science texts, teachers need to utilize various strategies to help students understand the vocabulary in the context of the passage and in science.

Vocabulary instruction is not limited to the classroom and its beginning should be initiated at home when students are young.

Children learn their first words through oral language in the home. Students start school already knowing thousands of words, learned at home through verbal interactions. Children who are provided with the most verbally supportive atmosphere at home (e.g., word explanations, discussions, storybook reading, etc.) learn far more words than those whose families engage in fewer of these verbal behaviors. (Ebbers & Denton, 2008, p. 91)

Without the foundation of common reading skills students are quite unprepared or “under” prepared or both, by the time they reach the secondary science classroom. Combine the lack of basic vocabulary and reading knowledge with the complexity of a science text, and there may be little chance for the student to ever understand the material in a passage. However, there are ways to assist students with reading science texts and to keep them on pace with their peers and increase understanding.

### **Bridging the Reading Gap**

Together, it seems as if teaching science literature is an impossible task in which no student will ever succeed, no matter how hard or diligent a teacher applies his/her knowledge and skills. This feat of teaching students to read and understand science literature is not as difficult as could be perceived. However, it may require accommodations in order to bring students with lower reading skills to the same level as their peers. Before examining the various intervention methods used to accommodate the needs of students, it would be beneficial to review the differences between accommodation and modification. Scanlon and Baker (2012) described an accommodation as a change in the way a lesson is instructed to all individuals in a classroom, and does not require an IEP or a 504 plan in order to do so. Accommodations allow students an opportunity to learn on the same level as their higher achieving peers. When utilizing an accommodation, the curriculum does not change, and all students are being held to the same educational standards. A modification is quite the opposite and requires the alteration of the curriculum and not all students are held to the same educational standard. Modifications “require specific definitions within an IEP or 504 plans for a specific individual student, not an entire class” (Gennerman, 2015, p. 6).

Some interventions that can help in developing various accommodations that any teacher can use in his/her classroom will be discussed. Mason and Hedin (2011) stated that “in science classes, teachers must consider the need for explicit, systematic reading instruction for students with learning disabilities (LD)” (p. 214). Further, they suggest that “The complexity of the information conveyed through print may make science texts the greatest reading challenge that students with LD encounter in school” (p. 215). Due to the complexity of science literature, students require a proper foundation in order to comprehend the material. This foundation as rich background knowledge of science concepts and the ability to make a variety of type of inferences. Problems could arise from this if students are lacking that foundation, making teaching an impossible task in the secondary science classroom (Mason & Hedin, 2011).

To be able to use certain strategies to promote student learning of science concepts from the text, Mason and Hedin (2011) recommend the use of text enhancements. “Text enhancements specific to science text validated in research include: instruction in the use of text

illustrations, creation of representational illustrations, imagery (i.e., visualization), and adjunct aids” (p. 217). Along with text enhancements, the following practices are suggested for effective instruction:

(1) scaffolded and segmented lessons, moving students from simple, concrete text to complex, abstract text; (2) organized, focused, and appropriately paced lessons that contain only well-organized and critical strategies and concepts; (3) review of prior skills and knowledge; (4) goal setting, both the teacher and students should establish goals for what is to be learned; (5) teacher-led modeling by thinking out loud the complete process for applying the strategy to reading science text; (6) use of example and nonexamples of strategy application to text; (7) multiple opportunities for students to respond to what is learned in text; (8) monitoring – teacher monitoring with corrective feedback and student self-monitoring text comprehension; (9) ample guided practice, distributed over time, that ensures students’ mastery and maintenance of strategy application; and (10) opportunities for teacher and student reinforcement for meeting goals. (Mason & Hedin, 2011, p. 220)

These practices offer many ways to modify secondary science curriculum to increase the success of students. Applying these skills in a science classroom will help increase the reading ability and comprehension of science literature.

## Implications

In research studies, there is a focus on accommodating science literacy for students with learning disabilities, but there is little research on accommodations for students who struggle with science as a whole. I believe that all students are in need of some accommodations to succeed in science. This could include the use of a graphic organizer to help students diagram a lesson topic, or something as simple as reading test questions or lab procedures aloud. There needs to be a change within the science teaching community on how our students are being taught to read science literature.

There are multiple ways that science text can be transformed from an intimidating reading passage into a practical piece of literature. Through scaffolding, graphic organizers, and instructing students on the vocabulary within the passage, students should be able to understand the content knowledge that is being presented in the passage. Another key piece is to allow time for students to process the knowledge. Without adequate time for students to learn the vocabulary and to analyze the text, the content knowledge is lost. There is a learning gap amongst educators between science and special education and this needs to change. Additional research is required for advancement in ways to bridge the gap between science and special education teachers, but improvements are slowly being implemented. Making accommodations is a beneficial practice for all students. Once the right accommodations are implemented, the learning possibilities are endless. The accommodations will take time to develop and try, but the success of students being able to read and comprehend science literature will make this time well spent.

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