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How does the use of children's literature support student construction of basic biological concepts?

Dennis J. Mucenski  
*St. John Fisher College*

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"How does the use of children's literature support student construction of basic biological concepts?"

Dennis J. Mucenski

St. John Fisher College
Chapter #1 Introduction

The following is an autobiographical synopsis of why I became a teacher and my motivation to improve my ability to instruct my students. It also includes the question I plan on devoting my next year to answering.

I am a teacher of biology at Pittsford Mendon High School in Pittsford, NY. I have been teaching for three years while also attending St. John Fisher College pursuing my Master's degree in MST. I am very motivated by increasing student learning and retention. I like to try different teaching techniques and see what ones work best in which particular situations. It inspires me when students enjoy an activity, discuss it outside of the classroom and say they learned something. The teacher I am today is a far cry from the teacher I was when I started. Initially, I used teacher-led activities, especially lecture, because of my insecurities as a teacher. Over the course of my tenor at Mendon I have added numerous student-led activities to my bag of tricks thanks in part to what I have learned in graduate school. I have integrated some constructivism techniques learned in a variety of courses whenever possible. I have also found or developed more inquiry based labs allowing students to think more like scientists and less like drones who just follow directions. My teaching and my student motivation have improved as a result of my growth as a teacher. I do not believe that I have even tapped my potential for being a well-rounded teacher. I abhor any class in which my students sit docily and passively, taking in knowledge thrown at them. I yearn for the day when just about every class consists of a fun activity in which students are challenged to think and grow. This is a daunting task not only due to my inexperience, but also because of my student clientele. My students are from the upper middle class, whose interests and interests of their
parents, lies almost exclusively in the grade they receive. Some of the questions I hear on a daily basis are:

“Do we need to know this?”

“Will this be on the test?”

“Why don’t you just tell us the answer?”

“Is this going to be on the regents?”

“Is this in our notes?”

Although the students are highly motivated it is usually for the sole purpose of getting a good grade on the test or in the course. Most of the middle-of-the-road students memorize terms and statements for enough time to regurgitate them on an exam or report. All night cram sessions before the test, or regents review books with questions about topics stated three to four different ways, assist them with this task. The highest achieving students realize this cramming does them no good in the long run and have ascertained that if they learn 5-10 basic concepts they can apply them to the different situations. The learning of concepts allows these higher achieving students to easily pass the exams, but also retain the material for future higher-level science courses. My middle-of-the-road students struggle in these later courses because they no longer remember the information from my class and they are overwhelmed with the sheer volume of facts they have to memorize.

This problem of memorization, and the fact that I want to add another teaching method to my bag of tricks, has led me to the inspiration for my capstone project. I believe that by using children’s literature to teach basic concepts students will memorize less, understand concepts more and be more motivated to learn. I learned a little about
this new cutting edge technique in a literacy class last spring when tradebooks in which discussed. Children's literature can be defined as a "specific picture books, which are a type of tradebook that contain thirty pages with pictures on every page. Both text and illustrations in a picture book work together to create meaning" (Giorgis & Hartman, 2000, 34). This topic piqued my interest because I am a visual learner and look to the pictures or graphic displays in the text to help explain the text. I find it difficult to read long stretches of text without accompanying graphics or illustrations. But, since it was the end of the school year the idea came and went without any action on my part. At the end of the summer I went to the National Science Museum in Minneapolis, Minnesota where I stumbled on some children’s literature about DNA. The illustrations were magnificent and the reading made the vocabulary easier to understand. One of the employees at the museum mentioned that some of the children’s literature was used in high school as tradebooks. I proceeded to search the Internet for these books and ones similar, and found many to do with my subject area. I ordered some books on topics that are saturated with misconceptions and difficult concepts to use in my classroom.

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Chapter #2 Literature Review

The following literature review contains information about what science is, and how to teach science, including procedures. The literature review concludes with how children's literature can be implemented into the learning cycle to increase learning comprehension.

What is science? "The nature of science is to investigate through experiences and then to logically explain the data gained through those experiences. Science is not merely facts, laws, principles, and concepts but rather the process of finding them" (Marck, 1999, 5). The goal of teaching science is to have students apply their prior knowledge to a situation and alter their thinking construct about a topic. This is in direct contrast to the memorization of facts that do not allow students to retain as much of what they have learned (Brown, 2003). The study of biology at the high school level has a particular problem with this since there is a vast amount of material to cover in a one-year period. Biology teachers often complain that high school biology courses contain too much subject matter. These teachers are concerned about students memorizing too many terms,
and stifling meaningful learning, such as the process of science (Chiappetta, 1998). The fact that most biology teachers, especially in New York State, have to prepare students for a standardized exam can further stifle teaching methods. The objectives of science instruction at all levels should be conceptual understanding of topics and scientific inquiry. Unfortunately, during this day in age students and parents equate success as achieving good grades on exams. These tests frequently contain factual multiple-choice questions for which students have (or have not) memorized answers. Science is then reduced to a rote level boring students and making science a chore (Gabel, 2003). These standardized tests put a tremendous amount of pressure on the teacher to “cover” all the material. “Translated, this means. ‘The topic was mentioned in a lecture, reading assignment, or a lab we did last week.’ with little or no exploration by the teacher of student understanding” (Drayton, 2001, 31).“Looking back to every science course I had enrolled in, I remember a ‘teacher generated, teacher motivated, and teacher owned’ situation. The way to learn science was to read a chapter, partake in a ‘cookbook’ lab, and take an end of the unit exam which actually only tested one’s ability to regurgitate facts which, by the way, were usually forgotten within a week. After all, room had to be made for all the new details found in the next unit. Undoubtedly, we have been producing students armed with facts with no guarantees, however, on how long they will remember these facts or even more important, whether they will be able to use them creatively or to communicate their knowledge intelligibly to others” (Grant, 1990, 13).

The problem teachers face, especially biology teachers, then is how to instruct in a way that allows students to retain concepts, but also understand the complex vocabulary associated with these subjects. If students do not understand the vocabulary then how will
they fully comprehend the concepts? Unless students are able to master the vocabulary associated with scientific concepts and retain these concepts as they advance to higher levels of scientific explorations, they will fail to achieve full comprehension of higher-level science concepts (Omer, 2002). “What is needed in more courses is a blend of basic facts with higher level learning in which skills of organizing, producing, and applying facts is pursued” (Anonymous, 1972, 59). A way to achieve this blending of facts with higher-level learning is to move away from teacher-led instruction, such as lecture, and towards a student-led concept-based instruction. Teacher-led instruction, especially lecture, has led to students becoming fact “memorizers” instead of concept “understanders.” Teachers need to shift the responsibility of learning to their students. “First and perhaps most important, the center of action shifts from the teacher to the student, which is where it must be if true learning is to occur. The teacher becomes a facilitator versus a ‘spouter’ of knowledge, and the student becomes an active participant in the learning process rather than a passive recipient of facts” (Grant, 1990, 13). This task might be hard for some teachers because of the added workload that is required, but is one that is necessary nonetheless. “Science teachers must realize that teaching students of today will require far more of them. They will have to become adept at teaching ‘cooperatively’ because the world of education, which was once teacher centered, now has become student centered. The teacher, who use to be infinite, has become finite and is now required to be accountable, not only to the principal, but to evermore-vocal and disgruntled parents and students” (McGraw, 1999, 29) This change in instruction will no doubt though, have a positive affect on the student population increasing motivation and even the quality of work. Students are more enthused about learning because they own it
and they are responsible for it. There work no longer only reflects on the teacher’s ability to teach it also reflects on the student’s ability to learn for themselves (Grant, 1990).

In order to make the move to a more student-led classroom a teacher must select a teaching style that incorporates hands on learning. In science, a teaching style that achieves this is one of concept-based instruction. This shift to concept-based instruction is necessitated not only to move to a more student-led classroom, but also because of the students that teachers now instruct. “American teenagers interact physically with their world. Most do not read books of their knowledge or entertainment. Instead, they log onto the Internet as soon as they get home from school or interact in cyberspace with the latest hero of video games. So what happens to these ’90’s kids when they get stuck in a ‘traditional’ ’50’s science classroom? Some goal-oriented kids meticulously take notes and read every assigned page of their boring textbook because they realize how important grades will be when they are facing their parents at report-card time or trying to get into college. Yet, far too many others, who find it difficult to discipline themselves to a ‘pencil and paper’ classroom, drift through tedious lectures, skim over difficult textbooks, skip boring questions at the end of each chapter, and finally fail highly structured tests with very fine-tuned grading scale” (McGraw, 1999, 29).

What is exactly is concept-based learning and how can teachers implement it in the standard based world of education? According to Von Secker concept learning is the replacement of traditional teacher-centered instructional practices, such as emphasis on textbooks, lectures, and scientific facts, with inquiry-oriented approaches that (a) engage student interest in science, (b) provide opportunities for students to use appropriate laboratory techniques, (c) require students to solve problems using logic and evidence.
and (d) encourage students to conduct further study to develop more elaborate explanations (2002, 151). The National Educational Standards further state that the use of cooperative learning with inquiry based techniques will further enrich science learning. When students are exposed to scientific inquiry they are getting at the heart of science and science learning by acting like scientists (Standards, 1996). Working collaboratively with others enhances the understanding of science and fosters the practice of many skills, attributes, and values that characterize science (Standards, 1996). There are masses of studies to support the National Research Council’s claim. “Many researchers have indicated that inquiry teaching results in greater student achievement and enhances positive attitudes toward science more than those strategies reflected in traditional science classrooms” (Chun-Yen Chang, 1999, 340). In a study performed by Chun-Yen Chang and Song-Ling Mao on a group of Taiwan students learning earth science this preface was confirmed. This study supported the idea that the inquiry-based approach enhances the study of science and is more effective than more traditional teaching methods. Results also showed that students who work cooperatively performed significantly better than those who worked alone (Chun-Yen Chang, 1999). Although this study was conducted in Taiwan, Chang believe that the findings can be generalized, and applied to United States or other countries and to different levels of science and other content areas (1999, 345).

How does a teacher incorporate inquiry instruction? “Science education is bedeviled by three characteristics of its subject matter: the growth in the quantity of information; the quality, that is, the provisional nature of scientific understanding; and the diversity of science. These three truths about science present those who develop the
science curriculum with agonizing choices. The inquiry-based approach to science education is a response to these three characteristics of science and also takes into account an increasingly clear understanding about the nature of learning and the classroom culture that supports it" (Drayton, 2001, 24-25). It must be understood that inquiry is not process versus content; rather, it is a way of learning content. The approach requires students to learn something about how science is done—posing questions and seeking answers based on observations, experimenting, evaluating results, analyzing data, and having dialogue with their peers (Drayton, 2001). Through inquiry a learner can "build durable understanding that is flexible and sophisticated enough to respond intelligently, over a lifetime, to the science rich culture and the world it tries to comprehend" (Drayton, 2001, 25). An inquiry based science classroom is one in which students implement science strategies to learn science. "The mission of a (inquiry based) science class is the careful, data rich building of understanding within the content area. The teacher and the student gain valuable insights from students’ questions and from the process of finding answers to those questions. Also, the students see and hear the teacher asking questions about the material (not of the students) and seeking the answers for himself" (Drayton, 2001, 26). Since students are implementing science principles to learn science, they must know the purpose of their study and receive feedback about where they are in the continuum of understanding the specified purpose. The teacher’s goals for student learning at all times should include retaining content in usable form, acquiring skills in data gathering and analysis that are widely applicable, and building an understanding of the fundamental ways that knowledge of the year’s subject is created
In an inquiry-based classroom these goals are achieved and students retain learning for longer spans of time.

There are identified several effective strategies for implementing inquiry-based instruction in the classroom. These include: learning cycle approach, analogies, collaborative learning, wait time and concept mapping” (Gabel, 2003). Of these approaches the learning cycle and concept mapping can be used with children’s literature to create an inquiry-based classroom (Gabel, 2003).

The learning cycle is a method teachers can use to structure their lessons to ensure inquiry-based instruction is included. The learning cycle uses constructivist-teaching methods, in which inquiry-based instructional strategies are emphasized, to allow students to explore and develop scientific concepts (Omer 2002). When the use of cooperative learning and discussion is used to augment the use of the learning cycle social learning can take place as well as the clarification of concepts (Omer. 2002). The learning cycle has shown particular success in the teaching of biology. “When the learning cycle method was implemented in the context of biological instruction it was proven effective at helping students construct concepts, and conceptual systems as well as develop more effective reasoning patterns” (Lawson, 2001, 165).

The learning cycle can be broken up into five basic steps. The engagement phase in which students are exposed to a topic and misconceptions are revealed. The second phase is the exploration phase students learn through their own actions and reactions as they explore new materials and ideas. “Exploration should raise questions, complexities, or contradictions. Exploration may also lead to the identification of a pattern of regularity” (Lawson, 2001,166). After the exploration phase an explanation phase takes place in
which new terms and patterns discovered during exploration are explained. After students have had new terms and patterns defined the teacher must design scaffolding activities so students can apply their newly acquired knowledge. “During this concept application, students apply the new terms or reasoning patterns to additional contexts” (Lawson, 2001, 166). “Concept application is necessary to extend the range of applicability of new concepts and reasoning patterns. Without such applications, meanings may remain restricted to examples used in their introduction. In addition, applications aid students whose conceptual reorganization takes place more slowly than average, or who did not adequately relate the teacher’s original explanation to their experiences” (Lawson, 2001, 166). The final stage of the learning cycle, evaluation, actually takes place throughout the learning cycle in which student understanding is constantly monitored to ensure the accurate understanding of the concepts. In the final evaluation students must use their reasoning skills to construct new concepts based on their prior beliefs and newfound information different types of assessment must be used. It is important to note that teachers cannot solely test the acquisition of that knowledge through multiple-choice questions alone, but must use different types of authentic assessment to test for full acquisition of new concepts. “The techniques we use to measure students’ progress must match the form and nature of the instruction. Consequently, the use of authentic assessment is clearly consistent with the learning cycle teaching procedure. Such assessment may include conventional tests, but most often utilize alternative and innovative evaluation techniques. Most importantly, assessment must be streamed throughout learning cycles to measure students’ progress as learning occurs. These assessments may include: journals or learning logs, concept maps, laboratory practical
experiences, diagrams, three-dimensional models, analogies, oral presentations, poster presentations, teacher observations, oral quizzes, mental model or open ended essays, and library research” (Marek, 1999, 15).

During the learning cycle the acquisition of new concepts is not a purely abstractive process. Rather, concept learning depends in part the student's ability to generate and test ideas and reject those that lead to contradictions (Lawson, 2001). “In this sense, concept learning can be characterized as 'constructive', as new conceptual knowledge depends in part upon generating and testing of ideas. As one gains skill ingenerating and testing ideas, concept 'construction' becomes easier. This view is consistent with Piaget's when he claimed that 'learning is subordinated to development' a view supported by numerous studies that have found that following instruction, students who lack reasoning skills do more poorly on measure of conceptual understanding than their more skilled peers” (Lawson, 2001, 166).

Implementation of the learning cycle also causes the instruction to be student-led most of the time, which increases comprehension through the use of reasoning. This is in direct contrast to teacher-led instruction in which students passively learn the information. The advantages of this type of instruction are numerous. “If students are simply told the answers they will not engage in the knowledge construction process, thus will not employ and improve their present reasoning skills. On the other hand, if instruction is more open-ended then considerable opportunity exists for students to use and improve reasoning skills” (Lawson, 2001, 167).

The studies of the effectiveness of the learning cycle have been nothing less than complimentary especially about their effects on conceptual learning. “It suffices
to say that the learning cycle has proven effective on teaching science concepts and improving generalizable skills in students from first grade to college” (Lawson, 2001, 168). "Learning cycle students were found superior to textbooks students on measures of several process skills (i.e., observing, classifying, measuring, experimenting, interpreting, and predicting). Perhaps more importantly, when general achievement was assessed by the Stanford Achievement Test, the learning cycle students scored higher on math applications, social studies skills, and paragraph meaning. These results are particularly important as they indicate that learning cycle based instruction promotes generalizable intellectual gains” (Lawson, 2001, 169). The learning cycle has even aided in students rectifying misconceptions. More recently, the learning cycle has been found to be effective at helping students eliminate scientific misconceptions” (Lawson, 2001).

One of the ways to assess student acquisitions of new concepts during the learning cycle is with concept maps. “Concept maps are schematic diagrams that use words to show the relation of one concept to another” (Gabel, 2003, 74). Concept maps can be used in varied ways depending on the goal of the teacher. “Teachers can use concept maps in planning their lessons to make certain that appropriate subconcepts are included. They may also ask students to make concept maps before instruction to determine their conceptual understanding of subconcepts on which to build lesson plans. During instruction, the use of concept maps requires students to focus on the relationships among concepts. After instruction, teachers can ask students to make concept maps of the topic studied to determine if they have grasped the relationships or if additional instruction is needed” (Gabel, 2003, 74).
Concept maps allow students to demonstrate their understanding about how new concepts interrelate with previously learned concepts and have greatly enhance the learning that takes place during the learning cycle. “Concept mapping has become a way for students to visually recognize their knowledge and understand a topic” (Brown, 2003, 192). Concept maps also combat the problem teachers are faced with in terms of rote memorization. “According to the constructivist view, one problem with lecture, and teachers requiring rote memorization is that students only receive a fragmentation of knowledge. Today, however, most educators from middle school up through graduate school use this instructional strategy, concept mapping, without hesitations to combat this problem (Brown, 2003). Concept maps can even be made and compared between groups to increase their effectiveness (Brown, 2003). “Group mapping allows those who do not fully understand a topic to get explanations from some of their peers who do understand, and allows those giving the explanations to develop a greater depth of understanding of the topic” (Brown, 2003, 193).

The positives of concept mapping are numerous. “Concept mapping helps students focus on the relationships among concepts so that students’ long term memories will accord with the scientific view” (Gabel, 2003, 74). Studies have shown that use of concept maps, especially in groups, allows for a greater understanding of content. Brown’s studies on the use of concept maps indicate “that the classes involved in group concept mapping outperformed the classes where students created concept maps as individuals or did not concept map at all. From pre- to post-test, students on average increased their scores by more than two questions in the group mapping classes as
compared to increasing scores of approximately one question in both of the other groups” (2003, 198)

The main topic of this study is the use of children’s literature in the exploration phase of the learning cycle. Elementary teachers to aid in the teaching of science have long used trade books, but textbooks replace these books as students reach the middle school and high school levels. New studies have shown that well chosen tradebooks can increase student conceptual learning, motivation, as well as encourage students to read more and stretch student minds by “enlarging their vocabulary and stimulating their imaginations” (Janke 1983, 46). “The instructional possibilities of using tradebooks to awaken scientific curiosity and increase scientific skills and knowledge are practically limitless. Good science and good literature can be strong patterns and valuable allies to imaginative, energetic teachers” (Janke 1983, 48).

Textbooks alone have many deficiencies that can hinder student passion for reading and their conceptual development. Textbooks are designed to present a great deal of information in a limited amount of space for a mass audience. Textbooks cannot take the individual reading ability of each student into account. (Edgington, 1998, 122).

“Textbooks are written poorly, lack stimulating content, uninspiring and dull” (Edgington, 1998, 122). Most biological textbooks introduce more new concepts than most foreign language texts. (Chiappetta, 1998). Textbooks can also present fundamental concepts unclearly. (Chiappetta, 1998). In stark contrast tradebooks, when used in conjunction with textbooks, can make up for these deficiencies. Tradebooks can provide an in depth look at a fewer of concepts than a textbook can. Tradebooks can take into account different reading abilities and even different learning styles. (Rice, 2002, 553).
Tradebooks are more interesting, flexible, and relevant to students and their lives. The use of tradebooks can promote constructivist-based instruction in math and science, promoting more positive attitudes towards both in addition to literacy. (Daisey, 1994, 170). Actively constructing meaning through the use of tradebooks can help students see that science and math are not just isolated facts and skills. (Daisey, 1994, 170). If students are varying reading levels are given books at or below their reading level then reading ability is not as much of an issue and the students can concentrate on the content concepts. This can rekindle even the most reluctant reader to give reading a chance again. (Daisey, 1994). “Tradebooks can help teachers inspire ‘at risk’ students to become ‘at promise’ students” (Daisey, 1994, 172).

What is a picture book and why should one select these types of books as their tradebooks? A picture book is any book with picture on every page, with limited text and limited to around 32 pages. The text and pictures work together to create meaning to aid in student understanding. Children’s literature taps into students natural curiosity about science and stretches their understanding and imagination in numerous ways that nurtures this curiosity to grow. (Kaser, 2001). The illustrations visually enhance the teaching of concepts, making these books valuable to students of all ages. (Giorgis, 2000). Reading picture books in secondary courses can also increase motivation, understanding of concepts, and aesthetic appreciation. (Carr, 2001). The use of children’s literature also enlivens instruction by allowing teachers to present material in different ways and the brevity of these types of books allows even high school teachers to use them in one class period. (Baird, 1997).
Picture books allow students to appreciate art when related to the content subject and also helps visual learners understand concepts better. (Carr, 2001). We now live in a society that is more visually oriented through the use of picture books students can gain a greater appreciation of artistic style and technique while also learning about content in science. (Giorgis, 1999). The reading and concept load of picture books is lighter due to the limited text and increase in illustrations. The illustrations also can provide clues to the meaning of some of the vocabulary, enhancing student understanding of that vocabulary and of literacy techniques. The illustrations in conjunction with the text can get reluctant readers to “engage in the process of learning higher-order thinking skills” (Baird, 1997, 22). These higher-level thinking skills come about because the reluctant reader must use the pictures to help create an understanding of the text. The motivation of reluctant readers will also intensify if they achieve these higher level thinking skills which may lead to these students reading more on their own. (Liang, 2002).

Picture books can also enhance motivation by focusing on just a few concepts more in depth than a textbook. (Carr, 2001). High quality picture books can contain rich vocabulary and well crafted sentences and stories that enhance student interest in the subject area. (Carr, 2001, 147). Instead of presenting numerous concepts at once picture books frame a few concepts into an applied setting that students can relate to. (Madrazo, 1997). These few concepts can stimulate discussion, which gets students to talk about and link science to previous knowledge to increase retention. (Madrazo, 1997). The pictures books can be used to foster the recognition of individual learning styles multiple intelligences, which can increase concept construction. (Madrazo, 1997). This recognition can be taken a step further and be used as a tool to introduce differentiated
instruction. Picture books can enhance and broaden understanding of science topics by serving as resources for scientific inquiry. (Madrazo, 1997). Picture books also get students interested in careers in science because they are able to relate science to content outside the classroom, and successfully use the information in normal everyday conversations. (Carr, 2001).

“Picture books should not be utilized as textbooks, but as wonderful pieces of literature. With picture books, middle school teachers will be able to integrate and extend content and skills of various curricular areas” (Giorgis, 2000, 39). The use of multiple tradebooks and/or textbooks together can foster middle school and high school understanding of science. (Baumann, 1997, 28). When using multiple texts students can see information presented in various forms, compare and contrast the information and think critically about the content concepts. (Baumann, 1997, 29). The use of multiple tradebooks also allows students to personalize their inquiry, which increases motivation towards learning and towards metacognition. (Daisey, 1994). Students also see concepts evolving from the literature instead of the teacher and textbooks asking them to accept what they say at face value. (Pond, 1992). “Opening students to looking at commonly accepted phenomena through different eyes or from different perspectives is doing the same thing as scientists do in their work” (Kaser, 2001, 72). Using multiple texts is yet another way we can teach students to act like scientists and get a feel of what being a scientist is like.

“When choosing a book a teacher must ask the question: ‘Can this book be a ‘hook’ to introduce middle and secondary students to scientific concepts?’” (Baird, 1997, 22). After this question is answered the next step is to make sure all the facts presented in
the book are accurate. (Janke, 1983). To ensure that the facts are accurate the teacher must become a critical reader and ask themselves the following questions:

“Does the author have scientific qualifications to write a book on the subject?

Is the text and illustrations accurate?

Are significant facts omitted?

Are facts and theories distinguished?

Are differing views presented on controversial subjects?

Is the information up-to-date as possible?

Are stereotypes used?

Does the text encourage critical thinking?


The National Science Teachers Association (NSTA) and the Children’s Book Council (CBC) have published a list of tradebooks that fit these criteria in their “Outstanding Science Tradebooks for Children” list. Once a teacher has selected a book that have fit the criteria of the questions the teacher then must make sure that the book focuses on the major topics of the particular unit by looking at the National Science Standards. The content, length, complexity and level of sophistication must also be examined to make sure it is appropriate for secondary level science students. (Giorgis, 2000).

Students and adults both assume facts are accurate if presented in science class because they do not believe that teachers would present misconceptions in class either through books or discussions so when deciding on a book a teacher must look at several aspects of that book to ensure it is misconception free. (Rice, 2002). Tradebooks have to be error free in both content and illustrations while not over simplify difficult concepts to
ensure the greatest amount of learning can take place. (Ford, 2002). If the tradebooks selected contain any inaccuracies, in text or illustration, then the development of student's concepts will be impeded. (Rice, 2002). Illustrations are often overlooked during this step, which is a crucial mistake. The illustrations should be scrutinized for alignment with and representation of scientific concepts. (Ford, 2002). The pictures should engage the reader and encourage active reading while at the same time strengthening student understanding of the text. (Ford, 2002). The illustrations should also actively involve students so they are not bogged down by text, which can impede motivation. (Baird, 1997).

Once a teacher has selected a book their preparation for the lesson has only begun. First a teacher must identify the major concepts contained in the book. (Butzow, 1990). A teacher then must select an activity to implement before the use of the book to stimulate thinking and expose prior knowledge about the subject. (Butzow, 1990). Teacher must then identify scaffolding activities to go along with the major concepts presented in the book to deepen understanding. (Butzow, 1990). Finally the teacher must find activities that allow students to apply the concepts learned in the book. (Butzow, 1990). The implementation of the learning cycle allows teachers to achieve all of this. During the engagement phase students should be exposed to the new topic to expose student misconceptions and increase motivation. During the exploration and explanation phases teachers should prepare literacy activities so students will be actively involved in the reading process. In the elaboration phase a teacher must design scaffolding activities so students can apply their newly acquired knowledge. Throughout
the learning cycle the evaluation phase occurs to judge if concepts must be explored more in-depth or if students have successfully gained a complete understanding of them.

During the exploration and explanation phases a teacher must design a lesson to ensure that students use the book correctly and gain the desired conceptual learning outlined in the Standards. Students should be active during the reading process, manipulating ideas not just memorizing facts to regurgitate on tests or papers. (Butzow, 1990). Teachers must provide a rationale for using the book and how it relates to the topic at hand. (Daisey, 1994). The teacher must then select active reading activities that encourage critical reading and discussion of the topics presented. (Daisey, 1994). Teacher should encourage the use of metacognition at this point in time so students are forced to organize ideas and analyze them critically. (Daisey, 1994). The literature must become a catalyst for critical thinking and problem solving skills. (Kaser, 2001). A teacher can use class or small group discussion, What I Know- What I learned- What I want to learn (K-W-L) charts, and graphic organizers to achieve this goal. Teachers must identify discussion topics to be addressed after the reading of the text and present these topics to the students before they read the text. (Baumann, 1997). After the reading when teachers and students discuss ideas presented in the selected discussion topics different points of view arise with respect to the reading material and a deeper more thoughtful understanding of the text can be achieved. (Baumann, 1997). Students will also listen to and use new vocabulary presented in the text, which increases learning and retention those terms this increases student understanding and avoid memorization of isolated facts. (Baumann, 1997). Students will also have a chance to engage and test their new
ideas and gain respect for ideas of others, which increases student motivation to read in the future. (Baumann, 1997).

The use of K-W-L charts allows teachers to identify student misconceptions about the desired topic before the reading has taken place, by having students fill in the first column of the chart. A teacher can then develop discussion questions, to be used in small group discussion, to address and alter these misconceptions. (Rice, 2002). After the reading students will then be forced to address their misconceptions when filling in the rest of the K-W-L chart and create questions about what concepts are still unclear. The teacher can then select appropriate activities for students to apply their new concepts and clear up any of these lingering questions. (Rice, 2002).

At the conclusion of the unit a student can then use a graphic organizer to demonstrate how the new concepts that they just learned relate to one another. This will also afford students another opportunity to present their newly learned vocabulary in another medium. The use of graphic organizers allows students to visualize concepts making them more concrete and less mysterious in their own minds. (Royce, 1996). Students can also compare concept maps to allow them to see how other students have arranged their concepts broadening their understanding of the topic. These concept maps can be used to review topics at another time and can be expanded upon in other units.

"The breadth and scope of children’s literature is limited only by the teacher. Almost any topic can be covered following a conscientious review of the literature to ensure scientific accuracy and appropriate reading levels for students' abilities" (Baird, 1997, 23). If used properly, with the learning cycle, children’s literature can increase student conceptual learning and decrease the rote memorization of isolated facts.
Chapter #3 Methodology

During the methodology students will about DNA replication and protein synthesis by using the steps of the learning cycle. The exploration and explanation phase will consist of reading children’s literature using student-led literacy activities in which students will actively dissect the meaning of the text. Students will be required to critically watch videos on DNA replication and protein synthesis, complete two labs on these topics and construct a concept map with major terms from the unit. At the end of the unit a test will be given as a final assessment to assure correct understanding of the concepts has taken place.

The students of the Pittsford Mendon District are from high-income backgrounds. As a whole they are very adept at memorizing vocabulary terms, but they do not interrelate the terms to construct the overall broad picture of how the concepts relate. The biology classes are made up of mostly freshman and sophomores ranging in age from thirteen to sixteen years old. The freshmen are accelerated and usually achieve higher overall averages, somewhere between high 80’s and mid to low 90’s. The sophomores range from above 90’s average students to special education students who struggle to pass. The students are very social and enjoy cooperative learning student-led methods over individual teacher-led methods.

The learning cycle will be used to implement the use of the children’s literature. In the engagement phase, students will perform a DNA isolation lab to increase interest and expose prior knowledge. During this exploration phase students will fill out a K-W-L chart that asks what they already know about DNA and Protein Synthesis before they have done any reading (Appendix A). The class will then perform a lab in which they
isolate DNA from wheat germ. This process will engage students in the topic of DNA study.

In the exploration and explanation phases a jigsaw method will be used to initially break up students into certain literacy circle roles. The role of one expert group will be that of summarizer. The summarizer group will read the children's literature and try to extrapolate the steps for DNA replication and protein synthesis (Appendix B). Another expert role will be that of the Literary Luminary, who will mark passages in the children's literature with sticky notes that he/she deems necessary for the understanding of DNA replication and protein synthesis; then he/she will write those passages down (Appendix C). There will also be an expert group that will identify vocabulary in the children's literature that they believe is necessary to understand DNA replication and protein synthesis called the Linquist (Appendix D). Finally, the last expert group will be illustrators, and they will draw out the steps of DNA replication and protein synthesis (Appendix E). One person from each expert group will form a second group, which will share their information with one another. At the end of this cooperative learning activity each person should have a summary of the steps of DNA replication and protein synthesis, a collection of passages, a list of important vocabulary with each term defined and illustration of DNA replication and protein synthesis. The students will then fill out the last two columns of their K-W-L chart with what they learned during the reading and what questions they still have about DNA replication and protein synthesis.

Next, students will watch two short videos on DNA replication and protein synthesis that will hopefully address some of their questions about both processes. During the watching of the videos students will fill out a Video Questionnaire with
questions about DNA replication and protein synthesis. After the videos are over the students will then take their questionnaire and complete the Venn diagram on the Making Connections worksheet (Appendix F).

During the elaboration phase of the learning cycle students will engage in a lab activity in which they will go through the steps of DNA replication and then protein synthesis (Appendix G). This will allow students to apply the concepts they have learned during the exploration and explanation phases in a laboratory setting. Students will then make a concept map with the following terms: DNA, mRNA, tRNA, adenine, cytosine, guanine, thymine, uracil, translation, transcription, amino acids, proteins, enzymes, hormones, and antibodies during the evaluation phase of the learning cycle. During this phase students will demonstrate an understanding of the new concepts they attained in the reading of the children’s literature and performing the DNA replication and protein synthesis labs. The evaluation of whether they grasp the new concepts will also be evaluated on a test. (Appendix H).

Data to support demonstrate if children’s literature aided in the construction of basic biological concepts will be gathered using numerous techniques. The first technique will be the viewing of the K-W-L charts to see if the students built on prior knowledge to construct a new understanding of the concepts of DNA replication and protein synthesis. One of the teaching groups in which four of the experts try to explain their roles of summarizer, vocabulary identifier, Literary Luminary, and illustrator will be taped and field notes taken. This group will be composed of average students with cumulative GPA’s somewhere in the B range. This will be done to judge if the average student demonstrates an overall grasp of the material. Concept maps will be viewed and graded
based on students' overall comprehension of how the concept words interrelate to one another. Finally four students will be interviewed. Each student will represent a different part of the student population. One student who currently has a low C or high D overall average in the course, one student who has a solid C or low B average, another student with a solid to high B average and a final student with a low to high A average. During the interview several questions will be asked to test their comprehension of DNA replication and protein synthesis as well as ask students how they feel about the use of children's literature. The questions are as followed:

1. How did you like the children's books compared with the use of our regular text?
   - What were some of the positives of the use of children's literature?
   - What were some of the negatives?
   - Prompts will include:
     i. Where is DNA located?
     ii. What is DNA made out of?
     iii. When does DNA replicate itself?
     iv. How does DNA replicate itself?
     v. What are proteins made out of?
     vi. Where are proteins made?
     vii. List some different types of proteins.
     viii. How does DNA control the synthesis of proteins?
     ix. Give an example of how proteins control organelles in a cell.

2. Did you understand the book better using the K-W-L chart and the jigsaw method?
What were some of the good points of using these methods?

What were some of the bad points of using these methods?

3. Did the illustrations in the book help in your understanding of the concepts?
   (If so, point out the diagrams that helped you and explain why they did.)

4. Did you enjoy this unit compared to other units that we have done throughout the year? Why or why not?

5. Overall would you recommend the use of children’s book in the future to learn science concepts? Why or why not?

6. Will you be more willing to read books or magazine articles about science due to the use of children’s books? Why or why not?

The interviews will be taped and field notes taken to judge if students learned the desired concepts and if they enjoyed the use of children’s literature.
References


