THE EFFECTS OF SCIENCE STRATEGIES SUPPORT FOR IDENTIFIED STUDENTS WITH LEARNING DISABILITIES

by

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STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE program shall make it available to borrowers under rules of the program.

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ABSTRACT

Today's inquiry-based science classroom is continually academically challenging. This can be even more of a struggle for students identified with learning disabilities. All students, including those who receive special education services, are required to participate in the regular education science curriculum. In this study specific science strategy interventions were implemented over a six-week treatment period to support students with learning disabilities in the regular science education classroom. The data indicates that with appropriate content interventions, all students participated and engaged in the classroom environment with a greater confidence. In addition to academic engagement, most students saw an increase in their academic achievement in the regular education classroom. In conclusion, the treatment led to an increase in positive attitudes toward the science classroom and in content learning.

INTRODUCTION AND BACKGROUND

The overarching purpose of this study was to investigate the effectiveness of the science strategies support in the special education setting. Science Strategies support is a class that identified special education students can take in addition to the regular science class. Specifically, the study involved a collaborative research team composed of other science and special education teachers in the school, to support the learning of special education students participating in the regular education science curriculum.

I have taught special education at Castle Rock Middle School for the past three years. As a special education teacher, I teach one class period of study strategies. This class is designed to help students with daily organization, homework completion, studying for tests, as well as pre-teaching and re-teaching of content taught in their regular education classes. Students who are identified to receive Special Education services can take supported classes in the areas of English and Math. The supported classes offer smaller class sizes; content at their academic level, as well as content delivered at a slower pace. This group of identified students received support in Math and English, however, are required to take the regular education science classes with their on-grade level peers. I have experienced the struggle that these students face keeping up with the science curriculum, reading the textbook, and participating in inquiry based labs. It is my hope that with specific science strategy support and intervention that the students will succeed academically in the regular education class, but also feel more confident to participate with their peers.

Special education students in seventh grade at Castle Rock Middle School in Billings, Montana are all required to take the regular education science content class. The special education students are identified for a variety of learning and or physical disabilities. This population of students is also able to take a study strategies class during another class period of their school day. The science strategies support class offers a pull out, small group setting to review concepts, reconstruct labs, as well as re-teaching of the science curriculum. This study evaluated the effectiveness of science strategies support in a special education setting, on the learning in the regular education classroom setting, for special education students, which was inspired by the research done by Palinscar, Magnusson, Collins, and Cutter (2001). In their research they asked the following:

"What are the opportunities and challenges that guided inquiry science instruction presents to students with special needs? How do students with special needs respond to these opportunities and challenges? How can teachers mediate students' participation in guided inquiry science instruction for the purpose of enhancing their engagement and learning? What are the learning outcomes of advanced design and mediation of learning?" (p. 16).

The study I conducted researched the following questions:

1) What are the opportunities and challenges that guided inquiry science instruction presents to students with learning disabilities?
2) How do students with learning disabilities respond to these opportunities and challenges?
3) How can teachers mediate students' participation in guided inquiry science for the purpose of enhancing their engagement and learning of science?

4) What are the learning outcomes of the curriculum support and the mediation of learning?

CONCEPTUAL FRAMEWORK

Throughout the history of education in America, children have been provided a free education. Many areas of education have changed over the past 200 years. One of these areas specifically is the format in which this education is given to children of various religions, ability levels, and economic or cultural backgrounds.

History of Special Education

Disability inequity was brought to light during the seventies with *Mills v. Board of Education,* 1972. The next transformation in the history of education was the education of students with disabilities. The first special education legislation was the Individuals With Disabilities Education Act, IDEA, Public Law No. 94-142, 1975 (Skiba et al., 2008). In 1998 Congress reauthorized IDEA, and again in 2004. IDEA began the practice of inclusion of students with disabilities in the regular education classroom. Under President George W. Bush, congress enacted No Child Left Behind (NCLB) at the start of the twenty-first century. NCLB began the approach to reach challenging standards by all students, including those with significant learning disabilities (Fuchs & Strecker, 2010). With students now being held accountable for achieving challenging standards, standards-based assessment has taken root in our schools and districts. Student performance has now become the mark for accountability with schools, at both the district and state level. In order to meet the needs of all students, intervention and identification of struggling students at an early age is key.

Response to Intervention (RTI) has developed a tiered system of intervention and instructional support. Teachers are being asked to meet the needs of various ability levels within the walls of one classroom. RTI provides more intensive instruction for students who are unresponsive to generally effective interventions. This intervention includes possible services in special education only when necessary, and attempts to unify the general and special education instruction (Fuchs & Strecker, 2010). RTI is a strategy designed to meet the goals of NCLB as well as IDEA with tiered instruction that increases in intensity and complexity at successive levels. This is possible because of the collaborative efforts of both the general and special education teachers. In the past, special education students were tucked away in resource rooms and self-contained classrooms, and now students of all abilities are found in regular classrooms. With this inclusive movement, not only are students being placed in the regular education classroom, but also they are expected to engage and participate in meaningful activities as well as the same curriculum as their classmates (Jarrett, 1999).

Inclusion is based on the belief that each individual is valued and does belong (Falvey, Givner, & Kimm, 1995). An inclusive classroom builds on the varied strengths of all individuals in the classroom, not just those of the average achieving population. “Students with learning disabilities, like all young people bound for adulthood, need problem-solving and reasoning skills, as well as knowledge of key mathematics and science concepts” (Jarrett, 1999, p.1). With the inclusion of students with varied ability levels in the mainstream classroom, there is a need for individualized learning supports. Particularly in the area of science, students need guidance and support in the inquiry process.

Inclusion and Inquiry-Based Science Instruction

In inquiry-based science instruction, students are the directors of their own learning and are active participants. This is the view of a constructivist learning theory (Jarrett, 2009). When a teacher acknowledges this premise, and implements inquiry based instruction, learning occurs more effectively. Likely, students would be engaged in discussion and group activities with the teacher as primarily the facilitator, while sometimes students might participate in facilitating as well. Using open-ended inquiries, students conduct their own investigations based on their interest and their decision-making strategies. With this process the teacher may guide discussion or give prompts, however the students build their understanding based on critical thinking, conducting investigations, and communication of their findings through journals, written work, or oral presentations (Jarrett, 1997). Science inquiry engages the students to work towards the explanation of what they are investigating, throughout the process of investigation, while their knowledge and reasoning are redefined overtime (Palinscar, Magnusson, Collins & Cutter, 2001). In inquiry based learning, teachers assess the students by conducting both informal and formal assessments at multiple times throughout the learning process. Contrary to traditional assessment, an inquiry-based classroom may require the students to keep a science journal or develop concept maps to illustrate the learning and investigation process (Jarrett, 1997). Research indicates that students with learning disabilities will benefit from this activity-based and hands-on approach to science instruction (Dalton, Morocco, Tivnan, & Mead, 1997; Scruggs & Mastropieri, 1994; Mastropieri & Scruggs, 1992, 1993).

Science Strategies Support

With the movement of special education inclusion, challenging standards based accountability, and inquiry based science instruction, there is an ever-increasing need for strategies support for students identified with Specific Learning Disabilities. The definition of learning disabilities in the federal law IDEA-2004 is:

The term ‘specific learning disability’ means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations. Such term includes such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. Such term does not include a learning problem that is primarily the result of visual, hearing, or motor disabilities; of mental retardation; of emotional disturbance; or of environmental, cultural, or economic disadvantage (Lerner & Johns, 2009 p.10).

Students with this designation then become eligible for Special Education Services. Carlise and Chang’s (1996) three-year longitudinal study of students with Specific Learning Disabilities showed that special needs students fared poorly and expressed doubts about their ability to achieve in these classes. According to the research of Gersten and Baker (1998), students with learning disabilities must become “fluent with essential factual and conceptual knowledge” (p. 24) before they can fully engage in the inquiry-based instruction.

Jarrett (1999) states that, “students with learning disabilities generally have difficulties in listening, speaking, reading, writing, reasoning, or mathematics. They also often have trouble sustaining attention to task; remembering procedures, deadlines, and verbal information; and applying organizational skills,” (p. 2). Specifically in the area of science these students may struggle with computation, problem solving, terminology, making inferences, and integrating new and prior knowledge (Mastropieri & Scrugs, 1993). In addition to struggling with the tools necessary in the inquiry process, these students are generally bearing the weight of past failure in school and therefore low self-confidence (Mastropieri & Scruggs, 1993). Students with learning disabilities, come to the classroom with a wide variety of strengths and weaknesses. The collaborative efforts of both the special and general education teacher should strive to identify the support strategies needed for success in the inclusive classroom.

Although many professionals in the education setting are in support of the inclusive classroom and the new high standards based expectations placed on students, research shows that strategies and content area support must be modified for students with learning disabilities. “Students require an environment that will nurture their gifts, attend to the learning disability, and provide the emotional support to deal with their inconsistent abilities” (Baum, 1990, p. 4). Supporting students with learning disabilities with practice in basic skills, structured activities, vocabulary acquisition, and problem solving procedures, is vital to their success and academic growth (Jarrett, 1999).

Several strategies to support students with learning disabilities in the inquiry-based science classroom have been identified by Barrett (1999). Her research finds that the curriculum and instruction should be built around the big ideas, or important concepts that will help students connect and apply facts and ideas. When students with learning disabilities are given the big ideas, they are able to make connections to their personal interests. Students then are more likely to make connections between science, other content areas, and their personal experiences in life (Salend, 1998).

Students with learning disabilities will often need the support strategy of content review. The support of building a foundation with prior knowledge is essential, however these students will need frequent structured questioning to help construct their knowledge of the content (Jarrett, 1999). The class can discuss as a whole the previous day's topic as well as review at the conclusion of a learning activity. The teacher can build a positive and encouraging atmosphere of thinking out-loud. During this time, individual students can consider the ideas of others and add to the conversation what their investigation found. These conversations and content review will reinforce learning as well as help the teacher to monitor the student engagement and critical thinking (Mastropieri & Scruggs, 1993).

Vocabulary acquisition is one of the most foundational science skills and is imperative to the inquiry-based science classroom. During an inquiry-based science investigation, vocabulary may be necessary to the development of the science concept; however, the activity alone may not provide the help needed for the learning disabled student to learn the essential vocabulary (Jarrett, 1999). In an article (Jarrett, 1999), Scruggs and Mastropieri were quoted, "Students who don't master the essential language of science may find their ability to share experiences and participate in class discussions impeded," (p. 17). The strategy of pre-teaching necessary vocabulary will give the learning disabled student a foundation to understand the science content that will be investigated during the inquiry process. The vocabulary may then need to be reviewed and encountered in many different formats for the learning disabled student to feel confident in applying the vocabulary during an inquiry-based activity with the students' peers (Jarrett, 1999).

Inquiry-based science instruction provides students with learning disabilities the ability to actively partake in science investigation, however these students benefit from structured inquiry (Jarrett, 1999). Modifications to each lesson can support a student with learning disabilities by asking this question: "How can the instructional approach help each student to reach the next level of understanding?" This may mean providing the student with graphic organizers or a study guide to prompt the next step in the inquiry process. To identify which strategies and support the student with learning disabilities needs, a teacher may engage in conversation with the student directly. A teacher needs to identify the specific area in the inquiry process where the student's understanding of the concept is failing and then the teacher can adapt the lesson and materials where necessary (Jarrett, 1999).

Professional Learning Communities

In order to support these learning strategies in the classroom the regular education teacher as well as the special education teacher will have to collaborate effectively. The shared understanding of both parties will lead to targeted subject-matter understandings and the overall achievement of students with learning disabilities (Palincsar, Magnusson, Collins, & Cutter, 2001). The special education teacher has the specific learning disability background to be able to support the general education teacher with each individual student. Working collaboratively, the special education teacher will be able to support the identified students with the content and strategies support. The Special Education teacher will support the content through the use of additional learning strategies. This may take place in small group settings, within the inclusive classroom, as well as via one on one support. Jarrett (1999) states, “The general education teacher will want to use instructional strategies that respect and build on these differences while helping all students to learn important concepts and skills in mathematics and science,” (p. 34). Although the demands of student achievement and challenging content standard reform are increasing, teachers can meet the needs of students with learning disabilities in the inclusive, inquiry-based classroom, with the support strategies offered by effective collaboration between the general and special education teachers.

The format for this collaboration may be within a professional learning community (PLC).

> Professional learning communities are defined as educators committed to working collaboratively in ongoing processes of collective inquiry and action research to achieve better results for the students they serve. Professional learning communities operate under the assumption that the key to improved learning for students is continuous, job-embedded learning for educators (DuFour, DuFour, & Eaker, 2008, p. 14).

Within this structure all grade level science teachers can meet alongside the special education science strategies teacher to search for the best way to achieve the goals of the curriculum and enhance student learning. The PLC will work throughout the school year meeting regularly to work towards common goals. DuFour, DuFour, and Eaker (2008) state the following as the continuous cycle:

> Gathering evidence of current levels of student learning. Developing strategies and ideas to build on strengths and address weaknesses in that learning. Implementing the strategies and ideas. Analyzing the impact of changes to discover what was effective and what was not. As well as, applying the new knowledge in the next cycle of continuous improvement (p. 17).

The development of a PLC and community collaboration among professionals focuses on a commitment to all students learning and the members of the community are mutually accountable for attaining the results. “Given the mission of learning for all, it is more important for students to learn the content that is covered than for the teacher to simply cover the content” (Lezotte, 2004, p. 32).

Based on the belief that every student has the opportunity to learn, an inclusive classroom can provide many challenging as well as rewarding opportunities for both the teacher and the students. Given hands-on inquiry based science, all learners in the classroom, even identified special education learners, will be able to engage and contribute to the learning process. Support strategies such as content review, vocabulary acquisition, mnemonics, and structured inquiry may provide the tools necessary for success. The strategies will need to be assessed for effectiveness and tailored to individual students when needed, however, the time spent supporting the learner will translate to confidence in a learning environment where everyone can contribute.

METHODOLOGY

In this section an overview will be provided of the action research process for this particular study. First, I will present a description of the setting and the treatment. Included with the treatment is a timeline for the period when the research took place. Next, I will address the methods of data collection and analysis. Finally, I will provide the validity and reliability of the overall research and data collection methods.

Introduction

To answer the proposed research questions a set of data collection tools were developed to identify the effectiveness of science strategies support for students with learning disabilities. A Pre-treatment Interview (Appendix A) and an Engagement Survey (Appendix B), were given at the start of the second quarter during the 2011/2012 school year to determine what attitudes and opinions the students hold of inquiry based science. As well as, what help will motivate and excite this special learner population to engage and participate in the regular education science curriculum. During the initial six-week pre-treatment period, the first six weeks of second quarter, the researcher collected baseline data of special learner student engagement using a Classroom Observation Log as well as an Academic Engagement Record (Appendix C and D). During the pre-treatment period three regular education teachers and two special education teachers were given a Teacher Survey (Appendix E). This survey gathered thoughts and opinions from teachers of similar teaching situations in the school. At the end of the six-week pre-treatment period, school generated grades were looked at to gather baseline data for how the students with learning disabilities responded to the opportunities and challenges that an inquiry based science classroom presented.

During a six-week treatment period, the second six-weeks of second quarter, instructional support strategies were used to teach science concepts to special education learners. This group of seventh grade students, identified as special education students, at Castle Rock Middle School, attend a full inclusion regular education science class. At a later class period during the day, the identified special education students spend an additional class period with a special education teacher covering the same science content, while implementing the instructional strategies. There are a total of three seventh grade special education strategies classes. The class used for data collection and action research is the sixth period strategies class. This special education class is made up of 14 identified special education students. There are nine girls and five boys, all of whom have an individualized education plan. Of the 14 students, only 10 agreed to participate in this study. The special education teacher and the regular education teacher worked together to collect data using text book generated tests, teacher developed daily work, interviews and surveys (Appendix A and B), and structured observations (Appendix C and D) to monitor special education student learning and participation in the inclusive science classroom.

Treatment

Over the course of the six-week treatment period many instructional strategies were used to help remediate student learning. The instructional strategies included three primary strategies.

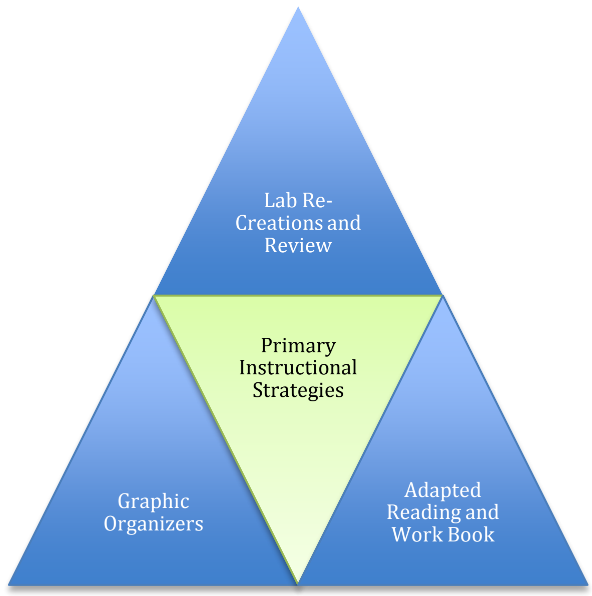

Figure 1. Primary instructional strategies.

The first instructional strategy implemented by the special education teacher during week one was to re-create the hands on, inquiry based, microscope lab in a structured setting. The special education students had already been introduced to the microscopes during the regular education class period. During the science strategies class period, the students were able to review, in a whole class setting, basic functions of a compound microscope and convex lens (Appendix G). The students kept a copy of the microscope model to review and refer to throughout the entire chapter. This strategy of frequent content review and activation of background knowledge is essential for the success of learning disabled students (Jarrett, 1999). After the microscope function review, the 10 students were paired up to explore with a microscope. The special education teacher monitored very closely to help with any difficulty. The goal for every student was to correctly focus three slides on their own while working with the help of his or her partner. This strategy gave the special education students a second opportunity in a small group setting to become more confident with the operations of a microscope with the support of a special education teacher. Through this support strategy the students were able to guide their own learning through conducting the investigation, however the teacher gave prompts to guide the inquiry when necessary.

The second instructional strategy implemented in the science strategies class was a graphic organizer. The use of graphic organizers provides a visual representation of the content. Jarrett (1999) states that, “Many science and mathematics textbooks contain numerous facts and details that are poorly organized.” Using the graphic organizer (Appendix H), the learning disabled students were able to follow along while the teacher read Chapter 1, lesson 1 of the text aloud to the class. The special education teacher stopped and filled out the graphic organizer on the overhead while each student completed his or her own copy individually. This graphic organizer targets the reading skill of sequence. The students filled out the sequence of events in the discovery of cells starting with Hooke seeing cells in cork. By sequencing the discovery of cells the students were able to see how Robert Hooke, by building his own compound microscope, was one of the first people able to observe cells. This led to Anton Van Leeuwenhoek discovering tiny objects in water, which were one-celled organisms. Which then led to Schleiden, Schwann, and Virchow, three German scientists, who found that all living things are made up of cells. This graphic organizer was filled out while reading aloud section1 of chapter 1. This process was used to help the students understand the sequence of events, which led to the scientific understanding of cells. This complete graphic organizer was then used for review as well as a study guide for the students.

The third instructional strategy implemented during the science strategies class was the use of the adapted reading and study workbook (Appendix I). This guided reading corresponds to the regular education classroom text. The adapted reading and study workbook is published by Prentice Hall Science Explorer and is the differentiated instruction companion for learning disabled students. This is a companion guide to use with the curriculum *Cells and Heredity* (2009). Throughout the six-week treatment period the identified special education students engaged with the grade level text as well as inquiry based science instruction presented in the regular education class. However, while in the science strategies support class, the students had an opportunity to revisit the content at a slower pace with the special education teacher. Adapting the curriculum content and providing slower paced instruction, repetition of the concepts, using graphic organizers, as well as multiple opportunities to engage with the academic vocabulary are necessary for structuring inquiry lessons for students with learning disabilities (Scruggs & Mastropieri, 1994). The adapted reading and study workbook includes summaries of the content, which helped the students identify the key concept. The reading is condensed to the key topics and is also provided in a larger print with bolded vocabulary and key concepts. In addition, the reading and study workbook includes graphic organizers to help students master key terminology. The study workbooks can be used to develop note-taking skills as the students read through the text with the teacher and complete the worksheets. The adapted reading and study workbook was used for strategy support during lessons one through four of chapter one in *Cells and Heredity*, during the six-week treatment period. The science content covered during this portion of the text is the discovery of cells, development of cell theory, light and electron microscopes, plant and animal cells, specialized cells, bacterial cells, elements and compounds, diffusion, osmosis, and active transport.

Throughout the treatment period it was essential that the special education teacher researcher work closely with the regular education science teachers. All students are individuals and some strategies may work more effectively for some students and not for others. Therefore, it was important that the science support strategies be modified to meet the needs of the students. Constant formative assessment was used to drive the pace of the intervention strategies. Working together during the PLC, the teachers monitored the student engagement in the regular education classroom as well as the mastery of the content. The instructional strategies support was then modified to best meet the needs of the students.

Methods of Data Collection and Analysis

Data collection was ongoing, before, during and after the conclusion of the treatment. I gathered school generated report card grades, post-treatment student interviews (Appendix F), Student Engagement Surveys (Appendix B), Classroom Observation Logs (Appendix C), Student Academic Engagement Records (Appendix D), as well as Teacher Surveys, (Appendix E). The data collected was analyzed to answer the four research questions. The data collection methods are summarized in Table 1. Table 2 shows a timeline of the treatment strategies used in this study. The research methodology for this project received an exemption by Montana State University's Institution Review Board and compliance for working with human subjects was maintained.

Table 1
Data Triangulation Matrix

RESEARCH QUESTIONS	DATA SOURCE 1	DATA SOURCE 2
What are the opportunities and challenges that guided inquiry science instruction presents to students with learning disabilities?	Pre-treatment survey for teachers Post-treatment survey for teachers	Pre-treatment student interviews Post-treatment interviews for students
How do students with learning disabilities respond to these opportunities and challenges?	Classroom observation Log Academic Engagement Record Engagement Attitude Survey	School generated grades with treatment School generated grades without treatment
How can teachers mediate students' participation in guided inquiry science for the purpose of enhancing their engagement and learning?	Classroom observation log Academic Engagement Record Engagement Attitude Survey	Pre-treatment Student interviews Post-treatment interviews for students
What are the student learner outcomes with the curriculum support and the mediation of learning?	Student performance based on unit tests. School-generated report cards.	Post-treatment Student interviews Classroom Observation Log Post Engagement Attitude Survey

Table 2
Weekly Schedule of Intervention Strategies and Data Collection

Period	Activities
Week 1	Non-treatment school generated student grades, Non-treatment student performance based on unit tests, Pre-treatment interviews
Week 2	Pre-treatment teacher survey, Engagement attitude survey
Week 4-12	Classroom observation log, Academic engagement record
Week 6-12	Treatment takes place with intervention strategies support
Week 13-15	Post-treatment survey for teachers, Post-treatment interviews for students, Post-engagement attitude survey, School generated student grades with treatment, treatment period student performance based on unit test

Pre-Treatment Student Interview

The first instrument used for data collection was a pre-treatment student interview (Appendix A). This structured interview asks five questions. Each question is designed to address the students' confidence level and perspective of their learning in the regular education science classroom. The purpose of this data collection tool was to gain insight on the students' view of the science classroom, science curriculum and material, lab groups, as well as what help and support they feel would be most beneficial. The student interview was a very important piece of data and provided oral feedback to me, in a non-threatening environment for the students, which, it was hoped, would lead to honest responses and valuable inquiry data.

This data collection instrument was given at the beginning of the data collection process. It is necessary to build a baseline of student confidence, as well as student perspective and attitudes on learning and engagement in the science inquiry process. Hendricks (2009) stated, “Allowing participants to express their ideas and opinions about various aspects of your study is a good way to add to the richness of your investigation,” (p.97). This data tool addressed three of my overall research questions (Appendix J).

The interview was designed specifically for this particular research study. One strategies support class, of 10 identified Special Education students, will be interviewed. The pre-treatment student interviews were developed with a structured interview approach. This design allows the researcher to ask broad questions and then let the interview process take its individual shape (Hendricks, 2009). The Special Education population is faced with various challenges: some of the challenges being communication through reading and writing. Allowing the students to interact orally through the interview process will help to support honest expressions and valid data. The structured interview was planned with five open-ended questions, which were aligned with the proposed research questions.

The data collection of the pre-treatment interviews took place over the course of two days during the strategies support class, during the school day. Half of the class interviewed on one day and the remaining students interviewed on a second day. The students interviewed with me, in an adjoining classroom, while a certified teacher’s aide was with the remaining students. The interviews were recorded using an audio file on a classroom iPad. Having the interviews recorded allowed me to review the details of the interview and document specific student responses, as well as allowing me to collect great amounts of information when the event occurred, providing validity to the data (Hendricks, 2009). The data collected was then transcribed verbatim into one word document. The data includes the student responses for each interview question as well as researcher notes. The students were recorded using a number code and not their name. Once the data was compiled the researcher, along with the PLC, reviewed the data to look for themes. Involving the PLC in the data analysis fostered validity in the process. This allowed all professional individuals on the committee to offer insight and knowledge in their area of expertise, as well as reducing the possibility of any individual bias.

This particular data collection strategy was also given again at the conclusion of the action research process in the form of a post-treatment interview. Giving the same interview at various points in the research allows for reliable results obtained over time, permitting student opinions to change and insight gained with the proposed science strategy treatment. Student responses most likely changed because of the intervention or days where they may seem to be having a tough time communicating. Multiple interviews with the same students provided more opportunities to gain greater insights and information from the students.

Teacher Survey

Another instrument used for data collection was the teacher survey (Appendix A). This survey was designed to gather information from the regular science education teachers. The survey included four questions that ask how successful special education students are in the science inclusion classroom. The teachers were able to give honest feedback with an anonymous survey. The data collected helped me gain valuable insight into the workings of the regular science education classroom and how the action research could be adapted for student success throughout the process. The survey developed was seeking to answer the overarching action research questions (Appendix K).

This data collection instrument was used at the beginning of the data collection process. Valuable parts of the action research team are the classroom teachers who interact daily with the students. The action research was designed to meet the needs of the special education students and develop a successful environment. A vital part of that successful environment is the regular science education teacher. Hendricks (2009) states, “in action research studies, inquiry data can provide a researcher with participants’ perceptions about the effectiveness of an intervention, ways the intervention could be improved, and feedback regarding positive and negative aspects of the intervention,” (p. 97).

This data collection strategy was designed specifically for this particular research group. The survey questions are aligned with the research questions. The questions were developed to gain information that the researcher is seeking to answer (Hendricks, 2009). Teachers often have very emotional opinions about how they operate and instruct within their classroom. These particular teachers, which make up the PLC, are a part of the action research team. The team consisted of myself, three seventh grade general Life Science teachers, as well as one special education strategies support teacher. By designing the teacher survey I was seeking feedback. Mills (2011) states, “It is always a good idea to seek feedback from colleagues. They will raise questions about the accuracy of the account and help you to go back to your classroom in your quest to get the story right,” (p. 111). By giving this survey at the beginning of the data collection process the team was able to express their ideas and opinions about the study and helped to develop the investigation.

Teachers are very busy and have already committed large amounts of their time to their classroom. Asking the research team to give more time may lead to quick responses that do not thoughtfully reflect their opinions of the action research. By providing the teachers an online and anonymous survey, they were able to complete the survey on their time when it was most convenient for them. In addition to filling the survey out online, the survey was anonymous. The survey was designed to be brief and to the point (Hendricks, 2009). The teacher survey was developed using Google Survey available through Google Documents. The teacher survey was emailed to the teachers on the research team a week before the action research began.

The teachers were given a week to respond. Using the Google Survey Document, the responses were emailed back to me anonymously. After the surveys were collected from all five participating members of the team the written responses were printed out and compiled for data analysis. Following the compiling of the data, the process of coding the surveys took place (Mills, 2011). After all five of the surveys were collected and analyzed for themes and meaning, I developed a concept map. The concept map included the major influences and ideas that were presented for the action research. After the major ideas and factors were noted, connecting ideas and “hunches” were noted under them. Reviewing this concept map allowed me to determine any “consistencies or inconsistencies that exist among the influences,” (Mills, p. 134). The concept map was also helpful for the team to review throughout the research process as new themes were brought to light or as ideas began to be connected to established themes.

Classroom Observation Log

The third instrument used for data collection was a classroom observation log (Appendix C). This classroom observation log was used to record the participation and engagement level of special education students in the regular science education setting. The log also included records of the lesson being observed as well as the lesson objectives. This additional information helped to note possible themes with specific content difficulties for students with learning disabilities. In addition, it included a space to record the type of inquiry-based method used for that particular lesson that was observed. The instrument was specifically designed by me to record the degree of engagement on the part of the special education students in the classroom along with areas for recording additional notes, such as student attitudes, possible changes, and other comments on the lesson.

This data collection tool was used to systematically observe an inquiry-based science lesson in the general education class once a week during the six-week treatment period. The entire 47-minute lesson was observed. The observer documented the content covered in the lesson, the date, lesson objective, and the inquiry-based method planned. Throughout the lesson the observer took notes and documented the level of engagement attempted on part of the identified special education students. Engagement can be defined by, “the amount of time the student actually spends performing an academic task” (Mercer, Mercer, & Pullen, 2011). By walking around the room and observing all groups, the observer did not point out specifically whom they are observing. The specific prompts for the observer to document were goals, engagement, teacher prompts, and perceived student understanding of the content. The observers were different each week, including all members of the PLC in the collection of classroom observation data.

This data collection strategy was designed specifically for this particular research study. The sampling of students who were observed are the 10 7th grade treatment group students at Castle Rock Middle School in Billings, Montana. All 10 students of the test group were observed in their regular science education class.

The classroom observation log was designed to gain a deeper understanding of how special education students' interact in the inclusive science classroom. Quantitative data, such as graded artifacts and student classroom academic performance, is helpful in identifying if the interventions had an impact on student engagement and achievement. However, the observational data is important to the understanding of how the intervention strategies and context of the setting influences the results (Hendricks, 2009). Special education students struggle to communicate their understanding of content. Given the observational log, a member of the PLC was able to document the students' activities while they were working in the regular education science classroom. Having multiple members of the PLC recording the observations ensured different perspectives of what was occurring during the study.

Academic Engagement Log

The fourth data collection tool is an academic engagement log (Appendix D). The academic log was designed to keep very frequent data on the day-to-day participation in the general education science class. Students with learning disabilities may struggle with participation in class. This can be for various reasons. Mercer, Mercer, and Pullen (2011) in *Teaching Students with Learning Problems,* describe the characteristics of students with learning problems as cognitive and metacognitive deficits, low academic achievement, poor memory, attention problems or hyperactivity, poor social skills, poor self-concept, poor motivation, debilitating mood states, adaptive behavior deficits, and disruptive behavior. When these characteristics are observed and identified, teachers are able to implement instructional strategies that support and enable students with learning disabilities to succeed.

The academic engagement log seeks to answer the following two over-arching research questions. How do students with learning disabilities respond to these opportunities and challenges? As well as, how can teachers mediate students' participation in guided inquiry science for the purpose of enhancing their engagement and learning? This data collection tool was designed to keep frequent data throughout the entire six-week treatment period. The regular education sciences teachers were asked to keep this log every day therefore, a total of 30 days were logged. The log was developed to take quick data and not be cumbersome to the teacher. The teacher recorded a plus sign or a negative sign for the overall observed engagement and participation of the day for each student. Research shows that the amount of academic engagement is directly related to student achievement (Mercer, Mercer, & Pullen, 2011). This quick glance data tool provided the researcher and the professional learning community a day-to-day trend in the student's ability to attend and participate in the lesson. This data was used to assist in the implementation of appropriate learning strategies and support within the science strategies classroom.

Engagement Survey

The fifth data collection tool used is the engagement survey. The engagement survey is designed as a Likert scale, which measured the positive and negative responses to questions about how students felt about academic engagement. The engagement survey was used to find students' attitudes toward the regular education science classroom and inquiry based learning. Students with learning disabilities have often experienced a cycle of failure in school and have negative perceptions of their true academic abilities (Mercer, Mercer, & Pullen, 2011). With the information the students provided in the engagement survey, the teachers and the research team were able to create and maintain a supportive classroom setting.

The engagement survey was given to the test group of students who are identified with specific learning disabilities. The survey was given one time prior to the start of the 6-week treatment period to gather baseline data on how the students perceive their learning and participation in the regular education science class. Specifically, the survey was given during the second week of base line data collection. The 10 students took the survey during the science strategies class period with the special education teacher. It was mentioned to the students that this was completely anonymous and their answers would not have affected their grade in the regular science classroom as well as the science strategies class.

The engagement survey seeks to answer two of the research questions that pertain to how students participate in the regular education science classroom (Appendix K). Using the Likert scale responses, I was able to find the median response of the specific population that the research is looking at. This data gave me a deeper personal understanding of how the special education students perceive their learning experience in the science classroom. Although this data collection tool was only administered once during the research, the interpreted data provided ongoing reflection as the research team worked to create a supportive learning environment for all students.

Post Treatment Student Interviews

Similar to the pre-treatment student interviews, the final data collection tool used was the post treatment student interviews (Appendix F). This structured interview asked five questions designed by myself, the teacher researcher. The questions looked to understand what effects the treatment had on the students. Throughout the entire six-week data collection period, the students were exposed to various data collection tools as well as instructional strategies to support their engagement in inquiry based learning as well as understanding of the essential elements of the curriculum. The post treatment student interviews were designed to capture the overall effects of the science strategies support as perceived by the students. Student interviews provided insight from the students themselves as to the changes they perceived in their own learning and participation.

The action research was designed to see increments of increased achievement in the general education science classroom among students who are identified to receive special education services. Although the school generated grades will show whether or not it was successful, this interview helped the research team understand why the strategies were successful or not. The post-treatment interviews were conducted in the same manner as the pre-treatment interviews.

Validity and Reliability

The pre and post-treatment interviews provided the researcher with truth-value validity. The students were able to respond openly and honestly to the extent in which they feel comfortable. This strategy allowed for persistent and prolonged observation (Hendricks, 2009). Throughout the research, multiple data collection strategies were used to ensure triangulation of data sources.

The teacher survey provided the researcher with truth-value validity. The teachers were able to respond openly and honestly to the extent in which they felt comfortable. This strategy allowed for persistent and prolonged observation (Hendricks, 2009). Throughout the research, multiple data collection strategies were used to ensure triangulation of data sources. This particular data collection strategy was given again at the mid-point as well as the conclusion of the action research process. Giving the same survey at various points in the research allowed for reliable results obtained over time, allowing for teacher opinions to change.

The observation log was used to ensure persistent observation throughout the treatment period. The weekly observations provided credibility to the research. A member of the PLC team was able to record observations, not the classroom teacher responsible for the lesson at hand. This allowed for observations to be recorded instantaneously and accurately during the class time, ensuring the validity of the research. Observations, recorded as soon as possible, capture the very essence of what transpired (Mills, 2011). In addition, the PLC met to review the results of the observation. Not only did the PLC review of the data provide credibility, it also provided dialogic validity.

With the Likert scale results of the Academic Engagement Survey, the research team was able to identify changes in students' metacognition, as well as in the way they perceive the regular education science curriculum and class design. Metacognition is the awareness of one's thinking process and how they monitor and use these processes (McLeskey, Rosenberg & Westling, 2010). The research team will use this data to identify specific learner struggles as well as planning for the implementation of the science strategies. The particular data collection tool provides the study with outcome validity.

DATA AND ANALYSIS

Introduction

Over the course of the six-week treatment period data was collected with seven different tools. In addition to me, other science teachers participated in collecting the data. Data was collected within the classroom setting through observational data, student surveys and interviews, student performance through school generated grades, as well as teacher surveys. All of the data was analyzed within the PLC setting. The data was then broken into three main themes; measures of student engagement, student performance, and teacher perceptions.

Measures of Student Attitudes and Engagement

An interview was conducted with ten identified special education students at Castle Rock Middle School. The interview questions were developed to gather baseline data from my students for my action research project regarding effectively supporting the participation of students with learning disabilities in guided inquiry science instruction.

Student Interview Analysis

The first interview question asked the students' opinion and feelings on their experience in the regular education science classroom. The majority of students expressed their frustrations with the subject. Of the 10 students interviewed, 6 students, or 60%, responded that they did not like science. One student replied, "I am not any good at science. I just feel so stupid in that class. I hate it." Other responses were similar with students expressing that they did not like their science class. The students interviewed did not come right out and explain why they felt they did not like science class. However, with time to process their response and with encouragement from me to explain further, the common response was, the science class made them feel uncomfortable because they did not understand the content being taught. The other 4 students, 40% of the students interviewed, replied with a neutral response. One student stated, "It's OK. I like to talk to other kids in class because we work in groups." Another said, "I like to do the labs, but it is my hardest class of the day." Although the four students had a neutral response, they seemed to have an open-minded perspective on their science class. The other six students were very forward with their negative opinion of the science class. Overall, there were no straightforward positive responses. Most of the students disliked their science class and felt that it was their worst, or hardest, subject of their day.

The second question posed during the interview asked the students what was the hardest part about learning the material in science. The students interviewed had a wide array of responses. All of the responses broke down into five major themes. Of the 10 students interviewed 40% responded with vocabulary, 20% reported reading the text book, 20% reported tests, 10% reported guided reading worksheets, and 10% reported the lab reports were the most challenging part of their science class. The dialogue that took place during this part of the interview was the most extensive. Students began to express the reasons why they did not have a positive opinion of their science class. One student stated, “The whole class is just really hard, but I have never liked science and I will never be any good at it. When the teacher is talking, she uses words I have never heard before and it doesn’t make any sense to me.” Another said, “I think I understand it when I am listening in class, but when take the test I never do very good. I have a hard time remembering all of the science words we were supposed to learn.”

The interview continued with a third question asking how a strategies teacher can support the students and prepare them for their science class. The students had a wide variety of answers. Two common themes were support with vocabulary and reading. Of the students interviewed, 6 out of 10, or 60% in all, included the science book as one of their greatest difficulties. These six students followed their response with how reading the textbook aloud would help them understand the content better. One student reported, “If the science teacher reads the book out loud to the class then I can listen, but sometimes we have to read by ourselves or with partners. If I have to read by myself then I don’t read it. If we have to read with partners then I try to find a friend who will just read it. I don’t like having to read to a partner.” The other major theme identified through the interview responses was the science vocabulary. During the responses for question three, 90% of the students interviewed included that assistance with the science vocabulary would be especially helpful. One student stated, “I would like my strategies teacher to help me understand the science words we are supposed to learn. I follow along in my science class, but I can’t always get the words. They are words that are hard to say and I don’t get them. Then we get tested on them and I never get a good grade.” In addition to the two major themes there were other ideas presented in the interviews. The students mentioned they would like help with completing their homework or worksheets, help to review the big ideas before a test, and would like to be able to ask questions and review the material that was presented in their science class.

The fourth question addressed how students’ felt they were able to participate within a group lab during inquiry based science. Out of the 10 students interviewed, 8 students responded with a positive experience with group labs. One student said, “Labs are the best part of science class. We get to work with microscopes and do really cool things like find bugs outside.” Another stated, “The best days are days that we get to work together. It is not so boring then. The time flies by and we have a lot of fun.” Overall the students who responded with positive experiences just thought that working in groups and doing hands on activities made the class fun for them. On the contrary, two students did not feel they liked the group labs in the science classroom. One student stated, “I don’t like anything about science class. I really don’t like having to work with other students. It is just too hard.” After this response, I continued to probe the student for further explanation about his negative response. With much encouragement on my part, the student finally stated, “I don’t like everyone to know that I am stupid and when I work with other students and I don’t get it, they make fun of me.” The second student with the negative response reported, “The rest of the group moves too fast. I just watch.”

The final question in the interview asked the students if there was anything else they would like to tell me about how I could help them learn in the science class. The majority of the students, nine out of the ten students interviewed stated that they needed a lot of help in science class but there was nothing more that they wanted to add. The one student who chose to elaborate on the interview question stated, “I just don’t get it. I wish you could help me understand it and then maybe I would like science class. I have always been bad at math and science. I don’t think I will ever get better.”

Interview Data Interpretation

This interview process was a very valuable step in my action research. I was not expecting the overwhelmingly negative responses. I have worked with the special education population in the past and I have witnessed frustration in the content area learning. However, this specific student group that was interviewed was very candid in their responses. Overall the students had many preconceived ideas that science was just too hard and it was never going to be a subject that they enjoyed or did well in. The students spoke openly about their frustrations with the general education science curriculum and how they felt they never understood the content of the lessons. I assumed this would be an underlying theme; however, it was clear that this group of students felt they would not do well in science even with additional help. I feel that based on the reported perception of science class, it will be critical for the science strategies and remediation techniques to provide a more comfortable environment to build a great foundation of confidence in the area of science.

Student Engagement Survey

The student engagement survey (Appendix B) was given to the 10 students participating in the research. The survey was administered once throughout the research period. The engagement survey was given during the first week of data collection. With the Likert scale format, the students were able to quickly reflect and respond to the five statements provided on the survey.

Findings

The first statement, "I participate in group activities and feel comfortable." The most common response was "sometimes", with 80% of the test group checking this box. The second statement, "I understand what is going on and I can add to class discussion." The most common response was, "very little" with 40% of the students selecting this answer. The third statement, "I try to blend in and not be noticed." The most common response was, "sometimes" with 50% of the students selecting that option. The fourth statement, "I am uncomfortable in the big classroom." The most common response was, "sometimes" with 50% of the students. The final statement, "There are times I feel like I don't know anything." Eighty percent of the students responded with, "very often." The following table displays the number of responses for each category.

Table 3
Student Engagement Survey Results

	Very Often	Sometimes	Very Little	Not at All
I participate in group activities and feel comfortable.		8 student responses	2 student responses	
I understand what is going on and I can add to class discussion.		3 student responses	4 student responses	3 student responses
I try to blend in and not be noticed.	3 student responses	5 student responses	2 student responses	
I am uncomfortable in the big classroom.	2 student responses	5 student responses	3 student responses	
There are times I feel like I don’t know anything.	8 student responses	2 student responses		

Survey Data Summary

The student engagement survey provided me with a deeper understanding of how special education students perceive their learning experience within the regular science classroom. According to the data, most of the special education students only feel comfortable participating in group activities some of the time. Although there may be many explanations for this perception, the most likely explanation is that special education students are struggling to understand the content of the lesson and therefore do not feel comfortable to participate in group activities with the general education population. This is gleaned from statement number two which addresses if the student understands what is going on within the science topic. When students don’t understand what is going on and do not feel comfortable to participate within the group activity, they most often choose to blend in and try not to be noticed. The social consequences of not understanding the science topic and standing out far outweigh the benefits of asking questions to clarify and attempt to understand the content. Therefore, students pretend to know what is going on and not be identified as a slow learner. This leads to special education students feeling uncomfortable within the larger classroom with 28 of their regular education peers. Perhaps the most astounding finding was that the majority of special education students very often feel like they do not know anything in the regular science curriculum.

Academic Engagement Log

The academic engagement (Appendix D) log was designed to keep a quick note of the engagement each day of the six-week treatment period. Each classroom teacher had a copy of the academic engagement log for each student in the test group that they had in class. The teachers marked the students' academic engagement record with a quick plus for on task behavior or a minus for off task behavior to identify the overall engagement for the class period. At the end of the treatment period, a total number of on-task behavior days and off-task behavior days were calculated for each student.

Findings

The data collected shows that 9 out of 10 students were engaged in the class activities for at least 50% of the time.

Table 4
Academic Engagement Log Findings

Student #	Treatment Days on Task	Percentage of Days on Task
1	20	66%
2	12	40%
3	19	63%
4	25	83%
5	18	60%
6	16	53%
7	15	50%
8	21	70%
9	23	76%
10	26	86%

Summary

Overall the data collection tool provided the data that the instrument was designed for. The only record for each day was a plus or minus. There were no anecdotal notes or comments made by the teacher. Therefore, it is more difficult to make connections between why the student was on or off task for each recorded day. Although the data was very basic at best, there are strong conclusions to be made. Overall, the majority of off-task behavior was noted in the first three weeks of the treatment period. In addition to seeing an increase in academic engagement throughout the treatment period, there was a noticeable direct relationship between the percentage of on task engagement and the post treatment grades. The students who were engaged a higher percentage of the treatment period scored higher on classroom assignments, tests, and quizzes. The data collection was taken over a period of 30 days, however it is not known if the 30 days were consecutive. The classroom teachers however, did collect 30 days of data on each participating student.

Classroom Observation Log

The classroom observation log (Appendix C) was used to record the class content, objectives, inquiry-based method used and the engagement level attempted by the identified special education students in this study one day a week for the six-week treatment period. The regular education teachers used the classroom observation logs to also comment on the lesson such as goals, teacher prompts, student understanding, student attitudes, changes for future lessons, and any other relevant information. This data collection tool was used to gain a deeper understanding of how the test group was able to participate in regular education inquiry based science lessons as well as to determine which support strategies would best support this population of students.

Findings

The classroom observation log week one took place on Monday, October 20^{th}. The content covered for the day's lesson was discovering cells. Specifically, the key concepts of cells, how the intervention of the microscope contributed to knowledge about living things, cell theory, and how microscopes produce magnified images. The inquiry-based method used was exploration with a hands-on activity so the students could explore using a microscope. The inquiry-based method of explanation was also used to introduce new concepts and skills so the students could make connections while exploring the microscopes during the lab. The objective of the lab was for students to observe black and white newspaper photographs using their eyes, a hand lens, and a microscope. The expected outcome was for students to see the individual dots of ink that make up the photograph. The students were asked to note what they could see with their eyes, how it changed using the hand lens, and ultimately what they could see with the microscope.

During the lab, notes were taken on student engagement, student attitudes as well as general comments about the lesson. The lab was designed to be staged by the teacher however with little teacher input during the actual lab. The observations taken were with little to no teacher intervention while the lab was taking place. The classroom teacher rated engagement on a scale of 1-5 with 5 being a very engaged student who was participating actively with their group, communicating the science concepts, observing, and fully participating in the lesson (Appendix M). The table below shows how the 10 students rated on the level of engagement attempted as well as comments noted from the classroom observation log.

Table 5
Week 1 Observation Log Engagement Level Attempted

Student	Level of Engagement	Comments
1	4	Student participated but struggled to discuss connections with the group.
2	1	Student refused to participate with group or do the activity.
3	3	Watched group and made an attempt to look at the picture with the hand lens.
4	2	Student talked with group but would not participate in the activity.
5	1	Student would not participate even when encouraged by teacher and group members
6	4	Student talked with group and listened while others made connections. Did look through microscope and hand lens.
7	2	Student observed group members and listened to discussion. Student looked through hand lens but did not communicate with group.
8	4	Student communicated with group even though had a limited understanding. Did look through the microscope.
9	5	Student participated with group, made an effort to describe the picture while using the hand lens and microscope.
10	4	Student participated with a limited understanding. Student had a positive attitude towards working with the group.

Overall the students did not engage much with the group activity lab. It was clear that their limited experience with a microscope inhibited their willingness to participate. It was noted that many of the students were willing to listen and observe their group but did not feel comfortable participating in the activity. The classroom teacher notes stated that they felt if the students had more background knowledge and an opportunity to be exposed to the microscope that the students may be more willing to engage during the lesson. From the classroom observation log, an intervention was developed to provide the test group with a visual model of a compound microscope (Appendix G) as well as a second opportunity during the science strategies support class to use the microscopes and discuss their observations.

The second classroom observation log took place on Monday, November 28th, 2011. The content of the lesson included identifying the parts of a microscope and describe their function. The classroom teacher taught that cells were visible only after the invention of microscopes. Class discussion included asking, “What shape is the lens?” as well as, “What does it do to light passing through?” The class discussed the two properties that a light microscope needs to work, magnification and resolution. The teacher described that an electron microscope magnifies by using a beam of electrons. The inquiry-based method used during this lesson was explanation of new concepts and skills. The lesson also included a small lab, where students could practice identifying the parts of a microscope and describe their function, which was an activity for the student to elaborate and apply the concepts in context and build on their understanding and skill. The table below shows the engagement level attempted by the student in the study group during the activity as well as comments noted by the classroom teacher.

Table 6
Week 2 Observation Log Engagement Level Attempted

Student	Engagement Level	Comments
1	5	Student used their microscope handout and practices identifying parts and functions of the microscope with a positive attitude.
2	1	Student refused to work with the microscope. It was noted that he sat with his arms crossed and did not participate.
3	4	Student used microscope handout and worked with a partner to begin to identify parts of the microscope.
4	4	Student used microscope handout and worked with a partner to begin to identify parts of the microscope.
5	3	Student did use their handout and worked with a partner. The student observed more than participating in identifying parts. Did not describe any functions.
6	5	Student used their microscope handout and practiced identifying parts and functions of the microscope with a positive attitude.
7	4	Student used microscope handout and worked with a partner to begin to identify parts of the microscope.
8	4	Student used microscope handout and worked with a partner to begin to identify parts of the microscope.
9	5	Student used their microscope handout and practiced identifying parts and functions of the microscope with a positive attitude.
10	5	Student used their microscope handout and practiced identifying parts and functions of the microscope with a positive attitude.

The classroom teachers all noted on their classroom observation logs that the majority of student in the test group used their visual model of a compound microscope (Appendix G) that they were given and used during science strategies class in days prior to this classroom activity. The classroom observation notes indicate that the classroom teachers did not even prompt these students to access their visual model for help if needed. Overall, the teachers' notes indicated that the attitudes of the students in the test group were very positive during this activity and they seemed to feel more comfortable with the inquiry-based science lesson than in past activities. From these classroom observation notes, it was decided that the science strategies support would include as many visual models and graphic organizers as possible for the students to be able to access during their regular education science class. One teacher noted, "The regular education students who do not have access to the science strategies support were very interested in the visual model of the microscope. There was an interesting sense of popularity among those who had the visual model."

Week three classroom observation log took place on Monday, December 5th, 2011. The objective of the lesson was to compare and contrast the difference between plant and animal cells. The teacher introduced and discussed figures of a plant and animal cell using a document camera to project the figures on the board. The teacher pointed out that the drawings of the plant and animal cells are generalized representations of cells. The teacher then projected prepared slides to have the students relate the organelles the students see to the representation drawings of the cells. The class discussion included how the actual cells vary in shape and structure from the generalized cells in the drawings. The teacher also addressed how cells have many different shapes and sizes as well as vary in the specific organelles they contain. The application question, “Why do you think different cells look so different from one another?” was posed and it was discussed that it is because they have different functions in the organism. After the introduction of both the plant and animal cell as well as the class observations and discussion, the class was asked to work in groups of two to create a Venn Diagram to compare and contrast the similarities and differences of plant and animal cells. Each student was to produce their own Venn diagram even though working in pairs. The inquiry-based methods used during this lesson were engagement using the projected images to engage the students, explanation of new concepts and skills, as well as evaluation. The activity Venn Diagram activity gave the students the opportunity to assess their knowledge about plant and animal cells, while providing the teacher with evaluation of student understanding and lesson effectiveness. The identified group of students in the test group had received a visual model of a plant cell (Appendix N) and an animal cell (Appendix O) as well as an introduction lesson during a previous science strategies support class. The following table provides the students’ level of engagement attempted as well as notes recorded by the classroom teachers.

Table 7

Week 3 Observation Log Engagement Level Attempted

Student	Engagement Level	Comments
1	4	Student was participating with partner and created Venn Diagram. Relied quite a bit on help from partner.
2	2	Student did talk with partner, but made little attempt to help find similarities and differences. Student had a negative attitude. Did not turn final product.
3	4	Student was participating with partner and created Venn Diagram. Relied quite a bit on help from partner.
4	4	Student was participating with partner and created Venn Diagram. Relied quite a bit on help from partner.
5	2	Student did talk with partner, but made little attempt to help find similarities and differences. Final product showed that student struggled with the concept.
6	5	Student discussed similarities and differences with partner and independently created final product.
7	3	Student worked with partner. Made attempts to identify similarities and differences. Relied on partner for help in completing project.
8	3	Student worked with partner. Made attempts to identify similarities and differences. Relied on partner for help in completing project.
9	4	Student was participating with partner and created Venn Diagram. Relied quite a bit on help from partner.
10	4	Student was participating with partner and created Venn Diagram. Relied quite a bit on help from partner.

For the most part teachers' notes indicated that this task was difficult for the student research participants. The notes reported that the students listened and observed during the lecture and discussion but did not add to the class discussion. Specifically, the notes stated that student number two was not paying attention and was daydreaming during the lesson. When it came time to complete the activity with a partner it was noted that student number two had a very negative attitude however, did discuss a little with his partner. In the end, he did not complete or turn in a completed Venn diagram. The regular education science teachers noted that because of the previous popularity with the visual models, they provided copies of them in class for all students. The visual models were copies of illustrations of the plant and animal cells found in the text book. The teachers mentioned in the notes that all students enjoyed having their own copy of the handout to keep rather than referencing the textbook. Of the students in the test group, five out of the ten students participated and discussed with their partners the similarities and differences, however relied greatly on help from their partner. The students were engaged but struggled with identifying the similarities and differences. However, it was noted that the regular education partners were very patient and helpful in assisting in creating the Venn Diagrams for the identified students. From the observation notes and assessment of the Venn diagram project, it was decided that the identified students would benefit from reviewing the concepts during science strategies support class. Specifically, the intervention strategy that followed this lesson was to reread Chapter 1, Section 2 using the adapted reading and study worksheets to give the student the opportunity to build on or extend their understanding of the key concepts.

The classroom observation log four took place on Monday, December 12th, 2011. The objectives of this lesson were to identify different types of cells and identify what bacterial cells is missing in compared to plant and animal cells. The lesson began with a video field trip on cell structure and function. This short video clip introduced the students to specialized cells such as red blood cells in a blood vessel, nerve cells, and bone cells while comparing the structures of these three types of cells. Following the video field trip students followed along in their textbook as the teacher read aloud. The teacher stopped to discuss concepts further and ask discussion questions to probe the students for understanding. A key discussion was that in many-celled organisms, cells are often organized into tissues, organs, and organ systems. The second key discussion was that while a bacterial cell does have a cell wall and a cell membrane, it does not contain a nucleus. Questions posed to the students during the discussion were, “Where is the genetic material?” and, “What organelles found in plant or animal cells do the bacterial cells appear to be lacking?” At the end of the class period the students were asked to respond on a 3x5 note card how the location of the genetic material in the bacteria differ from its location in animal and plant cells. The note card response was used to gather student understanding of the concepts taught. The following table shows the engagement level attempted by each student in the test group as well as comments from the classroom teacher.

Table 8

Week 4 Classroom Observation Log Engagement Level Attempted

Student	Engagement Level	Comments
1	5	Student followed along in textbook, observed, listened and participated in class discussion. Great Attitude!
2	2	Student did not follow along in the textbook. Student did appear to listen to some of the discussion.
3	4	Student followed along in textbook, observed and listened to class discussion.
4	5	Student followed along in textbook, observed, listened and participated in class discussion.
5	4	Student followed along in textbook, observed and listened to class discussion.
6	3	Student did attempt to follow along. Was distracted during the reading. Listened during class discussion.
7	3	Student did attempt to follow along. Was distracted during the reading. Listened during class discussion.
8	4	Student followed along in textbook, observed and listened to class discussion.
9	4	Student followed along in textbook, observed and listened to class discussion.
10	5	Student followed along in textbook, observed, listened and participated in class discussion. Very excited to answer questions!

The identified students had received a science strategies support on specialized and bacterial cells prior to this regular education science class lesson. The students had completed the adapted reading and study guide on specialized and bacterial cells as well as completing a cell organization flowchart (Appendix Q) and a Venn diagram (Appendix R) to show how plant cells and bacterial cells are alike and different. The teachers noted that there seemed to be a sense of excitement in the identified students. One teacher noted specifically that student ten said, “Oh, I know this!” Another teacher indicated that there was a greater level of engaged listening during the lecture from the identified students. She noted, “They seemed to perk up when they knew something, rather than looking glossed over with a new and overwhelming concept.” All three general education science teachers noted that building background knowledge in science strategies support class has provided the identified students the ability to engage and actively participate more independently in class. Of the ten students, seven students provided the correct response to the assessment probe using the 3x5 note cards. Two of the ten students received partial credit for answering that the genetic material is found in the nuclei of the plant and animal cells, but did not attempt to identify that the genetic material is located in the cytoplasm of the bacterial cells. Student number two turned in a blank note card. One teacher noted that an identified student in the test group wanted to show her the cell organization flowchart that she had created during science strategies class. Based on the findings of this classroom observation log the identified students will continue to use the adapted reading and study guides prior to the concept being taught in the regular education science class as well as graphic organizers to identify key concepts.

Classroom observation log five took place on Monday, January 9th. The first week of January was spent reviewing the previously learned concepts of Chapter 1 due to time off over Christmas. The lesson objectives taught during observation five were to introduce elements and compounds, to identify the main kinds of organic molecules in living things and how water is important to the function of cells. The beginning of the lesson was a short activity. The teacher provided containers filled with various substances. All of the substances were chemical compounds. The substances were water (hydrogen and oxygen), salt (sodium chloride), baking soda (sodium bicarbonate), and chalk (calcium carbonate). Each container was labeled with what each substance is and what each substance is made of. The students were asked to observe the containers of substances at each station and to observe each station. After completing all stations, each student was to write a definition of what they thought a chemical compound is on a 3x5 note card. Following the activity the teacher discussed elements and compounds. The teacher helped the class complete a table on the board, which compared and contrasted carbohydrates, lipids, and proteins. The class table also identified which elements made up the compound and the compounds function. The students were asked to follow along and create their own table like the one the teacher made on the board. The inquiry-based methods used during this lesson were engagement, exploration, and evaluation. The four stations set up for students to observe provided objects to engage the students. The students were able to explore substances with a hands-on activity. The students were then evaluated by having them create their own definition of a chemical compound. This tool provided the instructor a quick probe of the students’ background knowledge before starting the whole group lesson. The following chart shows the attempted level of engagement by the test group as well as comments from the classroom teachers.

Table 9
Week 5 Classroom Observation Log Engagement Level Attempted

Student	Engagement Attempted	Comments
1	5	Student discussed with peers the about the substances. Student participated in class discussion and the creation of personal compare and contrast chart.
2	3	Student discussed with peers about the substances. Student was distracted during the lesson. Student made minimal attempt to create chart.
3	5	Student discussed with peers the about the substances. Student participated in class discussion and the creation of personal compare and contrast chart.
4	5	Student discussed with peers the about the substances. Student participated in class discussion and the creation of personal compare and contrast chart.
5	4	Student discussed with peers about the substances. Student actively listened and observed during lesson. Student attempted chart.
6	4	Student discussed with peers about the substances. Student actively listened and observed during lesson. Student attempted chart.
7	3	Student discussed with peers about the substances. Student was distracted during lesson. Student made minimal attempt with the chart.
8	4	Student discussed with peers about the substances. Student actively listened and observed during lesson. Student attempted chart.
9	5	Student discussed with peers the about the substances. Student participated in class discussion and the creations of his or her own compare and contrast chart.
10	5	Student discussed with peers the about the substances. Student participated in class discussion and the creations of his or her own compare and contrast chart.

The teachers noted that the students were all actively engaged in discussion with peers regarding the substances. The discussion was on topic. The identified students made connections and seemed to build on background knowledge during the activity. Of the ten students in the test group, eight students gave a definition of a chemical compound that mentioned it is something that is made up of more than one substance. One student did not have any definition and one student's definition was that a compound was a jar and a lid. All of the teachers' notes stated that the identified students were actively listening and observing during the lesson and all but one student completed the compare and contrast table from the board. The one student made a few basic notes with little attempt to create the table. Three out of ten identified students were able to participate and provided answers to the compare and contrast table the teachers created on the board. One teacher noted, "The student seemed to beam when she was able to add to the chart on the board." Another teacher noted that, "Although his negative behavior affects his engagement in the lesson and group discussions, he was truly engaged in the lab activity today. As I was wondering the classroom making observations, he was adding to the small group discussion and was on topic while he thought I wasn't looking." Prior to this lesson, the identified group had completed the adapted reading and study guide for section 3 on chemical compounds in cells. As the strategies teacher, I began the introduction of chemical compound by building background knowledge. To begin the strategies lesson, I used a jar and lid. I asked the students if the lid could be separated from the jar. We then discussed how the jar and lid could easily be divided into two parts but the jar and lid individually could not be divided into more parts. We discussed how this is like elements. They cannot be divided. Then we discussed how the jar with the lid attached is something like a compound. Although I thought this would be a great visual to build background knowledge, one student proved there was still a misconception with what a compound is. The science strategies class had also discussed molecules and compounds. The students were provided with a molecule visual aide (Appendix S). With the findings from classroom observation log five, it was determined to continue the pre teaching intervention using the adapted reading and study guides along with visual aids and graphic organizers.

Classroom observation log six took place on Monday, January 16th. The science content being taught was the cell in its Environment. The objective of the lesson was to demonstrate and explain how substances that can move into and out of a cell do so by diffusion, osmosis, and active transport. This day's lesson specifically looked at diffusion. The lesson began with a demonstration. The students stood with their classmates in locations that were evenly spaced throughout the classroom. The teacher sprayed air freshener into the air. Over time the air freshener diffused evenly throughout the classroom, reaching students at the same distance from the source at about the same time. The teacher discussed how the farther each student was from the teacher, the longer it took for the student to smell the air freshener. After the demonstration the teacher presented the key terms, selectively permeable and diffusion. The teacher presented the cell membrane as like an ancient castle that protected the inhabitants within, and the castle gatekeeper allowed only certain people to pass through. The class then discussed diffusion. The teacher explained that molecules move from an area of higher concentration to an area of lower concentration during diffusion. The class made connections to the air freshener activity. The inquiry-based methods used during this lesson were engagement, explanation, and elaboration. The activity at the beginning of class was used to engage student and to be able to make connections later in the lesson. The new concepts and skills were addressed with an explanation. The analogy of an ancient castle was an elaboration of the science concepts allowing the students to apply and build on their understanding of the concept. The following table shows the engagement level of the students in the test group and comments as noted by the teachers.

Table 10
Week 6 Classroom Observation Log Engagement Attempt

Student	Engagement Attempt	Comments
1	5	Student participated in activity, lesson, and class discussion.
2	3	Student participated in activity. Somewhat distracted during lesson and did not add to class discussion.
3	4	Student participated in activity and lesson. Did not add to the class discussion, although actively listened.
4	5	Student participated in activity, lesson, and class discussion.
5	3	Student participated in activity. Somewhat distracted during lesson and did not add to class discussion.
6	4	Student participated in activity and lesson. Did not add to the class discussion, although actively listened.
7	4	Student participated in activity and lesson. Did not add to the class discussion, although actively listened.
8	4	Student participated in activity and lesson. Did not add to the class discussion, although actively listened.
9	4	Student participated in activity and lesson. Did not add to the class discussion, although actively listened.
10	5	Student participated in activity, lesson, and class discussion.

All of the classroom teachers noted that there was an overall sense of success among the test group students. It was noted that this was a particular difficult concept for most students to get, much less for students with identified learning disabilities. Teacher notes indicated three of the ten students seemed very confident with the concept and were able to easily contribute to the class discussion. All of the teachers' notes stated that all of the students in the test group were very engaged in the class activity and were actively trying to make connections and offer ideas and hypotheses of how to explain what was happening with the air freshener. Two of the teachers noted that the students participating in the research that are in their science class have made a noticeable change in their attempt to participate and engage in all classroom activities and lessons.

Prior to this particular lesson the identified test group was given background knowledge in the subject during the science strategies support class. The students had completed the adapted reading and study guide for diffusion. The students also received a visual representation of diffusion (Appendix T). Based on the notes made by the classroom teachers in the science strategies support class continued with the adapted reading and study guides as well as completed a chart showing the relationship among diffusion, osmosis, and active transport during the last week of the action research period (Appendix U). The students also received a visual aid of the effects of osmosis on cells (Appendix V) and active transport (Appendix W). The final intervention strategy used during the treatment period was a concept map of organic compounds (Appendix X).

<u>Summary</u>

Throughout the six-week treatment period, teachers noted an increase in student engagement attempts. Overall, it was noted that students seemed more confident to engage in whole group discussions, inquiry-based activities, partner work, as well as independent work. Teachers noted that there was as significant decrease in engagement during week three for most students. This was discussed during our PLC time and it was thought to stem from the increase in difficulty of the content, which was comparing and contrasting plant and animal cells. Along with the increase in difficulty, the students were asked to identify similarities as well as provide a written response in the form of a Venn diagram. The teachers all agreed that the analysis of the plant and animal cells as well as the organization of the Venn diagram presented a challenge for the identified learning-disabled students. However, the research did not take into account the students' previous experience with Venn Diagrams, which could impact their ability to create one in the science classroom. As the figure shows, eight students showed an increase in their engagement attempts at various points over the six-week treatment period, while two students maintained or decreased their engagement levels at various points.

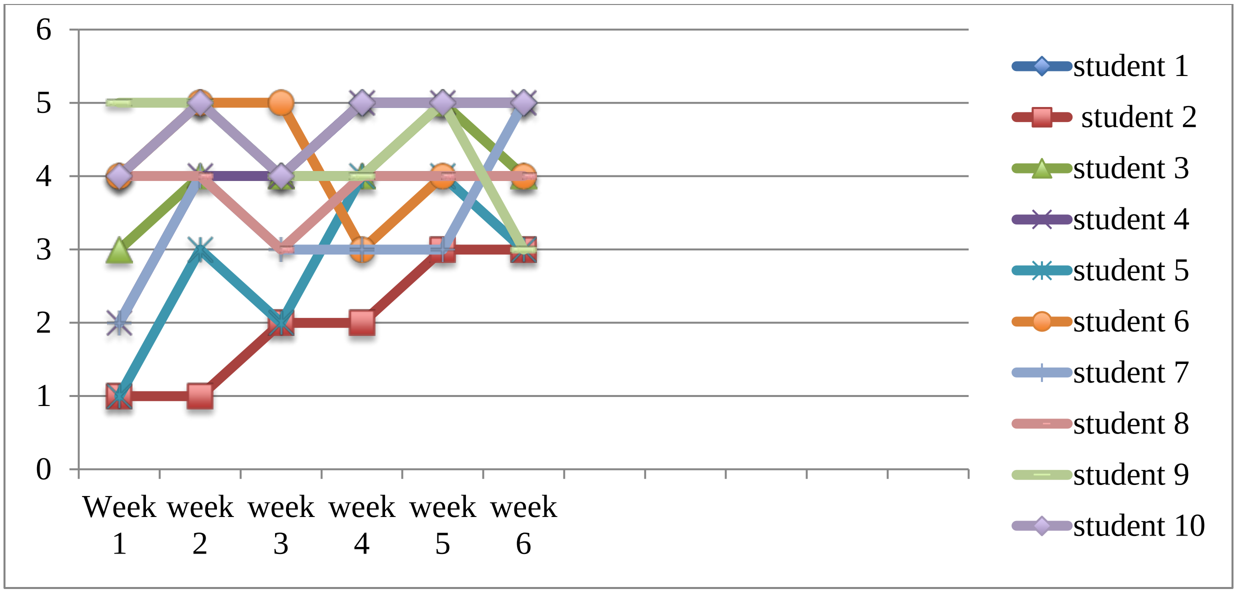

Figure 2. Comparison of Student Engagement over Treatment Period, (*N*=10).

The following table more clearly identifies the individual, week-to-week, levels of engagement as documented by classroom observation log.

Table 11
Student Engagement Over the Six-Week Treatment Period

Student	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Change
1	4	5	4	5	5	5	+1
2	1	1	2	2	3	3	+2
3	3	4	4	4	5	4	+2
4	2	4	4	5	5	5	+3
5	1	3	2	4	4	3	+3
6	4	5	5	3	4	4	+1
7	2	4	3	3	3	5	+3
8	4	4	3	4	4	4	Maintained
9	5	5	4	4	5	3	-1
10	4	5	4	5	5	5	+1

Post Student Interviews

The post-treatment interviews (Appendix A) were given to determine the changes in student attitudes toward inquiry-based science after the support of the science strategies. In addition to determining the change in attitudes the survey looked to find if students perceived themselves as more successful in the regular education classroom after the treatment period. The interviews were conducted in the classroom during the regularly scheduled strategies class. The interviews took place over two days. I was able to interview five students each day. The interviews were recorded with the school's iPad. Although the interview was videotaped and recorded, I took notes and records while the interview took place. The interviews were then transcribed verbatim into a word document and analyzed for themes by the PLC.

Findings

The first interview question asked the students' opinion and feelings on their experience in the regular education science classroom. The majority of the students expressed that they were doing really well in science. Of the ten students interviewed, 70% responded that science was going well. One student replied, "I am a science genius now!" The students did not go into great detail as to why they thought they were doing well. However, a common theme was that the students had just received their report cards the previous week and they had a good grade in science. Of the ten students interviewed, one student responded with neutral feelings. This student said, "It's fine." This student also chose not to comment further when I asked to have him comment further. Of, the ten students interviewed, 20% responded with negative feelings toward their science class. One student replied, "I am not any good at science and I hate that class." I gave him time to think about the response and he followed with, "It's just too hard."

The second interview question asked the students to identify what was the hardest part about learning the material in science. The students interviewed had very similar responses this time in comparison to the pre-treatment interview response. Of the ten students interviewed 90% of the students said that the science textbook was the most difficult part about learning science material. One student responded, “I can’t read the book by myself. If we read it out loud as a class then I can just listen.” Another student replied, “There is a lot of words in the science book that I can’t say and I get confused when we talk about them. It doesn’t make any sense.” Another common response to the textbook was that the students like the pictures in the book but the reading portion was the greatest struggle. One student replied, “When the teacher is reading the chapter to us, I usually just look at the pictures and that helps.” Of the ten students interviewed, one student responded that the guided reading assignments are the most difficult part of science class. This student replied, “I know that the guided reading is supposed to help us study for the test and is a review, but it is really hard. I can never find the information and I always get a bad grade on my guided readings.”

The third interview question addressed how a strategies teacher can support the student and prepare them for their science class. The student responses varied greatly, however, they fit into two main themes. The two main themes were re-teaching and reading. Of the students interviewed, 90% replied that reading the textbook was the greatest challenge. These students expounded on their thoughts regarding this question. One student replied, “I like how in strategies we go over the same information that we talked about in science class but we get to use the picture charts. It helps me to see a picture of what we are talking about. I saved my picture chart and my teacher let me use it on my quiz.” Another student stated, “When we are in strategies class you go over the lesson with us and help us with our vocabulary. It is easier to ask questions in this class that in my science class.” Another student reported, “It works best for me to fill out the map that we made in strategies class as we read the chapter. I think we should do a map for every chapter.”

The fourth question addressed how students’ felt they were able to participate with in a group lab during inquiry based science. Out of the ten students interviewed, nine students responded with a positive attitude toward group labs. One student said, “Lab days are the best days.” Another responded, “That is why science is my favorite class, we get to do really cool things that we don’t get to do in other classrooms. It is really fun.” On the contrary, one student out of the ten interviewed, replied that he did not like to work in groups or do the science labs. He replied that, “I am stupid and I don’t like it when I have to work with other students, I just sit there.” This is the same student who very negatively responded to lab activities in the pre-treatment interview. I encouraged him to identify specific reasons why he did not like the labs however, he was unable to communicate or identify any specific reasons other than, “I just don’t like science.”

The final question of the interview asked if there was anything else they would like to tell me about how I could help them learn in the science class. The responses were short and varied although there was one theme. The majority of the students reported that the science strategies support was helpful and they wanted me to continue to do the science strategies for the remainder of the year. One student replied, “This is the best grade in science that I have ever had. I love it.”

Post-Treatment Interview Summary

This was the most satisfying step in my action research. I was expecting a theme of more positive responses toward science in the post-treatment interviews, based just on my overall experience while implementing the treatment. However, the overwhelming positive responses from the students were very rewarding to me as the teacher researcher. Overall the students expressed that they still held concerns of struggle in science, especially with the textbook, however felt that the science strategies offered a support to the learning process. It was clear that this particular group of students benefitted from the tailored remediation techniques and the re-teaching opportunities that the science strategies treatment offered. The data shows that building a foundation of confidence in the area of science is obtained through remediation techniques in a comfortable environment. With that said, it is important to note that years of frustration in a particular content area along with an educational career stained with failure could take years to remediate and possibly never change for some students. With even the best of intentions and the most researched support techniques, a transformation in attitude toward learning could take more than a six-week treatment period.

Student Performance

Grades

An entire school year consists of 180 days. This school year is broken into four quarters. Each quarter consists of two six-week periods. Castle Rock Middle School reports the students’ grades to parents or guardians each six weeks. After the first six weeks a mid-term report is sent home. At the conclusion of the second six weeks, quarter grades are recorded and reported. The research took place over an entire quarter. For the first six weeks there was no treatment and baseline data was collected. The school generated grades that were collected for both the baseline data as well as the treatment period included all science classroom grades. The classroom grade categories include tests, quizzes, projects or labs, homework, and extra credit. The middle school grading scale is 90-100 A, 80-89 B, 70-79 C, 60-69 D, and 59 and below F. The pre and post treatment data of school-generated grades were collected for the ten participating special education students. The grades collected were the pre and post treatment regular education science classroom grades.

Findings

Of the 10 students in the treatment group, 2 students ended the pre-treatment period with an F or a failing grade for their mid-term report. The most frequently occurring school generated grade among the test group was a C. Two students received a B as well as two students receiving an A. These grades were gathered for baseline data prior to the start of the 6-week treatment period. School generated grades were collected again at the end of the six-week treatment period, which were also the second quarter report card grades. Seventy percent of the test group saw a marked improvement in their overall classroom grade. However, 30% saw a decrease in their classroom grade. Of the 70% that increased their classroom grade the average improvement was by 7%, with 1 student increasing his or her classroom percentage grade by 17%. The table below identifies all of the school-generated data for the ten students in the test group.

Table 12
Pre and Post Treatment School Generated Grades

	Pre-Treatment	Post-Treatment	Change
#1	76% C	82% B	↑ 6%
#2	56% F	64% D	↑ 8%
#3	84% B	82%B	↓ 2%
#4	91% A	93% A	↑ 2%
#5	78% C	83% B	↑ 5%
#6	54% F	71% C	↑ 17%
#7	72% C	79% C	↑ 7%
#8	79% C	85% B	↑ 6%
#9	81% B	80% B	↓ 1%
#10	93% A	91% A	↓ 2%

Summary

The support strategies used during the treatment period led to an overall improvement in student achievement. Although not all ten students saw marked improvement, I feel it is important to note that the three students who saw a decrease in there classroom grade percentage, only saw a decrease in 1-2% of their overall classroom grade percentage, which is small and within the variability range of the school grade.

Teacher Perceptions

Teacher survey

A teacher survey was given to all of the seventh grade science teachers at Castle Rock Middle School. The teacher survey was developed to gather baseline data from the regular education science teachers, for my research project regarding supporting students with learning disabilities as they encounter guided inquiry science instruction. The teacher survey, (Appendix E) was given to all three of the seventh grade Life Science teachers.

Teacher Survey Findings

The teacher survey was developed to gather baseline data from the teachers on their perception of inquiry based learning and teaching within an inclusive classroom. The first question asked the teachers how much, in their opinion, the special education learners participated in group activities. The most frequent response was, “sometimes”. The second question asked the teachers if they felt they had the support they needed to effectively teach in an inclusive classroom. “Very little” was the most frequent response to question number two. Of the teachers surveyed, two of the three reported that they had very little support to teach effectively to an inclusive classroom. One teacher reported having no support at all. The third question asked if the special education teachers on your team supported the science content with strategies support. The most frequent response was, “sometimes.” Of the three teachers surveyed, two teachers reported they sometimes had the science strategies support from the special education teacher. The third teacher surveyed reported that they often had the science strategies support from the special education teacher. The fourth question that was surveyed asked the teachers if they felt the regular life science curriculum is appropriate for all levels of learners. This question provided the most varied answers on behalf of the teachers surveyed. There was no most frequent response. One teacher surveyed reported that the science curriculum was sometimes appropriate for all levels of learners. One teacher surveyed reported that very little of the curriculum was appropriate for all levels of learners. The final teacher surveyed reported that the curriculum was not at all appropriate for all levels of learners.

The fifth and final question asked the teachers to respond with any comments that would be helpful in designing support strategies for the seventh grade identified special education population. Of the open-ended responses there were three clearly identified themes. Of the three teachers surveyed, all three reported that the academic reading level of the content area textbook was well above the reading level of most of the identified special education learners. One teacher stated, “Having the strategies teacher read aloud the text book, while assisting with lesson specific homework, would be the most beneficial strategies support. The special education students often miss a large portion of the content because the text is written well above their academic reading level.” The second theme was vocabulary support. Of the teachers surveyed, all three reported that the content vocabulary was difficult for even the average seventh grade students. One teacher responded, “The vocabulary at this level of science becomes very difficult. Often the students have very little or no background information in areas such as cells and heredity. Therefore cytokinesis can be very difficult vocabulary for most seventh grade students and even more so for the special education population.” The third apparent theme was to provide pre-teaching and re-teaching to the special education learners. Of the teachers surveyed, two teachers reported that it would be helpful for the strategies teacher to introduce the key concepts or vocabulary before the lesson is taught in the regular science classroom. In addition to the pre-teaching of key concepts, the two teachers specifically mentioned reviewing and re-teaching the lessons that the students struggle with specifically. One teacher stated, “With 29 students in my classroom, I find it hard to fill in the gaps that students have. I try hard to continually assess and find out where their weak spots are. If I had the support of the science strategies all year long, I would be able to communicate to the strategies teacher, specifically what the special education students are struggling with. Then, during their strategies class they would be able to get the one-on-one, or small group, help that I am not able to provide with a class of 29 students."

<u>Teacher data summary</u>

This teacher survey was very insightful for the design of science strategies that I would eventually implement during my action research. The teacher survey gave me a quick glance at how the teachers feel the students are supported within their classrooms, as well as how they, as teachers, feel supported with large class sizes and inclusive classrooms. Traditionally, the study strategies class has become a homework completion class. It is my hope, with the collaboration of the PLC, the specific science strategies support of my action research that are implemented, will lead to improved academic achievement. It is with this overall data that I hope will inspire all strategies teachers to support the science content with the specific science strategies. I know these teachers personally and we work together on a weekly basis in our professional learning communities. These teachers agreed to be part of my action research team. I know how passionate they are about the content they teach and how they honestly want to see all of the students successful in their science class. I feel the online anonymous survey was the most effective way to survey my coworkers. They were able to respond honestly without reservation. The feedback they provided me helped to drive my strategies support. With the support of everyone on the research team, I feel the science strategies implemented will greatly increase the students' confidence in the classroom. It is was expectation that the greater confidence would translate to academic success in the regular education science classes for all learners.

PLC Deliberations

The PLC team met each week of the pre-treatment period as well as during the treatment period. The team continued to meet after the action research was completed. The teachers met every Wednesday during second period. During this time the team was able to collaborate on lesson planning as well as to discuss the collected research.

Findings

The PLC found that the concerns for the special education population were similar for all of the regular education teachers as well as for me the researcher. The students struggled to understand the content as well as lacked the confidence to participate in activities and group work. One common theme from the PLC deliberations was that the identified special education students needed small group, scaffolded instruction in a non-threatening environment to foster background knowledge and build confidence. The PLC found that as the treatment period began and the implementation of guided inquiry in a science strategies class as well as instructional interventions took place, the students' attitudes toward the science classroom greatly improved. One specific finding was that when modifications were made for not only the identified special education student but for the regular education students as well, all students benefitted. For example, as the treatment period progressed, it was noted in a PLC meeting that the regular education students were commenting on, and were jealous of, the visual aids that the treatment group had received. Copies of all visual aids were then provided to all students, so that the treatment group of students would not be identifiable by their peers.

Summary

It was during this time that the team of teachers was able to gain support from one another as well as discuss ways that each teacher could support the diverse group of learners within their classroom. The teachers agreed that during the PLC time they had become more reflective of their own teaching practices. Recording data daily and reflecting on student engagement and achievement gave the teachers a renewed sense of excitement in their teaching. Over the treatment period a common theme of the PLC time was discussion of what teaching strategy or activity would encourage student engagement.

Grand Summary Across Findings

The data shows that over the six-week treatment period student engagement increased significantly. The intervention strategies were tailored to what the students needed, which was found through teacher observation as well as input from the students themselves. The increased exposure to the content, along with the visual aids and graphic organizers, lead to an increase in student confidence in the regular education classroom. In the end, the treatment group saw an increase in their classroom grades.

INTERPRETATION AND CONCLUSION

The data from the pre-treatment student interviews shows that students with learning disabilities are faced with many challenges in the inquiry-based classroom. These students bring to the table an established attitude towards science content as too difficult and therefore they will not understand it. There is also a lack of confidence among this population that translates into a lack of engagement during the science lesson and small group lab activities. Students in this population expressed that they did not want to be perceived as stupid by their peers and therefore, it was more socially acceptable to pretend like they were understanding the content rather than participate in group discussion.

The pre-treatment teacher survey showed that the teachers felt the challenge of inquiry-based science lessons for their students with identified learning disabilities as well. The teachers found it difficult to provide the amount of guidance that is needed for students with learning disabilities in the regular education classroom, however stated that the although the large group setting was not ideal, they felt that the regular education peer group plays a positive role in inquiry-based learning.

Both the pre and post treatment student interviews strongly indicated that there are challenges the identified learning disabled population faces in the regular education, inquiry-based, science classroom. However, with the support and guidance of the science strategies class the challenges became opportunities to grow and become more confident in the regular education classroom.

Given the science strategy interventions students began to respond to the challenges with a more positive attitude. The classroom observation log, academic engagement record, and the engagement attitude survey showed that there was a significant increase in attempts to engage in the class discussion as well as in lab activities by the students with identified learning disabilities. With an overall increase in grades, the school-generated grades also demonstrated that the treatment group responded positively to the opportunities the treatment period provided.

Overall the data showed that with teacher designed interventions and content support there was an increase in engagement and learning. The data showed that the most effective strategy were the visual aids and representations of the content that was covered. In agreement with Jarrett (1999), the students felt confident using the graphic representations during group work as well as lab activities in the regular education classroom. As well as the graphic representations, the adapted reading and study guide, graphic organizers, and special education teacher guided inquiry time in the science strategy classroom all proved to be effective ways to mediate student participation in guided inquiry science for the purpose of enhancing their engagement and learning.

Using the classroom observation logs to monitor progressive outcomes as well as looking at the pre and post treatment student interviews, the student outcomes increased in positive attitudes, as well as a perceived confidence among the students who had received the curriculum support. The greatest indicators of student achievement as an outcome of the curriculum support were the pre and post school-generated classroom grades. Of the ten students in the study, seven students increased their science classroom grade by an average of seven percent, often leading to a change in letter grade. It is important to note that the three students who saw a decrease in their classroom grade only saw an average decrease of 1.6%. Therefore, although there was a decrease, the data is inconclusive and could be due to an increase in content difficulty or other unidentifiable factors. In the end, even a decrease average of 1.6% poses not grave effects.

Overall, my research concludes that students with learning disabilities do benefit from the activity- based and hands on approach to science instruction just as the literature review suggested. The most important finding in my research is that students with learning disabilities enter middle school with a low self-confidence in the area of science. This low self-confidence translates into students not even making an attempt to engage in the science lesson, class discussion, as well as small group lab activities, and thus, loosing valuable time learning as well as falling further behind in the understanding of grade level content expectations.

Throughout the treatment period the students were guided with learning strategy support to build conceptual knowledge of the science content before the lesson in the regular education classroom. Consequently, the students were more confident in the regular education science setting and were increasingly able to engage in the classroom lesson, discussion, and small group lab work with their peers. In 1998 the American Association for the Advancement of Science stated, "All students with disabilities do have potential in science." My research concluded that with the appropriate support 100% of the test group became increasingly engaged in the inquiry-based science classroom.

The most difficult area of measurement in this study is student engagement. Although the regular education science teachers, as well as myself made all attempts, particular students were disengaged and even stubborn throughout the pre and post treatment. The PLC research team noted frequently that most students showed enthusiasm and had a positive response to the science strategy support. With that said, one student remained steadfast in his belief that he was not capable of learning science and therefore he would often refuse to make an attempt to engage in the lessons, class discussions or the small group lab activities. It is important to note that on two particular occasions, when he thought the teacher was not noticing and the lab and expectations were in the form of a small group hands on activity, he did engage with his group and seem happy to be participating. Based on this student's past classroom behavior and attitude, this may have been the greatest success.

If I were to change this study, I would extend the treatment period. It became very exciting for the entire PLC team in the last two weeks. We began to see the students blossom with confidence. Although as a school we plan to continue the strategies support, I feel it would have been more effective to show data collection over a longer period of time and possibly covering more than one science content unit. I believe that the data collected is valid and reliable; however, I would be very interested in seeing the data over multiple chapters to confirm that the learning strategy support success would remain consistent. In addition, I believe that it is hard to change years of failure and aversion to science content in six weeks. Sir Winston Churchill once said, “Success is the ability to go from one failure to another with no loss of enthusiasm.” Toward the end of the study students became more confident. In the future I would love to know if we could engage the disengaged, given a greater amount of time to prove to them that they are capable of learning and participating in the regular science classroom.

Based on the findings, all students can learn given the appropriate support. A particularly interesting note is that all students, regular education students as well as identified special education students, benefitted from the support strategies that were used during this study. Most often, the regular education students were more excited to receive the graphic representations than the treatment group. It is important for educators to accept the fact that all students are capable of learning the content with the proper support. When this concept is embraced as a challenge, all students win. Often the struggles of diverse learners can become frustration, as is brought up in discussion in many educator circles. Although the task is difficult, the study found that the PLC time traditionally was used to express frustration became a rewarding time of analyzing the impact of the learning strategies. A Chinese proverb states, “Tell me and I forget. Show me and I remember. Involve me and I understand.” Throughout the research period, the previous focus of covering the content became a mission of how to motivate student learning of the content.

The PLC time became a platform for positive collaboration and commitment by all members of the team towards one mission, student achievement. Our school was very lucky to have an administration that is willing to carve out time in the day to facilitate a PLC. This time proved very valuable and successful. Without this community, all of the teachers would be working independently towards a seemingly impossible goal. With the administration giving this time to the research team, the research process was equally rewarding for the teachers as the students. George Bernard Shaw stated, “If you have an apple and I have an apple and we exchange apples, then you and I still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas.”

Learning to individualize the curriculum and implement appropriate learning strategies is not a skill that comes to a teacher when given a teaching certificate. Sister Joanne Marie Klieban stated, “All children can learn, if we can learn how to teach them.”

The process of data collection, data based decisions, and content interventions are skills that classroom teachers develop over an entire career of teaching. It is important for college and university teacher preparation programs to recognize this need in their programs. Currently, only special education pre service teachers are required to take one, three credit semester class on individualizing curriculum for special education students. This study indicates that all students learn differently and will benefit from various learning support interventions.

VALUE

Throughout this research I have seen a shift in my goals and values as a classroom teacher. I have experienced firsthand the pressure to pace through curriculum to meet state and national expectations. When the students don't show achievement and are continually unmotivated it is often a great weight to bear as an instructor. With this mindset I found myself often accepting that this was their best work and most likely their potential. This research project challenged me to reflect upon my teaching styles as well as my personal commitment to the success of all students in my classroom. At the beginning of the research I even asked myself if I truly believe that all students are capable of learning the content.

I quickly began to realize that all of my students, regardless of their disability category, have gifts to bestow on me as well as the classroom. I found that it is important to identify the disability and know how to best support the student. However, my job does not stop there. Armed with this knowledge it is my charge to develop a strength based approach to my classroom environment. By supporting the students in a friendly and highly supportive environment, I gave my students a voice in the regular education classroom and the ability to engage with their peers on an academic level. I found that it is far more rewarding as a teacher to give a student confidence in their ability to learn, rather than simply content. The content that is learned today may or may not be retained; however, the confidence to approach a new and challenging concept will reap far greater rewards. The social effects of this study were not evaluated, however it was easy to see the socially defined walls come down as the once quiet student began to interact not only on an academic level but a social level.

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APPENDICES

APPENDIX A

PRE-TREATMENT STUDENT INTERVIEW

Pre-Treatment Interview

1) How do you feel in your regular science classroom?

2) What is the hardest part about learning the material in the science classroom?

3) How can your sciences strategies teacher help you to be more prepared and ready for science?

4) Do you feel like you are able to participate in all of the science labs with your group?

5) Is there anything else you would like to tell me that you think would help you learn better in the science classroom?

APPENDIX B

ENGAGEMENT SURVEY

Engagement Survey

Please check the box that best describes how you feel about the statements below. Remember your answers will be anonymous and no one will know how you answered.

	VERY OFTEN	**SOMETIMES**	**VERY LITTLE**	**NOT AT ALL**
I participate in group activities and feel comfortable.				
I understand what is going on and I can add to class discussion.				
I try to blend in and not be noticed.				
I am uncomfortable in the big classroom.				
There are times I feel like I don't know anything.				

APPENDIX C

CLASSROOM OBSERVATION LOG

Classroom Observation Log

Content: Date:

Objective:
Inquiry-based method planned:

Engagement Level Attempted:

Comments on Lesson (goals, engagement, teacher prompts, and student understanding.)

Student Attitudes:

Changes for the future:

Other relevant information:

APPENDIX D

ACADEMIC ENGAGEMENT LOG

Academic Engagement Log

Student Name:

+ on-task behavior -off-task behavior

6 week engagement record

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Total number of off-task behavior:

Total Academic Engagement:

APPENDIX E

TEACHER SURVEY

Teacher Survey

	OFTEN	**SOMETIMES**	**VERY LITTLE**	**NOT AT ALL**
Ho much do Learning disabled students participate in group activities?				
Do you feel you have the support needed to effectively teach an inclusive classroom?				
Special education teachers on your team support your content area class with strategies.				
Do you feel that the regular science curriculum is appropriate for all levels of learners?				

Please provide any thoughts or comments that would be helpful in designing support strategies for identified Learning Disabled students to be successful in your classroom.

APPENDIX F

POST TREATMENT STUDENT INTERVIEW

Post Treatment Student Interview

1) How did the science strategies help you in the classroom?

2) Did you feel more comfortable to participate in-group learning activities?

3) Did you understand the science that was being taught?

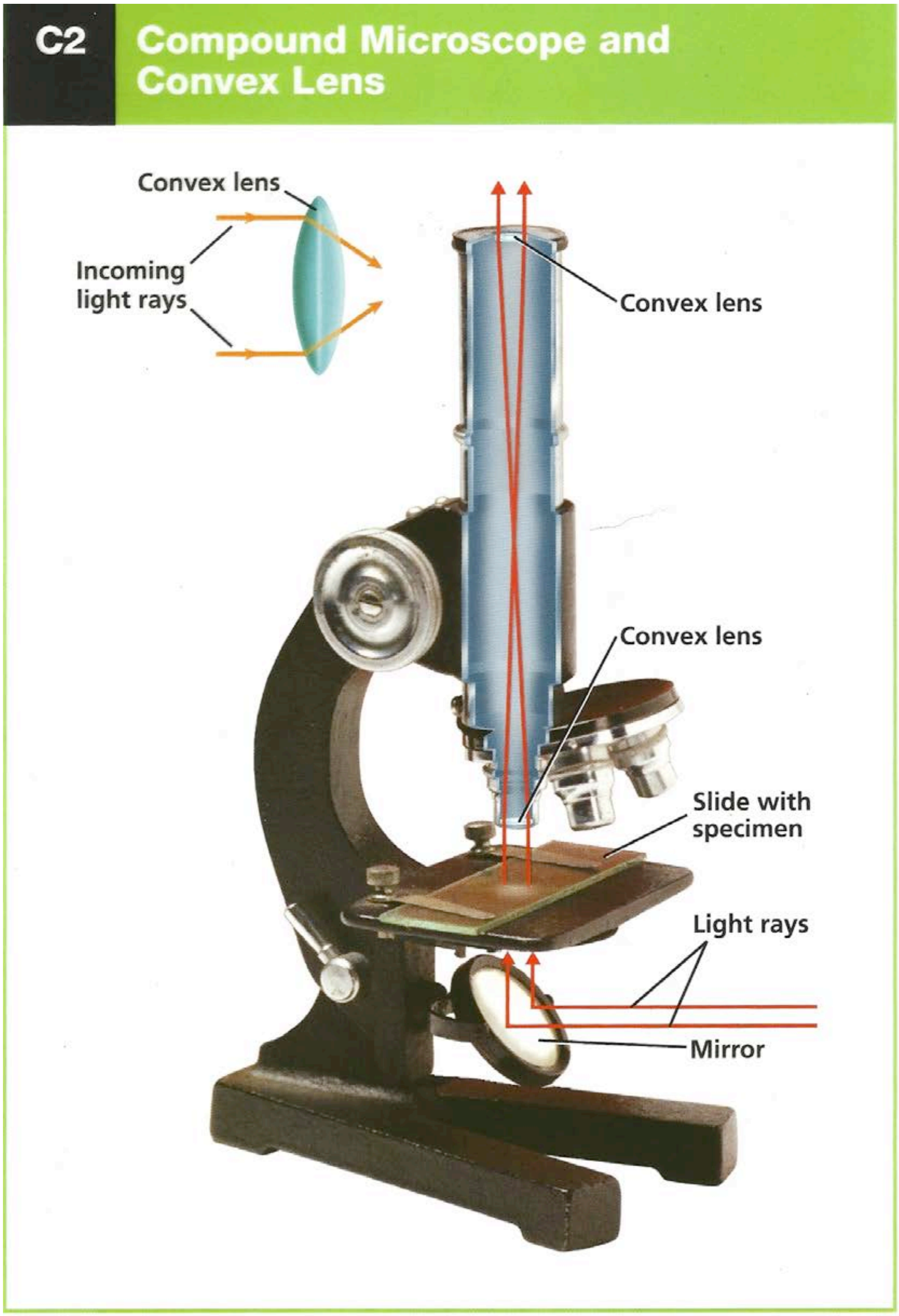
4) Would you like to continue the science strategies support?

5) Is there anything else that would better help you in the science classroom?

APPENDIX G

VISUAL MODEL STRATEGY COMPOUND MICROSCOPE

Visual Model Strategy Compound Microscope



APPENDIX H

GRAPHIC ORGANIZER STRATEGY: SEQUENCE

Graphic Organizer Strategy

Chapter 1 Cell Structure and Function

Lesson 1 Discovering Cells

Sequence

First, Hooke sees cells in cork.
Then,
Next,
After that,
Finally,

APPENDIX I

ADAPTED READING AND STUDY WORKBOOK

Name ______________________ Date ______________ Class __________

Cell Structure and Function

Looking Inside Cells (pages 16–24)

Enter the Cell (page 17)

Key Concept: **A plant's cell wall helps to protect and support the cell. The cell membrane controls what substances come into and out of a cell.**

- An **organelle** is a structure in the cell that has a specific function.
- The **cell wall** is a stiff layer that protects and supports the cell. Animal cells do not have cell walls.
- The **cell membrane** forms the boundary between the cell and its environment. The cell membrane controls what goes in and out of a cell.

Answer the following questions. Use your textbook and the ideas above.

1. A structure inside a cell that has a specific function is a(an) ____________________.

2. Read each word in the box. In each sentence below, fill in the correct word or words.

cell membrane	cell wall	organelle

a. A stiff layer that protects and supports the cell is the ____________________.

b. The cell boundary that controls what goes in and out of a cell is the ____________________.

3. Is the following sentence true or false? Animal cells do not have a cell wall. __________

APPENDIX J

INTERVIEW VALIDITY

Interview Validity

Research Question	Interview Question
What are the opportunities and challenges that guided inquiry science instruction presents to students with learning disabilities?	How do you feel in your regular science classroom? What is the hardest part about learning the material in the science classroom?
How do students with learning disabilities respond to these opportunities and challenges?	Do you feel like you are able to participate in all of the science labs with your group?
How can teachers meditate students' participation in guided inquiry science for the purpose of enhancing their engagement and learning?	How can your sciences strategies teacher help you to be more prepared and ready for science? Is there anything else you would like to tell me that you think would help you learn better in the science classroom?

APPENDIX K

ENGAGEMENT SURVEY VALIDITY

Engagement Survey Validity

Research Question	Engagement Survey Statements
How do students with learning disabilities respond to these opportunities and challenges?	I participate in-group activities and feel comfortable. I understand what is going on and I can add to class discussion. There are times when I feel like I don’t know anything.
How can teachers mediate students’ participation in guided inquiry science for the purpose of enhancing their engagement and learning?	I try to blend in and not be noticed. I am uncomfortable in the big classroom. There are times when I feel like I don’t know anything.

APPENDIX L

POST TREATMENT INTERVIEW VALIDITY

Post Treatment Interview Validity

Research Question	Post Treatment Interview Question
What are the opportunities and challenges that guided inquiry science instruction presents to students with learning disabilities?	Did you understand the science that was being taught?
How do students with learning disabilities respond to these opportunities and challenges?	Did you feel more comfortable to participate in group learning activities? Would you like to continue the science strategies support?
How can teachers mediate students' participation in guided inquiry science for the purpose of enhancing their engagement and learning?	How did the science strategies help you in the classroom? Is there anything else that would better help you in the science classroom?

APPENDIX M

ENGAGEMENT SCALE

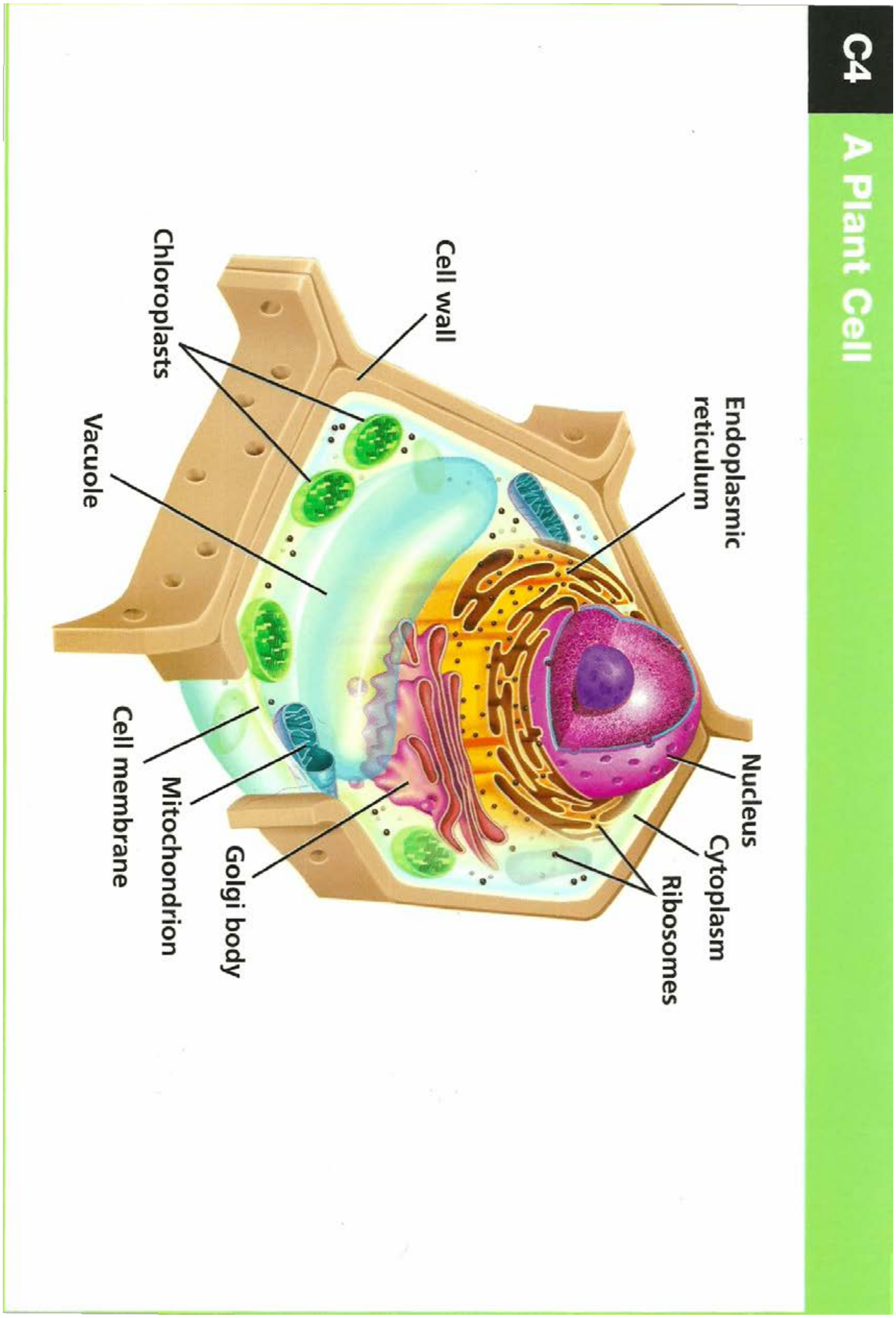
ENGAGEMENT SCALE

1	2	3	4	5
Student is not listening or participating in the discussion. There was need for much teacher redirection. Student lacks understanding and is unsure about the concepts of the discussion.	Student does not offer any answers to questions. The student needs some redirection. Student may contribute some to discussion. Student is only able to contribute with minimal understanding to the discussion of the science concepts.	Student is sometimes actively listening. Student does not provide answers unless directly called on. Student contributes some to the discussion and shows basic comprehension of the science concept.	Student is making an attempt to engage in listening most of the time. Student tries to offer answers to questions asked. Student makes an effort to contribute to discussion. Student understands science concept and is able to participate in discussion.	Student is an engaged listener throughout entire class time. Student offers to answer questions often. Student routinely contributes to discussion. Student shows firm understanding of science content and is able to make connections and contribute effectively to group discussions.

APPENDIX N

GRAPHIC REPRESENTATION OF A PLANT CELL

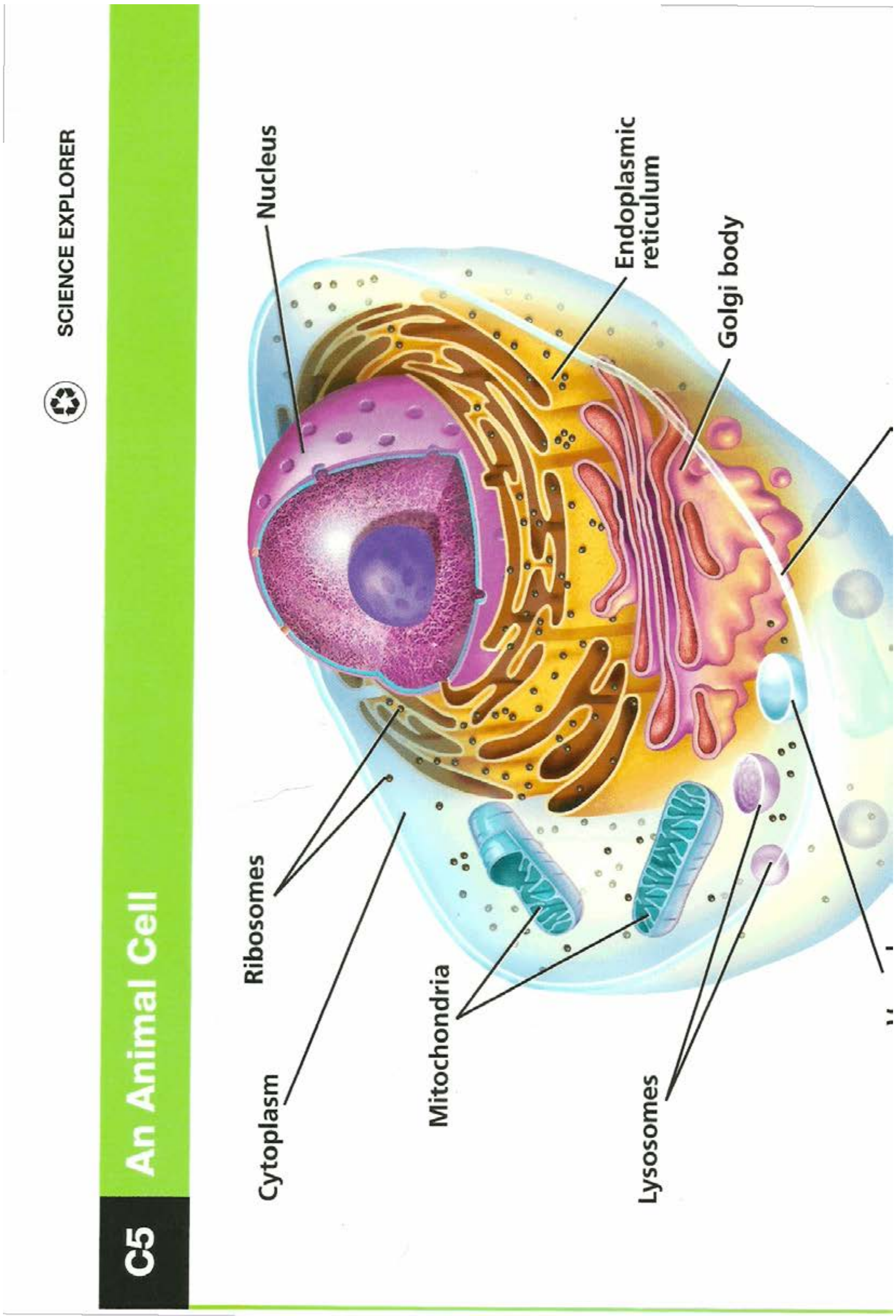
GRAPHIC REPRESENTATION OF A PLANT CELL



APPENDIX O

GRAPHIC REPRESENTATION OF AN ANIMAL CELL

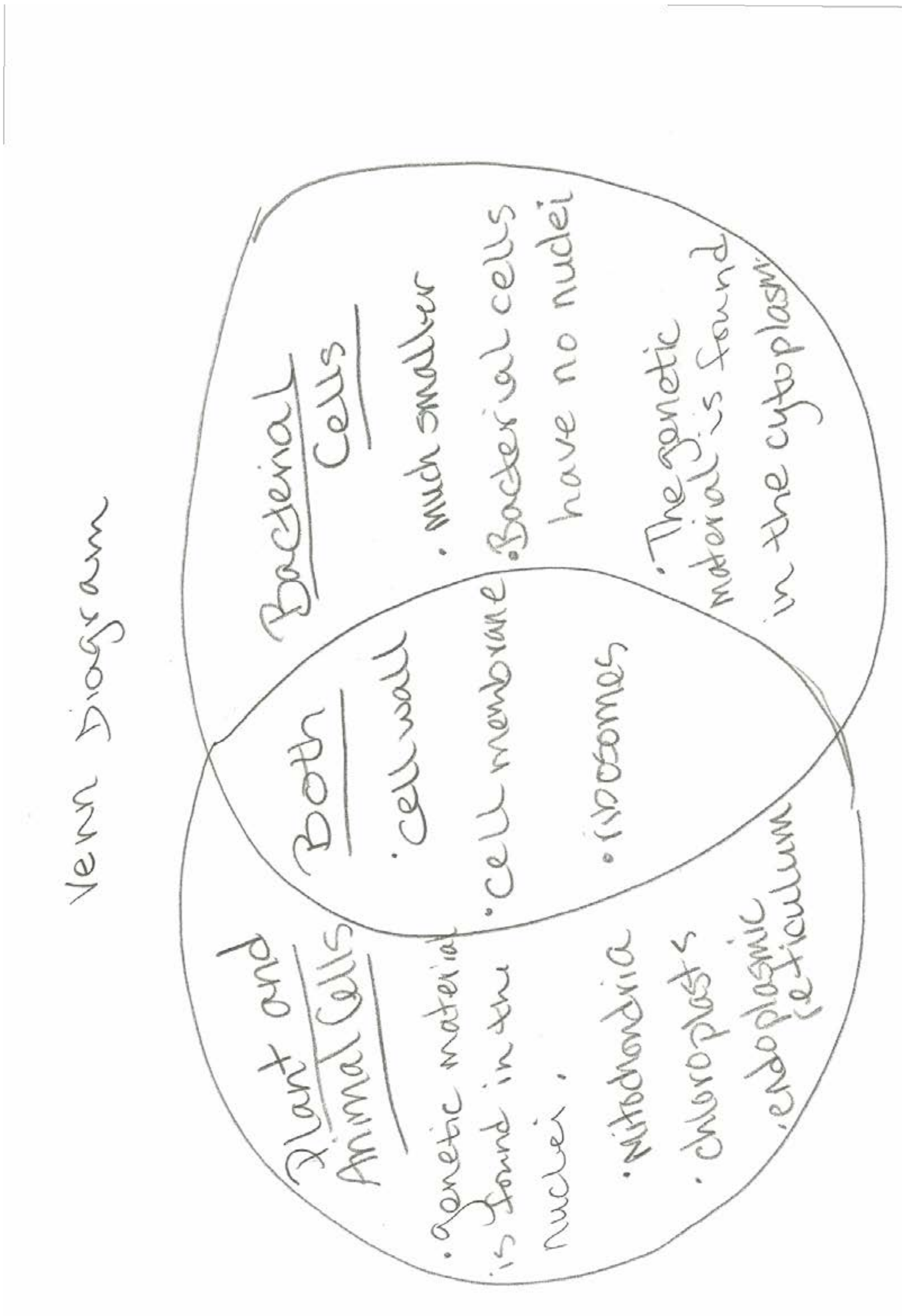
GRAPHIC REPRESENTATION OF AN ANIMAL CELL



APPENDIX P

STUDENT VENN DIAGRAM

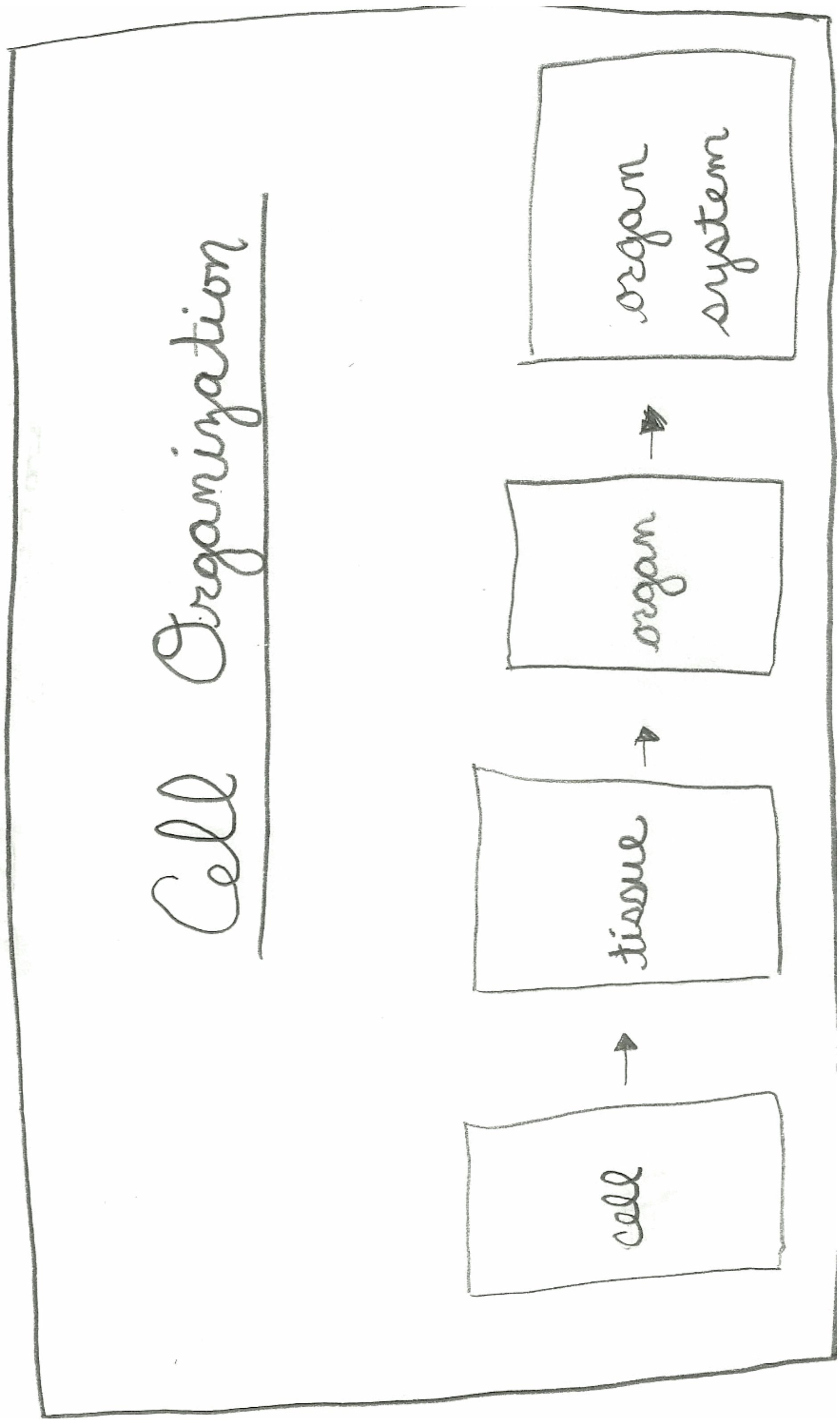
STUDENT VENN DIAGRAM



APPENDIX Q

STUDENT CELL ORGANIZATION FLOW CHART

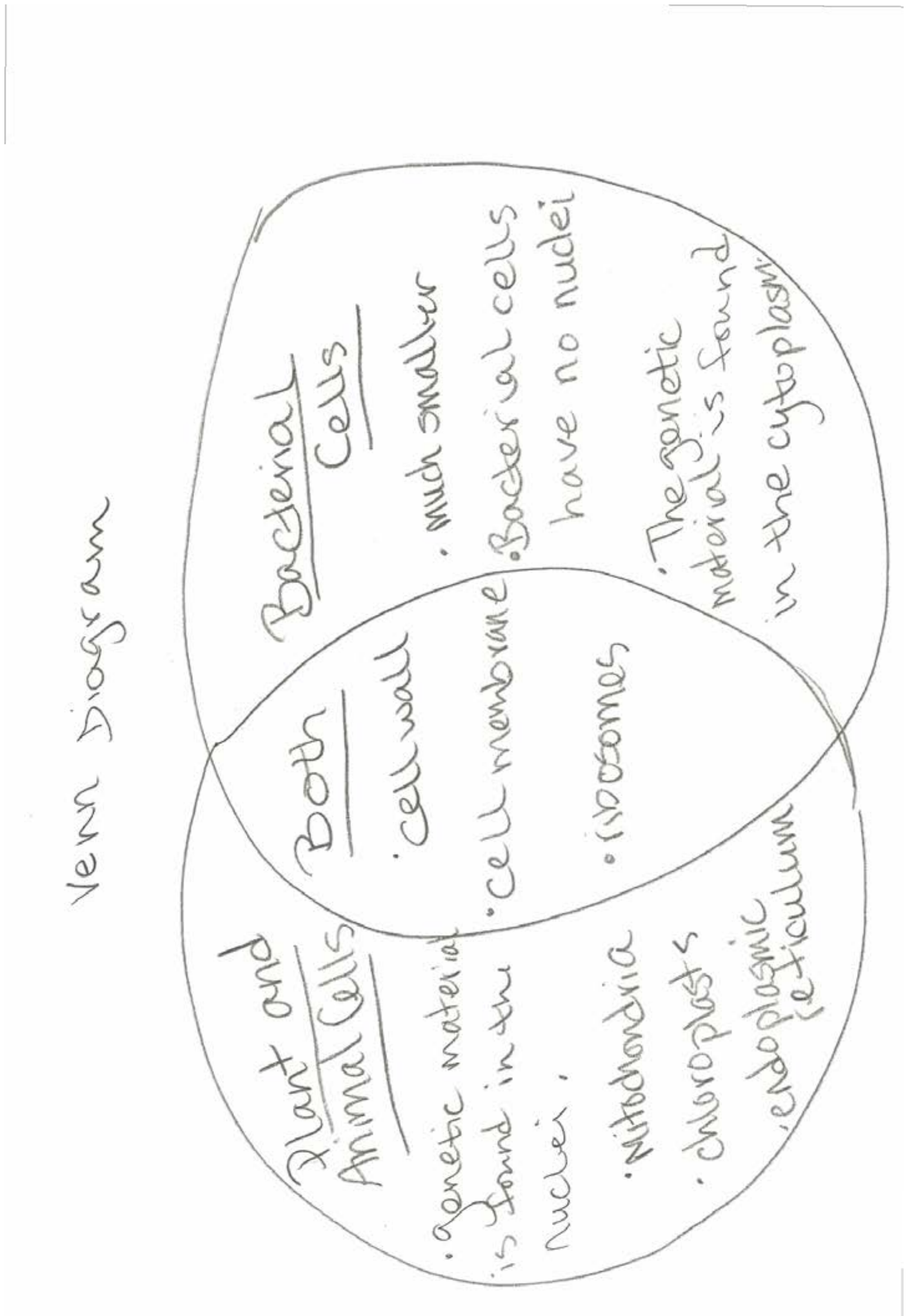
STUDENT CELL ORGANIZATION FLOW CHART



APPENDIX R

PLANT AND BACTERIAL CELL VENN DIAGRAM

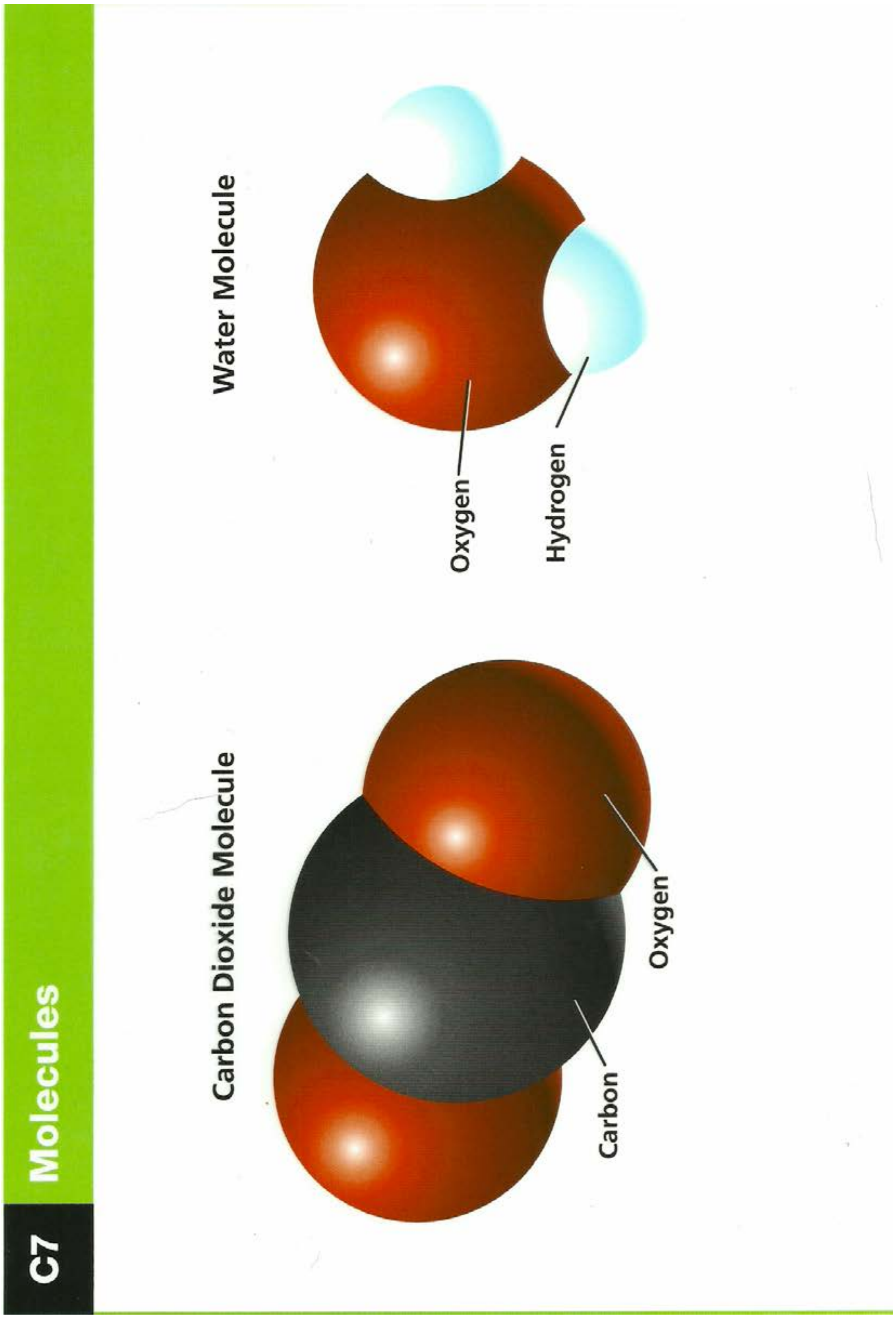
PLANT AND BACTERIAL CELL VENN DIAGRAM



APPENDIX S

GRAPHIC REPRESENTATION OF A MOLECULE

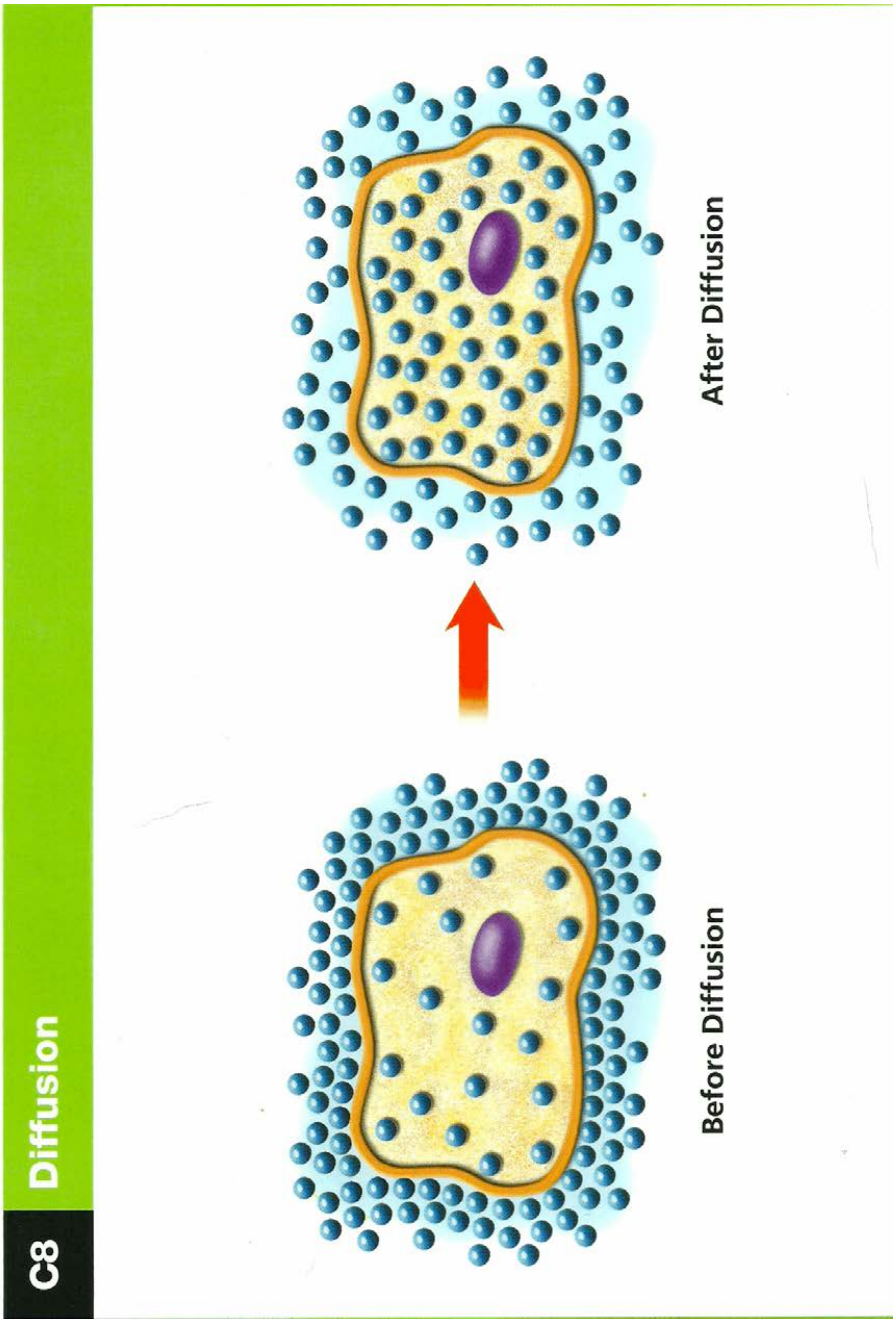
GRAPHIC REPRESENTATION OF A MOLECULE



APPENDIX T

GRAPHIC REPRESENTATION OF DIFFUSION

GRAPHIC REPRESENTATION OF DIFFUSION



APPENDIX U

DIFFUSION, OSMOSIS AND ACTIVE TRANSPORT CHART STUDENT SAMPLE

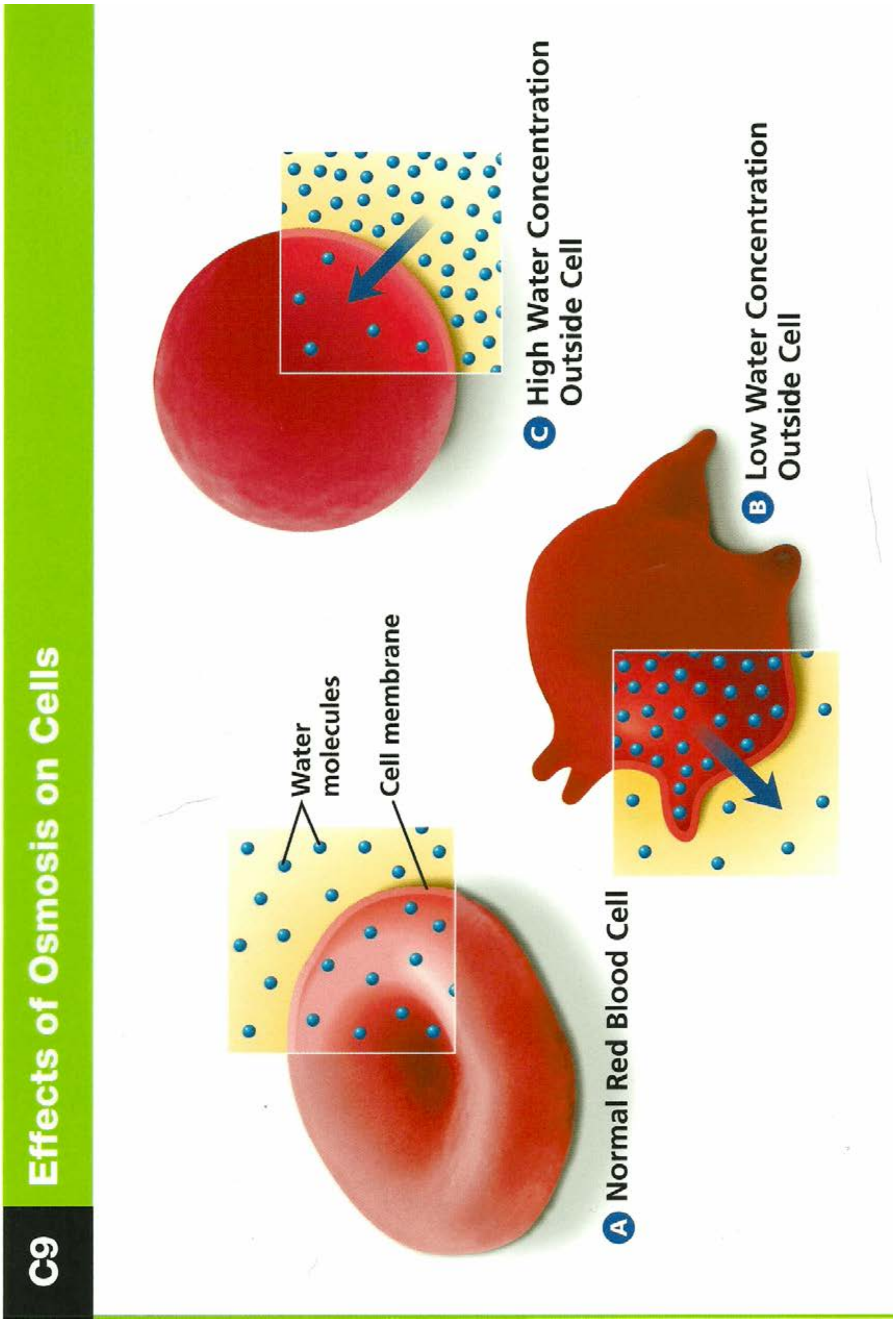
DIFFUSION, OSMOSIS, AND ACTIVE TRANSFER CHART STUDENT SAMPLE

difusion	Osmosis	Active Transport
∘ Main method	· diffusion of	Passive transport:
small molecules	water across	· does not need energy
move accross	cell membrane.	· substances move back
the cell membrane.		and forth through
	· water moves out	cell membrane
- cell only lets some	of the cell if	
substances pass	there is more	
through.	water inside than	Active transport
	outside of the	
· Oxygen, water,	cell.	· uses energy to move
food and waste		
can pass through	· Cells shrink when	· cells use active transport
	water moves out	to take in substances
		that are in higher
		concentrations inside
		the cell than outside
		· calcium potassium
		sodium

APPENDIX V

GRAPHIC REPRESENTATION OF OSMOSIS

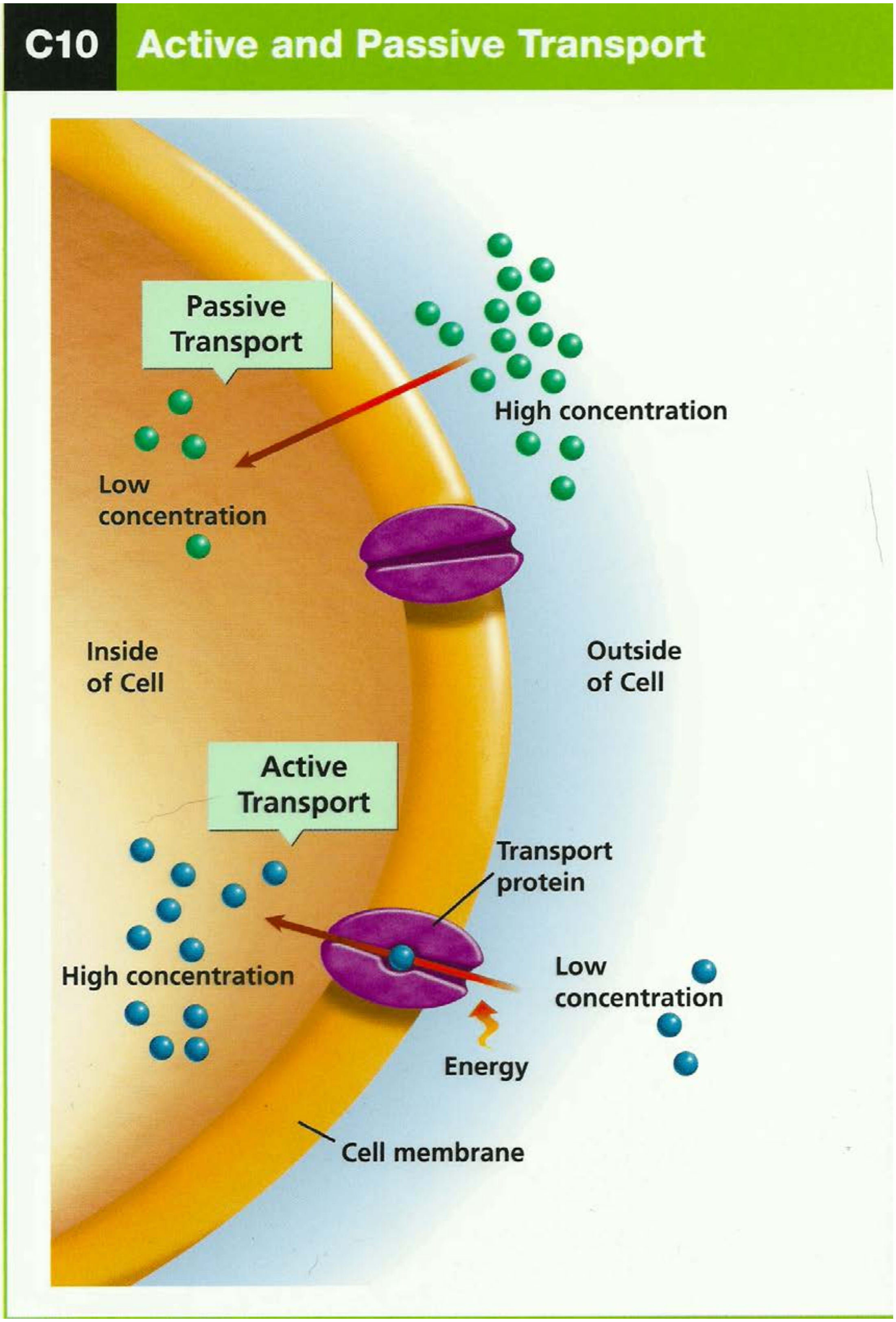
GRAPHIC REPRESENTATION OF OSMOSIS



APPENDIX W

GRAPHIC REPRESENTATION OF ACTIVE AND PASSIVE TRANSPORT

GRAPHI REPRESENTATION OF ACTIVE AND PASSIVE TRANSPORT



APPENDIX X

CONCEPT MAP OF ORGANIC COMPOUNDS

CONCEPT MAP OF ORGANIC COMPOUNDS