INSTRUCTION

Running Head: ENHANCING SCIENCE INSTRUCTION

Enhancing Science Instruction through the use of Graphic Organizers

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Is it possible for students to improve their memory of content? Can teachers do anything to help promote long-term memory in students with disabilities? Jean Piaget showed that "cognitive growth occurs in a series of invariant and interdependent stages" (Lerner, 2006, p. 165). Piaget referred to the fourth stage of cognitive development as the formal operations stage. This stage begins at around age 11. During this stage, children gain the ability to "work with abstractions, theories, and logical relationships without having to refer to the concrete" (Lerner, 2006, p.166). However, many students with learning disabilities have not yet transitioned from concrete operations to formal operations and/or may process information more slowly or differently, making the demands of high school content classes seem impossible.

The cognitive approach to learning uses instructional techniques which can make it easier for students with learning disabilities to grasp content. Since high school students are overwhelmed with a large amount of information that they have to retain and then later recall, it is imperative that teachers use strategies to help students improve their memory of content. One such technique is the use of graphic organizers. Graphic organizers are "visual formats that help students organize information for better comprehension" (Polloway, Patton, & Serna, 2005, p.108). The graphic organizer's origin is related to schema theory (Dye, 2000). Schema theory "states that new information must be linked to preexisting knowledge and that our knowledge is stored in a scaffold-like hierarchy, which includes our way of organizing information" (Dye, 2000, p.1). Since students with learning disabilities generally process information slowly or differently, they are not adept at retrieving the information. The teacher can help the student retrieve information and remember content by incorporating graphic organizers in the class room. Graphic organizers can be incorporated at different times during the class depending on what the teacher wants to accomplish. If the teacher is trying

> to activate prior knowledge, guide thinking, or develop vocabulary, the graphic organizer can be used at the beginning of the lesson. If the goal is to help students organize information and stay focused on the content, then the graphic organizer can be used during the lesson. The use of a graphic organizer at the end of a lesson allows the students to confirm or rethink prior knowledge and relate the new concepts to the old. (*Special connections*, n.d.)

The use of graphic organizers allows students to expand their schemas by "linking the new information with their existing knowledge" (Dye, 2000, p.1). Therefore, the act of remembering and comprehending content becomes more attainable for students with learning disabilities when they are exposed to graphic organizers.

According to Strangman, Hall, and Meyer (2003), the research literature provides "evidence for the effectiveness of graphic organizers in facilitating learning" (p. 4). Of the 12 studies they reviewed, "nine reported that graphic organizer use elevated comprehension" (Strangman et al., 2003, p.5). The other three studies did not report any effect of increased comprehension after graphic organizer use (Strangman et al., 2003). Strangman and her colleagues (2003) noted that some deficiencies could be attributed to the fact that "the students were not taught how to use the graphic organizers and the comprehension scores were already high before the intervention took place" (p. 6). Several of the studies that included students with learning disabilities are shown in Table 1.

Graphic organizers also seem to be effective when coupled with technology. In a pilot study conducted using students with learning disabilities in a secondary social studies class room, graphic organizers using Inspiration 6 Software were found to be effective (Boon, Fore, & Ayers, 2005). The results showed "a significant improvement from pre- to posttest measures on student recall and comprehension of the content material", as well as "the potential to increase recall of content-area learning tasks for students with mild disabilities" (Boon et al., 2005, p.107). A similar study by Boon, Burke, and Fore (2006), investigated the impact of "cognitive organizers with the integration of technology, Inspiration 6 Software, compared to traditional textbook instruction format on content-area learning in high school inclusive social studies classes" (p.5). The results showed that students "performed significantly better than students in the traditional textbook instruction class" (Boon et al., 2006, p.9).

Just as a secondary social studies class requires students to meet a demanding curriculum and have a good deal of background knowledge, so does a secondary science class. Since research supports the use of graphic organizers, the purpose of this study is to investigate the impact of graphic organizers on content–area learning for high school students in a resource room for biology class where the teacher uses effective teaching practices. The study will specifically focus on improving science vocabulary, comprehension, and storing and recalling information by enhancing science instruction.

Methods and Procedures

Before the introduction of graphic organizers, the teacher used effective teaching practices. The teacher structured her lessons so they were sequential and used many different models to enhance the learning of concepts in order to help students master the material. The

teacher used effective questioning techniques by calling on all students and varying the questions from literal to critical levels of comprehension. The teacher also incorporated mnemonics, hands-on activities, intentional mistakes, and scaffolding in her lessons. Although the students were experiencing success with the effective teaching practices present in the classroom (see Table 2), the teacher wondered if graphic organizers could enhance the learning of science content.

After the introduction of graphic organizers, the teacher continued to use effective teaching practices. A pretest/posttest design was used to determine the effects of graphic organizers on comprehension and storing and recalling information, such as science vocabulary. The students were first exposed to a teacher- made graphic organizer. Second, the students were exposed to Inspiration software via the teacher making a graphic organizer in class (projected on the screen via the LCD projector) while the students brainstormed what the teacher should put in the organizer. Third, the students were exposed to a graphic organizer created by the teacher using Inspiration. Finally, the students created their own graphic organizer using Inspiration.

Participants and Setting

One special education teacher and eight students participated in the investigation. Seven of the students were diagnosed with a learning disability while one was labeled OHI (other health impairment). Five of the students were sophomore boys and three were freshman (two boys and one girl). Six of the students planned to graduate with a modified standard diploma (MSD), while two planned to graduate with an IEP diploma. The class was taught in a special education classroom and the computer lab. A description of the participants is shown in Table 3.

Materials

Student materials consisted of student notebooks, desktop computers in the computer lab, paper, pencil, scissors, glue, and Inspiration software. The student notebooks were kept in the classroom and contained material handed out by the teacher, such as a hand-out of the Power Point presentation, graphic organizers, and practice worksheets. Teacher materials included lesson plans, CDs, a desktop computer, LCD projector, and use of Inspiration software. Also, graphic organizers designed by the teacher using Microsoft Word were used to supplement the Inspiration software.

Procedures

During the first four weeks, students were exposed to various graphic organizers (most using Inspiration software) designed by the teacher. During the last two weeks, students created their own graphic organizer using Inspiration software. Pre-tests and posttests were administered to determine the effectiveness of the use of graphic organizers on enhancing science content and improving vocabulary, comprehension, and storing recall information.

Week 1 - Week 2: The students were given a pretest on the steps of the scientific method. The students were taught the steps of the scientific method using a variety of techniques and activities. The students were given an incomplete outline to take notes and were taught how to use a mnemonic device to learn the steps. The students also completed three labs using the scientific method process. The culminating activity consisted of filling in a graphic organizer about the scientific method in relation to two of the lab activities (see Appendix A). The students were then tested on the scientific method using the same graphic organizer (see Table 4).

Week 3: At the beginning of a new unit on cells, students were given a video pre-quiz (10 multiple choice questions) about a video on cells. The students were then shown a video from unitedstreaming.com about different types of cells (blood, skin, cancer, and the one-celled organism known as *P. piscicida***).** After taking the video posttest quiz (same 10 questions as the video pre-quiz), the teacher and students brainstormed about the important information they learned after viewing the video. Using Inspiration, the teacher created a graphic organizer with the help of the students (see Appendix B). Since the computer was connected to the LCD projector, the students were able to view the graphic organizer as the teacher constructed it. The students were given paper and pencil and constructed their graphic organizer by following the teacher constructed organizer on the screen. The following day, the students were given a quiz on the cell video (see Table 5).

The students were given a pre-test on the scientist important to the discovery of cells and the cell theory. The teacher provided the students with a copy of the Power Point slides with a few blanks to fill in. The teacher then showed the Power Point and discussed the importance of each scientist and his discovery. The teacher suggested ways to remember each scientist (such as, relate Anton van Leeuwenhoek, who observed pond water, to Leesville Lake or Schwann was a zoologist and Schwann sounds like swan or Robert Hooke observed cork cells and Captain Hooke had to open a bottle of wine with his hook because he didn't have a corkscrew…). The teacher also showed a video clip about the history of the microscope, which included four of the seven scientists the students were expected to learn. The following day, the students were given a blank organizer by the teacher that had the scientist listed at the top (see Appendix C). The students were also given a sheet with all of the accomplishments of the scientist. The students cut out the accomplishments and glued them on their organizer in the appropriate spot. The teacher

then displayed the completed graphic organizer on the screen for all students to see and check their work (see Appendix D).The next day the students were given a quiz on the scientists. They were given a choice as to the type of quiz they would prefer to take, either a multiple choice/matching quiz or a quiz with a graphic organizer that they would complete (see Table 6).

Week 4: Before being introduced to the parts and functions of cells through a Power Point presentation, the students were given a multiple choice /matching design pre-test on the parts and functions of a cell Next, the students filled in a worksheet by matching the pictures of various objects (brain, electrical power plant, a policeman...) to a part of the cell. Then, the students compared a cell to Brookville High School and filled in a graphic organizer designed by the teacher. The students were divided into groups and asked to come up with different parts of the high school that could be compared to the organelles of a cell based on function or structure. After each group wrote down their ideas, the teacher called on the spokesperson in each group to share the group's comparisons. As a class, the best answer was decided and the teacher recorded it on the graphic organizer (which was on the computer hooked to the LCD for all students to see) while the students copied the information into their own graphic organizer (see Appendix E). The students then made a poster about the parts and functions of plant cells. The students cut out pictures from magazines that they felt represented the function or the structure of the organelles in the cell and glued them onto the poster board. The students wrote down the name of the organelle as well as why they chose the picture to represent the organelle. The posters were displayed around the room.

Week 5 – 6: The students spent four days in the computer lab learning how to use the Inspiration software and creating two graphic organizers that included the parts and functions of the cell. During the first visit to the computer lab, two instructional specialists were available to

guide the students through the process of using the Inspiration software. While one instructional specialist modeled and guided the students through the process of making a graphic organizer, the other instructional specialist and teacher were available to help the students. The assignment the students were given was to create two graphic organizers. One graphic organizer covered the nucleus and organelles within the nucleus, while the second one covered the organelles in the cytoplasm. Each graphic organizer was required to have a description of the function of each organelle and a picture that would help the students remember the function; for example, a picture of the brain might represent the nucleus. The students were given an assignment sheet with the requirements for the graphic organizers and an example of how to begin each graphic organizer (see Appendix F). After four days in the computer lab, the students had completed their graphic organizers, saved a copy to their folders on the network, and printed a copy to keep in their notebook (see Appendix F for examples). Upon returning to the classroom, students shared their graphic organizers in class via the computer and LCD projector. Finally, the students were given a test on the parts and functions of the cell exactly like the pre-test (see Table 7).

Week 9: Students were given a follow-up test several weeks after the units on the scientific method and cells had been completed to determine if the students were able to store and recall information (see Table 8). The test design consisted of approximately 6 questions from each of the following content areas: scientific method, scientist important to the discovery of cells, cell structure, and cell function.

Results

The results of the study indicate that the use of graphic organizers has the potential to enhance effective teaching practices by increasing student recall of information. Overall, the study indicated a significant improvement from pre- to posttest scores. As can be seen in Figure 1, the mean pretest score for three of the tests were 0, and one was 12, while the mean posttest scores were 85, 96, 93, and 91. However, Figure 2 shows that there was not a significant increase in a classroom where effective practices were in place as compared to a classroom with effective teacher practices plus the use of graphic organizers. Since the scores were already high before the use of graphic organizers, it was not surprising that there was not a significant increase.

What was surprising were the qualitative observations made by the teacher. First, one student wanted to know if the quiz on the scientists was going to be designed like the graphic organizer she had made in class. Second, after the students had created their final product, many of them wanted to know when they would be able to visit the computer lab again to use the Inspiration software. Third, the teacher observed that the students were focused, motivated and willing participants when they were creating their graphic organizer using Inspiration software. The qualitative results provide evidence that might impact the posttest scores. The questions posed by the students and their motivation help provide insight into the effectiveness of enhancing science instruction through the use of graphic organizers. The teacher felt that the students viewed the addition of the graphic organizer as an effective tool to enhance science content.

The follow-up test given to the students revealed that the students were able to retain and retrieve information they had learned (see Table 8). The class average for the follow-up test was 89. The data revealed that all of the students were able to retain the content about cell structure

with 100% accuracy. As a whole, the class had the most difficulty retaining information about the scientific method (78% accuracy). Although it is difficult to say that graphic organizers alone helped to promote long-term memory, it is obviously beneficial for students with learning disabilities to be in a class where the teacher uses effective teaching practices to aid in retention and retrieval of information.

Discussion

Even though the use of graphic organizers to enhance science instruction has potential, there are many limitations to be considered when drawing conclusions from the data. The limitations of the study were due to several factors. The most obvious limitation noted was the fact that the students were successful in science with effective instruction prior to the introduction of graphic organizers. The fact that the students scores were already near the ceiling before the use of graphic organizers accounts for the insignificant increase in the quantitative data after the introduction of the graphic organizers. The second limiting factor could have been related to enthusiasm. Since the teacher had a BS in Biology and was an experienced high school biology teacher, her enthusiasm and attitude were contagious in the classroom and may have been a variable in student achievement even prior to the introduction of the graphic organizers. Research has shown that "enthusiasm on the teacher's part can lead to excitement in students as well as to higher academic achievement" (Polloway et al., 2005, p. 402). A third limiting factor could have been that students had not been in a general education setting for science since elementary school and therefore may have not had the benefit of a highly qualified teacher. It has been "found that a significant number of special education teachers reported that they had not received any training in science" (Polloway et al., 2005, p. 397). Without effective training the

teachers may have felt “unprepared and uncomfortable teaching science and using activity-based lessons” (Polloway et al., 2005, p.397).

Besides the fact that special education teachers did not feel prepared is the reality that special education teachers face a “significant challenge due to the demands of science (abstractness, relevance, interest, new vocabulary words) and skill levels of students with learning disabilities” (Polloway et al., 2005, p. 401). Most special education teachers use “published science materials for general education settings that are not designed for the diverse learner” and so the teacher must “develop the ability to adapt materials and instruction proficiently for students to be successful” (Polloway et al., 2005, p.428). For most special education teachers in science, this seems to be nearly impossible to accomplish due to the lack of science knowledge and training in science. In the current study, the classroom teacher was not only prepared to teach science but had seventeen years of teaching experience enabling her to manage the different skill levels of the students, as well as the ability to adapt and develop materials suitable for the students.

Although there were limiting factors in the study making it difficult to draw clear conclusions, research has shown that the use of “advanced organizers contributes to effective teaching” (Lenz, Alley, & Schumaker, 1987, p. 53). In a study by Lenz et al. (1987), the information supported previous studies showing “that advance organizers can affect learning of students with learning disabilities” but also showed that “the effects are not obtained until students are taught to attend to and use the advance organizers presented by their teachers” (p. 64). Since it is imperative to teach students how to use graphic organizers in order to increase learning, teachers should strive to incorporate effective tools, like Inspiration, into their lessons

to teach students how to create and use graphic organizers and thus enhance science content and improve vocabulary, comprehension, and recalling and storing information.

Even though it is important for students to learn science content to enable them to pass their science class or SOL test or graduate from high school, the real importance lies in preparing students for life. Science instruction can strengthen problem solving skills, creative thinking, and the use of technology . Science instruction can also help students learn how to ask questions and foster working cooperatively in teams . The twenty-first century is inundated with scientific information, making scientific literacy a "necessity for everyone" (National Academies Press, 2006).

> Everyone needs to be able to engage intelligently in public discourse and debate about important issues that involve science and technology. And everyone deserves to share in the excitement and personal fulfillment that can come from understanding and learning about the natural world. Also, more and more jobs demand advanced skills, requiring that people be able to learn, reason, think creatively, make decisions, and solve problems. An understanding of science and the processes of science contributes in an essential way to these skills. (National Academies Press, 2006, p.1)

Secondary science classroom teachers that use effective teaching practices and strive to enhance science instruction can help students become scientifically literate citizens and thus better able to function in their everyday lives, as well as in the workplace.

Work Cited

Boon, R.T., Burke, M.D., & Fore, C. (2006). The impact of cognitive organizers and technology-based practices on student success in secondary social studies classrooms. [Electronic version]. *Journal of Special Education Technology, 21*, 5 -15.

Boon, R.T., Fore, C., & Ayres, K. (2005). The effects of cognitive organizers to facilitate content-area learning for students with mild disabilities: A pilot study. [Electronic version]. *Journal of Instructional Psychology, 32*, 101-117.

Dye, G.A. (2000). Graphic organizers to the rescue! Helping students link and remember information. [Electronic version]. *Teaching Exceptional Children, 32*(3), 72 – 76.

Lenz, K.B., Alley, G.R., & Schumaker, J.B. (1987). Activating the inactive learner: Advance organizers in the secondary content classroom. *Learning Disability Quarterly, 10*, 53-67.

Lerner, J., & Kline, F. (2006). *Learning disabilities and related disorders: Characteristics and teaching strategies* (10th ed.). Boston: Houghton Mifflin.

National Academies Press. (2006). *National Science Education Standards: An Overview*. [Electronic version]. National Academy of Sciences. 500 Fifth St. N.W., Washington, D.C. 20001. Retrieved November 22, 2006 from http://www.nap.edu/readingroom/books/nses/overview.html.

Polloway, E.A., Patton, J.R., & Serna, L. (2005). *Strategies for teaching learners with special needs* (8th ed.). Upper River Saddle, New Jersey: Pearson/Merrill Prentice Hall.

Special connections. (n.d.). *Graphic organizers*. Retrieved October 3, 2006 from http://www.specialconnections.ku.edu.

Strangman, N., Hall, T., & Meyer, A. (2003). *Graphic organizers with UDL.* Wakefield, MA: National Center on Accessing the General Curriculum. Retrieved October 3, 2006 from http://www.cast.org/publications/ncac/ncac_goudl.html.

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TABLE 1

Main research findings regarding the impact of graphic organizer use on students with disabilities.

Boyle & Weishar (1977)	Students with learning disabilities	Students taught to generate cognitive organizers for use during reading and students who were taught to use expert generated cognitive organizers during reading scored significantly higher than untaught peers on a comprehension test of literal and inferential comprehension
Bulgren et al. (1988)	Students with learning disabilities and students without learning disabilities	When teachers used a concept teaching routine to present concept diagrams to students with and without learning disabilities, all students significantly improved performance on tests of concept acquisition and improved their note taking
Gallego et al. (1989)	Students with learning disabilities	Learning and rehearsing a semantic mapping procedure was associated with a significant increase in quantity and quality of in class verbal contributions and a significant increase in their written summaries

Source: Strangman, Hall, & Meyer, 2003, p.

TABLE 2

Post test scores before the introduction of graphic organizers

	Test 1	**Test 2**
Andy	93	100
Brad	100	50
Clint	*N/A	83
David	87	85
Evan	100	80
Fred	100	85
George	83	75
Helen	93	75
Class Average	94	79

* student was not enrolled in the class at this point

TABLE 3
Description of Participants

STUDENT	LABEL	LEVEL OF FUNCTIONING age equivalent according to subtest raw scores on KTEA II Brief or other test (* WJIII)	AGE	GRADE	TYPE of DIPLOMA	WEAKNESSES
Andy	SLD	Reading 9.6 years old Math 11.0 years old Writing 10.8 years old	15	10th	MSD	Perceptual motor functioning, achievement delays in reading comprehension, new vocabulary words and decoding
Brad	SLD	Reading 11.4 years old Math 8.6 years old Writing 9.9 years old	15	10th	MSD	Organizational skills, sequencing, ability to concentrate and attend
Clint	OHI	Reading 13.4 years old Math 19.0 years old Writing 17.0 years old	16	9th	IEP	Deficit in visual motor skills, emotional concerns, attention and concentration problems, inconsistent work habits
David	SLD	Tested achievement is at expectancy in the average range for grade level according to WJIII*	15	10th	MSD	Clerical processing speed, ability to concentrate and attend
Evan	SLD	Tested achievement is at expectancy in the low average to average range for grade level according to WJIII*	15	9th	MSD	Difficulty with calculations and story recall, attention and concentration, emotional/behavioral difficulties
Fred	SLD	Reading 8.9 years old Math 9.9 years old Writing 9.9 years old	16	10th	MSD	Deficits in reading, writing and math… memory, planning and organizational skills, difficulty attending
George	SLD & SLI	Reading 12.0 years old Math 8.6 years old Writing 8.6 years old	16	10th	IEP	Mildly deficient verbal cognitive skills, perceptual motor functioning, written expression
Helen	SLD	Reading 8.3 years old Math 9.6 years old Writing 8.9 years old	14	9th	MSD	Achievement delays in the areas of reading and spelling

TABLE 4

Week 3: video on cells

	Pre-Test	**Post-Test**
Andy	0	100
Brad	0	80
Clint	0	100
David	0	100
Evan	0	100
Fred	0	100
George	0	90
Helen	0	100
CLASS AVERAGE	0	96

TABLE 5

Week 3: Cell video

	Pre-Test	**Post-Test**
Andy	0	100
Brad	0	Absent/never made up
Clint	0	100
David	0	100
Evan	0	80
Fred	0	100
George	0	40 matching quiz 100 (Retook quiz using graphic organizer style) Average = 70
Helen	0	100
CLASS AVERAGE	0	93

TABLE 6

Week 3: Scientists important to the discovery of cells

	Pre-Test	**Post-Test**
Andy	0	100
Brad	0	Absent/never made up
Clint	0	100
David	0	100
Evan	0	80
Fred	0	100
George	0	40 matching quiz 100 (Retook quiz using graphic organizer style) Average = 70
Helen	0	100
CLASS AVERAGE	0	93

TABLE 7

Week 5 -6: Cell Structure and function

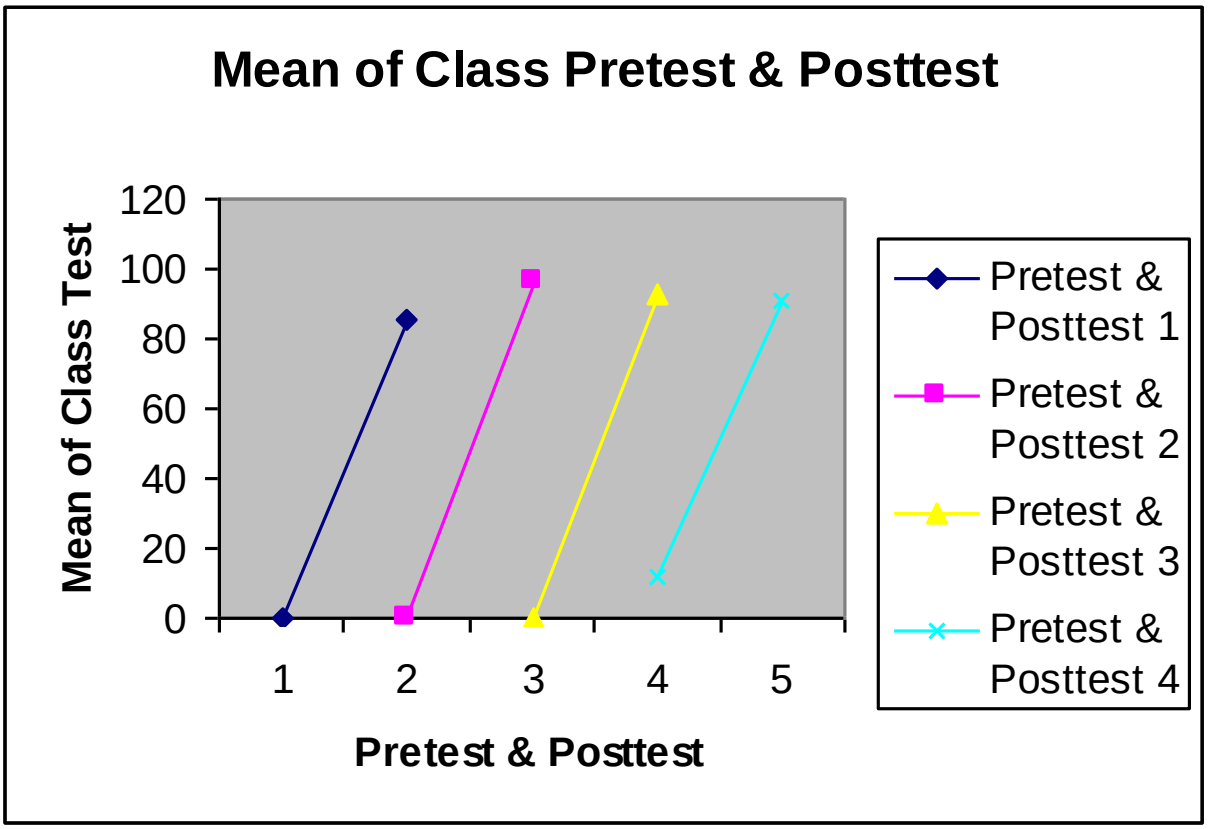
	Pre-Test	**Post-Test**
Andy	24	100
Brad	0	84
Clint	20	92
David	8	92
Evan	16	100
Fred	24	88
George	0	80
Helen	0	88
CLASS AVERAGE	12	91

TABLE 8

Follow-up Test

Student	Scientific Method Post test	Scientists Post test	Cell Structure & Function Post test	Follow-up Test (S.M., Scientists, Cell Structure & Function)	Categories on Follow-up test	Scores in each category
Andy	100	100	100	88	Scientist Cell structure Cell function Scientific Method	6/6 100% 5/6 83% 6/6 100% 4/7 57%
Brad	48	Absent	84	80	Scientist Cell structure Cell function Scientific Method	4/6 67% 4/6 67% 6/6 100% 5/7 71%
Clint	80	100	92	96	Scientist Cell function Cell structure Scientific Method	6/6 100% 5/6 83% 6/6 100% 7/7 100%
David	99	100	92	100	Scientist Cell function Cell structure Scientific Method	6/6 100% 6/6 100% 6/6 100% 7/7 100%
Evan	80	80	100	92	Scientist Cell function Cell structure Scientific Method	6/6 100% 6/6 100% 6/6 100% 5/7 71%
Fred	100	100	88	92	Scientist Cell function Cell structure Scientific Method	6/6 100% 6/6 100% 6/6 100% 5/7 71%
George	70	70	80	76	Scientist Cell function Cell structure Scientific Method	3/6 50% 4/6 67% 6/6 100% 6/7 86%
Helen	100	100	88	88	Scientist Cell function Cell structure Scientific Method	6/6 100% 5/6 83% 6/6 100% 5/7 71%
Class Average	85	93	91	89	Scientist Cell function Cell structure Scientific Method	89% 86% 100% 78%

FIGURE 1


Mean of Class Pretest & Posttest
Mean of Class Test
120
100
80
60
40
20
0
1
2
3
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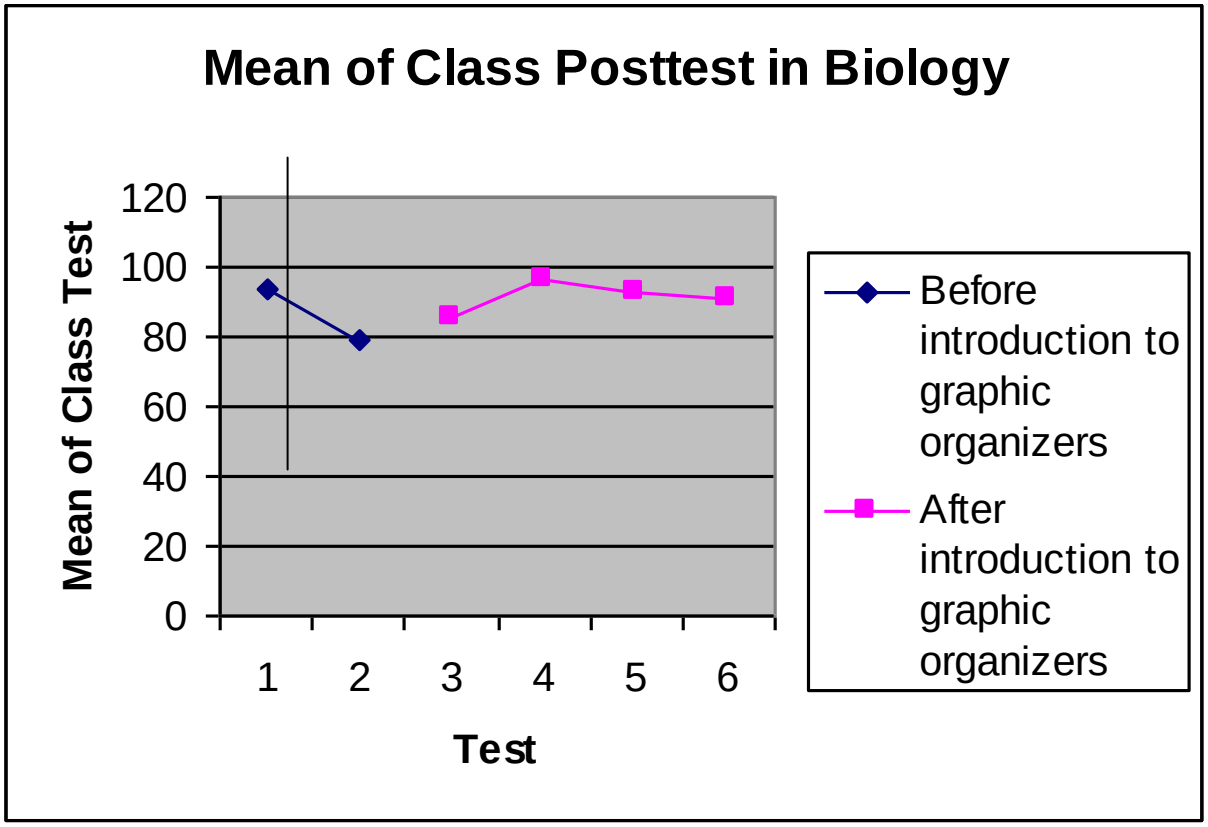
5
Pretest & Posttest
Pretest & Posttest 1
Pretest & Posttest 2
Pretest & Posttest 3
Pretest & Posttest 4

FIGURE 2


Mean of Class Posttest in Biology
Mean of Class Test
120
100
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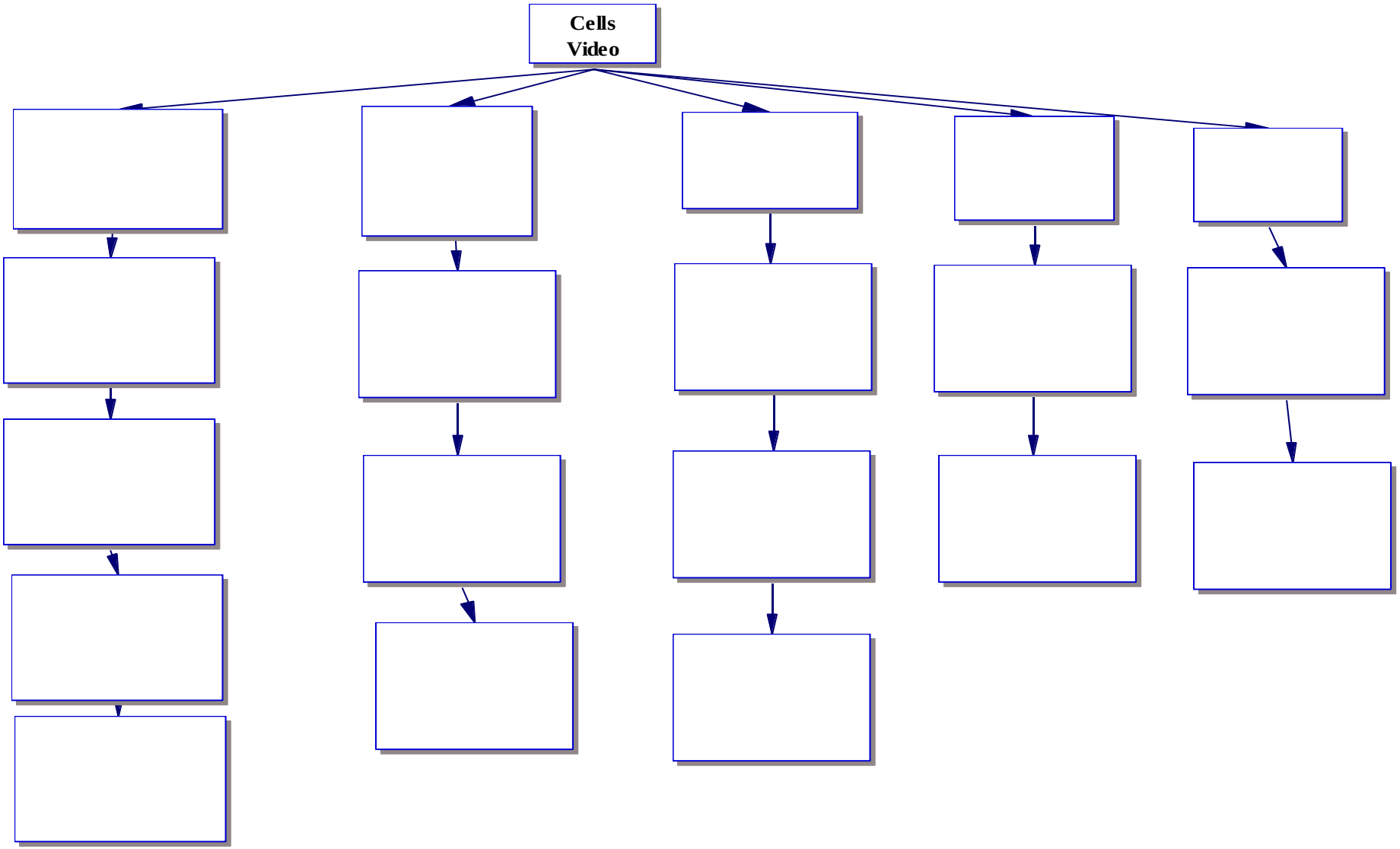
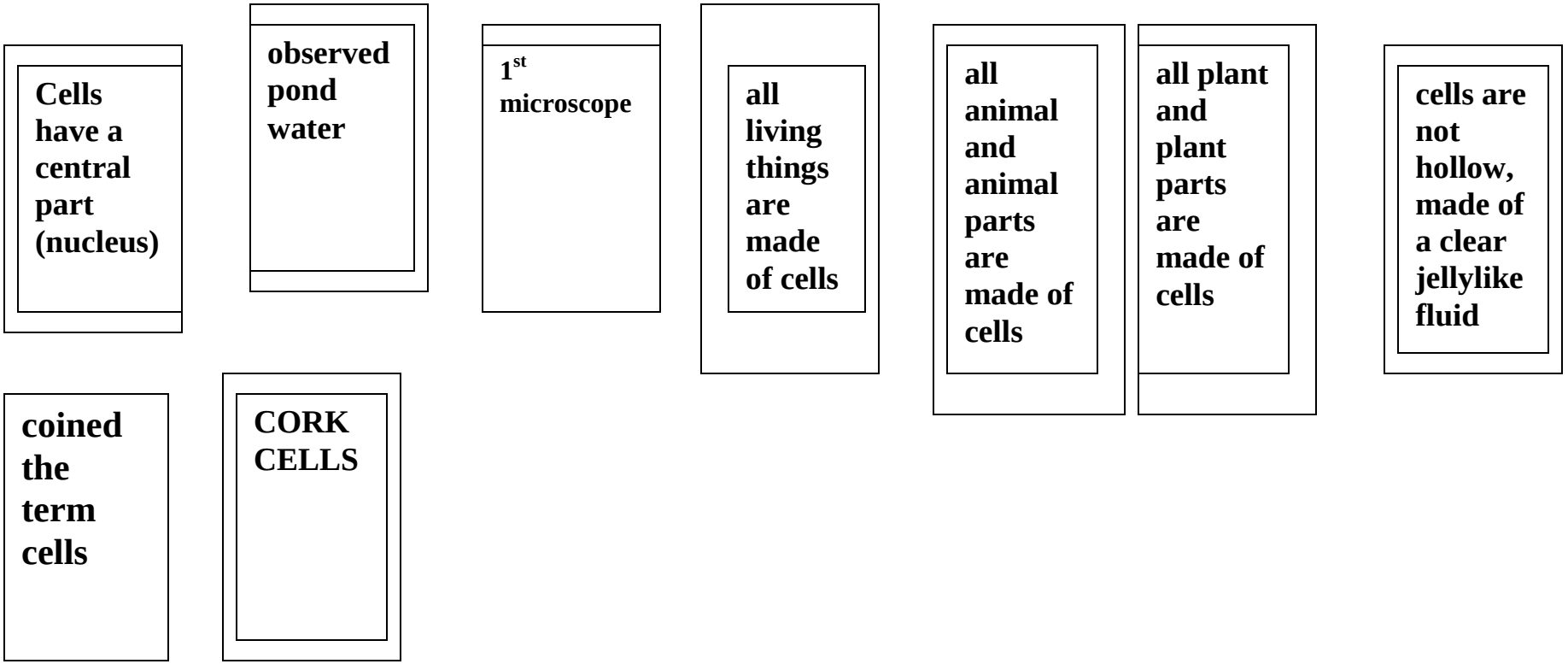
Test
Before introduction to graphic organizers
After introduction to graphic organizers

APPENDIX B

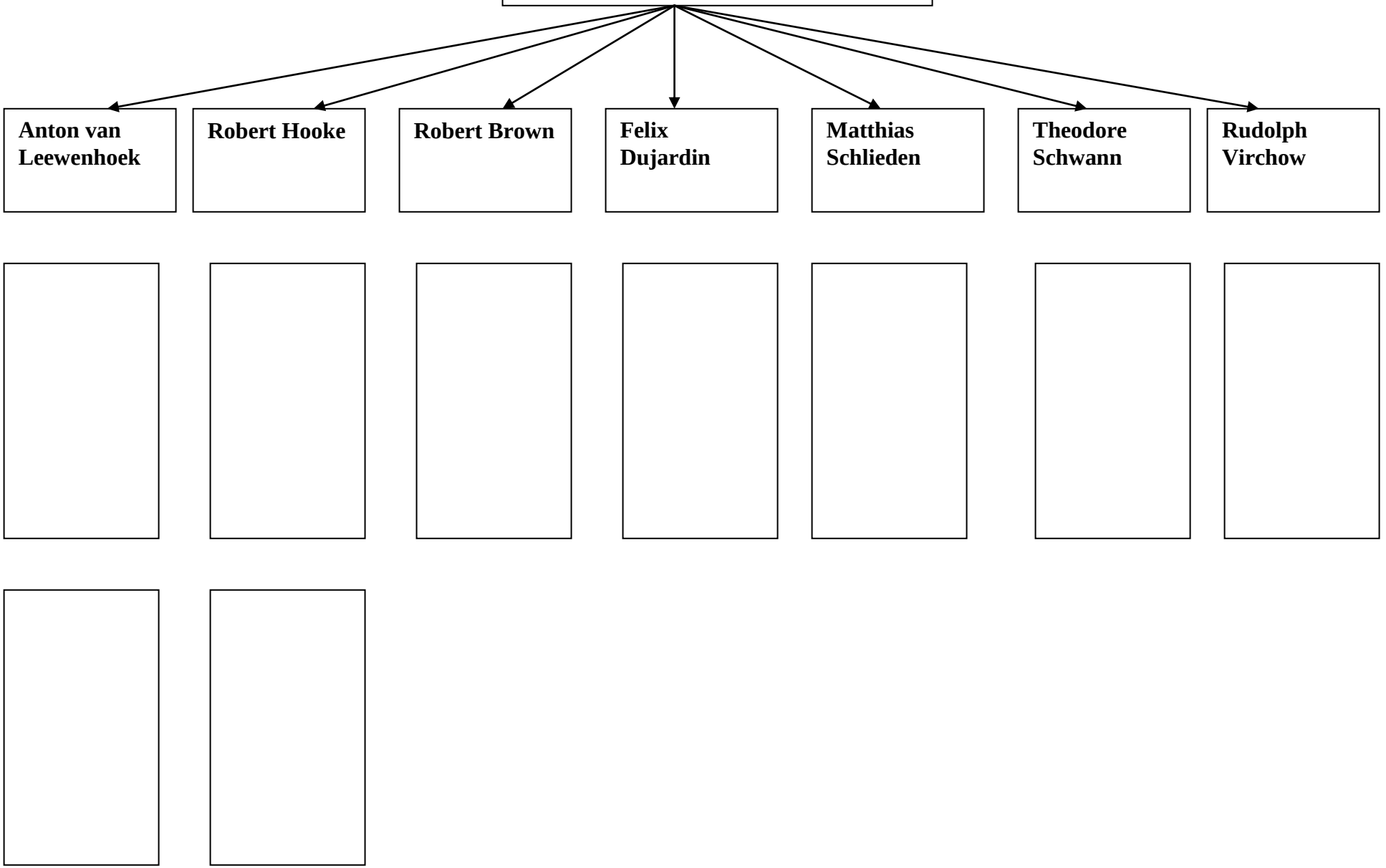


APPENDIX C


Cells have a central part (nucleus)
observed pond water
1st microscope
all living things are made of cells
all animal and animal parts are made of cells
all plant and plant parts are made of cells
cells are not hollow, made of a clear jellylike fluid
coined the term cells
CORK CELLS

APPENDIX C

EARLY MICROSCOPIC OBSERVATIONS



APPENDIX E

CELL ANALOGY CELL AND BHS Name _____

THE CELL IS LIKE	BHS	BECAUSE…
CELL MEMBRANE		
MITOCHONDRIA		
RIBOSOME		
ENDOPLASMIC RETICULUM		
VACUOLE		
GOLGI BODIES		
LYSOSOME		
NUCLEUS		
CYTOPLASM		
CHROMOSOME		
CHLOROPLAST		
NUCLEOLUS		

APPENDIX E

CELL ANALOGY CELL AND BHS Name _____

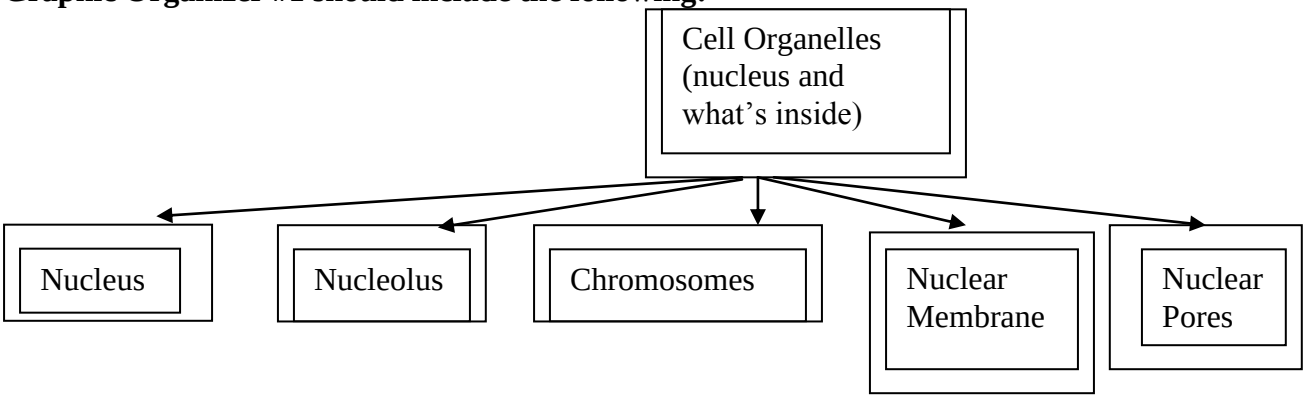
THE CELL IS LIKE	BHS	BECAUSE…
CELL MEMBRANE	Officer Glass Windows and doors	He controls what enters and leaves the building They let things go in and out
MITOCHONDRIA	The students The Electrical Room	Without the students there would be no energy in the school The room has all of the electrical power for the school
RIBOSOME	The lunch ladies The cafeteria	They make protein for lunch That is where the food (protein) is made
ENDOPLASMIC RETICULUM	The hallways	They transport students to and from class
VACUOLE	The water fountain Drink machines	It stores water They have bottled water
GOLGI BODIES	Student assistants in the office The mail coming and going at school	They sort, deliver and package information It has to be delivered and sorted
LYSOSOME	Custodian's closet Custodian	It contains chemicals to help get rid of the "bad' stuff in the school They are the clean up crew for the school
NUCLEUS	Mr. Whorley	He controls the school
CYTOPLASM	Teachers standing in the hallway	They move students along so they won't be late to class
CHROMOSOME	The blueprint of the school	It contains all the info of where everything is located
CHLOROPLAST	The kitchen	It stores and makes food
NUCLEOLUS	The oven	It makes the protein

APPENDIX F

Making a Graphic Organizer/Cell Structure & Function Name _____

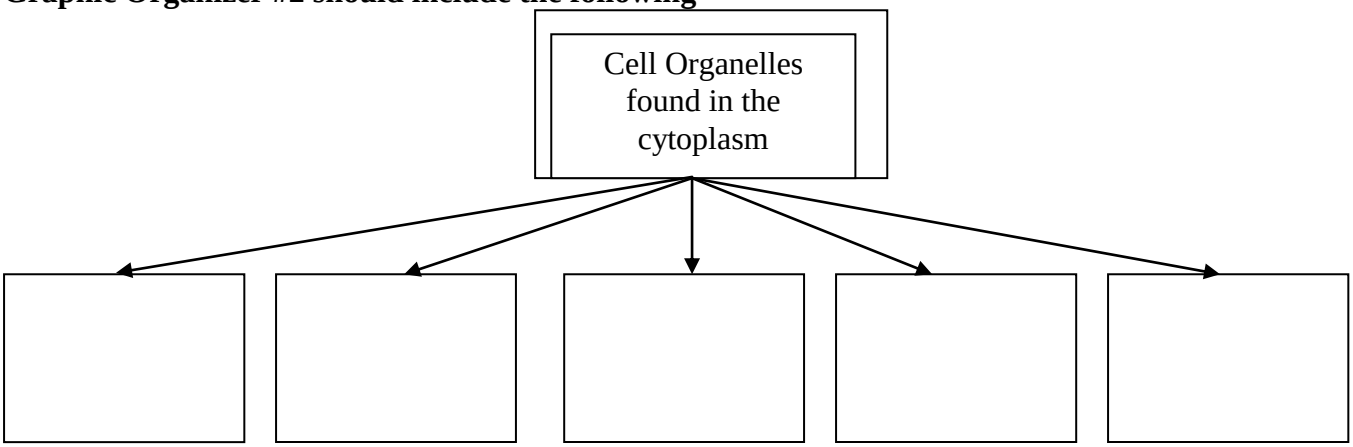
OBJECTIVE: The student will be able to make 2 graphic organizers using Inspiration software to enhance learning the functions of the cell organelles.

Graphic Organizer #1 should include the following:



Below each organelle, you should include 2 – 3 boxes. One or two boxes should include the function or functions. The last box should have a picture of something that will help you remember the function of the cell organelle.

Graphic Organizer #2 should include the following



Choose at least 5 organelles to put in the boxes

- Vacuole
- Chloroplast
- Rough Endoplasmic Reticulum(RER)
- Ribosomes
- Mitochondria
- Golgi Bodies
- Lysosomes
- Cell Wall
- Cell Membrane
- Smooth Endoplasmic Reticulum (SER)

Below each organelle, include 2 – 3 boxes. One or two boxes should include the function or functions. The last box should have a picture of something that will help you remember the function of the cell organelle.