GRAPHIC ORGANIZERS

FOR

GRADE VIII SCIENCE STUDENTS

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DEDICATION

This project is dedicated to my wife:

Valerie Luyten

I thank you for your understanding and your counsel.

But most of all

I am thankful for our partnership in

sharing and learning

together.

ABSTRACT

This paper is part of a series of classroom investigations into the effectiveness of graphic organizers in a junior high school setting. There were two main purposes for this study. The first purpose was to determine if the structure and design of the organizers were consistent. The second was to learn how students used graphic organizers as a review tool. Grade 8 students in a traditional junior high school were taught to creatively display key information in a graphic organizer. Organizers for the purpose of this study were considered to be a collection or summary of information presented in symbolic, pictorial and written form with supporting data radiating from the main idea. Students used these organizers as a review tool during their creation, as a focus for classroom discussion and as a reference immediately before the unit exam. This procedure was continued for the next three units and formed the basic source of data and artifacts for this study. The information gathering culminated with the students completing a questionnaire and discussing their strategies and insights during an interview. The resulting data addresses a number of educational aspects of graphic organizers. The data was analyzed to clarify the relationships between student achievement levels, strategies, and attitudes with the success and benefits of the mind maps. The consistency of the structure and design of the orgranizers were also assessed and were found to be aligned with the students' brain processing.

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I. HISTORY

How could I as a teacher help my students retain the information they have learned and improve their grades on exams? This question among others is one that I have asked myself since my first year of teaching. I have found a number of "solutions," some that have helped some of the students and others that have had little effect.

Possibly the most successful approach I have used is one that Cardellichio and Field (1997) describe as a strategy which challenges students to select and assimilate data in such a fashion as to promote the formation of strong concepts. The strategy I introduced was the concept of graphic organizers as described by Irvine-Devitis and Pease (1995). I perceive graphic organizers as a graphical and written expression of a concept or material which rather than being linear as in traditional note taking, usually starts with a central thought with radiating and supporting ideas (Margulies, 1991). In my mind I felt that the best use of this strategy in my classroom was as a summary of unit work, to promote students' understandings of concepts and their relationships.

The concept of graphic organizers appears to be very flexible as it is used in a variety of ways by other researchers. Cardellichio and Field (1997) indicate that using "web analysis" will lead to "neural branching" in the brain which actually promotes a richer network of synaptic connections and encourages students to look at familiar ideas from a new perspective. Margulies (1991) believes that as students find the information making sense the students are more likely to use both hemispheres of their brain (Margulies, 1991).

In the spring of 1996 I carried out my own action research (Luyten, 1996) based on the model described by Irvine-Devitis and Pease (1995) to assess the value of graphic organizers (mind maps) as a review tool for Grade 8 math and science students. My research indicated that while there may very well be some benefits associated with the use of graphic organizers, more questions were raised than answers were found. One of the most intriguing questions was the idea of a "relationship" between a few of my most academic students and the organizers. A number of high achievers in each of my classes posed the greatest opposition to the implementation of the graphic organizers. These students usually accepted assigned activities in their stride with few if any comments. However, in this situation a number of students continued to express negative comments. In particular one student whom I will call Art was quite vocal in his objection to this new activity, even to the point of rallying fellow students to his cause.

As the graphic organizers became a regular aspect of student work Art continued in his vocal opposition. I realized I had to take some action. However, Art arrived on his own accord to discuss the graphic organizers and to inform me that he felt so strongly about it that he was going to start a petition against their use in the classroom. I was quite taken aback and unsure how to respond to his strong feelings, which I felt were sincere. After an evening's deliberation and dialogue with other teachers I asked Art to see me after school to carry on the discussion from the previous day.

When we met I offered my solution. I explained that perhaps the reason Art found these organizers worthless was because in his particular case they were; he was right in his conclusion. I continued to explain part of the power of the organizers is to help students to order the data and to show connections; in Art's case his brain was already carrying out these processes at a high level of performance. For Art there were few if any noticeable benefits. Art's aggressive stance subsided as I explained my theory. He then responded that he had been right about the lack of value for the organizers. I agreed and added that this was true but only in a few cases with students who were in a similar situation to Art. I continued to explain that the other students would likely find these strategies rewarding and helpful in the formation of concepts in their own minds and hence in their success at school. He was quiet and almost withdrawn as he considered and reflected upon my theory and then nodded agreement. I asked him to accept that the strategy had the potential to help the majority of the students and for his permission to share our new consensus with my classes so that everyone could understand the complexity of the situation. He agreed, but didn't change his approach to the organizer assignments and continued to hand in assignments that demonstrated little thought as they were only composed of only a few lines and three or four words. However, he did desist in his opposition.

It is this set of circumstances which led me to ask a number of questions. Do different academic groups respond in varying ways to this approach? Do students with strengths in specific intelligences (Gardner, 1983) have a certain predisposition towards using graphic organizers? Is there a relationship between different intelligences and the

design of graphic organizers? These questions continued with me throughout the Master of Education (M.Ed.) program, right up to my final project.

As I read more I found many of the articles dealt with these very questions. For example, David Lazear (1994) who actively promotes the use of multiple intelligences in the classroom, has written of a definite connection between the way a brain operates and the manner in which graphic organizers are expressed.

> One reason these organizers are so effective is that they are in synch with how the brain organizes and processes information in a hierarchical manner moving from general concepts to the specific parts and pieces. A graphic organizer simply helps us make this process visible so that we can work with the process, enhance it, and use it with greater consciousness and intention. (p. 157)

It is this interplay between the expression of our activities and our brain processes that holds my interest. Are graphic organizers an expression of how our brain works, how our brain organizes data and how our brain processes and connects data? If this is the case then will there be a similarity, a pattern that exists for all students as they express the constructs of a lesson in a graphical format?

II. REVIEW OF LITERATURE

Brain Research

Because of my interest in brain research this was the first area I delved into. I was searching for the value of the graphic organizers in their direct relationship to the human brain. Sylwester (1994) suggests that knowledge of the brain should lead teachers to encourage students to construct their own categories and to create their personal solutions rather than always following the patterns of others. Even though these activities take time and effort, they form the foundation of the skills involved in producing graphic organizers. The value of taking this time to review is critical for the academic success of most students and, "is probably the key to success" (Palmer & Pope, 1984) for most students.

Another value of using graphic organizers is described by Margulies (1991) as a strategy that integrates the processing styles of both hemispheres, as the students combine the use of both words and symbols. McCarthy (1997) also indicates that the identification of such features as the dominant brain hemisphere is not important, but what is of value is that students have access to a variety of approaches to help them achieve a "balance and wholeness."

These statements and conclusions notwithstanding I have found it difficult to apply brain research to the graphic organizer construct concisely. I found this research rich and stimulating but I was not sure how I could have directly applied these ideas to my project. The brain's complexity and my meagre understanding of it must be considered as research results are played out in the real world which has an infinite number of actors

and interrelationships. However, I think once I understand these parameters, generalizations may be warily made to help support the value of graphic organizers as a review strategy.

Graphic Organizers

I have been using graphic organizers in my classroom over the past two years. One of the greatest advantages I have found is their flexibility. Margulies (1991) discusses the organizer as, "a flexible, evolving system with unlimited potential -- like the uncharted inner space of the human mind itself."

This flexibility, however, was not just restricted to the design an individual chooses, but was found as well in its usage. In my readings of graphic organizers the authors found them valuable for a variety of different reasons. Whether it be brainstorming, looking for relationships, balancing the learning strategies, or used as a review, the organizers appeared to have the adaptability and inherent value to fit in various situations.

In my mind this would give credence to Lazear's (1993) thoughts that the graphic organizers are "in synch" with the processes of the brain. If our graphic organizers are representative of our thinking style, it would follow that they would be valued in a variety of situations that reflect the organization of the mind.

Reflective Processes

Graphic organizers also promoted the self-reflective dynamic which Lazear (1994) claims is the "heart of the learning process." He suggested the organizers formed connections within the students' own cognitive framework and their own personal experience but this would only have meaning if students took time to carry out the process of reflection in a genuine manner which would then lead them to the assimilation of data to form their own conceptions within their reality (Cardellichio & Field, 1997). Hence, graphic organizers encouraged introspection, a way for students to make sense of data in their own terms. This last factor was one that gave me cause to reconsider the research paradigm appropriate for this project.

Qualitative Research

As I began planning my research there was little doubt that I would follow the traditional designs of quantitative research. In my previous action research, including the graphic organizers, I included hard number percentages of students that fell into categories, and the class average compared before the activities had begun or my own version of Likert scale questions. I have always felt comfortable and "right" about quantitative research. Therefore it was a natural step to accept my predisposition toward this paradigm.

So having chosen the quantitative paradigm, I was now looking forward to my entry into the research course at the university to refine my numeric skills. Even as fellow students in the research class found reason to switch their projects to the qualitative paradigm I remained convinced that my project belonged in the quantitative

dimension. Later with the help of the instructor and the research literature which was starting to "speak" to me, I began to see the value of the qualitative perspective. Items such as Lazear (1994) describing the value of self-reflection and self-awareness, or Margulies (1991) talking about mind mapping and the mind itself as evolving and changing, brought me to realize the value of not just finding a correlation, but attempting to understand what was actually happening as students became involved in this activity. I began to see the value of not restricting myself to a single succinct question and the value of casting out a net to draw in understandings that I hadn't planned on (Ellis, in press). It is this literature review and my understandings from the research class that allowed me to look at the broad and qualitative question about graphic organizers and my students.

III. PURPOSE OF STUDY

I had to put aside my long range interest in finding a relationship between the brain's framework and students' design of graphic organizers. Before research on these connections and relationships could be investigated graphic organizers themselves must be shown to be a stable and reliable representation of individuals. Only when it is shown that the organizers are consistent for each individual could further investigations be carried out to search for possible relationships with the conceptual organizations of the brain. As a result my overriding question became:

> *What is it I can learn from my students about their use of graphic organizers as a review strategy?*

More specifically I had hoped to be able to answer the following:

> *If students had experiences of producing three graphic organizers for three different topics over the fall could I study those for patterns that persist or become more discernible in spite of changes in "content" or the practice effect?*

IV. METHODOLOGY

A. Research Sample

The students I worked with were studying grade 8 science at Alexandra Junior High School in Medicine Hat. Only one of the science classrooms was selected to participate in the study on graphic organizers. The selected classroom was of a heterogeneous mix, students randomly placed into classrooms and not determined by academic achievement. Even though all of the 28 students in the class had parental permission to participate (Appendix A), only 13 students were selected as they were the only students who consistently handed in their graphic organizers for analysis and evaluation.

This sample group consisted of six males and seven females who were all taking grade 8 for the first time. Academically this group was made up of five above-average students, six average students and two below-average students (as determined by their final grade in the course).

Even though this class formed the research group for this study, the lessons and activities dealing with graphic organizers were conducted in all of my science classrooms. The expectations I had for this group were no different than those I had for the rest of my classes. I informed the students that all of the graphic organizers would be corrected and used towards their report card mark.

B. Introductory Phase - A Lesson on Mind Mapping

In the introductory phase of this project I sought to acquaint students to a variety of mind mapping strategies. Lazear (1994) believes that graphic organizers visibly show how the brain processes and organizes data. Therefore I felt it important that the variety of strategies presented should allow students to use an approach that would complement their own thought processes. At the same time I hoped to have students visualize and recognize some of the mental processes that we often use without much thought. I felt that discussing ways that we can represent relationships, connections and organization of data; or determining the main idea of a section, would give students a better understanding of how people learn.

To meet this end I gave the students the handout, Forms of Graphic Organizers (Appendix B), early in the year just as we were finishing up the introductory unit. Once the students had the forms I gave them a short talk on some ideas of the complexities of intelligence, Gardner's multiple intelligences, and the different ways our minds perceive and process information; for example, how witnesses to an accident give quite different stories. I used a transparency showing the different strategies of representing information displayed in the handout. As a class we shared and discussed these strategies in relation to the introductory science unit just completed. Students then gathered into small cooperative learning groups to prepare their own graphic organizer for the unit. To help with their motivation, students were aware that the graphic organizers would be graded and used as part of the unit mark.

The graphic organizers I gave the students to complete were 8½ by 14 inch sheets with the short side paper punched for their binders. The organizers were blank other than the unit title and its six major topics. When the graphic organizers were placed in their binders the page was folded over to wrap around the unit. In this manner not only could they serve as a review of the unit but also as a divider that "packages" the unit.

On the day of the test, students were allowed to examine their graphic organizers for five minutes before the start of the test. By marking the organizers, engaging in positive discussions, setting aside class time, sharing graphic organizers and using them to help them achieve a better grade on tests, I was hoping to motivate students and convince them that organizers are a valuable educational tool, so it is worth putting some effort in to their construction.

After the test and the graphic organizers were graded, I had the students look at their graphic organizers and their Forms of Graphic Organizers handout. I addressed a number of issues brought up by the students:

-Which ideas should be shown?

-Which ideas should **not** be shown?

-Which is the "correct" strategy to visually represent an idea?

-How can you put all the information on one page?

-What are key or "trigger" words?

-Can I just define terms for the organizer?

From the discussion, I concluded that the students had a reasonable understanding of graphic organizers and their educational value. The greatest difficulty appeared to be that there was not just one way but many correct strategies for making graphic organizers. It is on this note I strongly encouraged the students to make the graphic organizers their own; as a piece of creative art. I encouraged students to observe other graphic organizers and to adapt any strategy or idea that made sense to them. I told them that through experiencing a number of approaches and being encouraged to create their own "work of art" their organizers would be in synch with their pattern of brain processing.

This testing phase was also conducted on the first full science unit, Unit VI, from the grade 8 science text, Science Directions 8. Once again near the end of the unit students studied and discussed the Forms of Graphic Organizers and started preparation on their organizers. They used the organizers as a review immediately before the test and then, as a class, we discussed how to use the organizers.

These first two graphic organizers were **not** a part of the material analyzed for this project. These two units served to allow students to become acquainted and to experiment with the graphic organizers as an educational tool and to become comfortable with their use.

C. Creation of Graphic Organizers

In the first part of the actual study, the science unit to be analyzed was the next unit taught, Unit II - Energy and Machines. The blank graphic organizers

were handed out when we started the unit and were assigned to be handed in on the day of the unit exam, after their usual five minute review. In the first class students were given a short overview of the unit, assigned a brief assignment designed to have the students look at the whole unit and then given time to start their organizers. The organizers were used as a review tool immediately before the unit test and then collected for marking and analysis. The organizers were handed back to the students as the focus of a class discussion. They were then handed back to me for use in this study.

This same procedure was followed for the next two units taught: Unit III - Consumer Product Testing and Unit I - Matter and Mixtures.

D. Student Questionnaire

After all the organizers had been collected, students made an appointment to discuss their graphic organizers. The first item to be completed was the questionnaire (Appendix C). Before giving the form to the students I explained that the results were for my M.Ed. degree and that the interview forms would not be used towards their science mark. I then explained the importance of being candid and truthful in answering the questions during this interview. After I answered any questions dealing with the format and expectations of the interview I gave the questionnaire to each student. Students usually spent 3 to 5 minutes completing the form.

E. Phase V - Student Interview

The remainder of the meeting was a dialogue between the student and myself. The dialogue followed a set of questions found in Appendix D.

F. Phase VI - Evaluation Rubric for Graphic Organizers

Once the interviews were over I used the Evaluation Rubric for Graphic Organizers (Appendix E) as a means of organizing the strategies students followed in their creation.

V. RESULTS

A. General Results

While organizing the results from the study I became overwhelmed by the diversity of the data I collected. The assignment of graphic organizers seemed to provoke various emotions among the students; some students became rebellious while others felt the project was worthwhile. In a class of 28 possible subjects only 13 students completed and handed in the three designated units. These 13 students formed the sample of my research project, though all of the students had parental approval. Even the prospect of flexible and lenient grading did not encourage a majority of students to complete the assigned work and become part of the research group. A range of 6 to 12 students did not hand in their graphic organizers for each of the three assigned units. However, this level of response was consistent with what happened in the other four classes I taught this year and with other classes over the previous 2 years.

The data used in this project was derived from slightly less than half the students that make up the class (46%). Even though this demographic is not atypical when compared to the other classes, it must be realized that half the class is not represented by the results. The subjects are more representative by gender; six male and seven female. When classified by final grade, the split of five above-average students (A's), six average students (B's) and two below-average students (C's), compared to the final class distribution of 6 A's, 10 B's, eleven C's and 1 F is

not a representative sample. This distribution is typical of the other classes and is representative for gender but it is not representative of the C grade students.

I will present the results in four groupings: the questionnaire, the interview, the graphic organizers and consistency.

B. The Questionnaire

After students completed the three assigned graphic organizers an interview time was established. Completion of the questionnaire, using the Likert format, (Appendix C) was the first item scheduled in the interview. This allowed me to record students' impressions of the organizers before any discussion could influence their perceptions. The only communication before the questionnaire was for clarification of the expectations and instructions.

Table 1
Evaluation Summary of Student Questionnaire

Attributes of Student Questionnaire	Overall	Above*	Average*	Below*
Do Not like to..(1)---Like to make G.O.(5)	3.0	3.0	2.8	3.0
Not much effort(1)----------Much effort(5)	3.6	3.4	3.7	3.0
Less than 5 min.(1)--More than 60min.(5)	4.0	3.8	4.0	4.0
No help in studying(1)-----Very helpful(5)	4.0	3.6	4.2	4.5
No help in understanding(1)-Very helpful(5)	4.0	3.8	3.8	4.5
Never reflect(1)----------Often Reflect(5)	3.6	3.2	3.8	4.0

* The three graphic organizers for each student were averaged to produce one score.

The results from the questionnaire were quite favourable towards the process of mind mapping. All but one of the averages were higher than the midpoint score of 3 (a

range of 1 to 5 with the high score being more positive). The summary of these results can be found in Table 1.

The scores for the first question showed that all but two students selected the midpoint score of 3 or higher indicating that making graphic organizers was acceptable or even likeable.

Question two, which investigated the amount of effort that was put into creating the organizers, had the most diverse scores. Three students indicated they didn't put much effort into the assignment while the rest registered a midway score or higher. The remaining four questions had only one student in each case select a score of less than 3 or higher. All the negative scores of 2 were chosen by only three students, two of whom were 'A' students and one who was a 'B' student (except for question two).

C. The Interview

After the students completed the questionnaire, I explained that I would be investigating their feelings about the organizers. The data from the interview lends itself to qualitative reporting but I have converted three of the questions into a quantitative format in Table 2 for ease of interpretation.

The first question asked students how they study and prepare for exams. Their responses indicated that all students selected graphic organizers as one of their top three choices. A score of 5 was assigned to students who chose graphic organizers

as their first choice, a score of 3 for a second choice and 1 for a third place choice. The average results were then placed into Table 2.

Table 2
Partial Evaluation Summary of Student Interview

Question	Overall	Above*	Average*	Below*
1. G.O. Third Choice(1)-----First Choice(5)	3.6	3.0	3.6	5.0
2. Never used G.O.(1)---------Have Used(5)	1.0	1.0	1.0	1.0
6. Will not use G.O. again(1)--Will use it(5)	3.4	3.8	3.7	3.0

*The three graphic organizers for each student were averaged to produce one score.

Question two determined whether or not students had any previous experiences with graphic organizers. As the table shows not one student indicated any experience at all with mind mapping. The likelihood that students would use mind mapping next year was determined by the students' responses to question six. Most students, 6, indicated they would continue to use organizers, 5 thought they might continue and 2 said they would not use them again.

The other interview questions were not quantified but I was able to identify some patterns. Responses to the third question determined the resources students drew upon when creating their organizers. The two major groupings formed when synthesizing organizers focussed around either visual phenomena such as pictures or diagrams, or around linguistic phenomena such as words, written or spoken. When synthesizing the organizers students favoured text books, then diagrams, pictures and tables, and then key words. The spread of resources students used when classified by achievement level was quite interesting. Above-average students relied on up to six

differing resources, including notes, incorrect answers and the connections between items as a resource. Average students used four separate resources, and below-average students only used two. The resources used by the average students were the most common for all three levels of students; use of the text book and diagrams and pictures.

The fourth question focussed on how helpful the students found the organizers. Students reported the organizers easy to use and beneficial because they reviewed the key ideas. In the second part of the question 11 students agreed that the organizers helped them to remember things; two stated that they provided occasional help. In the third part of the question, remembering the 'big' picture or major concepts, 9 students found the mind maps useful, 3 found them useful some of the time and 1 said the organizers did not help at all.

Many students found question five required a great deal of thought. I asked students to mentally picture how they learn. I made it clear that they needn't worry about forming an answer in words as they would not have to explain their thought process. I then told them to take their time while forming this mental image. Students quietly spent from 30 seconds to 4 minutes following this procedure. Once they were ready I asked them to look at their graphic organizers and tell me what aspects of the organizers matched and differed with their way of thinking. Most students spent between 1 to 3 minutes in reflection and proceeded with the question.

One below-average student said he could not understand what I was asking. After my third attempt at an explanation I admitted the task was complex and difficult and that we would move on to the next question in the interview.

The results showed the foremost match between thought process and graphic organizers involved first the visual sense, then the linguistic sense and then how the information was grouped and organized.

When asked to identify differences between graphic organizers and the students' thought processes, 4 students indicated no differences existed. No response was given by 3 of the students and 6 indicated a difference did exist. However, when the discrepancies stated were examined, they seemed to demonstrate a difference in the medium, thought as opposed to the written word; for example, their comments indicated that their mind contained more information, or was not organized so definitively, or was not as clear as the information on the mind maps.

D. The Graphic Organizers

The student graphic organizers were evaluated according to the rubric which can be found in Appendix E.

The first two items in Table 3 deal with the students' general approach in placing data on the organizer. Out of nine various strategies taught and discussed in the introductory lesson (Appendix B) only two of these nine strategies were used by the students. As I examined all 39 organizers (three for each of the 13 subjects) I catagorized each organizer into the web or list strategy. By far the majority of the

students (74%) preferred the headings and list technique and the remaining (26%) used the web style.

Table 3
Evaluation Summary of Student Graphic Organizers

Attributes of Student Graphic Organizers	Overall	Above	Average	Below
Strategy - Attribute Web*	26%	47%	17%	0%
Strategy - Headings & List*	74%	53%	83%	100%
No Colour (1) ------Most in Colour (5)**	2.1	1.9	2.3	1.8
No Designs (1)-------Many Designs (5)**	1.1	1.3	1.0	1.0
No Definitions (1)--Defined Terms (5)**	4.1	3.7	4.2	5.0
No Pictures (1)-------Many Pictures (5)**	2.3	2.4	2.1	2.7
Sloppy (1)----------Neat (5)**	3.0	3.3	3.1	2.0

* - Each graphic organizer (three per student) was graded separately.
** - The three graphic organizers for each student were averaged to yield one score.

An example of an attribute web can be seen in Appendix F, Student K - Unit III. In this instance the webbing strategies may not be refined but the approach does capture the idea of subsidiary ideas branching from a main one.

The use of headings and lists can be seen in the example by Student M - Unit I. Note that though the data is scattered over the sheet the information is listed under headings.

The remaining five rubric items were dealt with differently than the first two questions. I found the average score each student achieved on the three graphic organizers, found the overall averages for all the students and then for each of the three student achievement levels.

There was little differentiation in the traits for use of colours or designs in the mind maps as few students used colour or designs in their organizers. However, use of pictures, terms and organizer neatness did vary among the subjects. The majority of students used only a few or no pictures while some used them extensively. Organizers with and without pictures can be viewed in Appendix F for Students D and Student M.

Most students, 12 out of 13, defined terms on their mind maps but varied on how extensively they were used. Above-average students used the fewest definitions while the below-average students used the most. These variations can be seen on the graphic organizers for Student D and for Student K (Unit III). Neatness and effort to produce a quality assignment also varied greatly between different achievement levels. Differences between the two extremes can be seen in Appendix F for students C and M.

While I have categorized and grouped the above data to help identify patterns that exist I do not want to underrate the value of a general observation. The three organizers created by two very different approaches can be observed in Appendix F for Student C (Units I, II and III) and for Student D (Units I, II and III).

E. Consistency

Table 4 indicates the consistency of strategies students followed while making their graphic organizers. The first row of the table indicates the consistency with which the students employed the nine-characteristics, evaluation rubric (Appendix E), while synthesizing their organizers. If a student was consistent in a characteristic on all three graphic organizers then 2 points were awarded. If one graphic organizer varied from the

other two 1 point was awarded and if there were no matches 0 was assigned. That is, if all the choices for each element differed a consistency rate of 0% would be calculated; if all the answers for each element were the same then a score of 100% would be achieved. These individual scores were then tallied for an overall average and for the three achievement levels. Table 4 indicates a very high level of consistency for all the achievers, with an overall average of 89%.

Table 4
Consistency of Student Graphic Organizers

Consistency for:	Overall	Above Average	Below
All characteristics of G.O. for each student	89%	83%	94%	89%
General strategy of G.O. for each student	96%	90%	100%	100%

The data in reference to the approach students selected, web attribute or headings and list, are presented on the second row of the chart. This does not indicate which method of approach was chosen, only the consistency with which they were chosen. Once again a very high percentage of consistency (96%) was indicated. As a matter of fact, only one student made a single variation in his approach. This variation can be seen by observing the graphic organizers for Unit II and Unit III for Student K.

The results of the data collected by the various processes I have described show many differences and similarities in the creation of graphic organizers. In the next section I will try to make some sense of this diverse data.

VI. ANALYSIS

Analysis of the collected data was confined to the two main areas that parallel the purpose of this study. First, I looked for patterns of similarity among the three mind maps the students produced. Secondly, I described what I have learned from the data that will inform me as a teacher about the use of graphic organizers as an aid to review.

A. Patterns in the Formation of Graphic Organizers

The most conclusive evidence that students form and persist in a pattern of approach when making graphic organizers is found in Table 4, the Consistency of Student Graphic Organizers, in the Results section of this paper. These results surprised me on two accounts; first, the very high consistency rate and, secondly, the lack of diversity in the students selection of the organizer style.

The general format strategy selected by the students was consistent in all but one case (an above-average student); others adhered to the same major approach that they selected for their first organizer, producing a 96% consistency rate. Once students selected a strategy it was unlikely they would experiment and try another.

The selection of only two strategies by all of the subjects was unexpected. A total of nine approaches were taught and discussed with the class (Appendix B) and, as well, students were encouraged to break with their traditional ways of making study notes and to experiment with different techniques in a search for a more effective strategy. Even with this encouragement, 74% of the students selected the traditional linear style of note presentation, headings and list, while the other 26% used the web attribute

strategy. I found this phenomenon difficult to explain. I have heard about how difficult many people find change but to see it to this extent in such a young group surprised me.

When examining the approaches in more detail and by looking at all seven of the traits, I found a slightly greater departure from students' established patterns. For example Student J used colour coding to highlight the key words but only on her last assigned organizer while Student K (Appendix F) defined terms only on his last organizer. Even though there were some variations from the students' set patterns the overall data still showed a high level of consistency (89%).

A qualitative examination of the organizers also supported the notion that students follow a consistent pattern during their construction. When observing the three organizers for Student C (Appendix F) obvious similarities were apparent. The list approach was used with only one or two definitions under each topic heading. The overall appearance, the writing style, the lack of pictures or diagrams and the rough and messy style were a common thread for all of Student C's organizers.

Uniformities could also be seen in the three mind maps produced by Student D (Appendix F). The common threads of style, use of pictures and diagrams, use of colour along with other traits formed a distinctive pattern for this student. Unique yet consistent patterns were seen for each of the students in the study.

It was quite apparent that students had a style or specific approach when preparing to review a science unit. As a teacher I do not find this surprising as most students, if not all, seem to follow a pattern of their own in many ways. Their behaviour, the manner in which they relate to other students and teachers, the manner in which they organize their lockers and binders, their propensities to use certain language

and their approach to learning are just some of the ways that students follow their own "personality" or pattern set by their brain processes. Also, as a teacher I have had to overcome "roadblocks" while trying to change a student's approach to learning. This persistence in maintaining a specific style also gives credence to Lazear's (1994) connection between how a student synthesizes and the manner in which the brain organizes and processes information. If a brain process is fully established, it becomes a formidable job to modify or change. Hence, motivating students to hand in assignments, to do their best on assignments and to use sound educational strategies can be a difficult task. Even when they realize the change is beneficial for them, if the process does not match the manner in which their brain processes and organizes information, they may be unwilling to change.

B. Graphic Organizers as a Review Strategy

In this section the data was analyzed in order to help me understand how students synthesize and view the use of graphic organizers as a review strategy.

The evaluation of the mind maps by the rubric (Appendix E and Table 3) indicated that, in general, students are not inclined to make their organizers different, complex or fancy but instead followed what one might consider a more linear and traditional approach. These results showed 74% of the students chose to list their ideas rather than use a webbing concept; used little colour and few designs to enhance the appearance or function of the organizer; used few pictures and diagrams; and showed a tendency for the mind maps to be untidy. The students seemed to rely on the use of definitions as their main source of information to synthesize the organizers and to help

them understand the concepts. Other than a strong use of terms the graphic organizers showed little variety of information and little more than a minimum of effort to complete this assignment.

The questionnaire (Appendix C and Table 1) also informed me about the students' "mentality" towards this review strategy. The most negative score on the questionnaire was in response to the first question, asking if they liked to make graphic organizers. That average result was in the exact middle of the continuum while the remaining answers were skewed to the positive side.

Students indicated that they did put a fair bit of effort and time into the assignment, but this was contrary to my perception. As discussed earlier my impression was that many of the organizers were rushed and contained just enough information to attain a "reasonable" grade. Of course, a divergence of perception between teachers and students over what is acceptable is not an unusual situation.

I did agree, however, with their next observation that they did find the review strategy helpful. A number of statements were made by students during interviews that would support this contention. Student K noted that the organizers gave him, "a chance to see important points I may have missed in class." Student G exclaimed in answer to the question if they were helpful, "Yes! Easy way of studying." And Student C responded with, "I see a part and then how the rest all fit together."

The interview questions (Appendix D and Table 2) also revealed some interesting information. In particular I was impressed by the fact that 54% (7 out of 13) of the students stated they would probably not use graphic organizers again. I found this number surprising as the data collected from the questionnaire indicated that the

students found the organizers very helpful as a study tool and also as an effective strategy in understanding science concepts. Another factor must be at play when students recognize the value of a strategy but will not continue its use.

Another surprise was the fact that not one student had been exposed to any form of mind mapping or graphic organizers before this year. That is, this technique was an original way to study and to represent ideas for all of the students. I have found students readily accepted new items of information but were more reluctant when presented with a change in a familiar procedure. Most, if not all, of the students have learned to note information in an organized and linear fashion such as a heading followed by a list of subordinate ideas on lined paper. In this study they were being asked to abandon or adapt the process and use main ideas, subordinate ideas and trigger words (no sentences and few phrases) flowing in a number of directions. I believe students were reluctant to try these new strategies simply because they were resisting change, as we all do from time to time. This reluctance could explain some of the incongruities in the results. Even though they value organizers they did not feel comfortable adopting such a new approach. It may also help to explain the negative review of the organizers and the fact that only 46% of the class completed the required number of organizers to become part of the research study.

It is this fact that may explain why so few students actually used the attribute web approach. The web strategy would have been a completely new idea to most of them. Perhaps it was this change, not new information and content of the units, but a novel way of reviewing and making study notes that some students found difficult. This may explain why students were reluctant to try or to accept this new technique.

This conclusion is also supported, in part, by the procedure by which the subjects were selected for the research study. Out of a possible 28 qualified students only thirteen (54%) were accepted as all students did not hand in three of the required organizers.

As part of the interview I asked students to form an idea of how they think and learn. Students spent from 30 seconds to 4 minutes contemplating their thought processes before continuing. At this point students were then asked to look for similarities and differences between their thought processes and their three graphic organizers. The 12 students (1 unable to answer the question) indicated a total of 20 similarities. These could be grouped into three categories:

1) Visual information: such as pictures, colour, and diagrams (7 responses).
2) Linguistic information: such as key words and reading out loud (7 responses).
3) Grouping and organizing information: such as large ideas supporting subsidiary ones, connections between data and a need for data to be neat and organized (6 responses).

These groupings indicated that different students rely on different strategies, or a combination of strategies, when synthesizing information. Some students depended on "picturing" information, others relied on the linguistic senses and yet others upon the manner in which the data was organized and presented. The following quotes from the student interviews support this conclusion.

Student H emphasized the need for neatness and organization in her comment, "Things need to be neat or else I'm distracted." In support of the linguistic style,

Student A said, "I remember better when I hear the words." Another student said she learned by writing things down but learned little from pictures. She went on to say a few pictures were, "O.K. but never big or many pictures." Yet other students found the visual style to be an important strategy. Student I stated, "I use symbols and think in symbols." Student K noted that pictures are helpful: "...I picture things in my mind as in the graphic organizer." This same student also stated, "... when paying attention if I hear it once I remember." These responses clearly indicate that some students relied heavily on a specific approach while others used a combination of approaches.

As for the differences between their thinking processes and the mind maps only 12 responses were listed. Four of these 12 comments clearly stated there were no differences between their organizer and how they think. As one student asserted, "I don't think anything is different cause I wrote it down."

The other eight responses could be placed into a single category; one that tries to describe the vastness and intangibility of the human mind. For example, one student articulated, "In my head it's not as clearly put into words." Another student reported, "I find graphic organizers more organized and concise. My mind is more spread out." And one other student commented, "I usually don't get into detail in G.O.'s; but detail is a part of my thinking." Students all felt that the maps matched the manner in which they think. They saw the differences as being a result of the medium; physical versus mental.

This information continues to indicate students followed an established manner of organizing, perceiving and remembering information. To take one more step in logic,

not only were the graphic organizers created as part of an established pattern, they were synchronized with our individual pattern of thinking (Lazear, 1994).

C. Graphic Organizers for Different Levels of Achievers

An earlier study (Luyten, 1996) found differences in attitudes towards the graphic organizers varied between above-average and below-average students. Accordingly, I looked at the results by comparing the students at different achievement levels to further investigate this phenomenon.

The questionnaire results (Appendix C and Table 1) clearly showed above-average students felt that organizers were far less helpful than below-average students (3.6 versus 4.5). Another difference would be the data that showed above-average subjects spend less time reflecting and studying the organizers than the below-average students. This would fit in with my classroom experiences. Above-average students completed and did well on organizer assignments but they seemed to treat them more as a task rather than a tool to assist their understanding. During the 5 minutes of review before the test I noticed that the above-average students had their organizers out and ready to hand in but many were looking over other sources of information or they were off task.

In the questionnaire, above-average students themselves gave the lowest rating for using the organizers as a study tool (Table 1), yet they reported the highest score indicating they would continue to use mind maps in the future (Table 2).

Data clearly showed differentiation in the variety of resources students use to create their mind maps. Responses to question three disclosed that the above-average

students used six different resources; average students used only four sources and below-average students used only two. This supported previous data which showed that top achievers were able to break away from the more traditional strategies of the text and the use of pictures and diagrams. In these obvious areas there were differences in the approaches and attitudes of above-average and below-average students.

When the data for the below-average student was analyzed it also produced an interesting student profile. Lower achieving students in this study saw themselves as spending more time making organizers, spending more time reflecting on the organizers and finding them more helpful. Organizers were the first choice as a study tool for below-average students, who most frequently used the most traditional strategies of listing items, defining terms and drawing pictures. Though these students seemed to use graphic organizers in a more traditional way, they said they found them useful. However, they also prepared the least tidy organizers and indicated they were least likely to carry on with this technique.

The above-average student profile also offered some mixed messages. Above-average students showed the most initiative and creativity in the creation of the mind maps. They used the traditional strategies of words, diagrams and pictures but they also added a dimension of webbing, colour and a variety of sources of information. For example, one student indicated that a source of information were the questions she answered incorrectly on assignments and quizzes. In addition, above-average students produced the neatest organizers and indicated the highest rank for using them next year.

Conversely these same students said they put in the least amount of effort, spent the least amount of time preparing and reflecting and found the organizers least helpful.

VII. CONCLUSIONS

From the data collected and the analyses I have discovered new insights into some of the factors that govern student use of graphic organizers as a unit review strategy and I have drawn a number of conclusions.

A. Patterns in the Formation of Graphic Organizers

Students were consistent in the strategy they selected to prepare their graphic organizers. Both the quantitative and qualitative data indicated that students did persist in following a set approach even with encouragement to break away from the usual and to experiment with new formats.

There appeared to be a reluctance to follow new processes, but not a reluctance to learn new data. Students accepted the teaching of information quite readily but balked at a new process that might change how they study and prepare for an exam and, I suspect, reacted in a similar manner to other new processes that trespassed on their traditional methods. Margulies (1991) also recognized this road block as she noted that the traditional linear approach is a deeply ingrained habit that can only be overcome by retraining the brain with practice and patience.

B. Graphic Organizers as a Review Strategy

Studying the organizers as a review strategy gave credence to the conclusions drawn above. Since none of the students had been exposed to graphic organizers, all students found the process of making graphic organizers an unfamiliar concept. It

follows that before this study began all of the students had established a strategy to produce review sheets or to make notes. This set of circumstances would explain why students were reluctant to continue the use of graphic organizers or to apply much energy to the project even though they realized it was helpful. As teachers it is then critical that we appreciate these conditions exist and try to promote acceptance of new processes with ingenuity and patience.

C. Graphic Organizers for Different Levels of Achievers

Clearly, the profiles, of the above-average student and the below-average student shown by the results of this study were different. The higher level student was more inclined to use more resources and be more open to new ways of doing things.

D. Future Implications

Some of the questions raised in this study that I would like to investigate further are as follows:

-Is the reluctance to accept new review strategies typical of any "how to" process or is it specific to the circumstances in this study?

-Does a relationship exist between Gardner's intelligences and the style of a student's graphic organizer?

-Why do above-average students show a greater willingness to accept new ideas?

-Do graphic organizers enhance student comprehension when the constructivist approach to education is followed?

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APPENDIX A
Student Permission Forms

<Date>
Dear <Parent's Name>:

I am conducting a research study on the development and design of graphic organizers as part of a Master's program with the University of Lethbridge. I have used graphic organizers in my classrooms over the past two years as a review tool for the units studied in both science and math. Students who effectively use graphic organizers are more prepared and are able to retrieve information more effectively for the unit tests and particularly for the year end comprehensive exams. I would like your permission for 40 to formally participate in this research.

As a part of this study your child will be asked to participate in the graphic organizer activities, respond to questionnaires, make reflective comments and possibly be interviewed by me. When the responses are compiled and released, they will be reported in summary form only. That is, all names, locations and any other identifying information will ***not*** be included in any discussion or publication of the results. In addition, you may withdraw your child from the study without prejudice at any time.

Please indicate your willingness to allow 40 to participate by signing and returning the consent form provided (keep this letter for your own files). If you have any questions please fell free to call me at the school, 527-8571. You may also contact the supervisor of this study, Dr. David Townsend and/or any member of the Faculty of Education Human Subject Research Committee for additional information. The chairperson of this committee is Dr. Craig Loewen who may be reached at the University of Lethbridge by calling (403) 329-2455.

Yours Sincerely,

Dave Luyten

APPENDIX A
Student Permission Forms page 2

Consent Form For Participation In
The Graphic Organizer Study

This consent form gives permission for <student's name> to participate in the Graphic Organizer Study. <student's name> will participate in the activities, respond to questionnaires, make reflective comments on the activities and possibly be interviewed by myself.

In return for your participation I will treat all responses in confidence and respect. Your child may withdraw from the study at any time without prejudice.

The Graphic Organizer Study

I agree to allow my child,_____, to participate in this study.

_____ _____
guardian's name (printed) guardian's signature

_____
date

or

I do **not** want my child to participate in this study.

_____ _____
name (printed) signature

------ Please Sign and Return ------

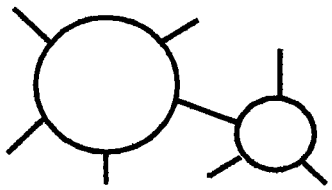
APPENDIX B
Forms of Graphic Organizers

Forms of Graphic Organizers

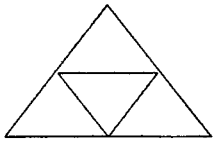
Graphic organizers can be an effective tool to help you with your school work. When your brain works with information it works in a specific fashion. It deals with general ideas first and then works to the next level of ideas and continues to get more specific and work with the fine details. Graphic organizers works well because it is your visual picture of what is happening in your brain. If you take the time and effort your graphic organizers should, in a fashion, reflect your working brain. Using this you can now take information from your classes and translate it into "your" language that your brain uses. Since the graphic organizers displays information that is in synch with your thought processes it can be a powerful and effective tool to help you understand your school work.

There are a number of ways that you can present the information that fits the data and/or that fits your understanding of the ideas. Listed below are a number of ways that data can be presented. (Lazear, 1994)

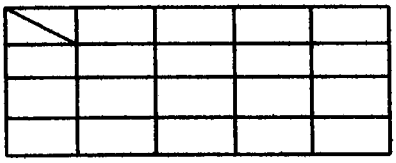
Attribute Web -The larger idea is listed in the circle and the smaller attributes are listed on the spokes or in other circles at the end of the spokes.



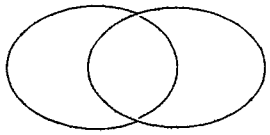
Triangle Chart -This chart can be used when you are going to describe an idea in three ways. The main idea is placed in the middle and the information in each of the three areas are place in the outside three triangles.



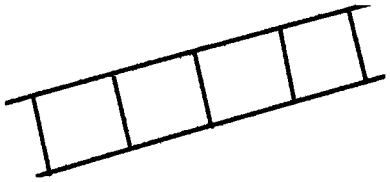
Classification Matrix -If you are looking at the same characteristics for a number of items this chart can be useful. The characteristics are listed across the top of the chart and then the various items are listed vertically.



Venn Diagram -This method can be used when comparing and contrasting two groups. The differences are listed in the outer portions of the circles and the similarities are listed in the middle area.

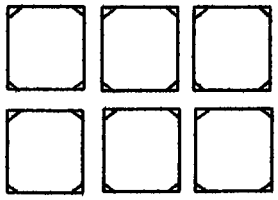


Ranking Ladder -This can be used when listing things in a specific order. The key items can be listed within the ladder and more information can be shown outside.

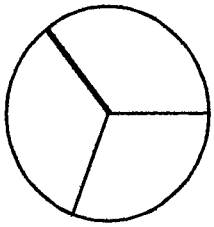


APPENDIX B
Forms of Graphic Organizers page 2

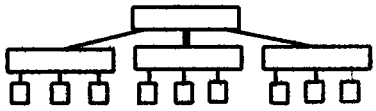
Snapshots -These may be used when you want to identify some important facts or ideas that need to be highlighted or repeated from other areas of the organizer.



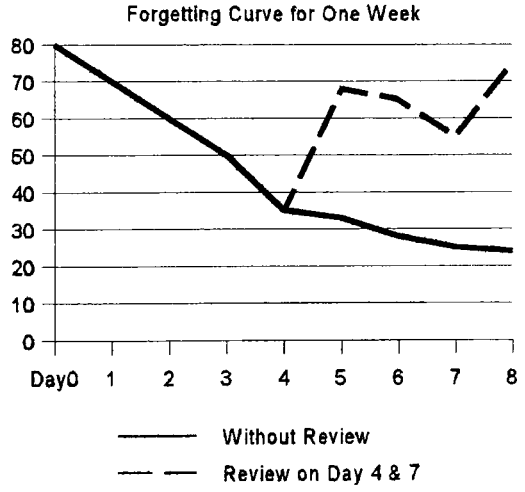
PNI -This is a circle that represent Positive, Negative or Interesting ideas about a particular idea. In this form you summarize the positive and negative attributes and then list any interesting or important conclusions.

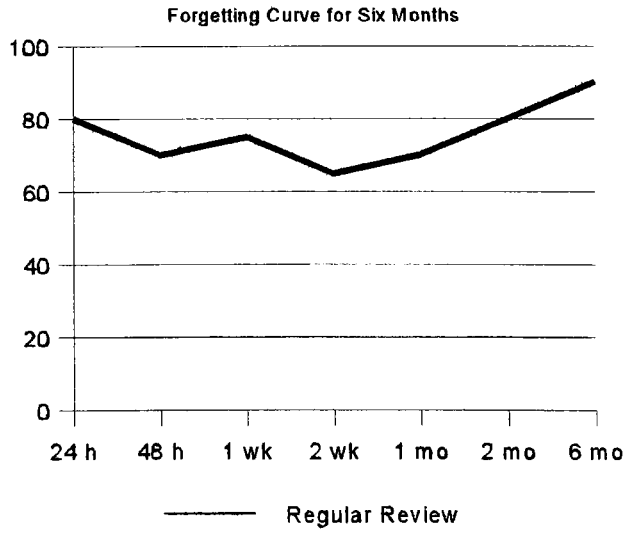


Thought Tree -Each box shows how the more specific ideas branch out from the main idea. This is similar to the attribute web but the ideas are lined up in a specific order.



Each of the above ideas are suggestions that you can adapt and use as you find them useful or appropriate. If you spend a bit of honest effort this approach should help you to improve your understanding of the course material. It has been shown that regular review work improves the amount of information you remember and that your mind can store the information for a longer period of time. (Palmer, 1984)

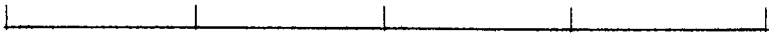




APPENDIX C
Student Questionnaire

Graphic Organizer Questionnaire

1. Do you like making GRAPHIC ORGANIZERS?

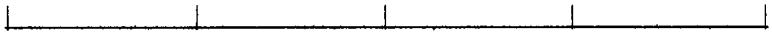


Not At All | Its OK | Very Much

2. How much EFFORT do you put into your Graphic Organizer?

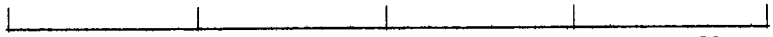
Not Much Effort | A Great Deal of Effort

3. How much TIME do you take to complete ONE entire Graphic Organizer?



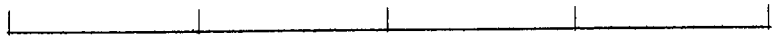
5 minutes or less | about 15 minutes | about 30 minutes | about 45 minutes | 60 minutes or more

4. I think that Graphic Organizers are a helpful method of study.



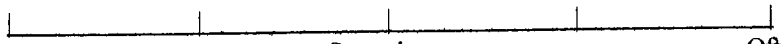
Not At All Helpful | OK | Very helpful

5. I think that Graphic Organizers have helped me to understand science ideas.



Not At All Helpful | OK | Very helpful

6. When you make your Graphic Organizers do you sometimes stop and take time to think about the information you are putting into your Graphic Organizer?



Never | Sometimes | Often

APPENDIX D
Interview Questions

Interview Questions

Name: _____ Date:_____

1. Describe **HOW** you study and get ready to write an exam.

   -read text and/or notes

   -with another person

   -make study notes

   -GRAPHIC ORGANIZERS

   -take time to reflect

2. Have you ever used GRAPHIC ORGANIZERS or MIND MAPS before this year?

3. Describe HOW you made your GRAPHIC ORGANIZERS.

   -list

   -linear

   -nesting

   -hyperlinks

   -diagrams

   -tables / charts / graphs

   -colour

   -art work

APPENDIX D
Interview Questions

4. HOW did you find the GRAPHIC ORGANIZERS helpful?

a) Do you think they helped you remember things?

b) Do you think they helped you understand the ideas being taught?

5. The longer I teach the more I believe we all think remember and reason our own way. That is; we all have our own special way of thinking.

a) In you own mind try to understand HOW you think & reason.

b) Look at your GRAPHIC ORGANIZERS. Now COMPARE your special way of thinking with the way you made your Graphic Organizers. Look at how the two are similar and different.

i) How do the Graphic Organizers **MATCH** your thinking?

ii) How do the Graphic Organizers **DIFFER** with your thinking?

6. Do you think you will use GRAPHIC ORGANIZERS or MIND MAPS next year at school?

7. Do you have other comments you would like to make about Graphic Organizers?

APPENDIX E
Evaluation Rubric for Graphic Organizers

EVALUATION RUBRIC
for
STUDENT GRAPHIC ORGANIZERS

___ ___ ___ GENERAL FORMAT STRATEGY

1. Attribute Web
2. Triangle Chart
3. Classification Matrix
4. Venn Diagram
5. Ranking Ladder
6. Snapshots
7. PNI (positive, negative, interesting)
8. Thought Tree
9. Headings and List
10. Other

___ ___ ___ COLOUR

1	2	3
Most in Colour	Some in Colour	No Colour

___ ___ ___ FLOWERY/DESIGNS

1	2	3
Much of GO	Some of GO	None

___ ___ ___ HYPERLINKS

1	2	3
More than 5	1-5 Links	No Links

___ ___ ___ DEFINITION of TERMS

1	2	3
More than 5	1 - 5 Terms	No Terms

___ ___ ___ PICTURES/DIAGRAMS

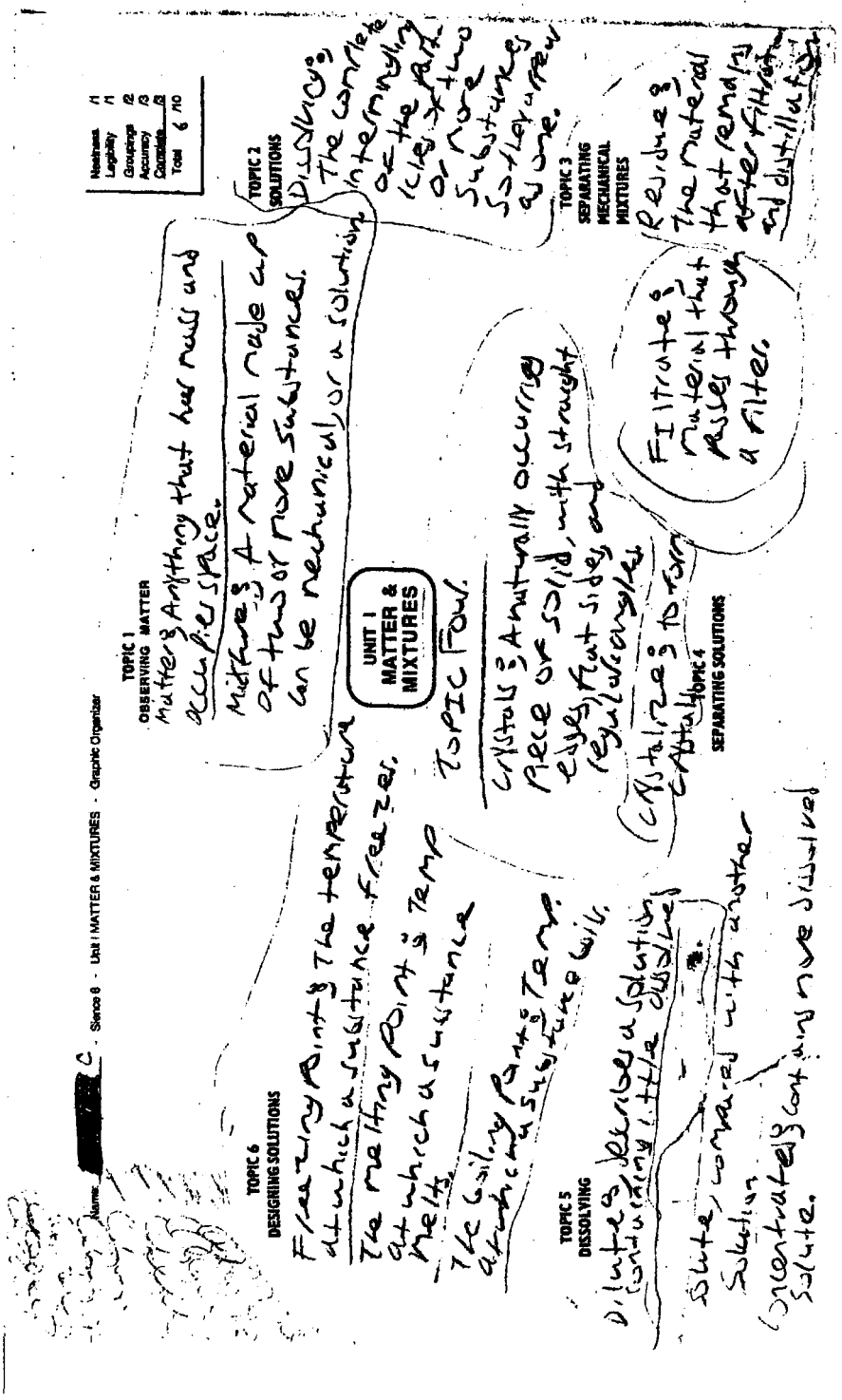
1	2	3
More than 5	1-5 Pictures	No Pictures

___ ___ ___ WRITING & DIAGRAMS

1	2	3
Very Neat		Sloppy

Other Identifying Characteristics:

APPENDIX F
Student C-I



Name: [redacted] C. - Science 8 - Unit II Energy and Machines - Graphic Organizer

Neatness	/1
Legibility	/1
Groupings	/2
Accuracy	/3
Complete	/3
Total	7 /10

UNIT II
ENERGY AND MACHINES

TOPIC 1
WHAT IS A MACHINE

Machine: A device that uses energy to do a useful job.

Energy: the ability to do work

TOPIC 2
LEVERS

Lever: a straight rigid bar that balances on a point

TOPIC 3
THE WHEEL & AXLE

wheel and axle: a large wheel and a wheel on a common axis so that they rotate together.

TOPIC 4
MISCELANEOUS SIMPLE MACHINES

wedge: a V shaped form of inclined plane.

Screw: inclined plane [illegible]

TOPIC 5
EXAMINING MECHANICAL DEVICES

subsystem: one of the working parts that make up a complex machine.

TOPIC 6
USING GEARS

Gear: Pairing: Two or more gears that mesh so that rotary motion and force can be transferred from one gear to another.

TOPIC 7
SOURCES OF ENERGY

Chemical energy: form of energy stored in food and fuels.

Potential energy: stored energy

mechanical energy: associated with mechanical systems.

TOPIC 8
ENERGY EFFICIENCY

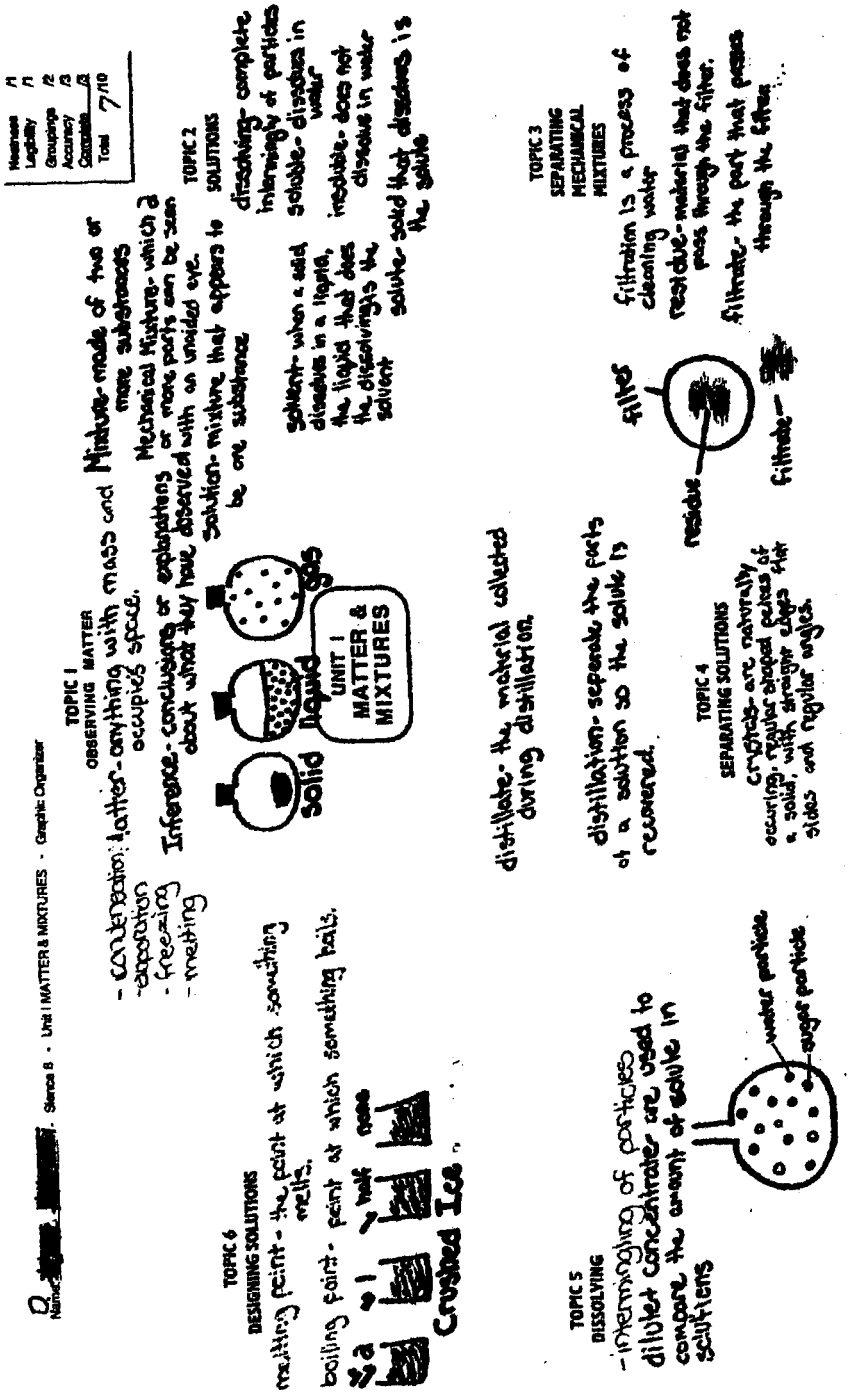
Electrical energy: the energy of moving electrons

Particle.

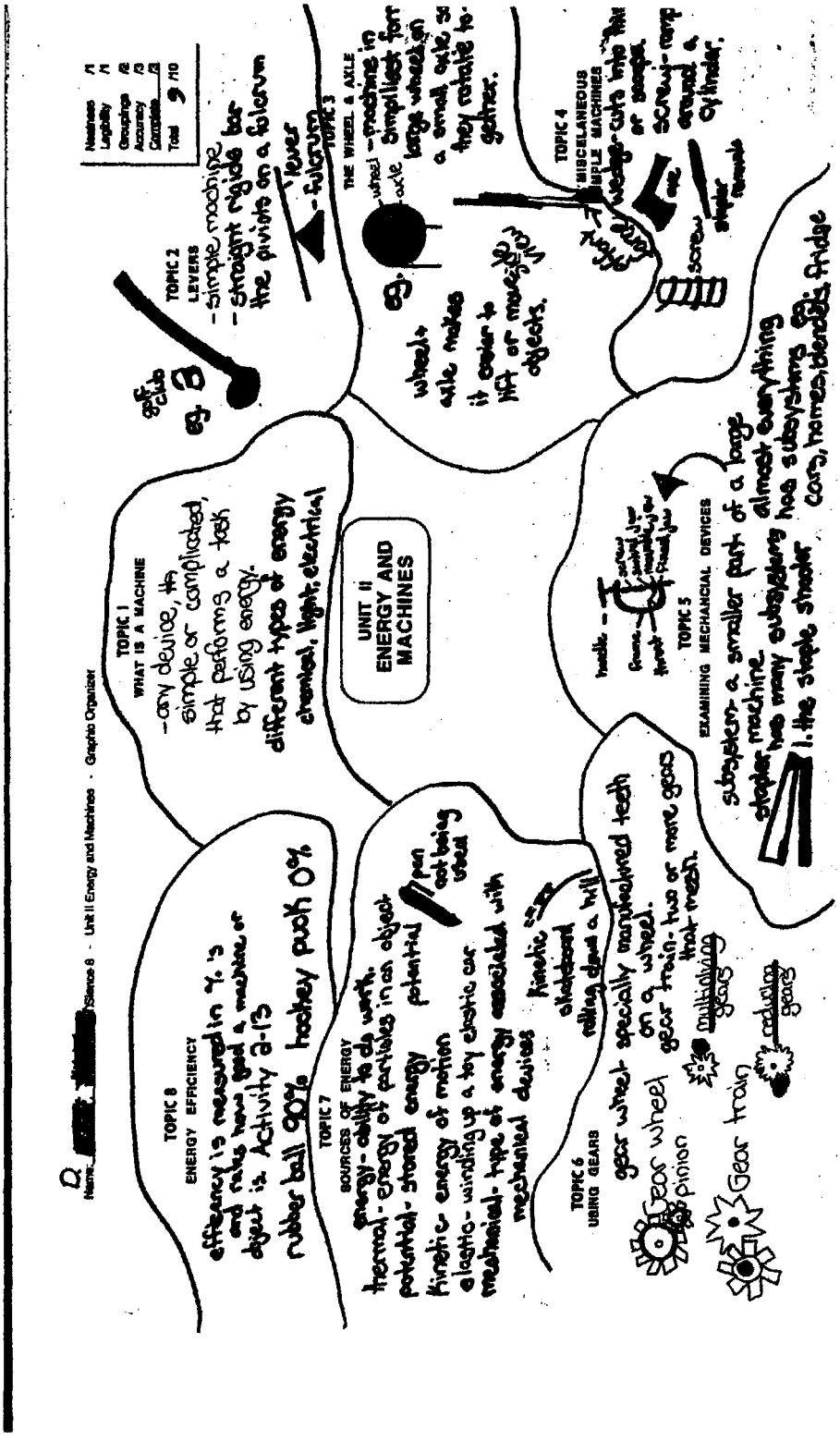
Efficiency: input energy compared to output.

APPENDIX F
Student C-III

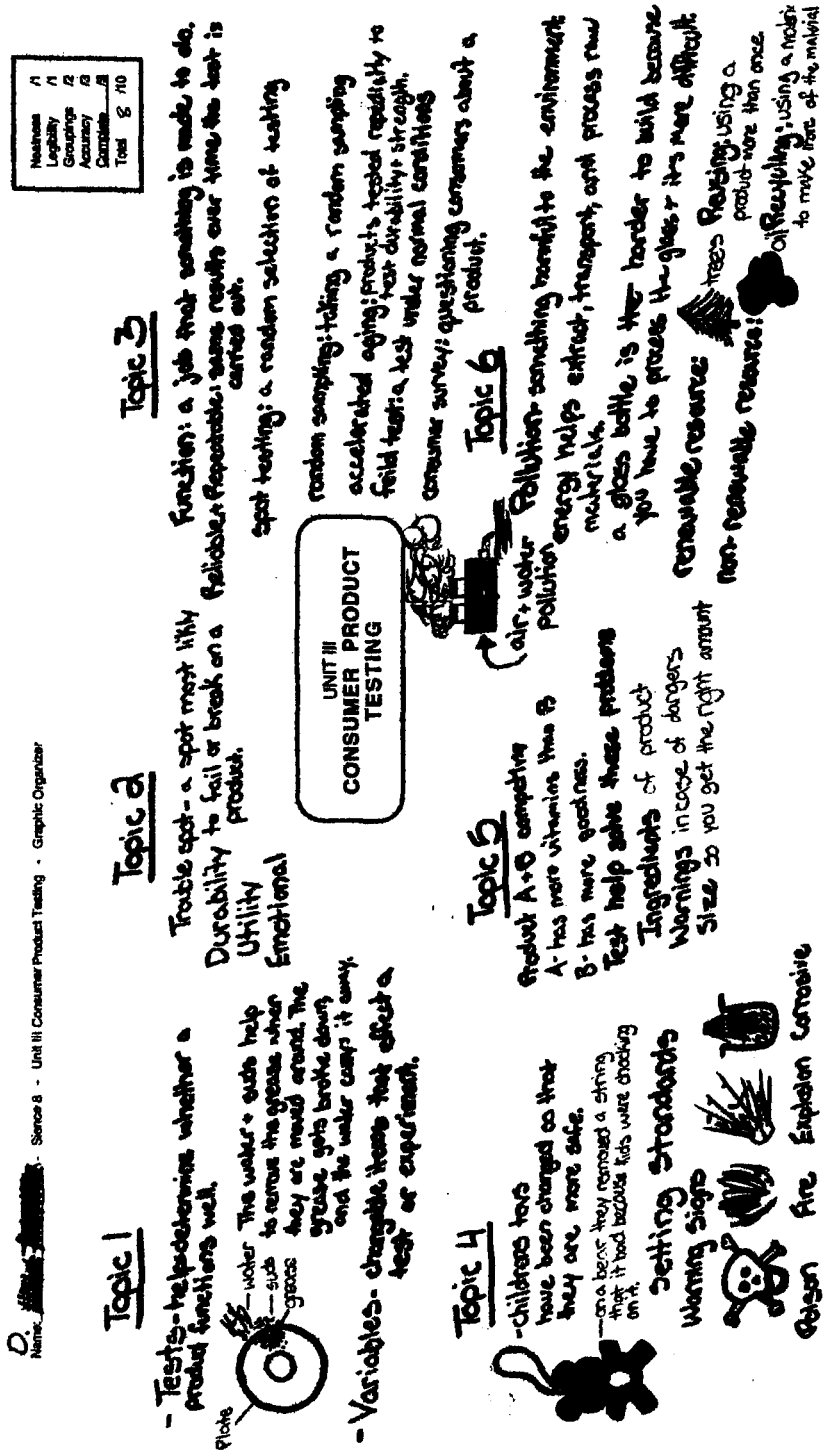
APPENDIX F
Student D-I



APPENDIX F
Student D-II

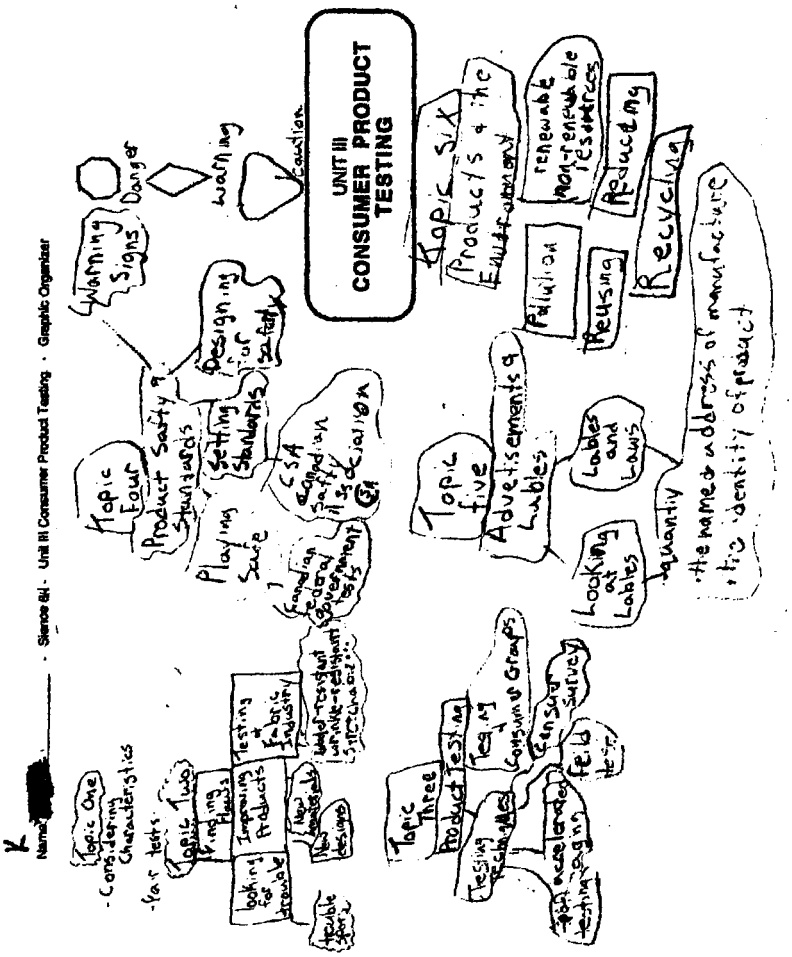
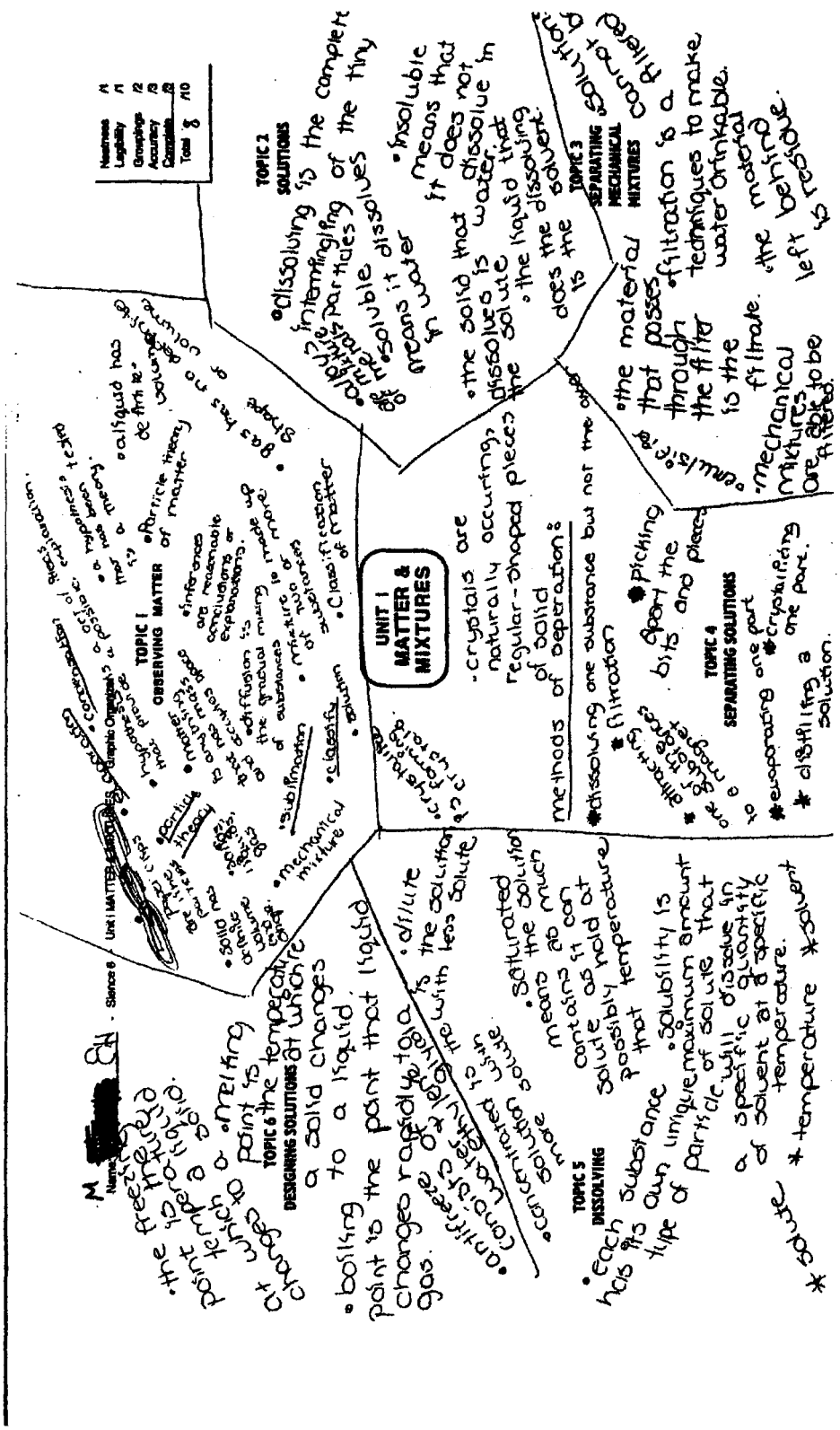


APPENDIX F
Student D-III



APPENDIX F
Student K-I

APPENDIX F
Student K-III



APPENDIX F
Student M-I