# 3. Text Analysis and Pedagogical Summaries: Revisiting Johns and Davies

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Although students are often required to write summaries, they often either lack appropriate strategies for writing effective summaries or are taught relatively inflexible strategies inappropriate to the genre they are reading. This chapter argues that Johns and Davies' (1983) topic types demonstrate how form and content interact and provide useful scaffolding for identifying the macrostructure of a text. Applications for research and pedagogy are described.

Summarizing is a common strategy in reading, writing and talking, both within our second/foreign language classrooms and without. Yet few, if any, course books or manuals give practitioners adequate assistance for teaching academic summarizing to ESL/EFL students or for analyzing and evaluating student summaries from different content areas once they have been written. This example of a set of summary instructions, taken from a popular ESL textbook written in the 1980s, *Approaches to Academic Reading and Writing*, is still quite typical. The authors tell students to:

1. Read the original text carefully.
2. Identify the controlling idea and the relationships among the supporting ideas.
3. Decide which examples are necessary for a clear understanding of the text.
4. Write a first sentence which includes the source of the summary and the controlling idea.
5. Indicate whether the author is uncertain of the facts or expressing personal opinions.
6. Avoid making comments about or adding information to text.
7. Make the summary one-fourth or one-third the length of the original. (1984: 145)

All of these instructions are challenging for second/foreign language students; however, #2 is particularly difficult, we have discovered. Many students find it impossible to identify the controlling idea, or thesis, since in some texts this "idea" is implicit, or in the cases of the scientific texts that we will be discussing, it may not be relevant. For students to be able to discover "the relationships among the supporting ideas" they must understand the macro-structure of the text, the organizational scaffolding upon which the text content is constructed. Few published curricula provide useful assistance in solving the problems that #2 poses for students or in figuring out the other summarizing problems that students face in their academic classes.

### Some Previous Research

We have been analyzing summaries written by college and university students for the past decade or so. (Johns, 1985; Johns & Mayes, 1990) In these efforts, we have attempted to understand the "theoretical formulations of the [text] comprehenders' goals" (Kintsch & van Dijk, 1975: 363) through examining how student summary writers reduce, replicate and distort the original texts. In our studies, the students were given an hour to "summarize in about 100 words" a 500-word passage from their assigned textbooks. Results from our studies (Johns, 1985; Johns & Mayes, 1990) indicated that the student subjects, at both high and low English proficiency levels, did not utilize text organization to assist them in planning and writing their summaries. They appeared to have little understanding of the text macrostructure that would aid them to replicate the organization of the original. The students also seemed to have no pre-conceived plan for integrating text structure and content, for discovering where in the text important ideas are found. Most student summaries concentrated upon information from the first paragraphs of the original text; the others focused almost exclusively upon interesting details. In addition, the students inserted what Kintsch and van Dijk call "distortions" (1975), personal comments about how they liked the reading or what they thought about the topic.

Because our students appeared to make little or no use of original text macrostructures to complete their summaries, they seemed to be unaware of how form and content interact for the purposes of comprehension and replication of text. Instead, students picked up bits and pieces of content to make up the required number of words in their assigned summary, with little or no regard for importance or the structural scaffolding. For these reasons, we turned to Johns and Davies (1983), "Text as a vehicle for information: The classroom use of written text in teaching reading in a foreign language" (1983), in our most recent research project (Paz, 1995a). Their study is an extremely useful illustration of the interaction of form and content, which has been of considerable assistance to us in developing our own pedagogies. In this publication, Tim Johns and Florence Davies discuss their extensive research into the interrelationships between text macrostructure, function, and content in secondary-school science course books. By examining a large number of course books, these authors were able to identify several repeated text structures, twelve "topic types" in which "categories of information co-occur" (p. 5):

**Figure I**

| *Function Type* | *Information Structure Constituents* |
|---|---|
| **Physical structure** | Part → location + Property + Function |
| **Process** | State or Form of Object/Material → Location + Time or Stage + Instrument or Agent + Property or Structure + Action |
| **Characteristics** | Defining Features or Attributes → Tests Measures of Data + Exemplar or Group |
| **Mechanism** | Physical Structure → Action + Object/Material |
| **Theory** | Hypothesis → Context + Text of Results + Interpretation |
| **Principle** | Law or Principle → Conditions + Instances + Tests/Measures + Application of Principle |
| **Force** | Source or Composition → Conditions + Instances + Tests + Effects |
| **Instruction** | Step or Procedure → Materials + Apparatus or Measure + Caution or Condition + Result + Interpretation |
| **Social Structure** | Member or Group → Location + Conditions + Role or Responsibility + Assets or Outcomes |
| **State/Situation** | Participants → Conditions + Location (Time & Place) + Effects + Event or Innovation |
| **Adaptation** | Species/Exemplar → Environmental Conditions/Effects + Adaptive Feature/Mechanism + Function |
| **System/Production** | Producer or Production System → Product + Location + Requirement + Distribution |

*Notes:*

Constituents immediately to the LEFT of the arrow are OBLIGATORY and can be regarded as constants. Constituents to the RIGHT of the arrow are optional. They can be regarded as the variables which define the obligatory constituents. Conditions for optionality are assumed, but no predictions are made about what these are. + indicates "*and*" not order. The list given here is not assumed to be either exhaustive or definitive.

From *Toward a classroom based methodology for identifying information structures in text*, J.Davies (1983).

Johns and Davies' text "topic types" relate specifically to the functions that texts serve within scientific cultures. The titles given to these categories refer to such functions as the (description of) **a physical structure**, the [narration of] **a natural process**, the [explanation of] **a scientific principle** and so on. For the purposes of this paper, then, we will rename Johns and Davies' "topic types" as "function types," because, in fact, these categories refer to the purposes that these text categories serve within scientific discourses.

Noting the interrelationship between text macrostructure and function represents the first part of these authors' theory of discourses within scientific course books. The twelve repeated function types in science [Figure 1] provide for practitioners a taxonomy of text elements that is very useful for both research and pedagogy. The second element in Johns and Davies' theory extends to the interrelationships among function, structure, and co-occurring topics. For each function type, the authors have identified certain "information structure constituents" that repeatedly co-appear within that category of text. As can be seen in Figure 1, the text organization of each function type elicits co-occurring "obligatory" and "optional" topic categories which provide the skeleton, or template, for the text macrostructure. The authors argue that within each of these function types (*physical structure, process, characteristics, mechanism* and so on), the topic categories may be repeated several times, not necessarily in consecutive order. Optional topics may or may not be included, depending upon a number of factors such as importance to the text, the use of accompanying visual elements, or the readers' needs and backgrounds.

Like Johns and Davies, we must recognize that in science and related fields, the exploitation of non-linear features such as visual representations, charts and graphs, is fully as important to the reader as the text itself. Thus, when we are considering the analysis of a written text in the sciences, we must also consider the visual representations that accompany it. Johns and Davies argue for the importance of these visual elements, and a number of their suggested ESL/EFL classroom exercises deal with the interaction of written text and visuals. For example, they ask students to label a physical structure diagram with the aid of the text before students are asked to complete other text-bound exercises.

Thus, in the exercises presented in their 1983 article, Johns and Davies tell students first to use this physical structure text to complete the labeling of an illustration of a tooth:

> A tooth has three regions: the crown is the part projecting above the gum, the neck is embedded in the soft gum and the root is out of sight, anchoring the tooth in its bony socket. Inside the tooth is a fairly hard material which contains some living tissues. This is the dentine. The dentine cannot withstand wear, so in the crown and neck it is covered with a substance called cement, which helps to fix the tooth in its socket. Inside the dentine, in the centre of the tooth is a hollow pulp cavity containing nerves, a small artery and a small vein.[1]

Students work in groups to complete the labeling of a diagram of the tooth structure, thus enabling them to have a visual representation of a tooth before completing additional reading and summarizing exercises. In the next exercise, the student groups analyze the text macro-structure, the interrelationship of form, of co-occurring topics and of language. Rather than asking them to "summarize" or to "identify the controlling ideas and relationships among supporting ideas," Johns and Davies give students a chart to complete in which co-occurring topics are listed. The chart looks like this:

**Figure 2:**

| *Part(s)* | *Location(s)* | *Properties* | *Functions* |
|---|---|---|---|
| | | | |

Under each category, students list their findings from the text. When they are finished, they have an organizational scaffolding of the text. In this particular tooth structure text, Johns and Davies' students found about thirty mentions of "parts," the obligatory element in the *physical structure* text. The nonobligatory elements, location, property and function, sometimes co-occur with the obligatory "part" and sometimes they do not. After students complete the diagram of the tooth and the text chart (Figure 2), the original reading is taken from them. They then jointly construct a summary based solely upon the diagram and chart.

This succession of exercises suggested by Johns and Davies provides for students the kind of summarizing support that will help them to approach different types of texts in the sciences. It assists them in understanding the relationships between visual and textual elements and the important interactions of function, structure, and content. It ensures that they will be precise in finding the correct terms and the appropriate co-occurring relationships among the topics in the text. The Johns and Davies' exercises also assist students in text differentiation, in realizing that all texts cannot be read or summarized in the same way because, in fact, they serve different functions and are therefore variously organized.

What students and teachers who use the Johns and Davies model have found is that many of the general principles for text summary, cited in the first part of this paper, do not apply for science course books. Students do not have to read the whole text before they begin to analyze it. (#1 in the list of general instructions.) Instead, students can begin to complete the diagram and the text analysis chart while they read. This keeps them occupied, interested, and involved in understanding the priorities in the text. For many science texts, there are no "controlling ideas" (#2) as there might be in an argumentative essay. Thus, the concept of controlling idea can be ignored, at least for texts within certain scientific categories. "Examples" (#3) is not an appropriate term for what students record from the text. Instead, they are finding co-occurring topics, those content items that are essential to text understanding. Writing a first sentence "which includes the source of the summary and the controlling idea" (#4) may also be irrelevant here. In the tooth structure text, students can begin with the first "part"; they do not need to write a sentence such as "The tooth has many parts." In fact, such a sentence might sound unscientific. Personal opinions (#5) do not play an explicit role in descriptions of physical structures in course books. Authors of these texts do not say "I think that the tooth has this type of structure." By the time this information appears in course books, the authors are quite sure about the facts they are presenting (See, e.g., Myers, 1992). Thus, we should teach students to vary summarizing strategies depending upon text function and content.

In short, our previous research has found that students have considerable difficulties with general summary instructions. Like other researchers (Nelson, *et al*, 1992; Perez, 1990), we discovered that students bring to their summarizing tasks few, if any, strategies for understanding the relationships between function, structure, and content. One very useful set of guidelines is the work of Johns and Davies (1983), which assists students in analyzing and summarizing texts, particularly in the sciences.

**An Example of Applications of Functional Types**

An example from some of our recent work illustrates how *functional types* can inform both teaching and research. In our most recent research in this area, thirteen-year-old secondary school students, all of whom are English/Spanish bilinguals studying in the same English and science classes (discussed in Paz, 1995a) were divided into two groups of 10 ("high" and "low" English proficient), based upon both their standardized test scores and the grades that they had attained in their English classes. The two reading texts[2] chosen for summary were taken from their science course book, Jantzen & Michel's *Life Science* (1986). One reading narrated a natural *process*, and the other was a description of a *physical structure*. The students were given one hour to read each original course book text and write and revise a summary of between 95 and 105 words. To provide a basis for comparison, we also asked a group of English and science teachers within the students' school to summarize the same course book readings.[3]

We then analyzed the original reading texts from the science course books into Idea Units [IUs] (Kroll, 1977), a taxonomy based primarily upon main clauses (See Appendix I for the IU taxonomy; See Appendix II through VI for analyses of physical structure texts.) Then the IUs from each of the texts were separated according to "information structure constituents," or topics, characteristic of the function type represented. Thus, the IUs in the *process* reading were analyzed into "state or form of object/material," "location," "time or state," "instrument or agent," "property of structure" and "action".[4] The IUs from the *physical structure* text were classified according to "structure," "location," "property/attribute," and "function," as shown in Appendix III. As is the case in many course books written for students, the discourse in the chosen readings was not pure; there are other functions being carried out in the same block of discourse for a number of rhetorical reasons.[5] In the *physical structure* text, for example, the discourse relating to the physical structure function type begins with IU #11. Other, introductory information is included in the first 10 sentences of the reading. (See Appendix II) Appendix III is dedicated solely to this functional analysis. It shows which of the major constituents for *physical structure* were represented in each of the IUs from #11-#36 in the text taken from the students' course book.

When the IU functional analysis of the original readings from the course book was completed, two researchers then analyzed each of the student and expert (teacher) summaries, first dividing them into IUs, and then dividing the IUs into the constituent structures or topics as had been done with the original readings. What was discovered, not surprisingly, is that the expert summaries completed by the teachers contained the essential "information structure constituents" for each functional text. The "experts" used the text macrostructure, realized in the information structure constituents, to construct their summaries, ignoring much of the introductory, non-scientific material in the first part of the readings. The teachers mentioned (repeatedly) those co-occurring elements that Johns and Davies argue are essential to the relationship between content and organization in science course book discourses. Appendix IV shows one of the teacher summaries. This expert writer devotes only one sentence to a "controlling idea" that summarizes the first part of the reading. Then she devotes the remainder of the summary to the major constituent elements of the physical structure text. Appendix V shows the analysis of IUs from the expert's summary and the breakdown of these IUs into constituent elements. Appendix VII breaks a poor student's text into IUs, and it shows that the text not only includes fewer of the constituent elements than did the expert text, it also includes inventions and distortions.

As in our previous studies; we found that unlike the teacher/experts, students had few, if any strategies for summarizing texts. This was particularly evident in their summaries of the physical structure texts. (See Appendix VI) Our statistical test[6] showed that both low- and high-English proficient students' physical structure summaries contained less than 50% of the information structure constituents found in the teacher summaries. Students at both proficiency levels seemed to lack the schemata necessary to identify the text macrostructure and to produce summaries based upon the predictable information structure constituents as identified by Johns and Davies. Instead, they produced a significant number of IUs from topics and functions that were not found in the Johns and Davies' taxonomy, that were not essential to the gist of the text. In analyzing the expert summary protocols, on the other hand, we found that the vast majority of the IUs replicated from the readings were parallel to the information structure constituents predicted to be characteristic of that function type.

A further discussion of our findings may explain some of the difficulties that the students faced. As was mentioned earlier, the *physical structure* text, which students found to be most difficult, began with information that was written to interest the readers but was not essential to the description of the structure represented. The student summaries for this text often included Idea Units #5, and #6, which read "Cells contain many small parts. Each part seems to help a cell do a certain job." This is an interesting finding because students may believe that it is necessary in all summaries to have a thesis or controlling idea, and the only controlling idea that they could find was contained in these two sentences. In both of the texts, the *physical structure* and *process*, the 13-year-old bilingual students seemed to be attracted to interesting ideas rather than to the core "sciences." They included in their summaries the information that the text writers had written to involve them in the reading. They also tended to include those ordinary, non-scientific words and phrases with which they felt comfortable. A third student characteristic, also found in our earlier studies, is that they tended to replicate IUs from the first part of the reading, ignoring much of the final portions which often included the essential constituents. The students completed their 100-word summary requirement and stopped, ignoring the text structure and other clues for effective text summarizing.

The differences between the expert (teacher) and the student summaries were clear: the teachers disregarded the familiar words and background information that were inserted into the first sections of the reading text to make it attractive to young readers. The students, with few strategies for completing scientific texts, tended to take their IUs from the initial, non-essential material or to draw from what interested them in the reading. The teachers appeared to have a schema for the function type and a strategy for completing their summaries; they concentrated upon the essential elements of the function type, as outlined by Johns and Davies. The students, on the other hand, appeared to do the assignment without schemata for the function type or for what is important in science texts. These findings parallel our earlier studies (Johns, 1985; Johns & Mayes, 1990) of older students and underscore the importance of the interaction of theory and practice and the careful teaching of reading and summarizing.

### Implications for Discourse Analysis and Pedagogy

How do we improve student summarizing? How do we assist students in understanding text function and the information structure constituents that co-occur in identified function types? These are important questions in the teaching of reading, of summarizing, and of writing and are essential to our students' attainment of academic literacy. We provide here a few suggestions, based upon our research and reading.

First of all, we believe that it is important to teach the interaction of language, text structure, and function in all of our reading and writing classes. In this effort, we can consult the work being done in Australian genre-based pedagogies. In Australia[7], the teaching of "genres" is directly related to the "jobs" that texts are said to do (Richardson, 1994). For example, Derewianka (1990) encourages children to recognize the genre called "A Recount" as having orientations and a series of events, an approach which provides a structure or a scaffolding upon which they can develop a summary. If students are to think about "recounts" as having orientations and series of events, they are already on their way to doing some effective "tree-trimming" (Rumelhart, 1977) for summarization, since they will look for the orientation and the specific events when organizing their summaries.[8]

However, in our view, the Australian pedagogies outlined in Derewianka and elsewhere might be enhanced by the work of Johns and Davies. Our students at every proficiency level are fairly good at reproducing narratives (and thus, recounts) in summary (Paz, 1995b); however, when texts become more complex, students need additional assistance learning what is important to text structure and content.

The Johns and Davies theories about science course books can assist us in curriculum development and teaching at a number of levels. First, they can help us to select and analyze texts for student reading and summarization as found in the appendices of this paper. Completing our own analyses enables us to understand more fully the relationships between text function, content, and macro-structure and to select appropriate texts for summarizing. With the text function-type list, we can recognize blocks of discourse, in course books and elsewhere, that serve an identified purpose. Once we have decided upon a function type, such as *instruction* or *description of a physical structure*, we can give students repeated reading and discussion practice to assist them in transferring their strategies for reading one text to other texts of the same function type.

Johns and Davies suggest that we begin our lessons by dividing the students into groups, providing each group with the same text from a function type, with a diagram or illustration to complete, and with a chart listing the information structure constituents of that function. We have found that students at all levels become very involved in completing the diagrams. They are often much better at relating words to visual elements than they are at paraphrasing or summarizing. When our students are given the constituent chart [See Figure 2], they begin arguing about the words or phrases that fit into the information structure "slots" (e.g., Part, Location, Property, Function for a *Physical Structure Text*) and using the grammar of the passage to make their arguments. They find, for example, that the "parts" in a *physical structure* text are nouns and are generally preceded by definite or indefinite articles. Location topics are often found in prepositional phrases, and properties are often found in adjectives. Thus, as the students work on their analyses, they also become increasingly comfortable with the syntax and morphology of the sentences they are reading. When the analyses are completed, one group puts its findings from their completed chart on the board and the class negotiates any differences between each group's charts. We have been using these group activities in our classes since we first discovered Johns and Davies' approach,[9] and we have found them to be excellent, for directed reading, for summarizing—and for writing.

As we noted earlier, when we ask students to summarize, we take the original text from them, and they use their diagrams and constituent charts to create their summaries, an exercise that requires them to restore and paraphrase in complete, grammatical sentences. Because the text they recreate is often too long for a summary of the original, they are asked to "tree trim," to make decisions about what particular co-occurring groups of "slots" are most important for the gist of the text. Sometimes they choose not to trim the text substantially (as is often the case when we use "tooth" structure"), but there are other times when such trimming is both possible and useful.

Although Johns and Davis' work has been tremendously useful in our research and our approaches to teaching text summarizing, we are indebted to others, as well. David Rumelhart (1977, 1980), Patricia Carrell (1983) and others who work in artificial intelligence and reading argue that we store in our schemata, or prior knowledge, particular text macrostructures which we "instantiate" when we confront a new text which appears to be organized in the same way. Carrell has been particularly influential in arguing that we must prepare students for both the content and the form in text readings. Another important influence upon our work has been Michael Hoey (1981, 1986) and his work on *problem/solution* (PS) texts. Like Johns and Davies, Hoey argues that these texts have certain co-occurring content slots, or "constituent structures," particular topics that readers expect to be discussed in a problem solution discourse. These co-occurring elements are "the problem" itself, "the causes" for the problem, suggested "solutions" and an "evaluation" of the various solution possibilities. All constituents but the final one, "evaluation," appear to be obligatory but, like the Johns and Davies' constituents, they do not necessarily appear in a particular order. The advantage of the Hoey text theory is that problem/solution can be applied across content areas or disciplines, within academic contexts and elsewhere.

One of the authors of this chapter, Ann Johns, has been using the Hoey functional taxonomy for many years: to analyze texts for their structure, to teach summarizing (1988), and to assist students in revising their own problem-solution texts to meet reader expectations (1986). In preparing to summarize, students are asked to read a problem-solution text and to copy, or paraphrase, each of the "slots" that Hoey identifies. What they discover, of course, is that the particular topics that the slots represent do not necessary come in order. The "problem" can be mentioned at the end, for example, and the causes at the beginning (Johns, 1988). They also discover that one topic may be mentioned more than once; for example, several problems can be identified that stem from one cause (e.g. *cause* = water pollution; *problems*: deaths of fish and fowl; lack of potable water for humans; uninhabitable living areas for fauna and humans). However, if they organize their text analysis by "slots," students will be able to trim the original text successfully and write a summary. By the same token, if students diagram the problem-solution texts they plan to write using the Hoey schema, they will be more successful in keeping track of text organization and content.

## Conclusion

In our studies carried out over the past ten years, we have consistently found that students have little knowledge of text functions or macrostructures to guide them in text reading or summary, and that they have few, if any, strategies for summarizing texts. We have found the Johns and Davies'(1983) work to be the best guide for analysis and assignment of science readings, and we advocate the teaching of this taxonomy of function types to science students. We have also found the more general function type, problem-solution, discussed by Hoey (1986), to be useful in many contexts, both for reading and for writing. Both analyses show explicitly the relationships among form, content, and function within texts.

We are surprised that although the theories and approaches discussed here appeared in the 1980s, they have not made significant inroads into curricula or course books in ESL/EFL classes. Students are still being given too many narratives to read and summarize, and when they are asked to write a summary of other function types, they are not adequately instructed. As we noted, the typical instructions that appear at the beginning of this chapter are inappropriate for reading and summarization in many contexts.

We hope that this discussion of summarizing, drawing from the work of Johns and Davies, and Hoey, will lead to a broader use of theoretically-grounded research and pedagogical approaches.

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**Notes:**

1. Taken from Evington, E.J. & O.F. Moore. (1971) *Human Biology and Hygiene*. London: Routledge and Kegan Paul.
2. 301 and 307 words, respectively
3. We had used the same methodology in our earlier work (Johns, 1986; Johns & Mayes, 1990)
4. The process text included IUs not related to the function type such as definitions and partial descriptions of other processes. These were not analyzed for the study.
5. One reason is to interest students in the material. Often textbooks begin with stories that will entice students rather than with the "hard" scientific information.

6. Fisher's Exact Two-tailed Test
7. Specifically in New South Wales.
8. Rumelhart argues that summarizing is a "tree-trimming" process in which the non-essential elements are cut off.
9. For Ann Johns, this was in China in 1981, when Tim Johns and Florence Davies presented this paper to her teacher trainees.

## Appendix I
### Kroll's Idea Units

1. A main clause is counted as one idea unit including (when present) a direct object, an adverbial element and a mark of subordination.
2. Full relative and adverbial clauses are counted as one idea unit.
3. Phrases which occur in sentence initial position followed by a comma or phrases which are set off from the sentence with commas are counted as separate idea units.
4. Reduced clauses in which a subordinator is followed by a non-finite verb are one idea unit.
5. Post-nominal-ing phrases used as modifiers are counted as one idea unit.
6. Other types of elements counted as individual idea units are :
   a. Absolutes: e.g., as microscopes improved, it became easier to look inside a cell.
   b. Appositives: A saclike lining, called the cell membrane, surrounds the cell.

Adapted from Kroll (1977: 90)

## Appendix II
### Idea Units of a Physical Structure Text

Animal Cells

(1 - Early microscopes showed the outer edge of a cell clearly.) (2 - As microscopes improved) (3 - it became easier to look inside a cell.) (4 - Microscopes today show) ( 5 - that cells contain many small parts.) (6 - Each part seems to help a cell do a certain job.) (7 - You have seen) (8 - that animal cells and plant cells seem very different.) (9 - Yet most cells of animals and plants have many similar parts.)

Look carefully at Figure 2-4. (10 - It shows some of the parts that are found in the cells of animals.) (11 - A saclike lining) (12 - called the cell membrane) (13 - surrounds the cell.) (14 - The cell membrane holds the insides of a cell together.) (15 - Certain substances enter and leave a cell) (16 - by passing through the cell membrane.) (17 - The cell membrane controls the in-and-out flow of these substances.)

Look (18 - inside the cell membrane) in Figure 2-4. (19 - Most of the cell is filled with a jellylike fluid called cytoplasm.) (20 - Scattered through the cytoplasm are many parts of different sizes and shapes.)

(21 - Most likely the part you will notice first is the large, round nucleus.) (22 - The nucleus (pl. nuclei) is the control center for the cell's activities.) (23 - It directs everything the cell does.) (24 - Structures inside the nucleus called chromosomes) (25 - store the directions for all cell activities.)

(26 - The nucleus is surrounded by its own membrane.) (27 - This membrane separates the nucleus from the cytoplasm.) (28 - It seems to control the flow of substances in and out of the nucleus.)

(29 - Outside the nucleus, there is a capsule-shaped body, a mitochondrion.) (30 - A mitochondrion helps to supply energy for the cell.) (31 - Mitochondria release energy from substances that enter the cell.)

(32 - Look outside the nucleus) (33 - for winding channels called the endoplasmic reticulum.) (34 - Some scientists believe) (35 - these channels help transport materials throughout a cell.) (36 - Some channels are dotted with tiny cell parts called ribosomes.) (37 - Ribosomes produce substances needed for growth and other activities.)

***Note:*** The number preceding text represents the idea unit number assigned to that text.

*(continued overleaf)*

## Appendix III
## Matrix for Physical Structure Text

| *Part* | *Location* | *Property/Attribute* | *Function* |
|---|---|---|---|
| (11) A saclike lining- | | (11) saclike-* (12) called the cell membrane- | |
| (12) cell membrane-* | (11) surrounds the cell- | | |
| (11) the cell-* | | | |
| (13) The cell membrane- | | | (13) holds the insides of a cell together- |
| (14) Certain substances- | | | (14) enter and leave the cell- |
| (15) cell membrane-* | (15) through the cell membrane | | (15) by passing through the cell membrane- |
| (16) The cell membrane | | | (16) controls the in-and-out flow of these substances- |
| (16) these substances-* | | | |
| (18) Most of the cell | | (18) is filled with a jellylike fluid called cytoplasm- | |
| (18) cytoplasm* | (18) Most of the cell is filled | (18) jellylike fluid* | |
| (19) many parts | (19) Scattered through the cytoplasm are | (19) of many different sizes and shapes. | |
| | | (20) …a large, round | |
| (20) nucleus | | | |
| (21) The nucleus | | | (21) is the control center for the cell's activities- |

| *Part* | *Location* | *Property/Attribute* | *Function* |
|---|---|---|---|
| (22) It | | | (22) directs everything the cell does |
| (23) Structures | (23) inside the nucleus | (23) called chromosomes- | |
| (23) chromosomes* | | | (24) store the directions for all cell activities- |
| (25) The nucleus | | (25) is surrounded by its own membrane | |
| (25) membrane* | (25) nucleus is surrounded by* | | |
| (26) This membrane | | | (26) separates the nucleus from the cytoplasm- |
| (26) the nucleus* | | | |
| (26) the cytoplasm* | | | |
| (27) It | | | (27) seems to control the flow of substances in and out of the nucleus* |
| (27) the nucleus-* | (27) in and out of the nucleus-* | | |
| | (28) Outside the nucleus there is | | |
| (28) a capsule-shaped body, a mitochondrion | | (28) capsule shaped-* | |
| (29) A mitochondrion- | | | (29) helps to supply energy for the cell- |
| (29) the cell-* | | | |
| (30) Mitochondria- | | | (30) release energy from substances that enter the cell- |
| (30) substances-* | | (30) that enter the cell-* | |
| (30) the cell-* | | | |
| | (31) (Look) outside the nucleus- | | |
| (31) the nucleus-* | | | |
| (32) (for) winding channels | | (32) winding-* | |
| (32) endoplasmic reticulum-* | | (32) called the endoplasmic reticulum- | |

| Part | Location | Property | Function |
|---|---|---|---|
| (34) these channels | | | (34) help transport materials throughout a cell- |
| (34) materials-* | (34) throughout a cell-* | | |
| (34) a cell-* | | | |
| (35) Some channels | | (35) are dotted with tiny cell parts called ribosomes | |
| (35) parts-* | | (35) tiny-* | |
| (35) ribosomes-* | | | |
| (36) Ribosomes | | | (36) produce substances needed for growth and other activities |
| (36) substances* | | (36) needed for growth and other activities* | |

*Notes:*

1. indicates end of surface structure string.
2. *marks items which occur in more than one slot.
3. Idea units 1-10, 17 and 33 were not included in the matrix because they did not fit any of the major constituents slots.
4. Numbers in the parenthesis preceding text, represent the idea unit number assigned to the text.(See Appendix III).

## Appendix IV

**Expert Summary:**

"Animal Cells"

Cells of animals and plants are similar in many ways. Cells have linings called membranes, which control substances entering and leaving the cell. Cells are filled with a jellylike fluid called cytoplasm. The nucleus, with its own membrane to separate it from the cytoplasm, is a large round control center for the cell. Inside the nucleus are chromosomes, which contain directions for all the activities of the cell.

Outside the nucleus are the mitochondria, capsule-shaped energy suppliers for the cell. Endoplasmic reticulum are channels that aide

transportation of materials within the cell. Some contain tiny ribosomes that produce substances needed for activities, including growth.
*(105 words)*

## Appendix V

### Idea Unit

I.U.#9 - Cells of animals are similar in many ways.
I.U.#12 - Cells have linings called membranes,
I.U.#16 - which control substances entering and leaving the cell.
I.U.#18 - Cells are filled with a jellylike fluid called cytoplasm.
I.U.#25 - The nucleus, with its own membrane
I.U.#26 - to separate it from the cytoplasm,
I.U.#20 - is a large round
I.U.#21 - control center for the cell.
I.U.#23 - Inside the nucleus are chromosomes,
I.U.#24 - which contain directions for all the activities of the cell.
I.U.#28 - Outside the nucleus are the mitochondria, capsule-shaped
I.U.#29 - energy suppliers for the cell.
I.U.#32 - Endoplasmic reticulum are channels
I.U.#34 - that aide transportation of materials within the cell.
I.U.#35 - Some contain tiny ribosomes
I.U.#36 - that produce substances needed for activities, including growth.

| Part | Location | Property | Function |
|---|---|---|---|
| (12) Cells | | (12) have things called membranes- | |
| (12) membranes-* | | | |
| | | | (16) which control substances entering and leaving the cell |
| (16) substances* | | (16) entering and leaving the cell-* | |
| (16) the cell-* | | | |
| (18) Cells | | are filled with a jellylike fluid | |

| *Part* | *Location* | *Property* | *Function* |
|---|---|---|---|
| | | called | |
| (18) cytoplasm* | | cytoplasm-* | |
| (25) The nucleus | | (25) with its own | |
| (25) membrane-* | | membrane- | (26) to separate it |
| (26) cytoplasm | | (20) is a large | from the |
| | | round- | cytoplasm- |
| (21) control | | | (21) control center |
| center* | | | for the cell- |
| (21) the cell* | | | |
| | (23) Inside the | | |
| (23) the nucleus* | nucleus are | | |
| (23) chromosomes | | | (24) which contain |
| (28) the nucleus* | | | directions for |
| | (28) Outside the | | all the |
| | nucleus are | | activities of |
| | | | the cell- |
| (28) mitochondria | | (28) capsule | (29) energy |
| (29) the cell* | | shaped- | suppliers for |
| (32) Endoplasmic | | (32) are channels- | the cell- |
| reticulum | | | (34) that aide |
| (34) materials* | (34) within the | | transportation |
| | cell-* | | of materials |
| | | | within the |
| | | | cell- |
| (35) Some | | | (35) contain tiny |
| | | | ribosomes- |
| (35) ribosomes* | | (35) tiny* | (36) that produce |
| (36) substances | | | substances |
| | | | needed for |
| | | | activities, |
| | | | including |
| | | | growth- |

# Appendix VI

## Low Proficiency Student Text

A cell is a little thin that helps the body to move it can see from a microscope. A cell have many parts it helps the cell work. The cell of an animal have a cell membrane that surrounds the cell.

The membrane cell holds the inside of the cell... Some cells are filled with jellylike is a fluid called cytoplasm. Cytoplasm are different sizes and shapes. Nucleus is a large part of a cell it have a black round thin. The nucleus in the control center the control the cell. The nucleus is surrounded by his own membrane.

## Appendix VII

**Idea Units of a Low Proficiency Student**

INVENTION - A cell is a little thin that helps the body to move
I.U.#1 - it can see from a microscope.
I.U.#5 - A cell have many parts
I.U.#6 - it helps the cell work.
I.U.#7 - The cell of an animal have
I.U.#12 - a cell membrane
I.U.#11 - that surrounds the cell
I.U.#13 - The membrane cell holds the inside of the cell.
I.U.#18 - Some cells are filled with jellylike is a fluid called cytoplasm.
DISTORTION (D1) - Cytoplasm are different sizes and shapes.
I.U.#20 - Nucleus is a large part of a cell
DISTORTION (D2) - it have a black round thin.
I.U.#21 - The nucleus in the control center the control the cell.
I.U.#25 - The nucleus is surrounded by his own membrane.

| *Part* | *Location* | *Structure* | *Function* |
|---|---|---|---|
| (12) a cell membrane | (11) that surrounds the cell- | | |
| (11) the cell-* | | | |
| (13) The membrane cell | | | (13) holds the inside of the cell- |
| (18) Some cell | | | |
| (18) fluid* | | (18) are filled with jellylike | |
| (18) cytoplasm* | | is a fluid called cytoplasm | |

| Part | Location | Structure | Function |
|---|---|---|---|
| (D1) Cytoplasm | | (D1) are different sizes and shapes- | |
| (20) Nucleus | | (20) is a large part of a cell- | |
| (20) a cell* | | (D2) have a black round thin- | |
| (D2) it | | | |
| (21) The nucleus | (21) in the control center | | (21) the control the cell- |
| (25) The nucleus | | (25) is surrounded by his own membrane- | |
| (25) membrane -* | | | |

(The invention (I) and idea units 1, 5, 6, and 7 were not included in the matrix since they do not fit one of the above major constituent function slots).