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Strategy Training in the Use of Graphic Organizers and Its Effect on Learning from Instructional Prose

Paul Chapman

A Thesis

in

The Department

of

Education

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for the Degree of Master of Arts at
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ABSTRACT

Strategy Training In The Use Of Graphic Organizers and Its Effect On Learning From Instructional Prose

Paul Chapman

This study investigated the hypothesized beneficial effect of training young readers to construct and use graphic organizers as a strategy to facilitate recognition and recall of an instructional prose text.

Grade four and five students (n = 97) attending two elementary schools in Pointe Claire were randomly assigned to four groups. Two trained treatment groups were given a graphic organizer modelled on the Barron (passive) and Alvermann-Boothby (interactive) types respectively. The third trained group and the control subjects received no organizer. The prose passage was on air pollution. Two posttests, delayed 24 hours and three weeks, consisted of free recall plus a three-part recognition/recall protocol comprising multiple-choice, true-or-false and short-answer measures. The free recall was scored by idea units, with interrater consensus resolving differences.

An analysis of covariance, with the covariate of reading ability measured prior to training, indicated that no significant benefit was attributable to either type of graphic organizer, nor was any significant interaction detected among effects. Results were discussed with respect to "live" classroom training and suggestions for replication advanced.

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CHAPTER ONE

RATIONALE

Children have to develop skills needed to cope with the daily influx of information and ideas. Whereas school programme content is often fairly well defined, the type of skills on which learning depends are, equally often, assumed simply to grow, like Topsy, from nowhere. Then, at graduation, with much memorized data slipping into oblivion, one may be permitted to wonder what has been achieved substantially.

Attention is being focused increasingly on the learner's ability to process information, an ability which translates into strategies for learning how to learn (Bruner, 1960; Kintsch & van Dijk, 1978). An example is a study, conducted by the University of Illinois' Center for the Study of Reading, in which students' awareness of their own cognitive structure in relation to instructional material was encouraged, together with sensitivity to the relative demands made upon them by the learning task (Brown, Campione, & Day, 1980).

The research reported here is concerned with one area of this mathemagenic approach (Rothkopf, 1966, 1970), specifically as it relates to reading comprehension and

content recall. Rothkopf's theory of mathemagenics postulates that instructional strategies which promote increased processing effort on the part of the learner, or which require incoming data to be processed at higher cognitive levels, will result in increased and more durable learning.

The last ten years have seen a proliferation of skill-training techniques, many of which have been validated by research studies. One such technique is the use of graphic organizers as a reading aid for instructional text. In order to appreciate the introduction of the graphic organizer one must look at its pedigree.

Advance Organizers

The graphic organizer has its roots in the large body of research which developed out of Ausubel's introduction of the advance organizer as a strategic reading aid, an operational tool designed to facilitate "meaningful reception learning" (Ausubel, 1960, 1963, 1968). Advance organizers are intended as high-level, generalized introducers of instructional material, a kind of conceptual "scaffolding" of "subsumers" (Ausubel, 1968) which will allow a wide range of detailed "compatible" material to be drawn into the reader's cognitive structure and effectively retained. A very similar but perhaps more

accessible approach, developed by Mayer (1979), helped to clarify some of the fallout misunderstanding generated by Ausubel's research and writings.

In spite of uneven research findings related to Ausubellian advance organizers, a number of second-generation theories and applications of his theory have evolved, including Barron's (1969) graphic organizer.

Graphic Organizers

Graphic organizers are intended to help students identify the top-level ideas in a reading passage. Using spatial arrangement on the page similar to that of a flow-chart, with important vocabulary terms and key concepts contained in boxes interconnected by lines or arrows, the graphic organizer can illustrate the top-level structure of an instructional text (Craik & Lockhart, 1972). This potential of the graphic organizer to act as a signaling agent has only recently been investigated. In a study by Meyer, Brandt, & Bluth (1980) the amount of signaling available to the ninth-grade subjects was manipulated in experimental reading texts by including or omitting explicitly stated information about the particular text's top-level structure. As hypothesized, students who were capable of using the top-level structure as a processing aid performed significantly better on comprehension and retention measures.

A study involving elementary school students (Baumann, 1981) indicated that the greater quantity of higher-level signaling included in a grade three social studies text, as compared to a sixth-grade text, may have accounted for the younger readers' ability to recall more high-level than low-level ideas whereas no difference in the level of recall was observed for the older subjects.

Several research studies in the early 1980's demonstrated the usefulness of graphic organizers as devices capable of top-level signaling. A comparison/contrast graphic organizer developed by Alvermann (1982) helped experimental subjects reorganize descriptive high-level text structure, with resulting superior performance by the treatment group.

Two classroom training studies, where the effects of graphic organizer instruction on comprehension (Boothby & Alvermann, 1984) and transfer (Alvermann & Boothby, 1984) were examined, produced significantly superior results in favour of training, though not for all treatments.

Two Types of Graphic Organizer

The Boothby-Alvermann approach to constructing and using graphic organizers differs from Barron's in several areas.

The stated purpose of introducing graphic organizers into a reading task is to help the reader develop a sense of text structure. Relationships between words are what ultimately convey ideas and concepts. When first introduced by Barron (1969), graphic organizers were also being referred to as structured overviews (Earle, 1970). There is, however, a considerable difference between Barron's fully constructed, "passive" organizer and the more dynamic model proposed by Earle, the essential difference being a matter of student involvement in the construction and elaboration of the reading aid. Herber (1978, p.147) cites Earle's suggested procedure for the development and application of the structured overview.

> 1. Take the list of words ... selected [for emphasis in this instructional unit] and arrange and rearrange them, add to them, and delete from them until you have a diagram which shows the relationships which exist among ideas in the unit, as well as their relationship to the semester's [or year's] work and to ... [the subject area] itself.
>
> 2. On the first day of the new learning unit, write the diagram so constructed on the board. While you are doing this, explain why you arranged the terms as you did. Encourage the

students to contribute as much information as they can. Between the students and yourself, the reasons for the diagrammatic arrangement should be verbalized.

3. Throughout the unit, as it seems appropriate and comfortable, refer back to the diagram. Sketch portions of it on the board. The major objective here is to aid the students in their attempts to organize the information in meaningful ways.

Here the reader is clearly involved in the process of elaboration of the graphic organizer / structured overview. As noted by Reder (1980), reader involvement in such a process results in additional, related, or redundant propositions and it follows that redundancy in this context "can be viewed as a safeguard against forgetting and an aid to fast retrieval" (p.8). Alvermann and Boothby have concentrated their research attention on this interactive model and have found modest gains in comprehension and recall for the use of graphic organizers by trained subjects.

Another aspect of the difference of approach between Barron and the Alvermann-Boothby collaboration is that of skill-training. Barron's "passive" organizer requires very little active processing on the part of the reader,

whereas Earle's structured overview and the Boothby-Alvermann organizer are developed specifically to foster the student's perception of links between concepts, this being seen as prerequisite to enhanced comprehension of the material being read (Alvermann, 1981). It seems likely that some inconsistencies in previous research results have issued from this divergence of attitude.

CHAPTER TWO

REVIEW OF THE LITERATURE

Teaching and learning strategies

In parallel with the time-honbured interest shown by researchers in the mental mechanisms responsible for the "learning" of "facts" runs a newer interest in how a child reads, processes and retains written material (Dansereau, 1978; O'Neil, 1978; Rothkopf, 1970; Levie & Levie, 1975; Paivio, 1971; Vacca, 1981). The emphasis has shifted away from a preoccupation with the manipulation of instructional treatments towards a concern with comprehension (Reder, 1980; Taylor, 1982; Bransford & McCarrell, 1974; Englert & Hiebert, 1984), cognitive strategies (Dansereau et al., 1971; Bruning, 1983; Bovy, 1981) and what might be termed kinetic recall, i.e. the ability to transfer, adapt and apply learned skills and concepts (Morris, Bransford, & Franks, 1977; Alvermann & Boothby, 1984; Mayer, 1980).

The variables studied are legion; among them are the addition to textual material of pictures (Dwyer, 1978; Winn, 1982), inserted questions (Rickards, 1979; Dayton, 1977; Faw & Waller, 1976) and advance organizers (Ausubel, 1960, 1968; Mayer, 1979; Mayer & Bromage, 1980). Others include strategy-training for rote recall (Campione

& Brown, 1977), mathemagenics (Rothkopf, 1966, 1970) and the marrying of task demands to the student's existing cognitive structures (Brown, Campione & Day, 1980; Bernard, Peterson & Ally, 1981).

Teaching/learning strategies are characterized as "embedded" where they are integrated into the instructional material itself (Merrill, Kowallis & Wilson, 1981; Wittrock & Lumsdaine, 1977) and as "detached" where the student may apply them to the instructional task in hand (Rigney, 1978). Improved comprehension and recall have been demonstrated for both types of strategy (Winn, 1982; Bovy, 1981; Bruning, 1983).

Detached strategy training has been used in a wide variety of settings to promote improved processing methods (Hansen, 1981; Hansen & Pearson, 1982; Gordon, 1980; Raphael & Pearson, 1982), with a resulting increase in comprehension of instructional text. Such training, aimed at teaching children how to "learn to learn" (Weinstein, 1978; Bruner, 1960), appears to be most apt at the elementary level, where students are beginning to evolve personal reading and study styles (Adams, Carnine & Gersten, 1982; Englert & Hiebert, 1984).

Boothby and Alvermann (1984) note that studies of detached-strategy training have typically involved time-consuming and often non-replicable methodologies

requiring the collection of extensive data in small-group instructional formats. The use of graphic organizers, in a study by Boothby and Alvermann (1984), seems a more effective strategy since it can be applied in a "normal" classroom (i.e. large group) setting without making overly difficult demands on time or programme content design.

The research reported here sought to replicate and extend the line of research adopted by Alvermann and Boothby.

Advance organizers

Graphic organizers originally evolved (Barron, 1969; Earle, 1970) from research initiated by Ausubel (1960, 1968) into the effects and effectiveness of advance organizers. Ausubel (1968) defines advance organizers, adjoined to prose instructional media, as "appropriately relevant and inclusive introductory materials... introduced in advance of learning... and presented at a higher level of abstraction, generality and inclusiveness" (p.148). By ensuring "the availability to the learner of relevant and proximately inclusive subsumers" (p.136), the advance organizer is intended to "provide ideational scaffolding for the stable incorporation and retention of the more detailed and differentiated material that follows" (p.148).

In short, the advance organizer, presenting the learner with the top-level structure of the material being read, should help make this new material "compatible" with the learner's existing cognitive structure. This process of "meaningful reception learning" is Ausubel's alternative to mere rote memorization.

Based on a meta-analysis of the effect of advance organizers on learning and retention, Luiten, Ames, and Akerson (1980) concluded that although advance organizers have been shown, in numerous studies, to facilitate learning, their utilisation produces inconsistent and unpredictable effects. In some of his early research on advance organizers, Ausubel showed that lower-ability subjects benefited more from using organizers than did high-ability readers (Ausubel & Fitzgerald, 1962). Interpretation of these results followed an intuitively sound line of reasoning, namely that "better" readers were more able to process effectively new information with the help of higher-level conceptual organizers. Later research did not, however, prove to be consistent with Ausubel's findings. Whereas Luiten, Ames and Akerson (1980) reported widely varying results in their meta-analytic review of advance organizer research, Mayer (1982) concluded that lower-ability subjects tended to benefit more from advance organizers although in numerous studies ability had no direct effect on performance. The

tendency for results to be unpredictable may be attributed to the fact that advance organizers are generally very difficult to compose, since (according to the Ausubel formula) they must be written with both the learner's existing knowledge and the top-level structure of the instructional material taken into account.

A different approach to the problem is proposed by Mayer (Mayer, 1979, 1980; Mayer & Bromage, 1980). He contends that provided the advance organizer, by presenting top-level content structure, facilitates the retention of lower-level concepts found in an instructional passage, the organizer need not also represent previously acquired subsuming concepts, as postulated by Ausubel. Based on his own extensive research, Mayer (1980) redefines the term "advance organizer" to include any top-level structure representation which proves to be effective, be it in the form of prose (Weinstein, 1978), model (Mayer, 1980), graphics (Haring & Fry, 1979) or verbal communication (Gagné & Smith, 1962; Weener, 1974).

A study by Bernard, Peterson and Ally (1981), which compared a graphic (i.e. pictorial) illustration of subsuming concepts with a verbal organizer, found that the form of the advance organizer is not important provided the organizer represents clearly the structure of the instructional passage being read by the learner. However,

in the literature dealing with graphic organizers, the form of the organizer poses a problem.

Graphic organizers

In the fifteen years since graphic organizers were introduced into the research literature, they appear to have been the subject of relatively few experimental studies.

Graphic organizers are defined by Estes, Mills and Barron (1969) as "visual and verbal presentations of the key vocabulary in a new learning task in relation to the subsuming and/or parallel terms that presumably have been previously incorporated into the learner's cognitive structure" (p.41).

The premise underlying the use of graphic organizers is that, like advance organizers (Ausubel, 1963; Mayer, 1979), they enable the reader to draw on prior knowledge in order to understand and retain new material being presented (Bransford & McCarrell, 1974; Brandt, 1978; Alvermann, 1981). Graphic organizers differ from their Ausubel scion firstly in that they are not written at a higher level than the instructional material they explicate and secondly that they are graphic or pictorial as opposed to being written in prose.

In a recent review of graphic organizer research, Moore and Readence (1983) found that research results indicate important gains in vocabulary retention, with smaller concomitant gains in comprehension. These findings tie in with those of Barron (1969) on the effects of graphic organizers applied to vocabulary learning. Higher gains were reported by Boothby and Alvermann (1984) on immediate and 48-hour-delayed comprehension testing, though no between-group differences were found on a 1-month-delayed test.

Direct comparisons drawn between the Moore and Readence findings and those of Boothby and Alvermann are questionable since the latter researchers included extensive training procedures in their method, while training played a considerably smaller role in some studies reviewed by Moore and Readence and was not even included in others.

Another factor tending to cloud any comparison of the two is the form of the graphic organizer itself. Figure 1 shows a graphic organizer based on the Barron model and typical of those reported on in the Moore and Readence meta-analysis, while Figure 2 features the type of graphic organizer used by Boothby and Alvermann. The Boothby and Alvermann "elaboration" model presents key terms (top-level structures) and shows clearly how those terms may be interconnected. Barron's "passive reception"

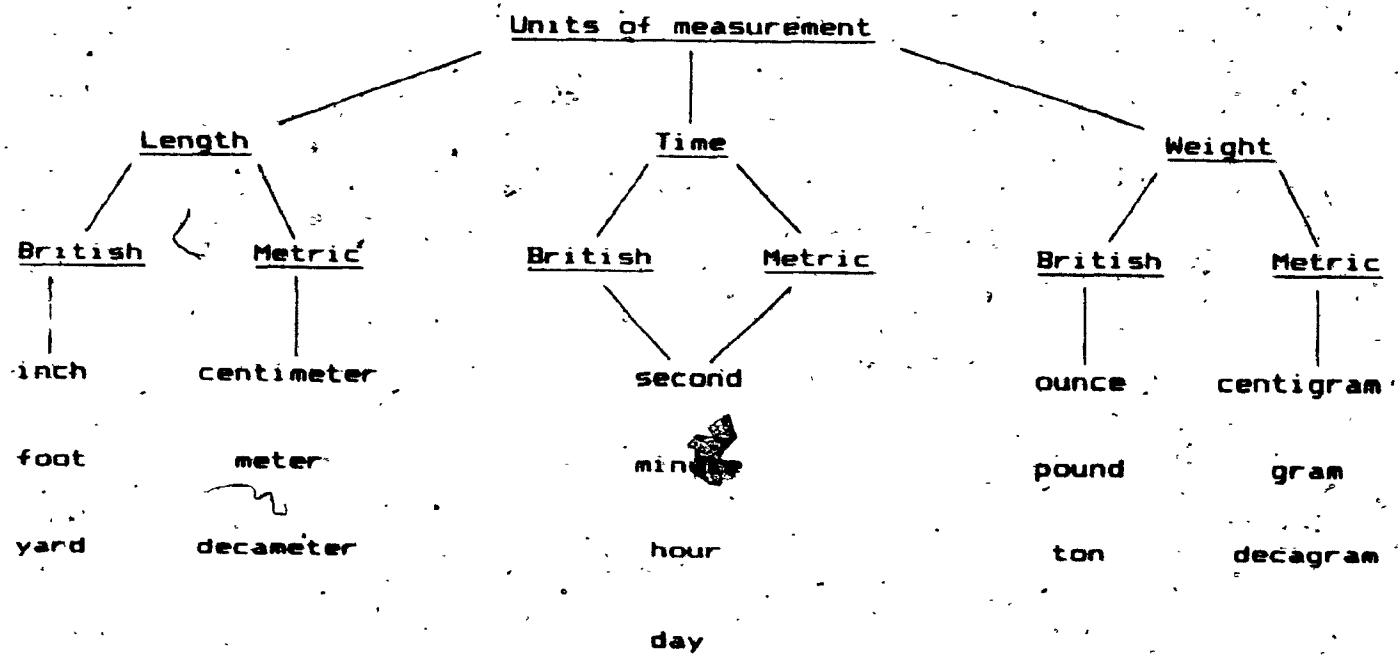

Figure 1. Sample Graphic Organizer of Measurement Terms: Barron "passive/receptive" model.

The Tobacco Trade Graphic Organizer

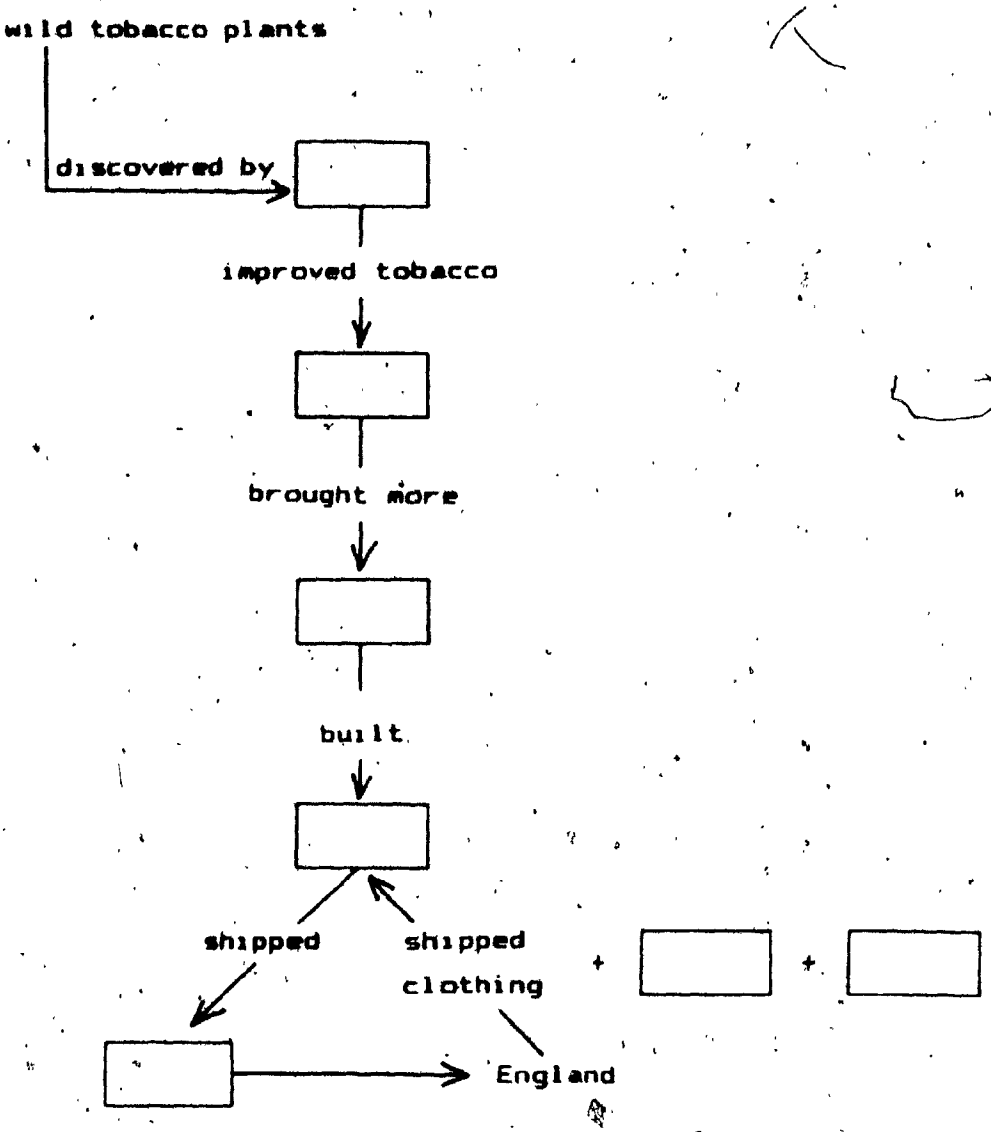

Figure 2. Sample Graphic Organizer of The Tobacco Trade: Boothby-Alvermann "elaborative/interactive" model.

organizer, however, is limited to isolating important vocabulary culled from the prose text which the learner is to study. Given that comprehension of prose is more complex than mere knowledge of isolated words, it is reasonable to assume that the Boothby and Alvermann graphic organizer would promote comprehension in addition to vocabulary retention. This model, featuring interconnected key terms, invites the learner to complete the organizer by filling in the blanks with appropriate words found in the instructional text.

Again, with the learner interacting with the graphic organizer in this way, through elaboration (Reder, 1980), another obstacle is added to the task of comparing the research findings of Moore and Readence with those of Boothby and Alvermann. In order for such comparison to be possible, research in this area needs to control for the differences mentioned above in order to isolate the variables which contribute to improved learning. The study reported here sought to make such comparison practicable.

Strategy training

The development of reading strategies aimed at improving comprehension of expository text has been the focus of an increasing number of research studies (for a

review, see Alvermann & Boothby, 1984). The ability to identify and harness text structure has been demonstrated as a particularly valuable strategic skill as applied to expository prose (Alvermann & Boothby, 1984; Taylor, 1980, 1982; McGee, 1982). The how, rather than the whether, to train students in such a strategy (Englert & Hiebert, 1984) is addressed in studies by Alvermann and Boothby (1984) and Boothby and Alvermann (1984). Procedures used by these two researchers were replicated and extended in the proposed study.

Summary of the Problem and Hypothesis

The research reported here was concerned with the inherently dichotomous approach to graphic organizers in the research literature and the two organizer types were included as components of the independent variable. The study was designed to replicate and extend the Boothby-Alvermann line of research in methods for training elementary level students in the use of graphic organizers as strategic aids to reading instructional prose.

The general hypothesis put forward was that, in the context of learner-processed instructional prose text, strategy training in the use of graphic organizers promotes more effective recognition and recall of the textual content than that achieved in the absence of such training.

During the training phase, all subjects in the experimental group received training in the use of graphic organizers constructed according to Boothby and Alvermann's elaborative/interactive model, together with brief exposure to Barronesque passive/receptive organizers. The latter was considered necessary for the purpose of cueing subjects to the target phase.

It was predicted specifically that superior recognition and recall would result from the use of graphic organizers modelled along the lines of the Boothby-Alvermann type as compared to the Barron type.

The reading ability-level of all subjects involved in the study (n = 92) was measured by the standardized Stanford Reading Achievement Test, administered to intact classes by the in-school faculty prior to the start of the training. This measure was incorporated as a predictor (control) variable in the analysis of the data obtained.

CHAPTER THREE

METHOD

Subjects

The population from which the sample was drawn typically comprises mixed blue-collar and middle-class working communities. Initially the sample consisted of 97 anglophone students attending grades 4 and 5 at two public schools administered by the Lakeshore School Board in Pointe Claire, Quebec; Northview Elementary and Seigniory Elementary. Owing to subject mortality (absence from either or both of the posttesting sessions) this number was reduced to 86.

To control selection bias, subjects were assigned randomly to the three experimental and one control condition groups.

Design

The design of the study was a fully randomized 4 x 2, with repeated measures on the second factor (see Figure 3). Between-group variables were as follows: three groups of subjects trained in the construction and application of graphic organizers were given, immediately

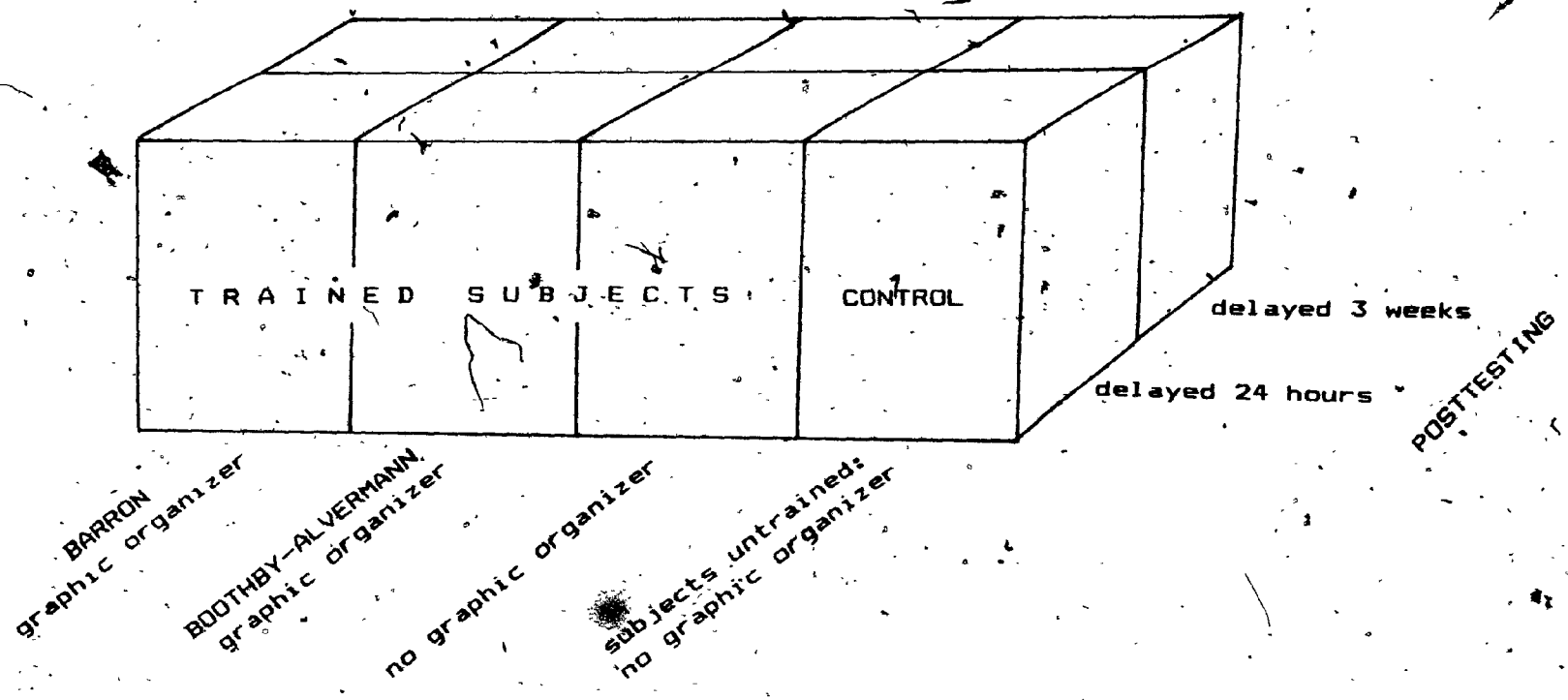

Figure 3. The Experimental Design.

prior to the first posttest, Barron-type, Boothby and Alvermann-type and no graphic organizer respectively. The fourth subject group, untrained and with no organizer supplied, constituted the control condition. There was one within-group variable: the first posttest followed 24 hours after the final training session, with the second posttest administered three weeks later. No pretesting was considered necessary since subjects were randomized to treatment and control conditions.

The dependent measure comprised written free recall and a mixture of multiple-choice, "true or false" and "fill in the blank" (short answer) items. The posttests were designed to measure recognition and recall.

Training procedures

Procedures throughout the training phase approximated to those outlined in Boothby and Alvermann (1984) and Alvermann and Boothby (1984). All groups, treatment and control, met with external instructors (i.e. not members of the in-school faculties) for approximately 30 minutes per week for six weeks. These sessions were arranged with the school administrators and teaching faculty in such a way as to interfere as little as possible with the normal school routine. The research team coped with minor setbacks (e.g. an unexpected change of classroom with consequent shortage of furniture) as and when they

occurred in the real-life school situation which obtained at all times throughout the training and target phases of the study. Generally speaking, every effort was made by all personnel concerned to make the subjects feel at ease in the rather novel circumstances which the study presented to the children.

A week before the first training session, all the subjects involved in the study attended an introductory session which had a triple purpose. It was intended to "break the ice" by allowing the students to meet the three external instructors as university researchers, before being involved together in the training situation itself. Twenty slides, with explanations delivered live by the instructor team, were used to illustrate, in the following sequence:

1. the instruction team of three, plus the research supervisor (a faculty member from the University of Concordia Educational Technology Programme) and the author of the present study;

2. the varied nature of research questions;

3. the necessity of having control subjects as well as experimentals;

4. the randomization procedure;

5. research findings and their usefulness.

The three instructors later concurred that this session was particularly valuable in that it anticipated many of the questions which might otherwise have interrupted the training sessions and used up premium instructional time.

Control subjects were assigned placebo activities throughout the training period. They viewed thirty-minute films selected from the Children of the World series (CBC, 1978). The three which were chosen by the instructor were about young people living in Thailand, Sri Lanka, and Guatemala. One half of a film was shown in each session, so as to allow time for brief discussion and a short quiz or test. The students discussed various aspects of the films and then were given varied-format practice tests similar to those administered to the experimental subjects. They were not, of course, exposed to any graphic organizers during the ten weeks from the start of the training phase to the end of the target phase.

Students in the treatment group were informed that they would learn a new method for picking out main ideas and details from reading texts. The role of the graphic organizer was explained and the top-level structure of a reading text identified. Subjects were encouraged to predict words required to fill in gaps left in the Boothby and Alvermann elaborative graphic organizer. The level of requisite student elaboration increased gradually over the

length of the training period. Student predictions were compared with terms included in the instructional passage, with ensuing discussion of the concepts and interrelationships depicted in the partly elaborated graphic organizer.

Once they had been allowed enough time to explore the possible inserts for an organizer, the instructor displayed an acceptable "solution" via the overhead projector and the students were encouraged to compare their own inserted words and phrases, and the arrangement of these on the organizer, with the one displayed on the screen.

As the training sessions progressed, the level of difficulty was raised slightly by reducing the degree of prior elaboration on the graphic organizer (see Appendix A).

All students in the sample were tested regularly during the training phase by means of a short posttest (five minutes at the most) at the end of each session. This obviated the danger of testing effects in the target phase. These tests, in written free recall and varied formats which included multiple-choice, were used to monitor recognition and recall of material studied. Written free recall testing was preferred to oral free recall for two reasons: written work is generally

perceived by students as being more "serious" than equivalent oral work and written free recall material can be more accurately assessed and scored.

Training materials

During the six-week training phase, ad hoc instructional materials were developed by a team of three University of Concordia Educational Technology Program Research Assistants: one a doctoral candidate with several years of experience teaching upper elementary grades and the others master's students, one of whom is the author. The third member of the training-instructors team did not participate in developing these materials as she occupied herself exclusively with activities for the control group.

The instructional materials comprised reading texts and graphic organizers. Short passages were selected from books and magazines aimed chiefly at the upper elementary age level, e.g. 3-2-1-Contact, Enter and Electric Company published by the Children's Television Workshop; Hidden Worlds, Far-Out Facts and World magazine published by National Geographic; and other sources including World Book Encyclopaedia.

Graphic organizers were similarly developed by the investigator-instructors team. Each graphic organizer was constructed in such a way as to represent as clearly as

possible the top-level structure of the instructional passage, with interconnections between superordinate and subordinate concepts indicated by lines or arrows. This technique, developed by the Boothby-Alvermann team, is based mainly on work by Barron (1969) and Earle (1970), as reviewed in Herber (1978).

The substance of the materials used in the six training sessions is outlined below. Texts, graphic organizers (partly and fully elaborated) and practice tests are included in Appendix A.

Session 1. Colour slides were projected and students were invited to suggest a title for each slide, based on its main visual idea. Subsidiary details were noted and discussed in relation to the principal element of each image. Initially four slides were presented simply for oral discussion; they depicted

(i) sardines being unloaded from a trawler;

(ii) a young boy washing his tricycle on a driveway;

(iii) a fruit-and-vegetable vendor at his open-air market stall;

(iv) a crowd of visitors around a monkey and its handler at an open zoo.

Finally, two more slides were shown (one of children beachcombing by the ocean and the other of young students at a judo class) and the subsequent oral discussion was

transliterated, using an overhead projector, in the form of simple graphic organizers. Throughout this first session instructors were careful to accept a variety of suggestions as being acceptable, with student consensus being sought on the identification of main and subsidiary ideas or on a title, e.g. "Trike Wash". Testing was considered premature at this stage and therefore was not included.

Session 2. Large photographs, clipped from magazines such as Life and Paris Match, were mounted on card and displayed, one at a time, at the front of the classroom. The three photos depicted, respectively, a young medical practitioner with a patient, a sidewalk cafe, and a proud father with his baby. Students were given a printed copy of a simple, partly elaborated graphic organizer for each of the three images and the organizers were completed during group discussion of the picture elements. A fourth handout included a photograph of a giraffe feeding in the upper branches of a tree, a short reading text about the advantages of being a tall animal living on the African savannah, and a simple, Barron-type graphic organizer designed to help the students make the transition from images-only to images-with-text.

Session 3. No pictorial images were used at all. The first task was to complete a very straightforward graphic organizer based on an accompanying text about kangaroos.

This was done individually by the students, with group discussion following. Secondly, students were given a fully elaborated graphic organizer relating to the nature of an oasis and they were asked to write a short text for which the organizer would be appropriate. A third assignment, followed by a short multiple-choice test, consisted of a passage on exploration, with a partly elaborated graphic organizer to be completed.

Session 4. As a short "warm-up" exercise, two magazine pictures, similar to those used in Session 2, were discussed in terms of main and secondary elements. Most of the session was taken up by work on two graphic organizers based on passages about animal homes and the shrew. A test on animal homes comprised true-or-false statements and short-answer items.

Session 5. As students grew familiar with concepts and techniques associated with the use of graphic organizers, more difficult texts were assigned. This session's material consisted of two texts with graphic organizers; one on underground buildings, the other on Yellowstone Park, with a free recall test of the latter administered in the last eight minutes of the session.

Session 6. In this final training session students were given two more graphic organizers to elaborate after reading texts on spacecraft and the night sky. A quiz in

multiple-choice format based on the first passage closed the session.

Instrumentation

Ten days before the start of the training phase, Test 2: Reading Comprehension, excerpted from the Stanford Achievement Test Battery: Intermediate Level I (Madden, Gardner, Rudman, Karlsen, & Merwin, 1972) was administered. Reading ability was identified on the strength of subjects' scores on this standardized test, which consists of ten reading passages and one nine-line poem, with several four-item multiple-choice test questions following each reading text, for a total of 67 questions. Students were given 50 minutes to complete the test.

In the target phase, all students were given a 331-word passage on the subject of air pollution, entitled Going out for a Breath of Gross Air? This was adapted from a unit in Conserving the Earth's Resources, by Trevor Marchington (1974), a booklet in the Macdonald Educational Colour Units series. The text was assessed as being equivalent to grade 5/6 reading level according to evaluation criteria set out in the Fry Readability Test for determining reading level (Fry, 1968). Subjects were given ten minutes to study the passage. Experimental

condition-subjects, trained in the use of graphic organizers, had been randomly assigned to three testing groups and were given, along with the target passage, either a Barron-type (non-interactive) graphic organizer or a partly elaborated Boothby and Alvermann-type organizer or none at all. Accompanying instructions directed them, respectively, to study the text and organizer, to study the text and complete the organizer or, in the no-organizer condition, simply to study the text.

Once the reading text and, where applicable, graphic organizer had been removed, subjects were asked to write down everything they could remember from the passage. This was done before handing out the varied-format recognition measures in order to avoid the possibility of the latter cueing the free recall measure. Subjects were given ten minutes for this free recall component. Scoring of the writing was by idea units. The target passage was subdivided into individual idea units by the two official scorers plus four independent scorers. These idea units provided the criteria by which the free recalls were scored, with interrater consensus being sought as needed.

Recognition and recall of the target passage was tested, secondly, by a three-part test protocol comprising seven four-option multiple-choice items, five "true or

false" sentences and seven "fill in the missing word/s" statements. The nineteen items on this recognition measure were selected from a pool of thirty questions by the researcher-instructors team and then vetted by a University of Concordia Educational Technology program faculty member expert in the area of content reading research. Two forms of this test were generated and all subjects were administered both: the first form (xeroxed on yellow paper) was given to half the subjects at the first posttesting session and the other form (on blue paper) to the remainder. At the second posttesting session, three weeks later, this component of the test was counterbalanced, so as to control sensitization bias. A secondary advantage gained from this manipulation was that, by distributing the forms to alternate rows of students each time, the possibility of seeing a neighbour's answers was eliminated. Again, as for the free recall test, this test was allocated ten minutes for completion.

In both the training and target phases the research team members were questioned by students as to whether scores given on quizzes and tests would be included in their overall class evaluation. They were, of course, reassured that any results gathered by the author and his colleagues would be used uniquely for university research purposes. This may have induced in some of the subjects

a tendency towards not taking all of the training and testing activities too seriously, a problem which all "live" research projects of this nature necessarily have to live with.

CHAPTER FOUR

RESULTS

Introduction

The purpose of this study was to determine the effectiveness of training in the use of graphic organizers on children's processing of expository text. It was hypothesized that students trained in the use of graphic organizers would demonstrate superior recall and comprehension compared to untrained subjects. More specifically, those students exposed to the interactive (elaborative) organizer based on Boothby and Alvermann's model would do better on the dependent measures than those exposed to the more passive Barron-modelled organizer.

Analysis of Covariance

A regression analysis was performed to test the assumption of homogeneity of regression, namely that regression lines for each level of the independent variable would be parallel. As a result of this test, it was determined that a single regression coefficient could be used to account for variation due to differences in

individual subjects' reading ability. The F-ratios produced in this analysis are as follows:

immediate multiple-choice, F (3,84) = [illegible], p = .11

immediate true/false, F (3,84) = 2.47, p = .07

immediate short-answer, F (3,84) = .48, p > .50

immediate free recall, F (3,84) = 1.72, p > .15

delayed multiple-choice, F (3,79) = .52, p > .50

delayed true/false, F (3,79) = 1.97, p = .13

delayed short-answer, F (3,79) = .90, p > .40

delayed free recall, F (3,78) = 1.09, p > .30

Table 1 shows the r and r^2 derived from the regression analysis for each dependent variable. Table 2 indicates that the reading ability measure was a significant predictor of posttest performance. Both multivariate and univariate regression analyses are shown.

Multivariate Analysis of Covariance

The hypothesis of the experiment was tested using multivariate analysis of covariance with repeated measures. Means and standard deviations resulting from this analysis are shown in Tables 3 and 4.

As the data indicate (see Tables 5,6 and 7), the only significant difference is to be found for the effect of

time, but this was not a factor of interest within the experimental study. No significant differences were detected either for the effects of treatments or for the interaction of the effects. The hypothesis is therefore rejected.

Table 1

Correlations of Reading Ability Measure with Dependent Variables

Measure	r	r^2
Immediate tests		
Multiple choice	.37	.14
True or false	.38	.14
Short answer	.61	.37
Free recall	.51	.26
Delayed tests		
Multiple choice	.51	.26
True or false	.25	.06
Short answer	.66	.44
Free recall	.47	.22

Table 2

Multivariate and Univariate Regression of Reading on the Dependent Measures

Variable	df	MS	F	P
		Multivariate		
All dependents	4	-	19.82	0
Error	78	-		
		Univariate		
Multiple choice	1	83.09	29.48	0
Error	81	2.82		
True or false	1	14.47	11.31	.001
Error	81	1.28		
Short answer	1	231.24	70.94	0
Error	81	3.26		
Free recall	1	6165.20	34.38	0
Error	81	179.33		

Table 3

Means and Standard Deviations for the Two Groups Supplied With Graphic Organizers

	Immediate test		Delayed test	
Measures	M	SD	M	SD
Boothby and Alvermann model (n = 24)				
Reading	46.13	9.78	46.13	9.78
Multiple choice	4.63	1.31	4.71	1.73
True or false	3.00	1.06	2.83	1.01
Short answer	4.46	1.59	4.29	1.76
Free recall	31.42	13.24	16.96	11.54
Barron model (n = 24)				
Reading	43.08	10.17	43.08	10.17
Multiple choice	4.46	1.47	4.25	1.73
True or false	2.83	1.13	2.75	1.11
Short answer	4.17	1.79	3.88	2.01
Free recall	23.29	9.94	12.08	8.30

Table 4

Means and Standard Deviations for the Two Groups Not Supplied With Graphic Organizers

Measures	Immediate test		Delayed test	
	M	SD	M	SD
Trained (n = 24)				
Reading	42.42	16.40	42.42	16.40
Multiple choice	4.67	1.37	5.00	1.72
True or false	2.88	.74	2.79	.88
Short answer	4.13	2.23	3.79	1.96
Free recall	28.79	19.19	13.17	10.83
Untrained (n = 14)				
Reading	43.36	12.31	43.36	12.31
Multiple choice	5.07	1.54	4.57	1.70
True or false	2.86	1.35	3.29	1.07
Short answer	5.07	1.86	4.29	1.59
Free recall	25.14	13.79	11.50	9.40

Table 5

Multivariate and Univariate Test of the Treatment Groups

Variable	SS	df	MS	F	P
		Multivariate			
All dependents	-	12	-	1.12	.35
Error	-	230	-		
		Univariate			
Multiple choice	8.13	3	2.71	.96	.42
Error	228.33	81	2.81		
True or false	1.41	3	.47	.37	.78
Error	103.64	81	1.28		
Short answer	8.85	3	2.95	.90	.44
Error	264.01	81	3.26		
Free recall	769.21	3	256.40	1.43	.24
Error	14525.52	81	179.33		

Table 6

Multivariate and Univariate Test of the Repeated Measure (Time)

Variable	SS	df	MS	F	P
		Multivariate			
All dependents	-	4	-	32.83	0
Error	-	79	-		
		Univariate			
Multiple choice	.02	1	.02	.02	.89
Error	95.31	82	1.16		
True or false	.02	1	.02	.03	.86
Error	58.21	82	.71		
Short answer	5.23	1	5.23	5.36	.02
Error	79.99	82	.98		
Free recall	8122.81	1	8122.81	132.12	0
Error	5041.38	82	61.48		

Table 7

Multivariate and Univariate Test of the Interaction of Time By Treatments

Variable	SS	df	MS	F	P
		Multivariate			
All dependents	-	12	-	.70	.76
Error	-	233	-		
		Univariate			
Multiple choice	3.66	3	1.22	1.05	.38
Error	95.31	82	1.16		
True or false	1.76	3	.59	.83	.48
Error	58.21	82	.71		
Short answer	1.78	3	.59	.61	.61
Error	79.99	82	.98		
Free recall	125.81	3	41.94	.68	.57
Error	5041.38	82	61.48		

CHAPTER FIVE

DISCUSSION

The general hypothesis put forward in this study was that elementary students trained in the use of graphic organizers would demonstrate superior recall and comprehension, compared to untrained subjects, on measures relating to an expository reading text. It was further postulated that the interactive Boothby-Alvermann graphic organizer would prove more beneficial than the passive Barron model.

Previous research into the use of graphic organizers as a strategy for increasing learning from instructional text has served to identify certain problem areas. In their meta-analytic review of the effect of graphic organizers on learning from text, Moore and Readence (1980) note that research findings "preclude the unqualified use of graphic organizers as a strategy to enhance learning" (p.216). They indicate that organizers elaborated by subjects as a post-reading activity tended to be more beneficial than fully-elaborated organizers offered as text adjuncts. The question of graphic organizer mode (interactive versus passive) has led to experimentation with one or the other but not, as far as

the author is aware, to comparison of the modes as assayed in the present study.

The findings reviewed by Moore and Readence should not come as any surprise when it is remembered that Ausubellian advance organizers continue to be the subject of a polemic centred on the very definition of an advance organizer. Proponents (Mayer & Bromage, 1980) reject the purist restrictions imposed by Ausubel in favour of a more open role for the organizer, that of explicating top-level structures which in turn allows for assimilation of lower-level concepts. It is on the strength of this approach that the graphic hybrid was developed (Barron, 1969; Earle, 1970). With many research studies still adhering to Ausubel's strict definitions for advance organizers, results have been inconsistent and have tended to further complicate the debate (Luiten, Ames & Anderson, 1980).

Research difficulties encountered in the present study

Unlike Ausubel's prototype, graphic organizers are not constructed at a higher level than the instructional text which they are designed to enhance. As noted by Moore and Readence (1980), many studies have supplemented their graphic organizer treatment with such activities as "study guides, purpose-setting questions and separate group discussion" (p.215). The present study sought to

isolate the graphic organizer and investigate the differential outcomes from providing elaborative, as opposed to passive, graphic organizers as strategic reading aids. In seeking to discriminate between the effects of the two organizer types, the study has run the risk of comparing apples with oranges. The Barron-style organizer, being entirely non-interactive, depends on the learner for a cognitive structure into which "subsuming and/or parallel terms" have been previously incorporated (Estes, Mills, & Barron, 1969). This presupposes a certain range of prior knowledge compatible with the demands made on the reader by the instructional text for which the graphic organizer is a learning aid. A disturbing factor in this study, and perhaps one which limits the internal validity of any such research project, is that in the target phase the three treatment groups were assigned essentially different tasks.

One group was given a Boothby-Alvermann graphic organizer along with the reading text. It is possible that these students, who had met once a week with two external instructors to learn how to construct and elaborate graphic organizers, paid less attention to the reading task and more to the job of filling out the organizer, with all the attendant anxiety one would normally associate with a novel experience, wishing to please the teacher and "wanting to get it right". Some

subjects may well have tried to complete the partly elaborated organizer before reading a single word of the passage on air pollution. Writing on the general topic of visual information processing, Bransford and Johnson (1973) warn that in such circumstances the reader risks wasting valuable processing time while busy creating inappropriate elaborations. Another point, made by the same writers and which seems very pertinent in the circumstances of the study being reviewed here, is that prior knowledge of clear referents in a reading passage does not aid comprehension or recall. Students relying partly on prior knowledge and partly on information freshly assimilated from two sources at once (reading text plus graphic organizer) may well be sufficiently befuddled to find the recognition and recall measures more difficult than they might otherwise.

Many students given the Barron-type organizer, on the other hand, may have felt disappointed that they did not have to fill out any blanks on the chart. Several asked why they received an organizer where "there was nothing to do". However, these subjects had a little more time (and perhaps less anxiety) for the reading component of the task.

Some students who had undergone six weeks of training and then received no organizer at all in the testing phase also expressed disappointment and wondered aloud why they

had been taught to use them. It would be ironic if the untrained group (controls) benefited more from a simple Hawthorne effect than the three treatment groups.

Problem areas identified in classroom training studies

Alvermann and Boothby, in their second and purportedly improved study (1984) into the use of graphic organizers, found support for Gordon's (1980) and Tackett and Dewitz' (1981) contention that the length of the treatment period is an important variable in classroom training studies. Whereas this study's training phase consisted of six weekly half-hour sessions, their study allowed for 25 minutes of training on 14 consecutive school days for one experimental group and 7 consecutive school days for the other. The training of both treatment and control groups was carried out by a member of the in-school faculty. The 14-day Experimentals performed significantly better than the Controls, with no significant difference being reported in the case of the 7-day Experimentals. Respective cell sizes for the three groups were not disclosed in their (to date) unpublished study report, though it is worth noting in passing that the study sample was small (n = 24).

Classroom training studies inherently present the researcher with potential threats to internal validity (Tuckman, 1963). The necessity of employing three

external instructors in the present study (two for the treatment condition, the third for the control group) may have produced teacher effect. Thus differences in the results of the measures may be partly attributable to a combination of logistical differences necessitated by variable "live" research environments.

Suggestions for improving this type of study

In retrospect, certain methodological details might have been improved upon. The differing tasks facing the treatment groups when they were given the reading passage may have generated less anxiety and curiosity if students supplied with an interactive Boothby-Alvermann organizer had all been together in one room, Barron-organizer subjects in another, with no-organizer and control subjects together in a third location. The level of logistical difficulty already inherent in the "live" school situation would certainly have been raised by this manipulation and this must be weighed against the possible benefit derived from more homogeneous task-grouping at this stage of the study.

An unfortunate limitation imposed by the design restrictions on the present study was the fact that many students in the with-organizer (Alvermann-Boothby) group filled out some or all of the spaces left in the partly-elaborated organizer but gained no credit for the

degree of skill demonstrated. This, again, was a detail which might have been worth measuring.

Another improvement, more evident after the fact than before, would have been to hand out the graphic organizers once the students had been allowed five minutes to peruse the reading passage without extraneous distraction. This, however, raises an apparently intractable problem endemic to any such study which seeks to compare interactive with passive adjunct material, that problem being one of on-task time.

The problem of on-task time

Assuming that all groups (treatment and control) should be allowed the same amount of time for study of the reading text, the researcher must choose between three equally unpalatable alternatives:

a) the interactive-organizer group is given enough time to read the passage thoroughly and to complete the graphic organizer unhurriedly, while the other three groups become bored and listless;

b) the passive-organizer group is given enough time to read the passage thoroughly and study the fully-elaborated organizer, while the without-organizer groups grow impatient and the

interactive-organizer subjects run out of time for interacting:

c) the two without-organizer groups are given enough time to read the passage thoroughly, whereas the two with-organizer groups are deprived of the chance to study and/or elaborate the graphic organizer.

The problem of on-task time is one which has simply been avoided in many studies. Faw and Waller (1976) reviewed a number of experiments, involving graphic organizers, where the control subjects were assigned some other task in order, presumably, to keep them from growing bored or impatient while the treatment group was studying an organizer. In a study conducted with elementary school subjects (Proger et al., 1973), the control group was not given anything to do to compensate for the extra time spent on the organizer by the experimental subjects. However, on-task time for the two groups was neither equated nor measured, leaving open the question as to whether experimental subjects indeed learned more efficiently than controls or simply performed better as a function of having spent more time on the assigned task. Another study involving elementary-school children did control on-task time and found no significant differences

in performance between the groups (Clawson & Barnes, 1973).

Inherent appeal of graphic organizers

It is interesting to note that the teacher recruited by Alvermann and Boothby (1984) to conduct the in-school training in the use of graphic organizers mentioned to the researchers that the graphic organizer has "inherent appeal" as a reading strategy. This was also felt by the instructors involved in the present study but, as the results indicate, did not prove to be a significant contribution to the students' processing of the reading text. Although many textbooks, such as those by Estes amd Vaughan (1978) and Herber (1978), advocate the regular use of graphic organizers for improving students' comprehension and retention of text material, perhaps it is still important to heed Tierney s (1983) caution that the efficacy of instruction in identifying top-level text structure is still short of research evidence, in spite of general agreement that spontaneous use by children of expository text structure does enhance comprehension and recall (Alvermann & Boothby, 1984).

Recommendations for further research

In the light of difficulties inherent in the classroom-training research environment, replication of

this study could be useful, perhaps with some modifications as outlined below.

1. Without compromising the internal validity of the design by differentiating on-task time allocations, the skill involved in completing an elaborative graphic organizer should be operationalized as a dependent measure.

2. Different treatment groups, during the target phase, should be tested in different locations, so as to obviate the possibility of any informal task comparison and consequent distraction.

3. In this study it was felt that six training sessions were just sufficient for the students to "get the hang of" the strategic manipulation of text involved in the use of graphic organizers. It is recommended that future projects allocate 50% more training time.

This study makes one more modest contribution to the growing volume of "live" classroom-training research projects. Any new insights into the ways in which elementary children process what they read in school may help nurture the belief that learning to learn can and should be an enriching experience.

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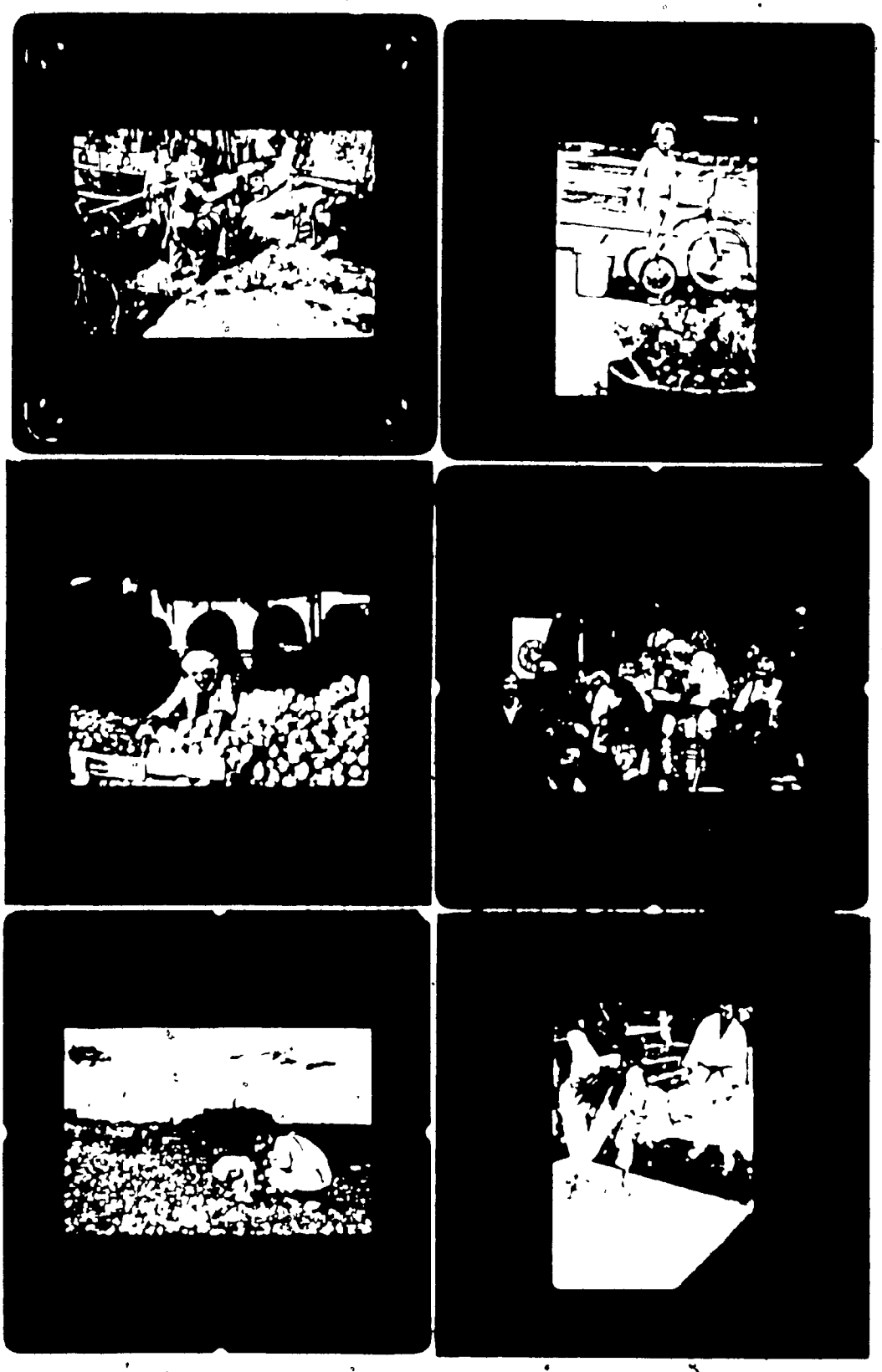
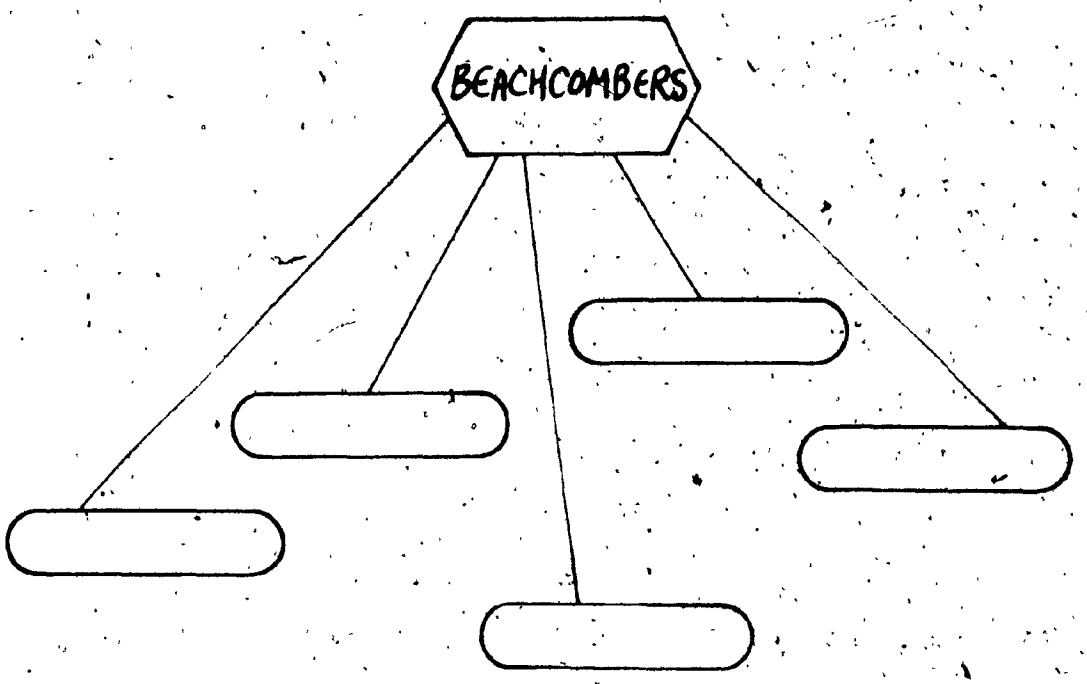
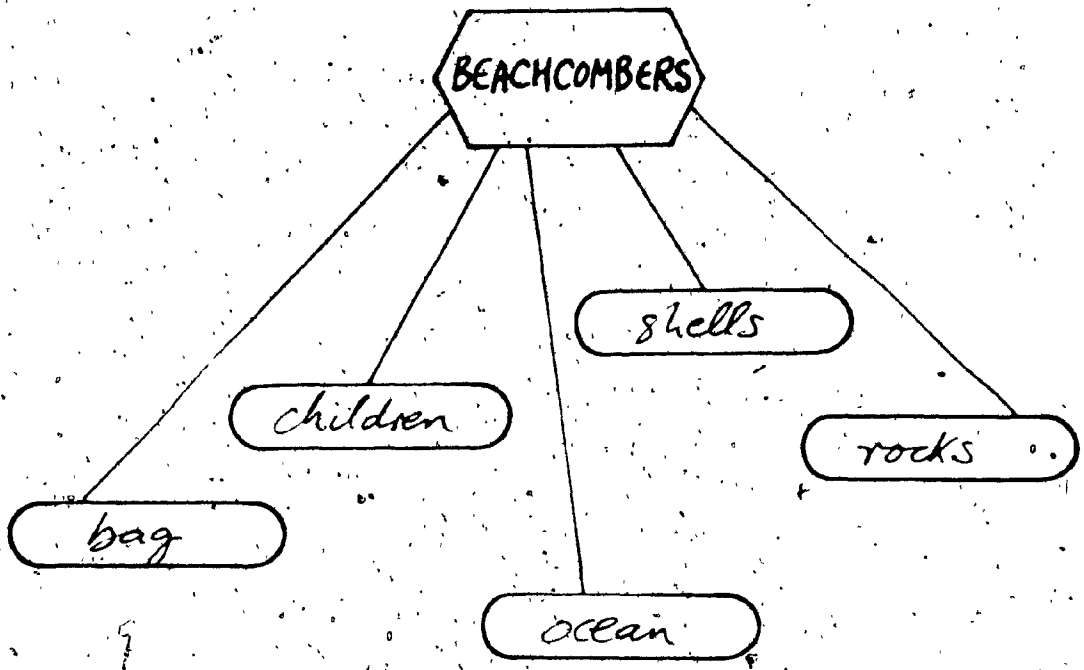
appendices

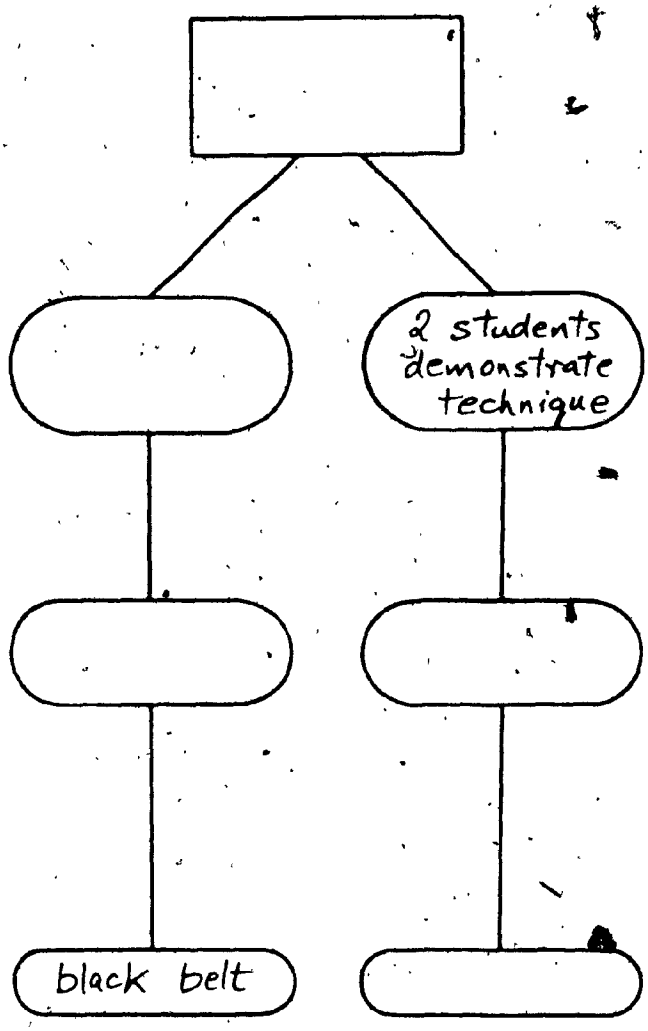
APPENDIX A

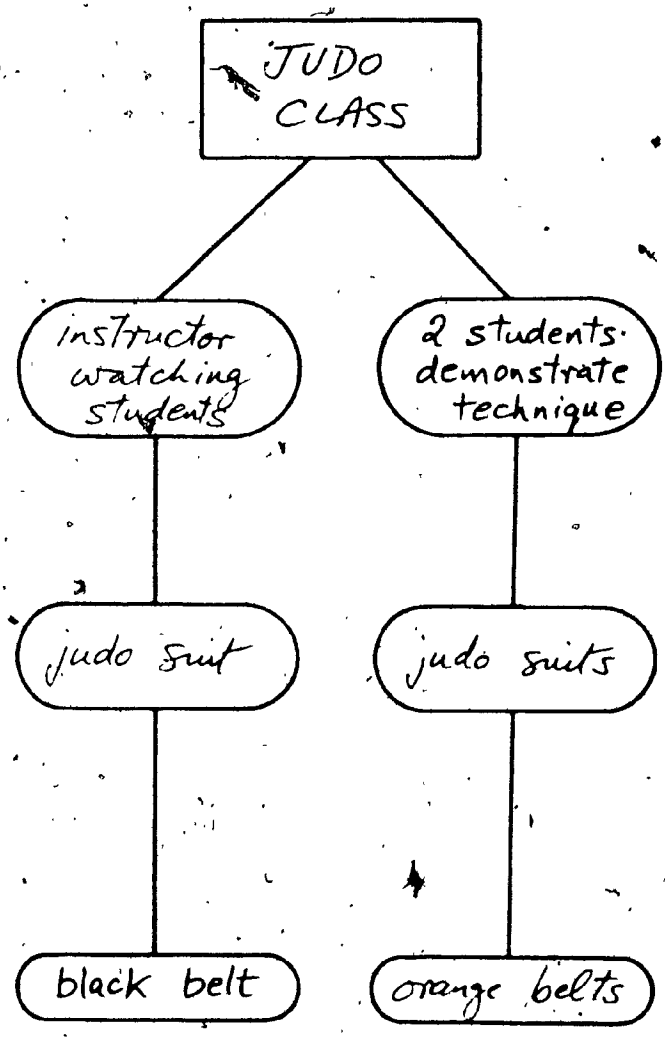
Training Phase Materials

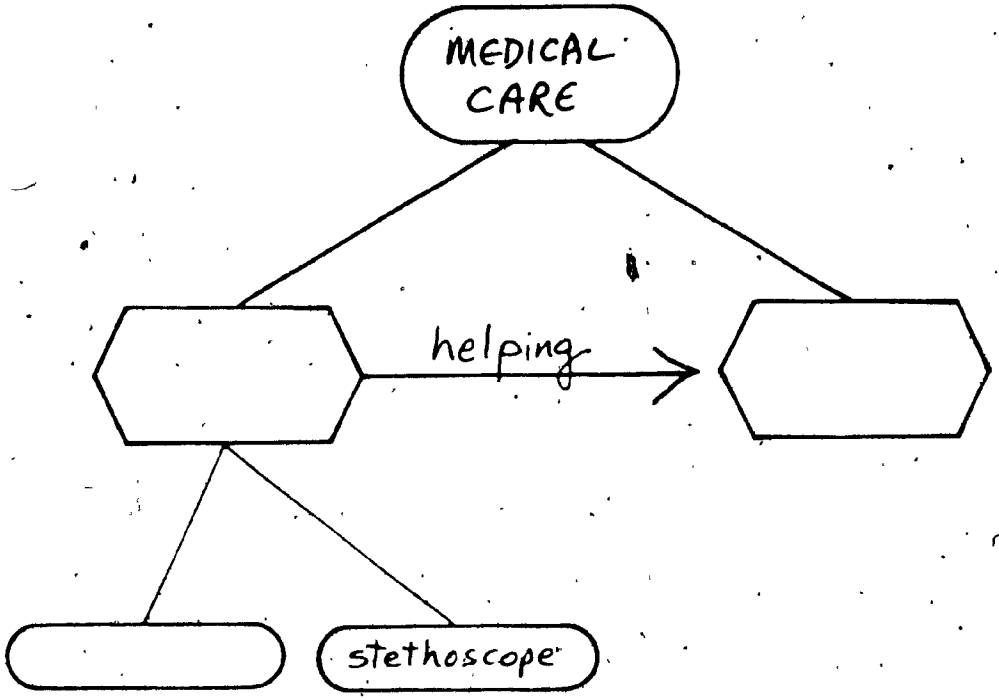


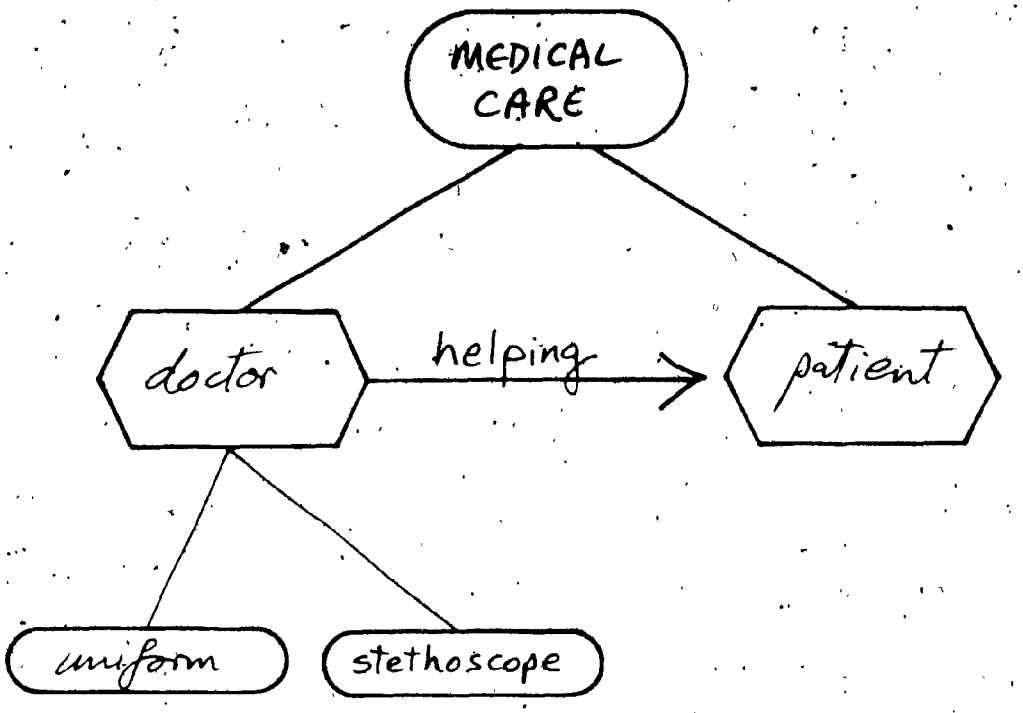

BEACHCOMBERS

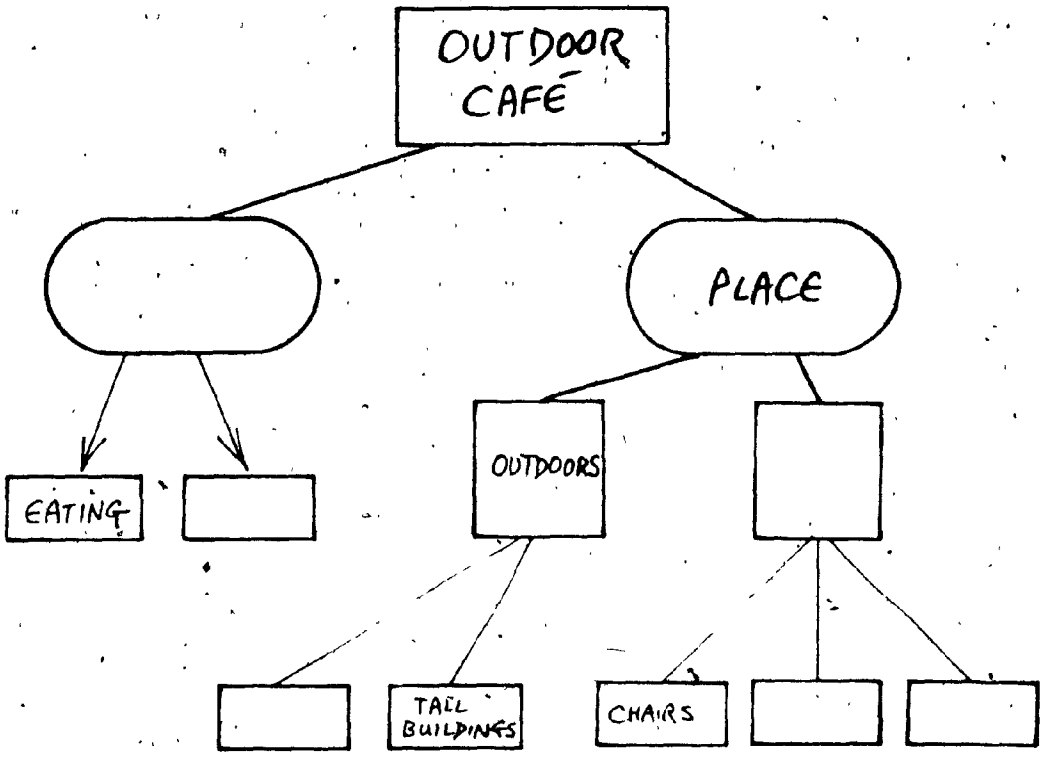

BEACHCOMBERS
shells
children
rocks
bag
ocean

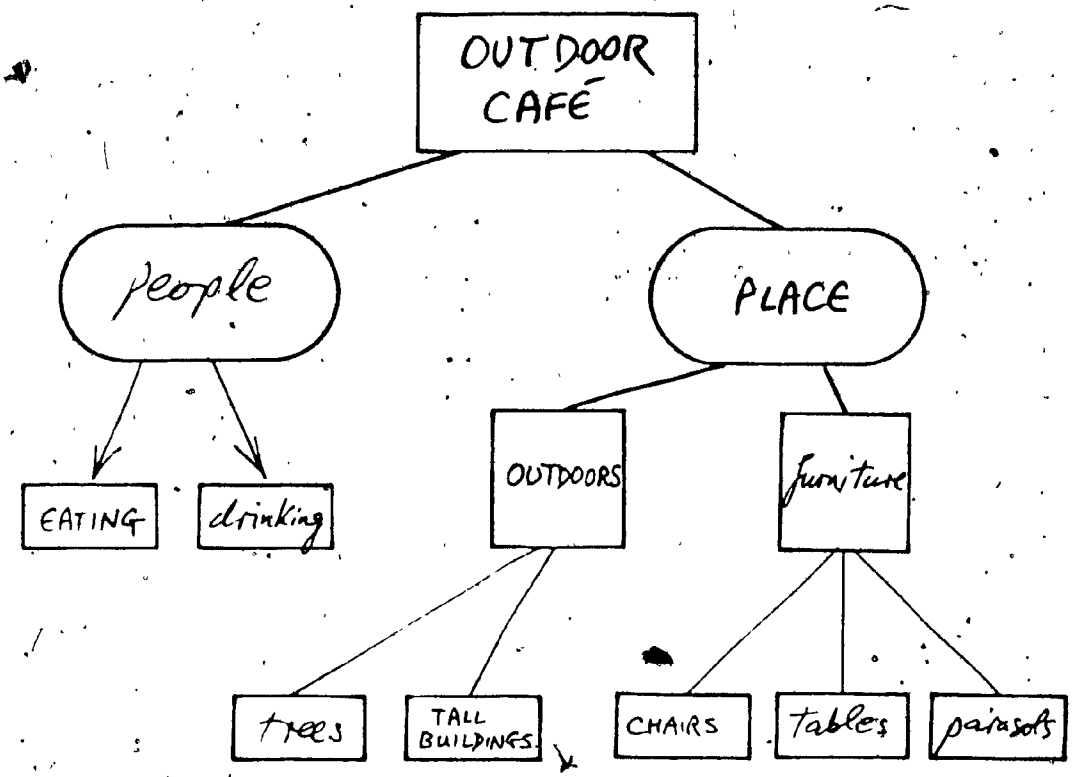

2 students demonstrate technique
black belt

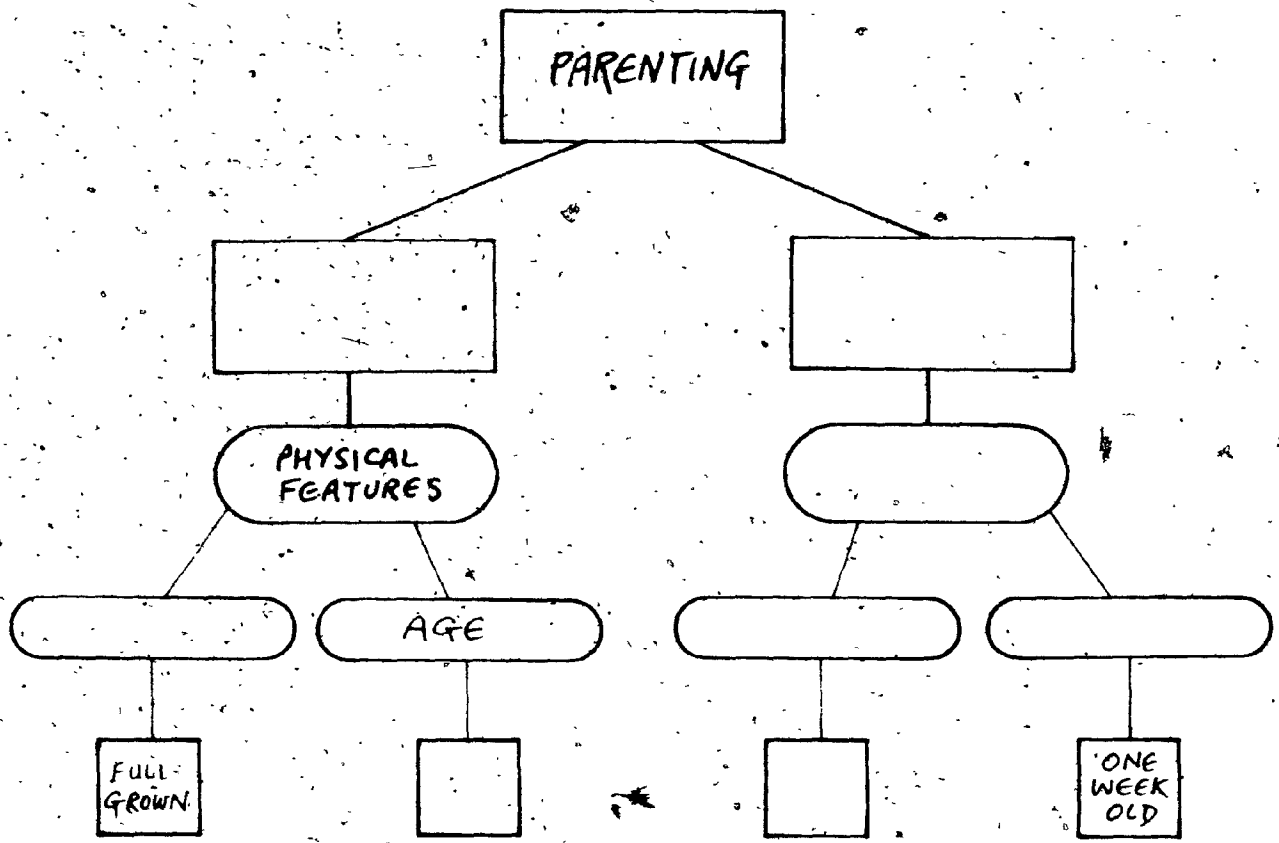

JUDO CLASS
instructor watching students
2 students demonstrate technique
judo suit
judo suits
black belt
orange belts

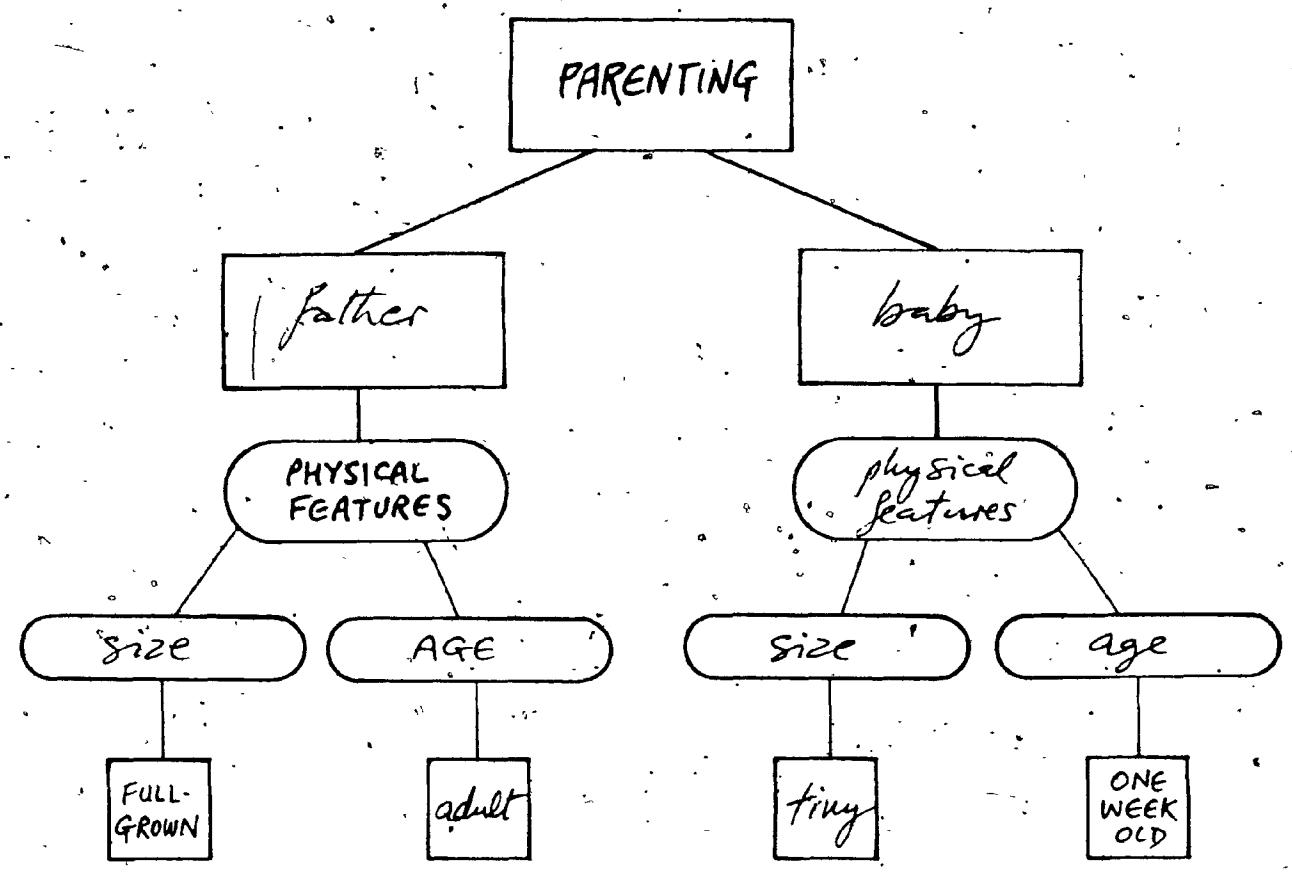

MEDICAL CARE
helping
stethoscope


MEDICAL CARE
doctor
helping
patient
uniform
stethoscope


OUTDOOR CAFÉ
PLACE
EATING
OUTDOORS
TALL BUILDINGS
CHAIRS

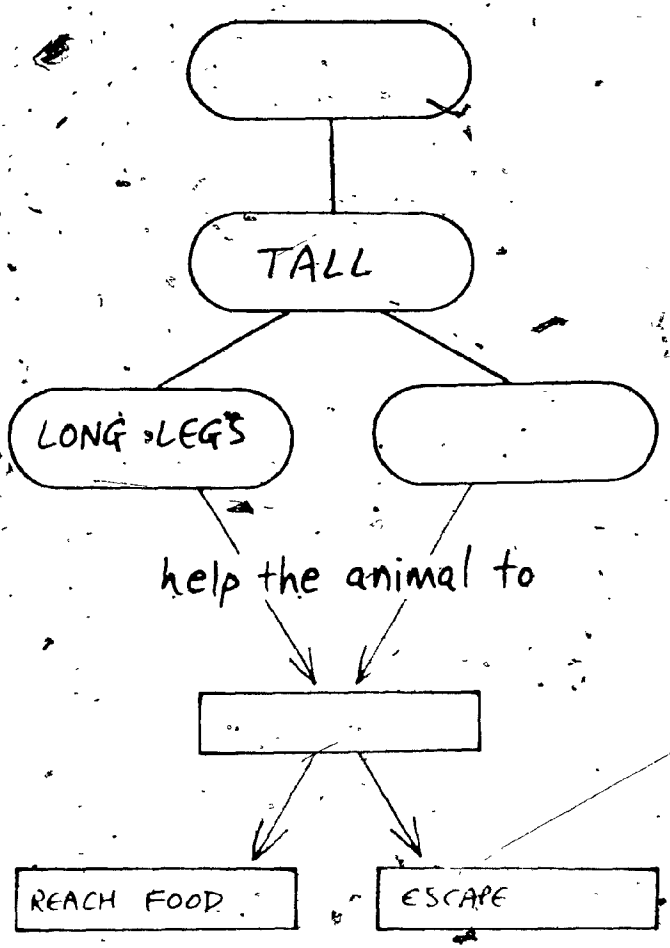

OUTDOOR CAFÉ
people
PLACE
EATING
drinking
OUTDOORS
furniture
trees
TALL BUILDINGS
CHAIRS
tables
parasols


PARENTING
PHYSICAL FEATURES
AGE
FULL-GROWN
ONE WEEK OLD


PARENTING
father
baby
PHYSICAL FEATURES
physical features
size
AGE
size
age
FULL-GROWN
adult
tiny
ONE WEEK OLD

TALL

If the giraffe had dumpy legs and a short neck it probably wouldn't survive long. It wouldn't be able to find enough food on the hot African plains and it would soon fall prey to lions. To a giraffe, being tall is very important.



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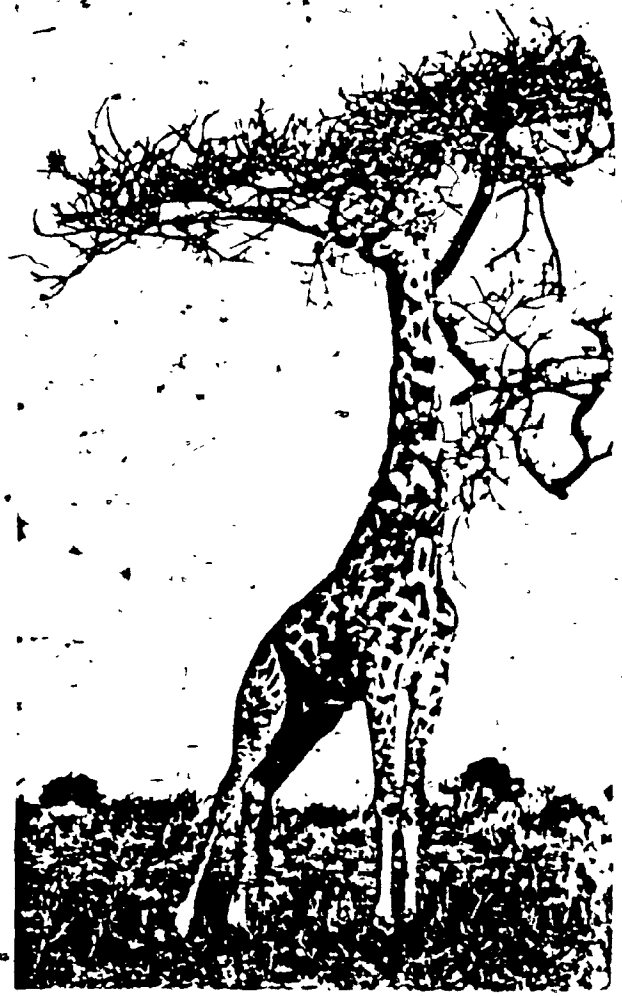
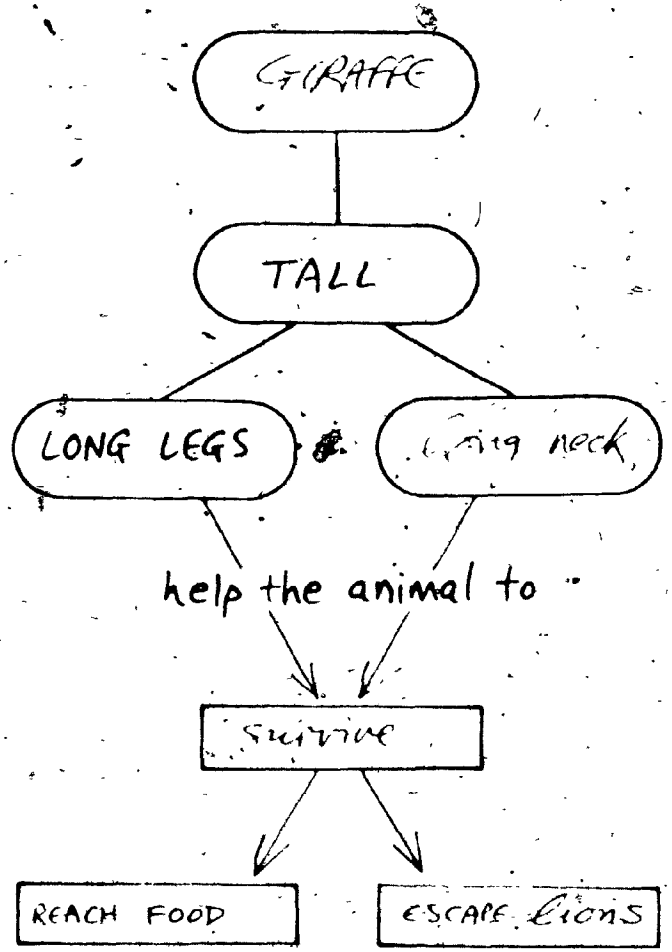
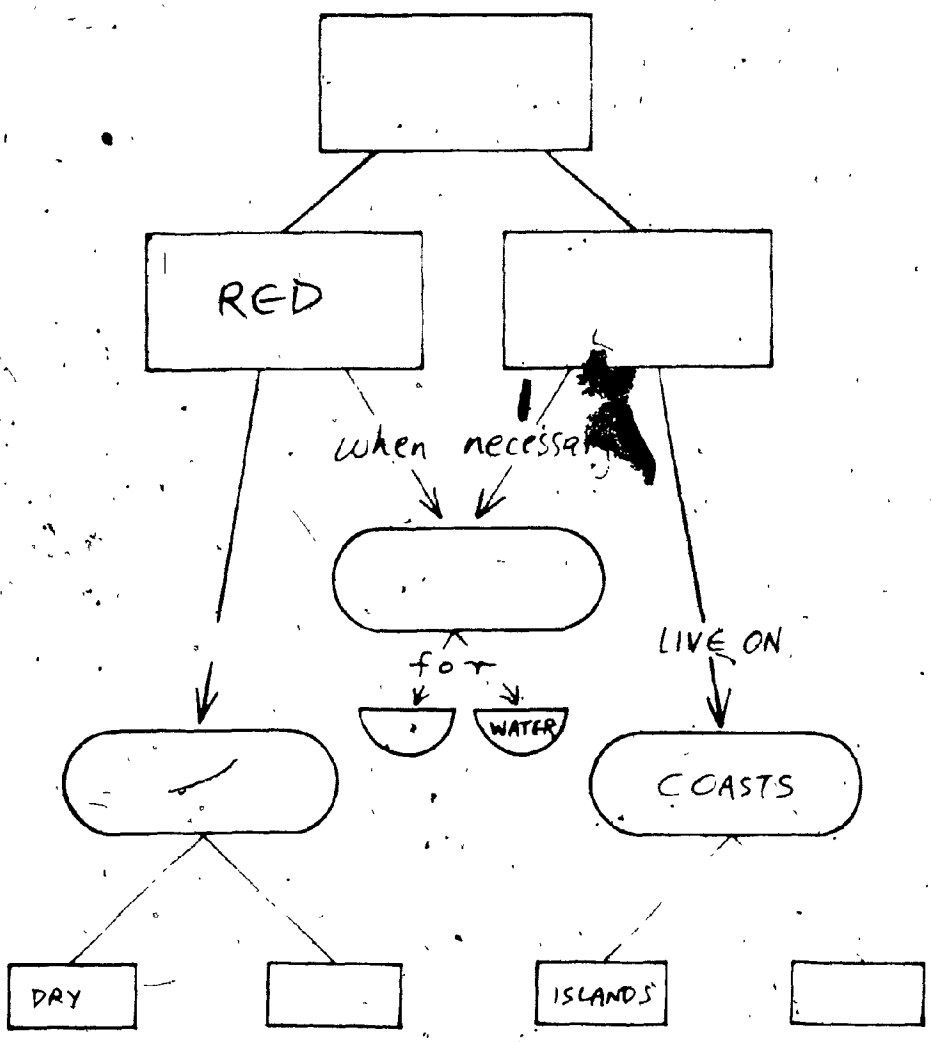




Red kangaroos roam the dry, grassy plains of Australia. Grays live in forests along the coasts of Australia and on some nearby islands. When necessary, these animals travel great distances in search of food and water.



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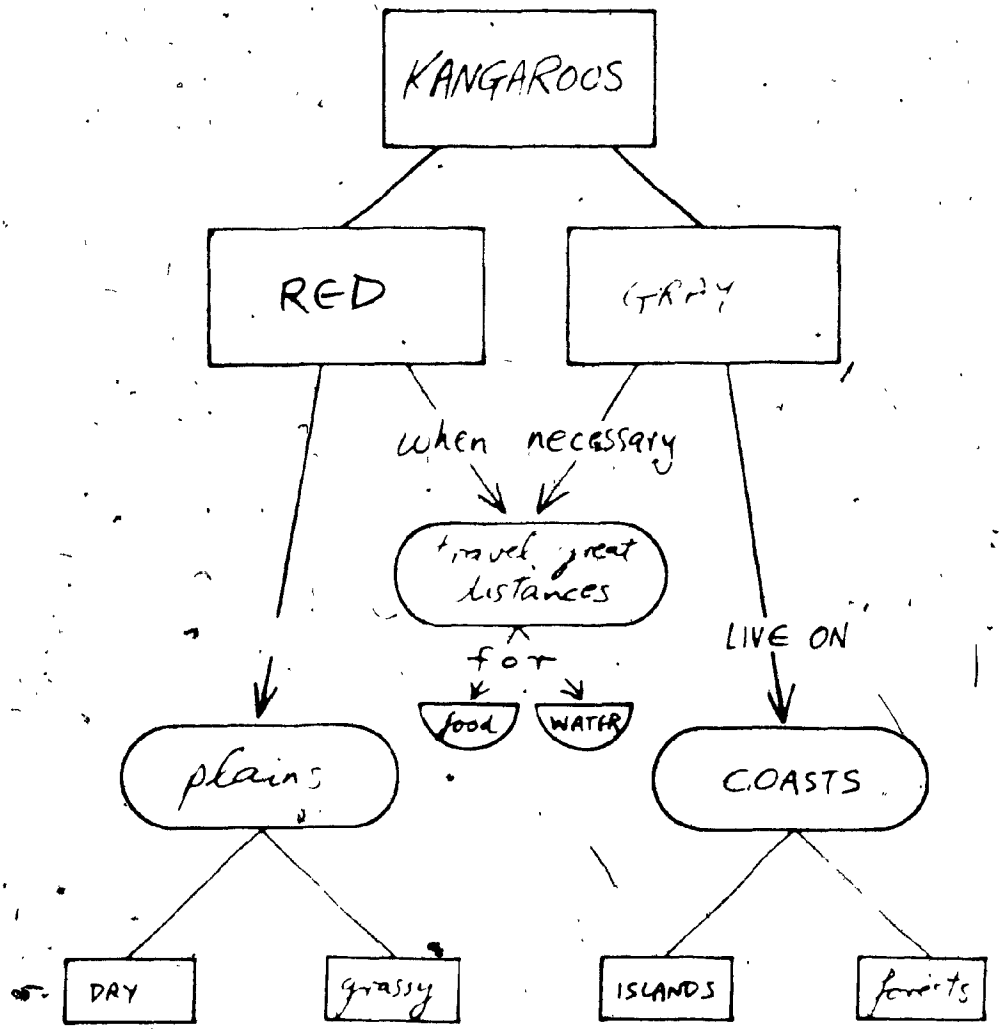
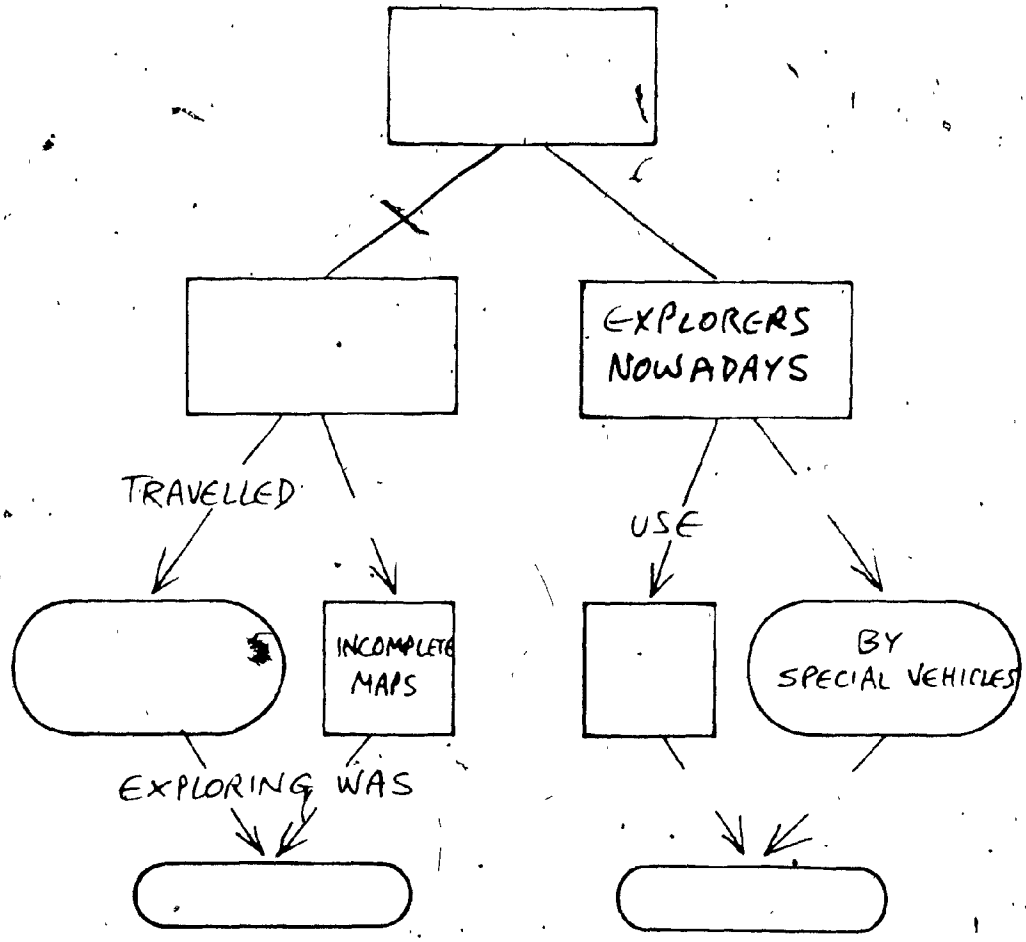


Exploration now is much easier than it was 100 years ago. Travellers from Europe or North America used to get lost in parts of Africa, for instance, because it was impossible to make good maps of areas which had not yet been fully explored.

Today's explorers use accurate maps, not like those incomplete maps of the 1880's. Back in those days, explorers travelled slowly, by boat, by animal (on horseback, or on a mule, camel or elephant), or else they simply walked! Sometimes it took days to cover just a few kilometers.

Now it is much easier for us to satisfy our curiosity about strange, faraway places. There are specialised vehicles to take people deep down in the ocean or way out into space.



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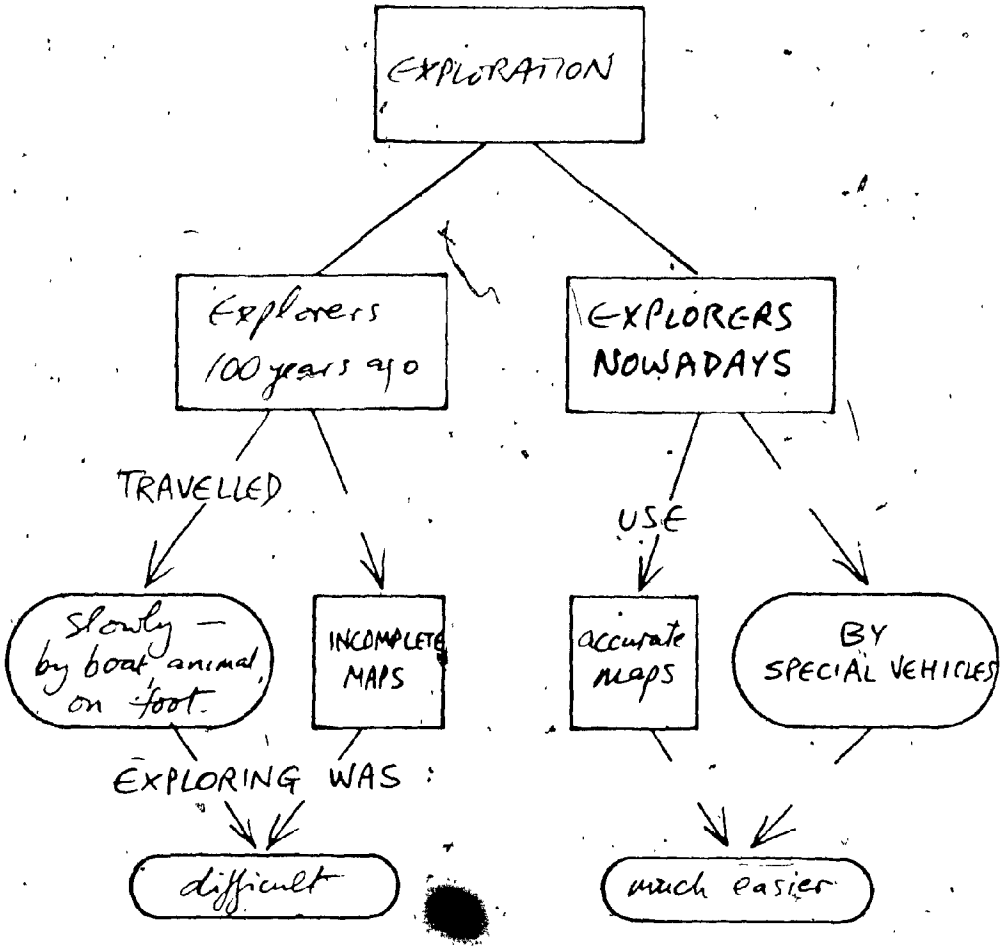


first name : _____ family name : _____

Pick A, B, C, or D to complete each of the 5 sentences below. Please put your answers in the boxes provided right HERE!

1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]

1. The best title for the passage would be...

A "Maps"
B "Oceans"
C "Exploration"
D "Europe"

2. Travel in Africa used to be...

A confusing
B impossible
C very easy
D fast and comfortable

3. The author of this passage compares exploration nowadays with exploration...

A a few years ago
B 1 880 years ago
C 100 years ago
D in the future

4. Maps nowadays are usually

A incomplete
B strange
C impossible to make
D accurate

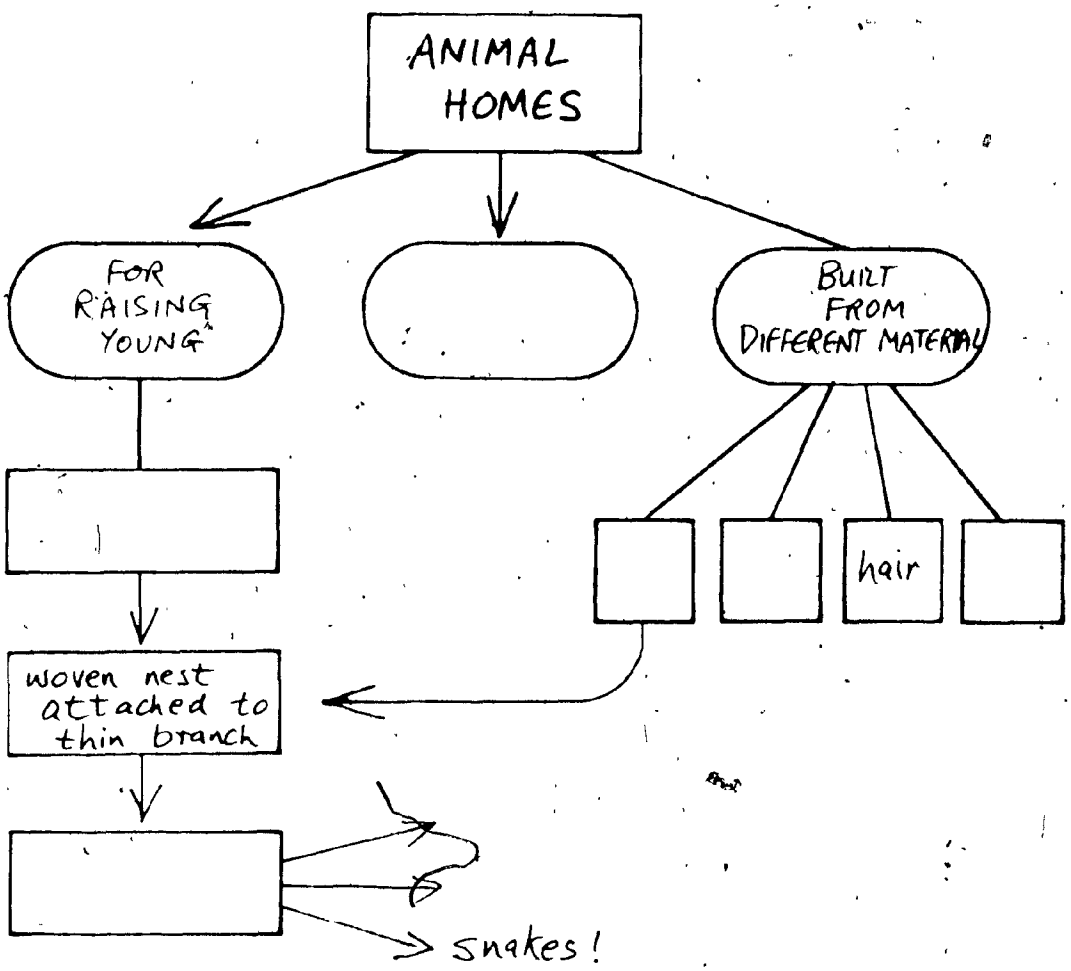
5. In the 1880's explorers did not travel...

A in specialised vehicles
B by boat
C on foot
D on horseback

Many wild creatures work hard building homes. Some build homes mainly as places in which to raise their young, while others build homes to live in.

All sorts of materials are used in home construction. Birds generally use materials found around them. Some prefer string, others look for animal hairs. Many birds will make use of whatever grasses and leaves are plentiful during the nesting season.

The weaver birds of Africa are faced with an unusual problem. They have to protect their young from tree-climbing snakes. To do this, they choose a very thin branch which can not support the weight of a snake. Then they weave long blades of grass together into a nesting ball attached to the twig. The tiny home is out of bounds to snakes and it protects weavers from sun and rain.



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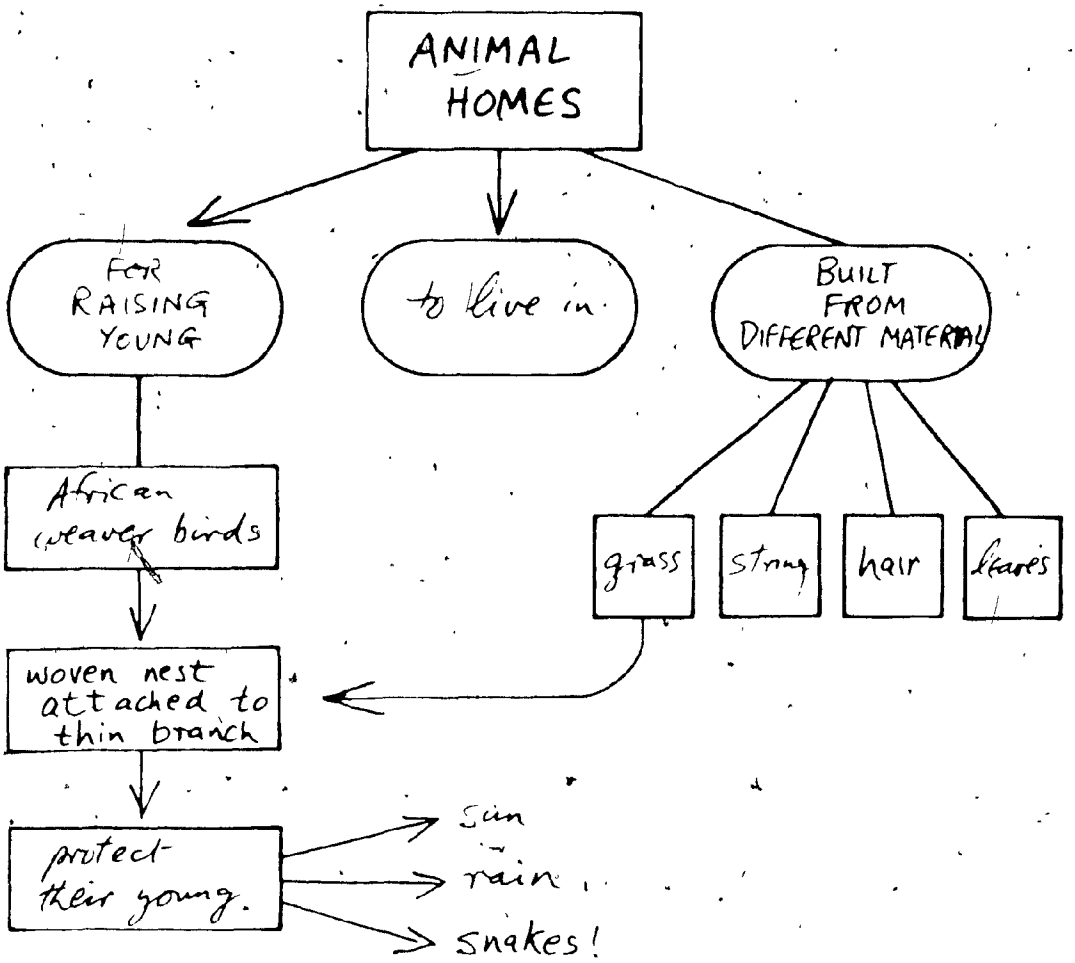


first name : _____ family name : _____

TRUE OR FALSE?

Directions: Read each sentence. Write a T in the box if the sentence is TRUE. Write F if the sentence is FALSE.

[ ] Most wild creatures are too lazy to make a home.

[ ] Animal hair is suitable for building some homes.

[ ] Africa has problems with tree-climbing birds.

[ ] Weaver birds build on thick, strong branches.

[ ] A nest can be made entirely out of grass.

FILL IN THE MISSING WORDS...

Directions: Read each sentence and fill in the blank with the best answer.

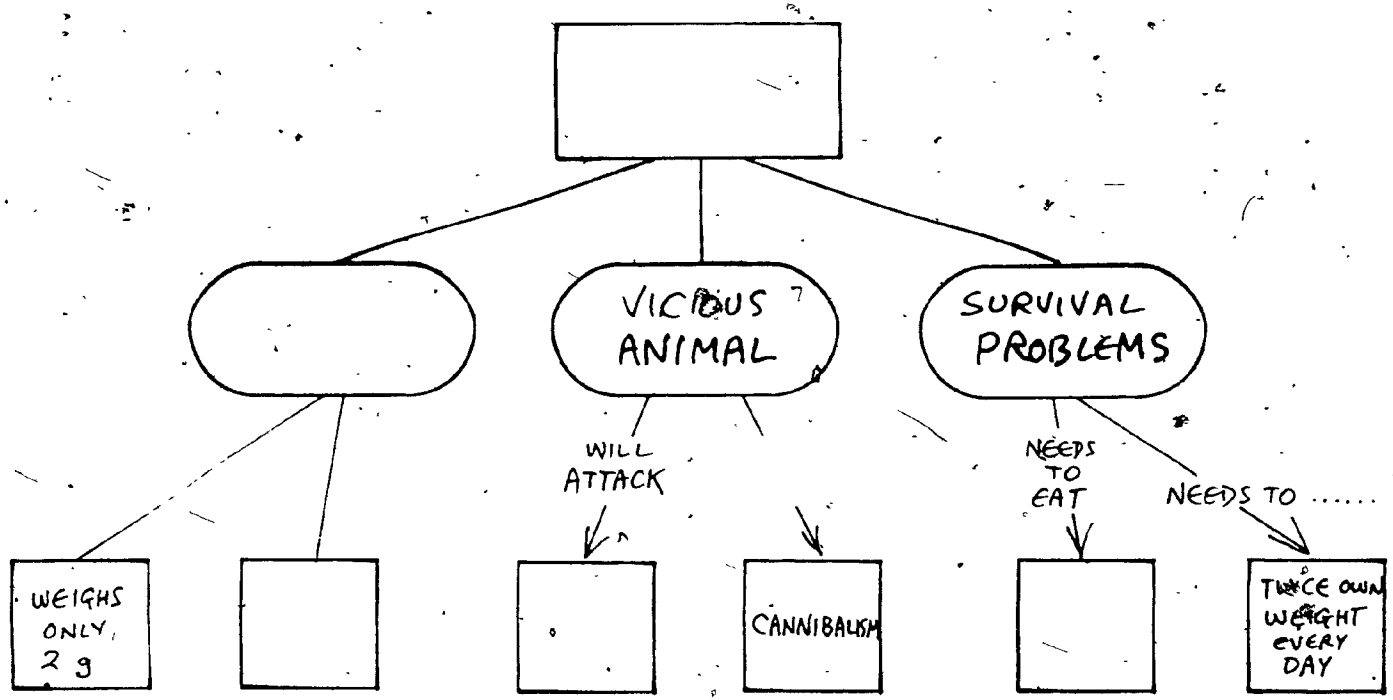
1. Some wild creatures build homes in which they will raise their _____.

2. To build a home, many birds use whatever is abundant during their _____ season.

3. Weaver birds of Africa have to _____ their homes from snakes.

4. A weaver nest shelters the family from _____ and _____.

Luckily for us, the most vicious animal in the world is very small! The shrew measures only 5 cm and weighs only 2 g But what it lacks in size, it certainly makes up for in courage! It will attack anything that moves and will even resort to cannibalism when no other food is around This nasty little fellow doesn't kill just for fun, though It will starve to death if it doesn't eat at least once every two hours It needs to consume twice its own weight in food every day To help in its never-ending hunt for prey, the shrew stores poison in its salivary glands There is enough poison in one of its glands to kill 200 mice!



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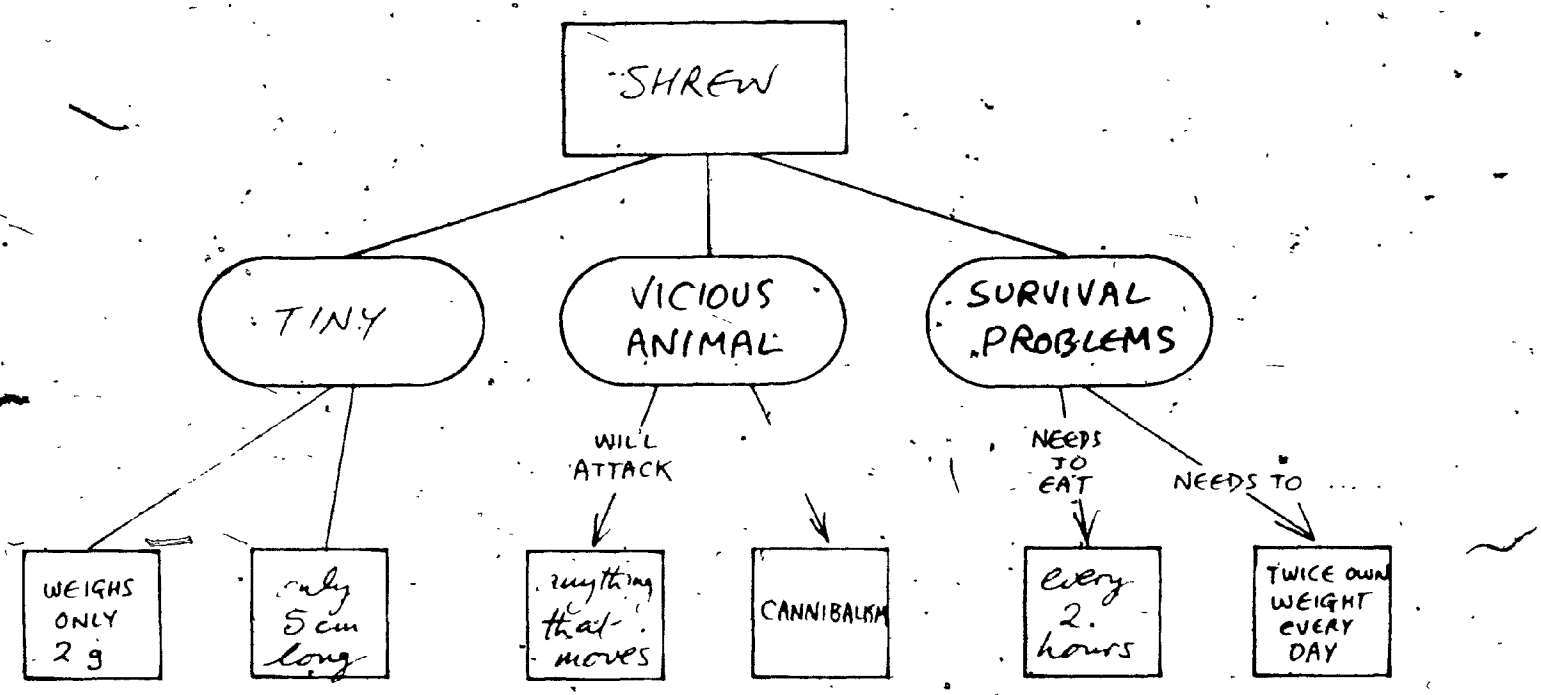
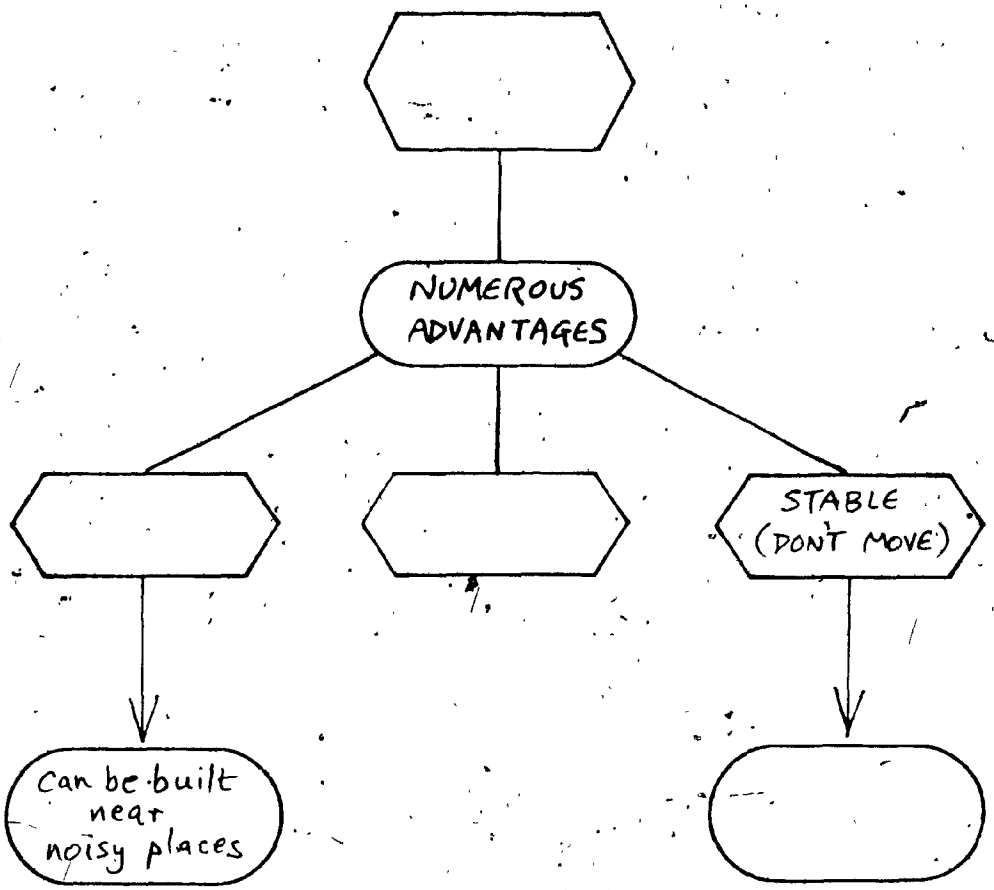


Underground buildings have numerous advantages aside from being energy efficient. They are extraordinarily quiet and stable, so much so that factories producing sensitive instruments in Kansas City and Montreal have been built below ground to avoid stray vibrations. The quiet of underground homes means they can be built near highways and airports and other noisy places.



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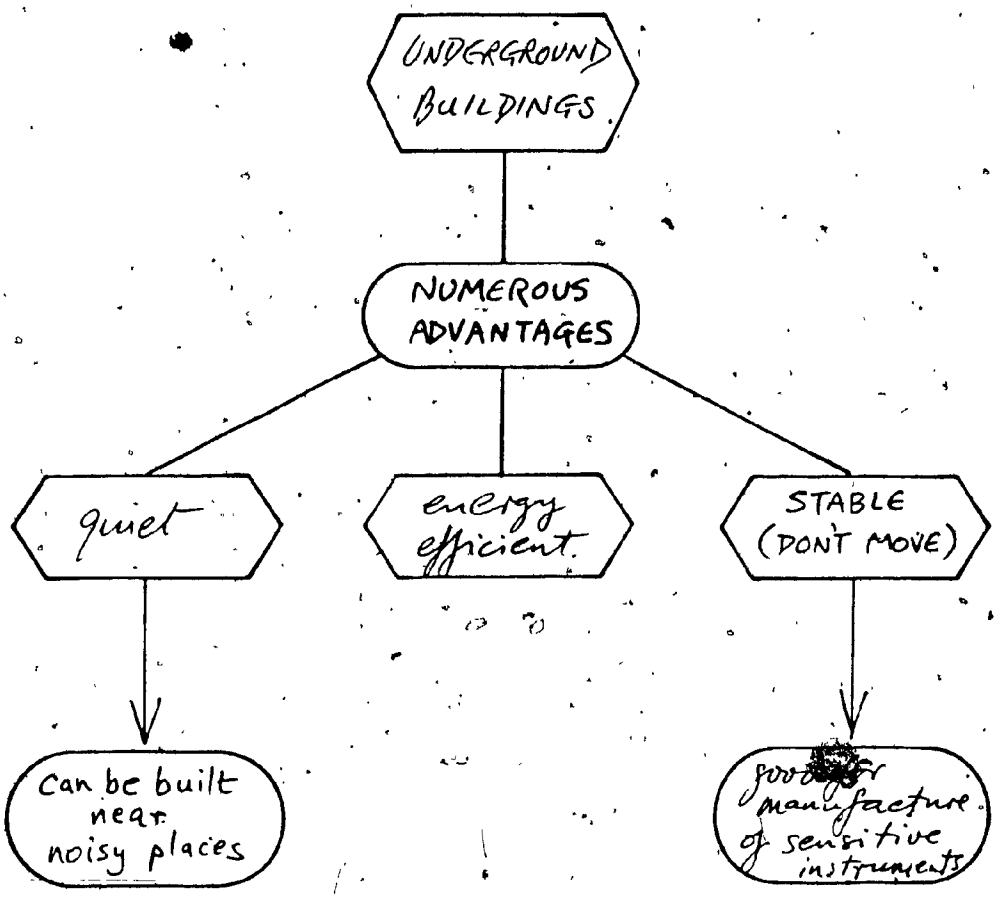
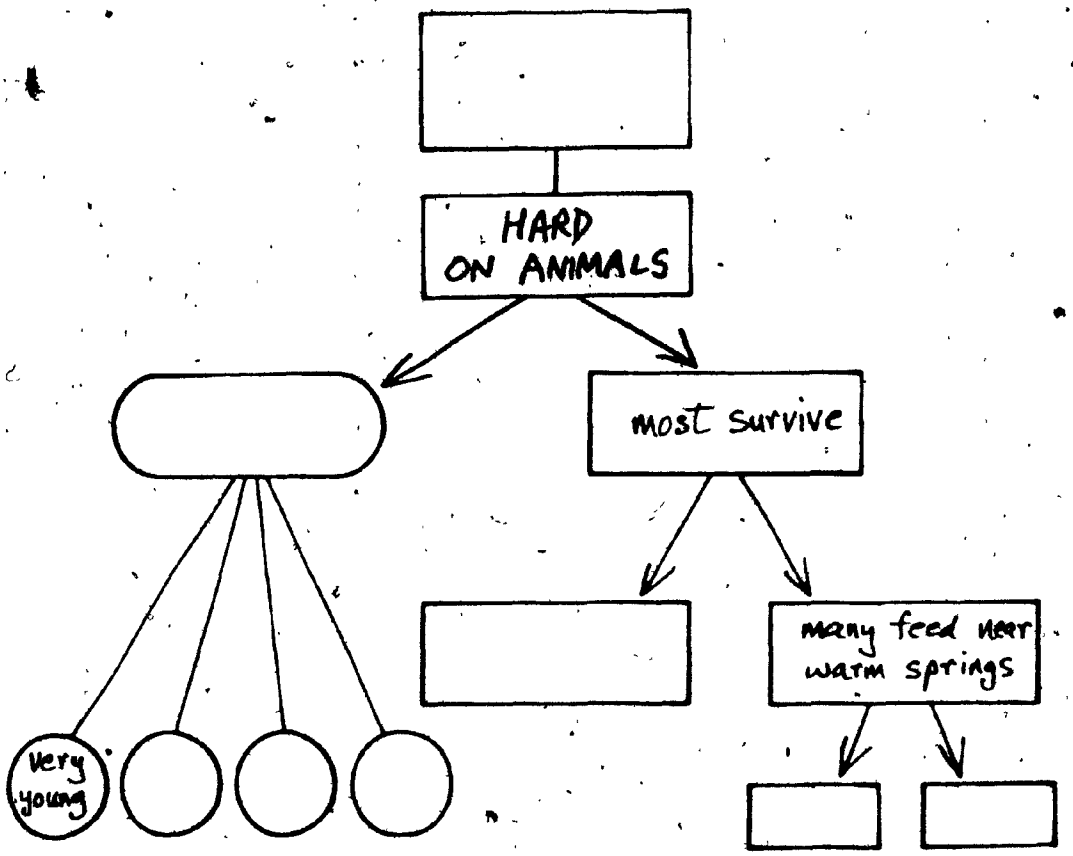


Winter lasts a long time in Yellowstone National Park. For six months deep snow covers the ground and temperatures fall as low as -40 degrees Celsius. That's hard on the animals of Yellowstone. Animals that are sick, weak, old or very young die during those long cold months. But most of the Park's bison, bears, moose and mountain lions survive.

Bison make their way through deep snow by swinging their huge heads from side to side. This action pushes the snow out of their way, just as a snow-plough would. As they go, they uncover grass which they can eat.

Many animals survive the winter because of the warm springs found in Yellowstone Park. Moss and grass can be found all through the winter in places where the ground is warmed by the springs.



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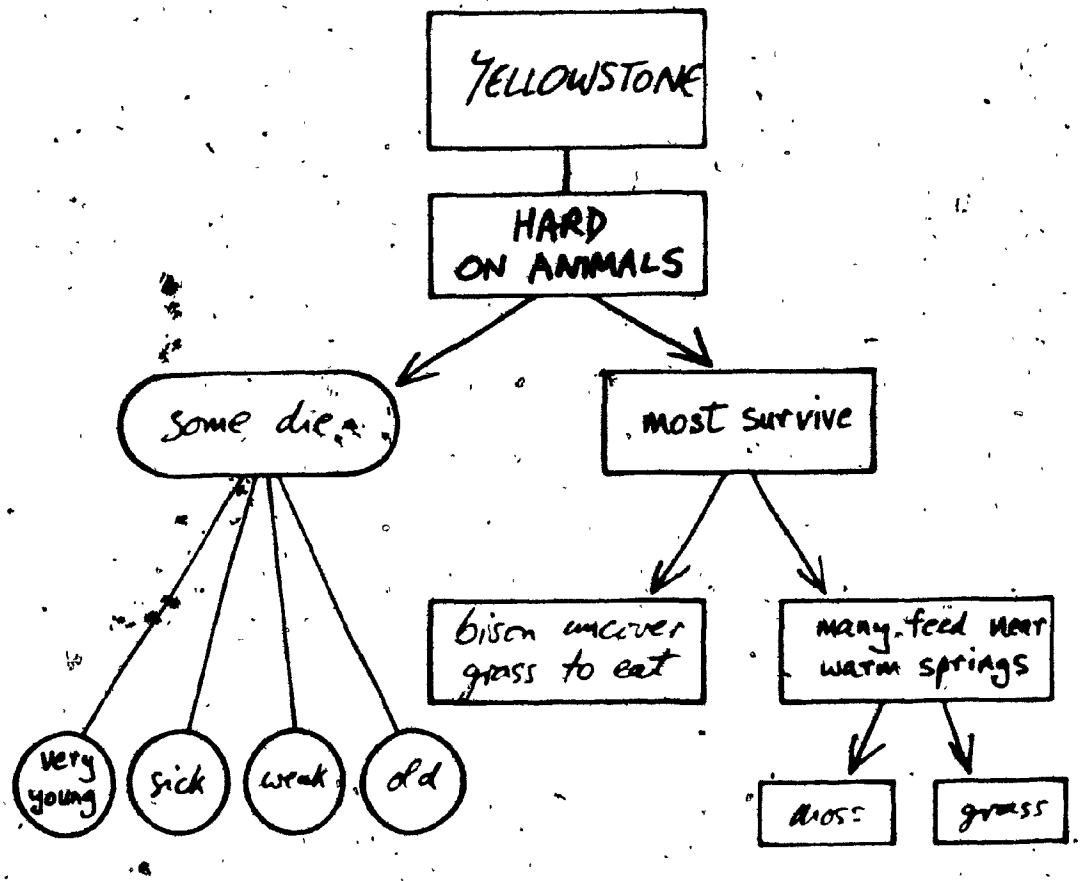
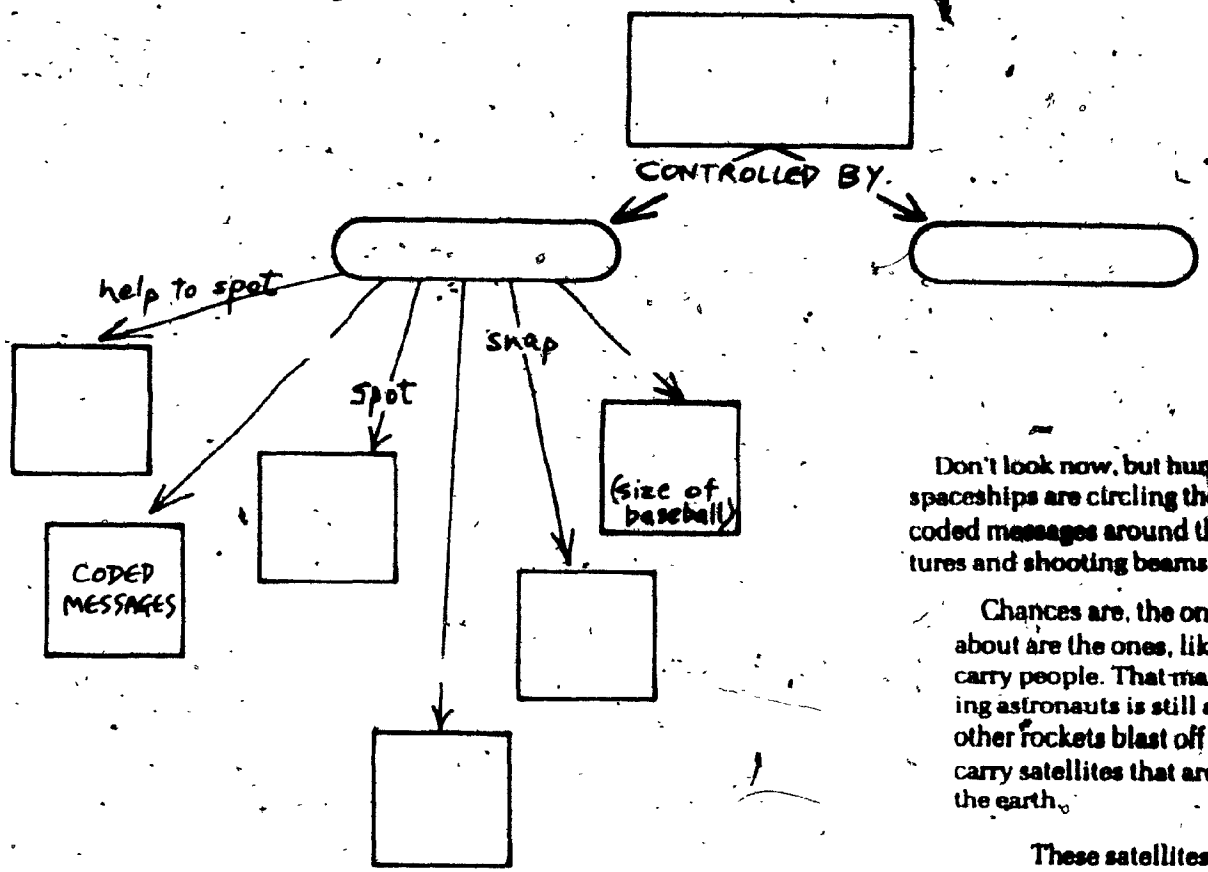
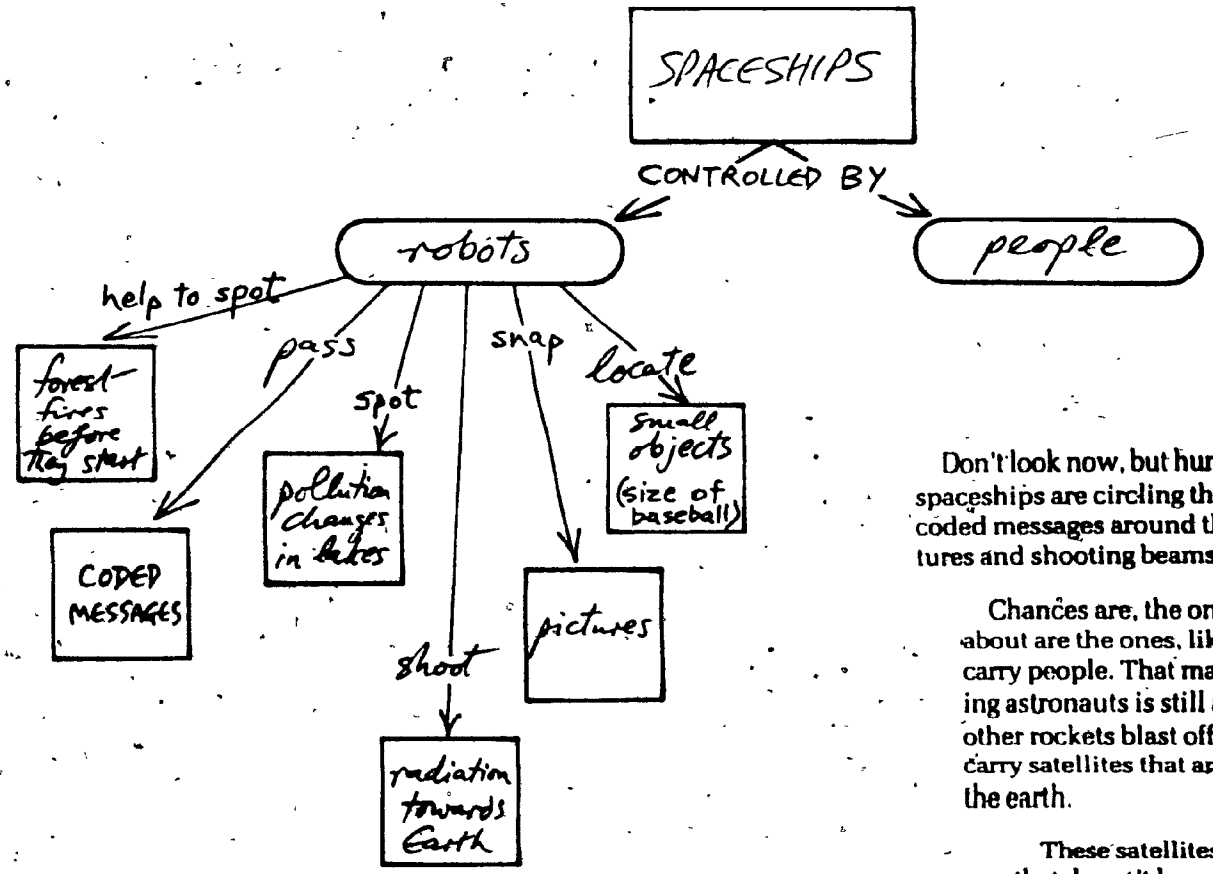




Don't look now, but hundreds of robot-controlled spaceships are circling the earth. They are passing coded messages around the planet, snapping pictures and shooting beams of radiation at the earth.

Chances are, the only spaceships you ever hear about are the ones, like the space shuttle, that carry people. That makes sense but spacecraft carrying astronauts is still a rare event. Dozens of other rockets blast off into space every year. They carry satellites that are placed in orbit around the earth.

These satellites have no people on board. But that doesn't keep them from doing some amazing and important things. Some satellites help spot forest fires *before* they happen. Others can spot pollution changes in the middle of lakes. Still others can locate objects as small as a baseball!



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first name : _____ family name : _____

Pick A, B, C, or D to complete each of the 5 sentences below. Please put your answers in the boxes provided right HERE!

1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 [ ]

1. Satellites are described here as being...

A controlled by astronauts on board
B uncontrollable
C controlled by robots
D uncontrolled

2. The space shuttle is special because it...

A sends radiation beams down to Earth
B has no-one on board
C prevents forest fires
D carries people

3. Satellites are capable of...

A finding lost baseballs
B noticing damage caused by pollution
C placing astronauts in orbit
D starting forest fires

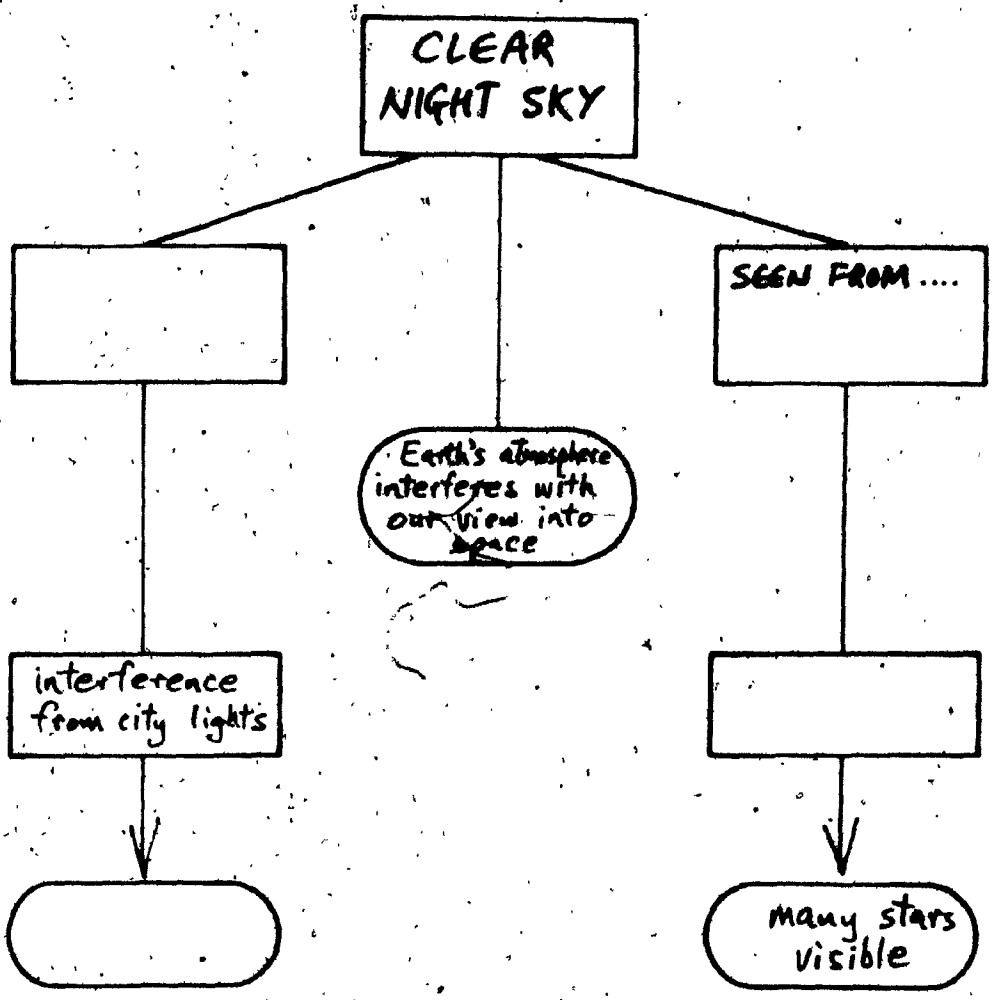
4. Photographs of our planet can be taken by...

A a satellite or someone in the space shuttle
B satellites only
C space shuttle astronauts only
D snapping turtles

5. Orbiting around Earth, there are...

A dozens of space shuttles
B hundreds of spaceships manned by people
C about a dozen satellites
D hundreds of unmanned satellites

Look at the night sky from a city street. If it's clear, you'll be able to see the stars. Look up from a field in the country on a clear night, and you'll be able to see many more stars. City lights interfere with our view into space, and so does the atmosphere. The atmosphere is the thick layer of air surrounding the earth.



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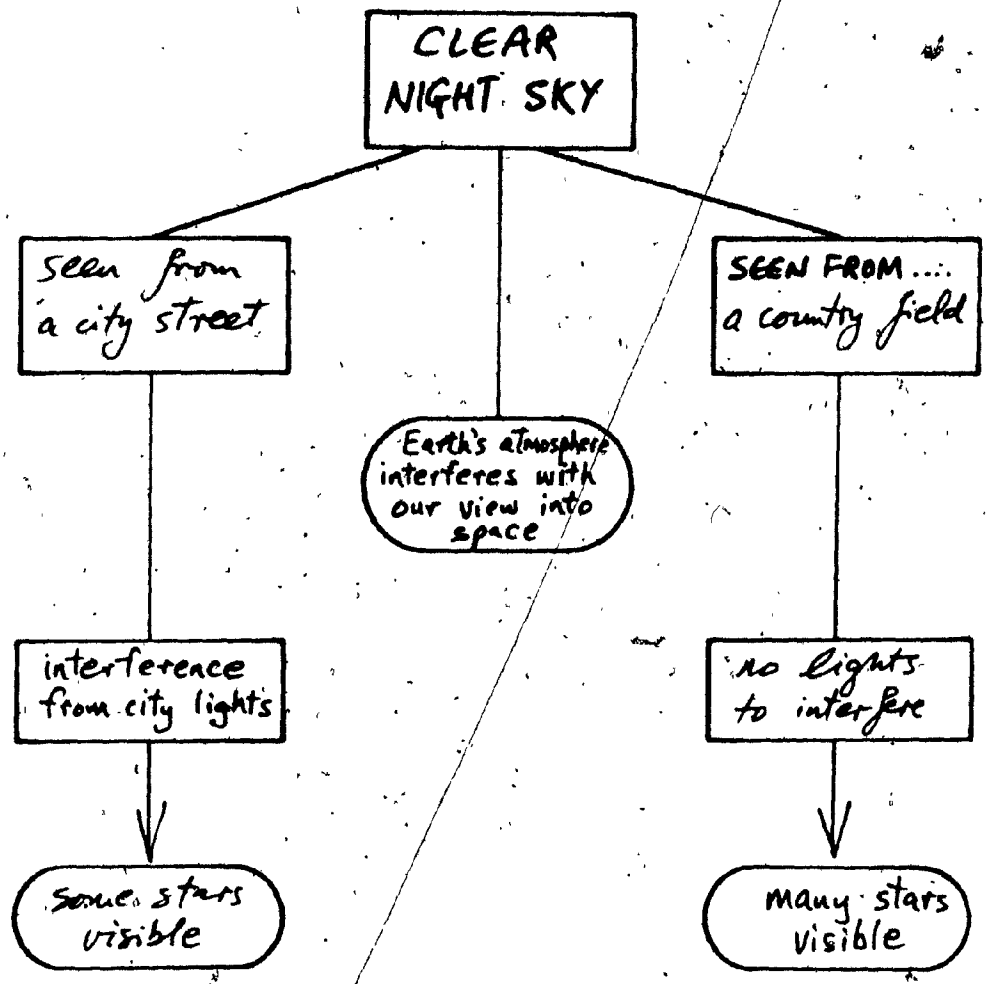


APPENDIX B

Target Phase Materials

DIRECTIONS

Read the following paragraphs.

DIRECTIONS

Read the following paragraphs. Study the graphic organizer which is provided.

DIRECTIONS

Read the following paragraphs. Fill in the best answers for the empty boxes of the graphic organizer. Don't worry about spelling.

GOING OUT FOR A BREATH OF GROSS AIR ?

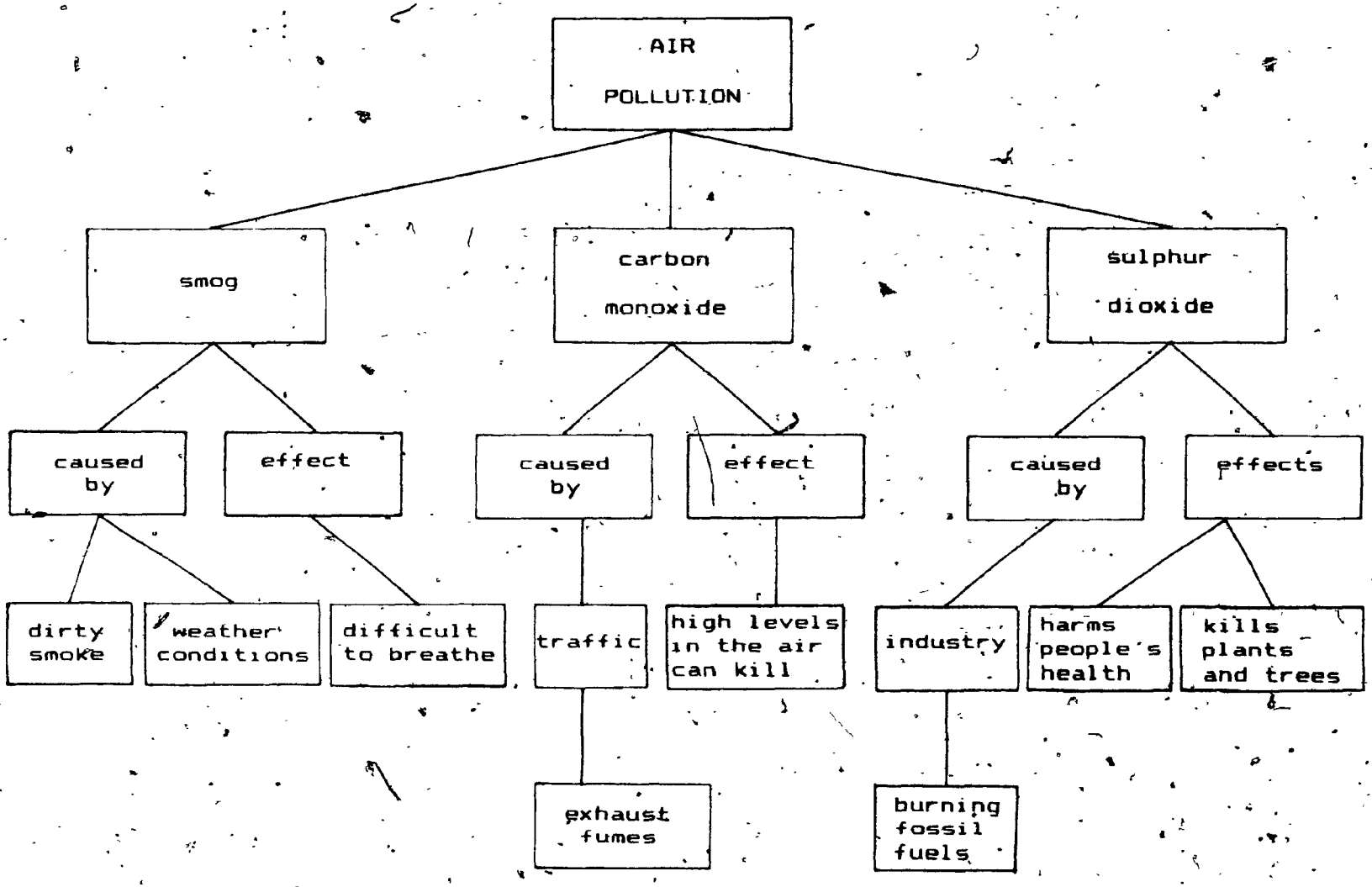
Air pollution is a growing problem. Since man learned to make fire, he has polluted the air. This did not matter for thousands of years. But as man's numbers have started to expand, so has the waste he pours into the air. If a country becomes industrialized, the problem grows rapidly worse. Let's look at three causes of air pollution and their effects.

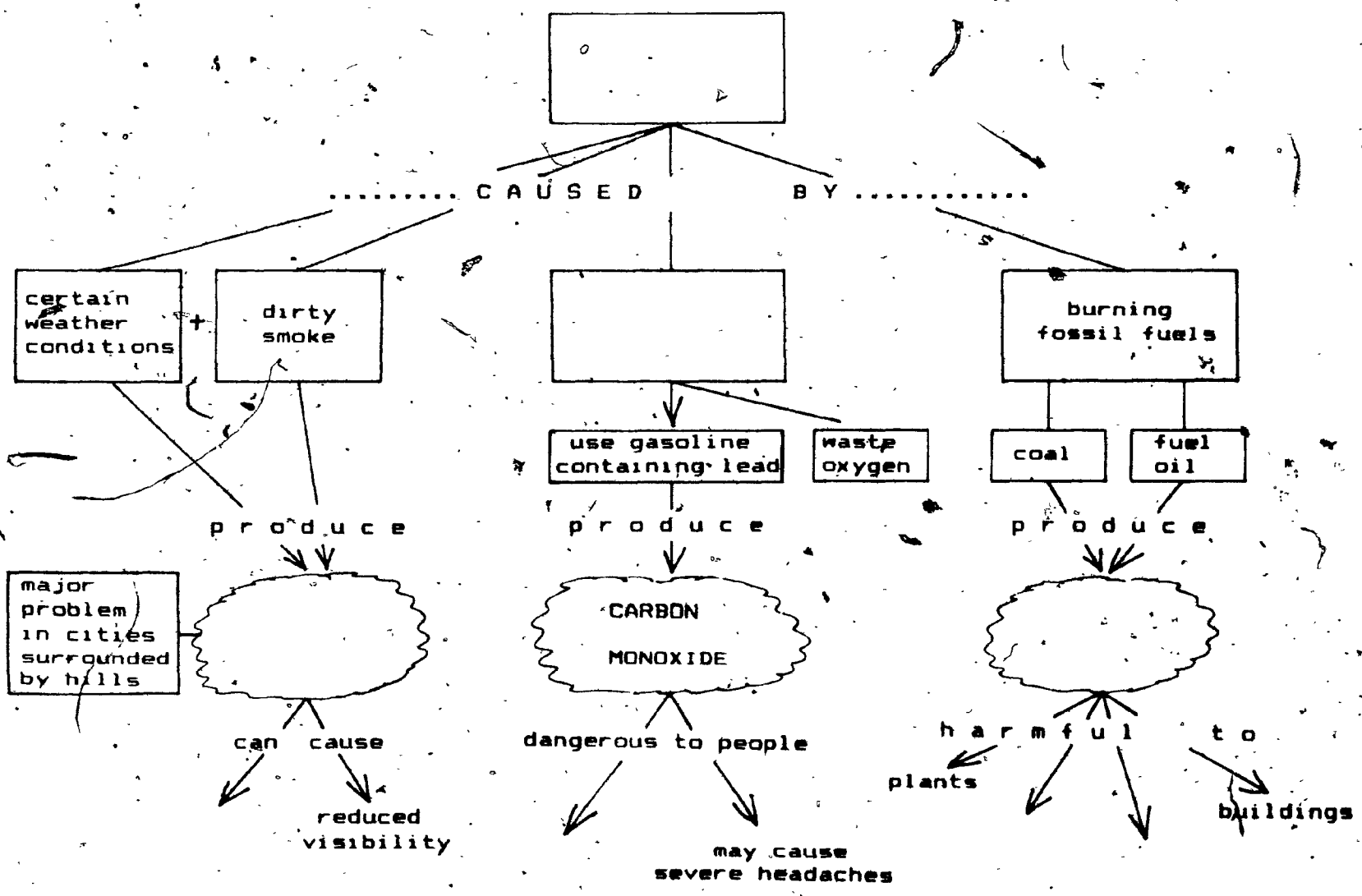
One example is the burning of fossil fuels. Most air pollution comes from burning fossil fuels such as coal and fuel oil. Sulphur dioxide is created if these are burned. It harms people's health, it poisons plants, it stunts the growth of trees, and it hastens the decay of buildings.

Automobile traffic is another example. 60 per cent of air pollution is estimated to come from automobiles. Most of the pollution is carbon monoxide (a dangerous gas). Congested traffic between high buildings can make the situation dangerous. Some cities, such as Tokyo, have fresh-air machines. These are needed by police on traffic duty, and by other people in places where pollution is heavy. In large amounts, carbon monoxide can kill. In smaller amounts, it may cause severe headaches.

The automobile has other drawbacks. It has been designed to use gasoline containing lead. Many countries have controlled the amount of lead in gasoline. They would like to ban it altogether. Cars are great wasters of oxygen. On a 600-kilometer journey, a car uses as much oxygen as a person needs in a year.

Some weather conditions make pollution much worse. In the lower layers of the atmosphere the temperature usually falls as you go up. Warm dirty smoke rises and disperses. But sometimes the air at ground level is cold, with a warm blanket of air above. Smoke is trapped because it cannot rise through the warm blanket. The result of this is called smog. It is a major problem in cities surrounded by hills. Smog can cause breathing problems, and it can reduce visibility in traffic.


AIR POLLUTION
smog
carbon monoxide
sulphur dioxide
caused by
effect
caused by
effect
caused by
effects
dirty smoke
weather conditions
difficult to breathe
traffic
high levels in the air can kill
industry
harms people's health
kills plants and trees
exhaust fumes
burning fossil fuels


CAUSED BY
certain weather conditions
+
dirty smoke
use gasoline containing lead
waste oxygen
burning fossil fuels
coal
fuel oil
produce
produce
produce
major problem in cities surrounded by hills
CARBON MONOXIDE
can cause
reduced visibility
dangerous to people
may cause severe headaches
harmful to
plants
buildings

First name:_____ Family name:_____

DIRECTIONS : Read each question. Pick the best answer. Circle the letter in front of your answer.

Here's an example: The best title for this reading is...

A Monkeys
(B) Pollution
C Cars
D Weather

O.K.? Now start the test...

1. What is created when fossil fuels are burned?

A carbon monoxide
B rain
C sulphur dioxide
D ashes

2. Air pollution is caused by the following things:

A industries, fossil fuels, car fumes
B atmosphere, forests, rivers
C buildings, cities, towns
D fish, insects, rodents

3. Sulphur dioxide harms people's health, but it is more dangerous to...

A animals
B plants
C cars
D pets

4. Continued pollution may lead to...

A no police in Japan
B larger factories
C fewer plants and animals
D all children born with deformities

5. Air pollution could become dangerous to you if...

A your car uses a lot of gasoline
B you're driving too fast through a forest
C you're driving too slowly on a highway
D you're in a traffic jam with tall buildings all around

6. Everyone can help reduce the problem of air pollution by...

A driving larger cars
B walking or cycling whenever possible
C burning more fossil fuels
D buying a fresh-air machine

7. To prevent automobile pollution, humans may have to control...

A the use of cars
B the production of sulphur dioxide
C the size of parking spaces
D the use of fresh-air machines

DIRECTIONS : Read each sentence. Write a T in the box if the sentence is TRUE. Write F if it is FALSE.

Example : [F] Pollution is healthy.

8. [ ] Dirty air can damage buildings.

9. [ ] The worst polluters of air are factories.

10. [ ] Exhaust fumes from cars are poisonous.

11. [ ] Lighting a fire makes pollution.

12. [ ] Many countries control the amount of lead in gasoline.

DIRECTIONS : Read each sentence and fill in the blank with the best answer.

13. _____ is formed when the air at ground level is cold and smoke becomes trapped under a layer of warm air.

14. As industrialization grows, _____ also increases.

15. Sixty per cent of air pollution is caused by _____.

16. In Tokyo, police on traffic duty use _____ machines to protect themselves from air pollution.

17. Automobiles contribute to air pollution problems because they waste _____.

18. The growth of _____ has been affected by sulphur dioxide.

19. The problem of smog is most common in cities surrounded by _____.

First name:_____ Family name:_____

DIRECTIONS : Read each question. Pick the best answer. Circle the letter in front of your answer.

Here's an example: The page I have just read is about...

A sports
(B) pollution
C racing cars
D the weather

O.K.? Now start the test...

1. Some things which cause air pollution are:...

A fish, birds, reptiles
B streams, rivers, lakes
C buildings, cities, towns
D industries, fossil fuels, car fumes

2. The burning of fossil fuels creates...

A sand
B sulphur dioxide
C rain
D carbon monoxide

3. Increased air pollution may result in...

A fewer plants and animals
B smaller factories
C all children born with deformities
D no police in Japan

4. Sulphur dioxide can harm people's health, but it is even more harmful to...

A plants
B animals
C trains
D pets

5. To reduce automobile pollution, people may have to control...

A the use of fresh-air machines
B the production of sulphur dioxide
C the use of cars
D the number of traffic lights

6. Air pollution might be a danger to you if...

A you're driving too fast in the country
B you're in a traffic jam with tall buildings all around
C your car uses a lot of gasoline
D you're driving too slowly on the highway

7. Air pollution can be reduced by...

A burning more fossil fuels
B talking less on the phone
C walking or cycling whenever possible
D driving bigger automobiles

DIRECTIONS: Read each sentence. Write a T in the box if the sentence is TRUE. Write F if it is FALSE.

Example: [F] Air pollution is good.

8. [ ] The worst polluters of air are industries.

9. [ ] Lighting a fire makes pollution.

10. [ ] Many countries limit the amount of lead in gasoline.

11. [ ] Polluted air may damage houses.

12. [ ] Exhaust fumes from automobiles are poisonous.

DIRECTIONS: Read each sentence and fill in the blank with the best answer.

13. When the air at ground level is cold and smoke becomes trapped under a layer of warm air, _____ is formed.

14. _____ causes sixty per cent of air pollution.

15. Sulphur dioxide has affected the growth of _____.

16. By wasting _____, automobiles contribute to air pollution problems.

17. The problem of smog is found more often in cities surrounded by _____.

18. As industrialization increases, the problem of _____ also increases.

19. _____ machines are used by Tokyo traffic police to protect them from air pollution.

APPENDIX C

Raw Scores

Subject	Control	Trained		Reading	24-hours-delayed				3-weeks-delayed			
	B-A	Barron	none		mc[a]	t/f	sa	fr	mc	t/f	sa	fr
				67	7	5	7		7	5	7	
01	x			46	5	2	3	30	3	1	3	9
02		x		43	4	2	6	28				
03			x	46	4	2	3	24	5	4	3	9
04			x	46	7	2	3	22	7	2	5	26
05			x	19		2	4	22	7	3	2	14
06			x	48	5	4	4	21				
07	x			46	5	1	7	27	5	2	6	14
08		x		25	5	3	0	5	1	2	2	1
09	x			63	6	4	6	31	7	2	5	13
10			x	43	3	3	1	7	3	2	3	4
11	x			16	5	2	0	11				
12		x		31	4	3	3	17	1	4	2	18
13	x			52	5	4	4	19	5	4	6	9

[a]mc = multiple choice t/f = true or false sa = short answer fr = free recall

Subject	Control	Trained		Reading	24-hours-delayed				3-weeks-delayed			
	B-A	Barron	none		mc	t/f	sa	fr	mc	t/f	sa	fr
				67	7	5	7		7	5	7	
14			x	25	3	3	1	17	2	3	2	0
15	x			41	4	3	2	18	3	2	2	0
16		x		60	5	4	6	29	5	3	6	10
17			x	44	5	3	1	6	6	1	3	1
18			x	51	4	3	2	9	5	2	3	11
19		x		52	5	3	3	8	5	2	3	14
20			x	28	5	2	3	26	4	3	2	3
21			x	60	7	4	7	57	6	4	6	12
22		x		53	2	3	5	18	5	4	7	5
23	x			52	4	3	6	60	5	3	6	19
24	x			50	6	4	6	22	7	3	3	20
25			x	7	2	3	0	10	2	3	0	1
26			x	28	3	2	4	14	1	2	2	5
27	x			55	4	4	6	52	6	3	5	27
28		x		27	3	3	3	28	4	3	1	9

Subject	Control	Trained		Reading	24-hours-delayed				3-weeks-delayed			
	B-A	Barron	none		mc	t/f	sa	fr	mc	t/f	sa	fr
				67	7	5	7		7	5	7	
29	x			47	3	3	2	15	4	2	2	4
30		x		42	5	2	5	16	6	1	6	6
31		x		36	4	1	1	13	2	2	1	3
32	x			39	4	2	1	24	4	2	3	17
33	x			49	4	4	5	23	3	3	4	13
34		x		41	5	1	6	14	4	3	2	8
35		x		47	1	1	3	20	2	1	3	8
36			x	60	5	2	7	55	7	1	6	20
37		x		41	5	2	3	26	2	1	3	26
38	x			51	5	3	5	37				
39		x		37	4	1	3	18	5	4	3	10
40	x			29								
41		x		38	2	4	4	15	4	2	2	0
42	x			40	3	3	5	16	5	4	5	4

Subject	Control	Trained		Reading	24-hours-delayed				3-weeks-delayed			
		B-A	Barron	none		mc	t/f	sa	fr	mc	t/f	sa	fr
					67	7	5	7		7	5	7	
43				x	54	5	3	6	32	7	3	5	25
44				x	27	5	3	3	17	4	3	2	1
45	x				54	5	2	6	32	6	3	4	9
46	x				33	4	4	5	12	3	4	6	3
47	x				32	5	3	2	11	2	3	4	13
48	x				58	4	4	7	40	5	5	6	31
49	x				41	6	2	5	25	5	4	5	6
50	x				60	6	5	7	42	5	5	6	29
51	x				43	6	5	6	20	5	3	3	4
52	x				19	2	1	2	4	0	1	1	3
53	x				51								
54				x	50	6	4	6	66	6	4	6	32
55				x	59	5	2	7	51	6	3	5	22
56			x		52	7	2	5	30	6	3	6	0

Subject	Control	Trained			Reading	24-hours-delayed				3-weeks-delayed			
	B-A	Barron	none			mc	t/f	sa	fr	mc	t/f	sa	fr
					67	7	5	7		7	5	7	
57		x			35	5	2	5	18	4	3	4	4
58	x				59	5	3	4	44	6	3	6	40
59		x			61	7	5	6	31	7	5	7	24
60	x				39	7	3	5	34	5	3	4	12
61			x		55	4	4	7	56	5	2	7	12
62		x			27	5	3	4	34	5	2	4	28
63	x				37	5	3	4	25	4	1	0	6
64	x				58	5	3	5	37	6	4	6	33
65	x				55	4	4	6	48	1	5	6	44
66			x		60	4	3	5	44	4	3	5	36
67		x			51	5	4	5	29	6	2	4	4
68			x		61	7	4	7	56	7	2	5	28
69		x			38	4	3	7	44	3	4	5	12
70	x				41	5	3	4	14	6	3	4	14

Subject	Control		Trained		Reading	24-hours-delayed				3-weeks-delayed			
	B-A	Barron	none		mc	t/f	sa	fr		mc	t/f	sa	fr
				67	7	5	7			7	5	7	
71		x		51	5	4	5	30		7	2	6	4
72	x			40	4	1	3	17		2	3	2	6
73			x	17	4	2	4	8		5	3	2	5
74	x			53	7	5	5	44		7	4	7	33
75		x		55	6	4	6	36		5	4	7	20
76			x	63	6	4	6	32		6	4	7	21
77	x			22	4	3	6	54		4	2	5	13
78			x	52	6	3	5	10		6	3	4	3
79	x			62									
80			x	28	3	3	5	35		4	3	5	17
81			x	39									
82	x			34	5	1	3	35		2	4	3	17
83		x		42	4	3	2	17		5	3	1	17
84		x		48	3	2	3	24		3	3	3	17

Subject	Control	Trained			Reading	24-hours-delayed				3-weeks-delayed			
		B-A	Barron	none		mc	t/f	sa	fr	mc	t/f	sa	fr
					67	7	5	7		7	5	7	
85				x	35	5	3	2	15	5	4	1	8
86			x		52	6	4	6	29	5	2	6	20
87		x			33	6	4	3	31	7	2	4	26
88				x	49	5	2	3	24				
89		x			56	1	2	6	34	6	3	6	14
90			x		52								
91	x				30	3	1	2	6	5	2	4	1
92	x				52	5	4	6	19	4	3	6	9
93	x				46	7	2	7	37	6	3	6	11
94	x				39								
95	x				58	7	2	6	44	5	3	3	21
96	x				45	7	3	6	38	7	3	4	8
97	x				36	4	2	4	22	5	3	3	13